Sensitivity of Coincidence Gravity-wave Burst Experiments Involving Individual LIGO Detectors of Differing Sensitivity:

I. Experiment Strategy and Summary of Results

R. Drever August 4, 1989

1. Introduction

The possibilities of triple coincidence experiments involving 3 LIGO interferometers, two full length and one half-length, have made it important to estimate how the use of detectors which might differ in amplitude sensitivity by up to a factor of 2 might affect overall experiment sensitivity.

There are several different experimental situations which are of interest; and in particular the situations in which half-length interferometers show their major advantage are ones in which spurious pulses from phenomena such as gas bursts have a serious effect on performance, and in at least some of these cases it is clear that the use of half-length interferometers can give a significant improvement in effective experiment sensitivity. This two-part report will NOT deal with these cases, where there are obvious advantages in use of half-length interferometers. Instead we will consider here the least favorable situation for half-length interferometers, when the interferometer noise is almost entirely pure Gaussian noise, and discuss how much the use of one interferometer of lower sensitivity than the others in a coincidence experiment may degrade experiment sensitivity when spurious pulses are not significant.

This case is the simplest for initial analysis, and the result for this is interesting, since it indicates that degradation in sensitivity can be significantly smaller than might be expected at first.

2. The Basic Idea

For a real gravity wave experiment, the sensitivity of the experiment as a whole is more important than the sensitivity of the individual detectors used; and in fact the experiment sensitivity can be affected strongly by how the experiment is performed and how the data are analyzed. For example in an experiment to count gravity wave bursts it might seem possible to improve apparent burst sensitivity by using very low discrimination thresholds, but this could lead to such a high accidental rate that the results would be useless if the real event rate were low.

To make our analysis specific and clear here we will adopt some definite criteria for a simple experiment, and then compare performance to be expected with two different experimental arrangements:

(a) A triple coincidence experiment done with three full-length interferometers, two located at site 1 and the third at site 2, and

(b) A triple coincidence experiment done with two full-length interferometers, one at site 1 and one at site 2, together with a half-length interferometer at site 1.

We adopt the following definition for the sensitivity of an experiment:–

"The Sensitivity of a gravity-wave experiment is the amplitude of gravity wave which, with optimum polarization and direction of propagation, has a 50% probability of being detected by the experiment".

To keep the analysis simple at this stage we will consider a simple threshold-crossing experiment, in which we choose the three thresholds to give the optimum sensitivity as just defined – that is the sensitivity for triple-coincidence detection – subject to the following two constraints on accidental rates:

(a) We set a maximum triple coincidental accidental rate for the whole experiment. To make a detection of a single pulse in one year of operation have some significance, we wish to make the accidental rate less than this. We have chosen an accidental rate of 0.1 triple coincidences per year for this analysis.

The accidental rates obtained depend on the resolving times used. Here we take for the resolving time for coincidences between the two interferometers at one site a value t_1 equal to half the gravity wave period being considered. For coincidences between interferometers at different sites we must extend the resolving time to allow for delays of up to the light travel time, L, between the sites, so we take a resolving time in this case $t_2 = t_1 + L$.

(b) We set an upper limit to the singles accidental rate of any of the interferometers so that the corresponding coincidence gate open time is never more than 1% of the total time. This condition is not essential, but it makes this initial analysis simpler and it does not affect sensitivity significantly.

For each experimental situation we have explored the range of thresholds for the three interferometers satisfying these two conditions, to find the set of thresholds which give the optimum sensitivity as defined above. In Part 2 of this memo we give tables of sensitivities obtained for thresholds near the optimum values, along with the corresponding singles accidental rates.

3. Summary of Results to Date

The main conclusions from these results may be summarized by a comparison of the overall sensitivity of an experiment done with the three identical interferometers (arrangement (a)) with that done with one interferometer replaced by a different one of poorer sensitivity (arrangement (b)), with each experiment optimized subject to the same conditions on accidental rates. We find:

(1) that if the amplitude sensitivity of the less sensitive interferometer is worse by a factor of $\sqrt{2}$ than that of the others, then the amplitude sensitivity of the whole experiment is worsened by a factor of 1.09, and

(2) that if the amplitude sensitivity of the less sensitive interferometer is worse by a factor of 2 than that of the others, then the amplitude sensitivity of the whole experiment is worsened by a factor of 1.20.

4. Application to Full and Half-Length LIGO Interferometers

The application of these results to compare triple coincidence experiments with three full-length interferometers to those with two full-length and one half-length one depends on the relative sensitivities of the full and half-length interferometers. The ratio of these sensitivities depends on which noise source is the limiting one in each case, and predicting this depends on the assumptions made.

A recent analysis was made for the LIGO Construction Proposal, by R. Spero and P. Saulson. They assumed that in a recycling system, the number of recycles would be limited to fixed number by wavefront distortions, and not be mirror losses. With this assumption the number of recycles is independent of arm length. The overall results of this analysis are shown for an initial LIGO interferometer in Figure 67 of the Draft Proposal, and for a candidate broadband advanced interferometer in Figure 68. Using these and other results gives the predictions in Table 1 for the ratio of sensitivity of a 2 km interferometer to a 4 km one; together with the corresponding percentage degradation in the sensitivity of triple-coincidence experiment using one half-length interferometer, as found from the present work.

Table 1

Interferometer	Assumption	Frequency	Interferometer Sensitivity Ratio	Experiment Sensitivity Degradation with One Half-length Interferometer
Initial	Non-recycling	>150	1.00	None
Initial	30 recycles	>200	1.00	None
Initial	Mirror losses limit recycling	>200	$\sqrt{2}$	9%
Candidate Advanced	100 recycles	>80	1.00	None
Candidate Advanced	Mirror losses limit recycling	>80	$\sqrt{2}$	9%
Candidate Advanced	Limited by thermal and other stoc. noise	<50	2	(estimate near 20%)*

* Estimate only – computed results for low frequency not available yet.

5. Additional Notes

(1) This initial analysis has not made use of pulse height correlations between genuine coincidences between the interferometers. These could be used to reduce the accidental coincidence rates to some extent. However the accidental count rates are predominantly from near-threshold noise pulses, where pulse height resolution is relatively poor, so large improvements are not expected. And as the two interferometer arrangements being compared would both be affected in a similar way it is expected that the sensitivity ratios found here would be essentially unaltered.

(2) This work is not complete yet, and is still in progress; and some of the detailed analysis has been done in more than one way, as shown in Part 2. However in view of the urgency in assessing potential LIGO systems it was felt useful to give the results to date at this early stage. These results should be regarded as preliminary at present.

Sensitivity of Coincidence Gravity-wave Burst Experiments

Involving Individual LIGO Detectors of Differing Sensitivity

2. Detailed Theoretical Analysis

Yekta Gürsel and Massimo Tinto (Revised) October 10, 1989

I. INTRODUCTION

A LIGO observatory will have at least two laser interferometric gravitational wave receivers separated by a large distance. In addition, one of the sites may have more than one interferometer installed in its vacuum system. One of the options for the double interferometer site is to make both interferometers the same length. The other option is to make one of the interferometers on that site one half the length of the larger interferometer. The latter option would enable one to distinguish gravitational wave signals from locally induced spurious pulses, since the responses of the interferometers to a gravitational wave signal are proportional to their arm-lengths. The spurious pulses due to pressure fluctuations in the pipes or due to seismic disturbances, etc.. will not cause pulses whose amplitudes are correlated with the arm-lengths as in the case of a gravitational wave. However, this option may be more costly than having two full-length interferometers in the same vacuum system due to the need for additional buildings to house the shorter-interferometer vacuum tanks.

In this part of the memorandum, we calculate the threshold levels for a given coincidence accidental event rate of a LIGO observatory consisting of either three full-length receivers (two on one site in the same vacuum system, one on a distant site) or two full-length and a half-length receivers (a full-length and a half-length interferometer on one site in the same vacuum system, and another full-length receiver on a distant site). We also compute the minimum gravitational wave amplitude which has a given likelihood of being observed in coincidence by the observatory in either configuration described above. The computations are performed for two receiver designs: the root-mean-squared noise level at the output of the receiver is inversely proportional to the square root of the length of the arms or it is inversely proportional to the length of the arms. In these calculations, we have not imposed any restrictions on the pulse heights of the coincident pulses in the three receivers. We will examine this possibility in a forthcoming memorandum.

II. THE DESCRIPTION OF THE METHOD

We assume that in the absence of a gravitational wave, the output of the receiver i in the observatory consists of Gaussian, band-limited noise with zero mean and variance σ^2_i. These output signals are assumed to be uncorrelated with each other. Let x_i be the amplitude of the noise at the output of the detector i at any given time. The probability distribution p of x_i is given by:

$$p(\sigma_i;x_i)=\frac{1}{(2\pi)^{1/2}\sigma_i}\exp[-x^2{}_i/2\sigma^2{}_i] \quad (1)$$

This probability distribution is normalized in the usual way so that the "sum" of the probabilities of all possible outcomes is 1:

$$\frac{1}{(2\pi)^{1/2}\sigma_i}\int_{-\infty}^{+\infty}\exp[-x^2{}_i/2\sigma^2{}_i]\,dx_i=1$$

Let a threshold $T_i \geq 0$ be set at the output of the receiver i so that the threshold circuit records a pulse above the threshold T_i if the receiver output x_i is smaller than $-T_i$ or if it is larger than $+T_i$: $|x_i|>T_i$. The probability P that this output x_i will exceed the given threshold T_i in the manner described above is given by:

$$P(\sigma_i;|x_i|>T_i)=2\int_{T_i}^{\infty}p(\sigma_i;z)\,dz \quad (2)$$

This simply is the area under the curve described by Eq. (1) outside the interval $[-T_i,+T_i]$ (Fig. 1). This probability $P(\sigma_i;|x_i|>T_i)$ can be expressed in the following way:

$$P(\sigma_i;|x_i|>T_i)=1-\text{erf}\left[\frac{T_i}{2^{1/2}\sigma_i}\right] \quad (3)$$

where erf(x) is the error function defined by:

$$\text{erf}(x)=\frac{2}{\pi^{1/2}}\int_0^x\exp(-t^2)\,dt$$

where $0\leq x<\infty$.

An expansion for the error function which is valid everywhere within the range of its argument is given by:[1]

$$\text{erf}(x)=1-(a_1t+a_2t^2+a_3t^3+a_4t^4+a_5t^5)\exp[-x^2]+\varepsilon$$

where $t=1/(1+qx)$, a_1=0.254829592, a_2=−0.284496736, a_3=1.421413741, a_4=−1.453152027, a_5=1.061405429, q=0.3275911 and $|\varepsilon|\leq 1.5\times10^{-7}$ for $0\leq x<\infty$. In what follows, we will use this expansion to compute the error function erf(x).

We will now derive the equation which constrains the threshold values of the three detectors in the observatory by holding the coincidence accidental rate of the observatory constant. We consider two different ways of deriving this equation. The first one has appeared in the literature[2]; the latter one is a better approximation to the actual experimental procedure.

A. The method introduced by B. F. Schutz

The output of a receiver in the gravitational wave observatory will be a band-limited signal. If the bandwidth of the output signal is f_c, then this continuous signal can be uniquely determined from a knowledge of its sampled values (Sampling Theorem). The minimum sampling frequency for the digitization is $2f_c$. We assume that the detector output consists of band-limited, Gaussian white noise with a bandwidth of f_c in the absence of a gravitational wave. This output can then be represented by a digitized set of samples collected at the rate of $2f_c$. These samples are statistically uncorrelated with each other. This follows from the fact that the auto-correlation function $C(\tau)$ for band-limited white noise which has a constant spectral density over the bandwidth f_c vanishes at times τ that are multiples of $1/(2f_c)$: $C(\tau)=0$ for $\tau=1/(2f_c), 2/(2f_c)$, etc.[3] The rate R_i at which the digitized output x_i exceeds a given threshold T_i is given by:

$$R_i = 2f_c\, P(\sigma_i; |x_i| > T_i)$$

where we assume that all of the receiver outputs are digitized at the same rate $2f_c$ and the digitization clocks are synchronized with each other.

Let τ_1 be the resolving time for coincidence experiments between the receivers that are located on the same site. Then, τ_1 is equal to the time between the digitized samples:

$$\tau_1 = \frac{1}{2f_c}$$

Let τ_2 be the resolving time for coincidence experiments located between separated sites and D be the maximum time-delay between these sites for the reception of a gravitational wave. Then, τ_2 is given by:

$$\tau_2 = D + \tau_1$$

For an observatory consisting of three detectors (two of which are located on one site, the remaining one is located at a distant site), the accidental coincidence rate R_{acc} for the observatory entirely due to the Gaussian noise in the receivers is given by:

$$R_{acc} = 4\tau_1\tau_2 R_1 R_2 R_3$$

Substituting for R_i, τ_1 and τ_2, we obtain:

$$P(\sigma_1; |x_1| > T_1)\, P(\sigma_2; |x_2| > T_2)\, P(\sigma_3; |x_3| > T_3) = \frac{R_{acc}}{32 f_c^{\,3}\tau_1\tau_2} \qquad (4)$$

Eq. (4) is equivalent to the following expression:

$$P(\sigma_1; |x_1| > T_1)\, P(\sigma_2; |x_2| > T_2)\, P(\sigma_3; |x_3| > T_3) = \frac{1}{2}\,\frac{1}{W\,N_{obs}} \qquad (5)$$

where $W = (2f_c)(2\tau_2)$ is the coincidence window between the separated sites in units of the time between the samples, $N_{obs} = 2f_c / R_{acc}$ is the total number of data points collected at the rate of $2f_c$ during an observation run which is long enough to give one coincidence pulse on the average from the observatory entirely due to the Gaussian, band-limited white noise in the receivers. The probabilities $P(\sigma_i;|x_i|>T_i), i=1,2,3$ are given by Eq. (3). B. F. Schutz[2] derived an expression similar to Eq. (5). He omits the factor (1/2) which appears on the right-hand side of Eq. (5).

B. The method suggested by R. W. P. Drever

[Note: This derivation is done by Y. Gürsel; M. Tinto is in Italy.]

In order to derive the constraint equation between the receiver thresholds by holding the accidental coincidence rate of the observatory constant, we need an expression for the singles accidental rate R'_i for each receiver in the observatory. R. W. P. Drever suggested another approach which is closer to the actual experimental procedures for deriving the equation governing this rate. This method is an analogue of what is done in pulse coincidence experiments. In what follows, we assume that the output of the receiver i consists of Gaussian noise with zero mean and variance σ^2_i in the absence of a gravitational wave.

When the band-limited analog (non-digitized) signal crosses a certain threshold level in a given receiver, a coincidence window is opened and the output of another receiver is examined. If that output exceeds its threshold level within the coincidence window, then these events are marked as coincident. Note that if the pulses stay above the threshold level within the coincidence window before this window is closed, they are not counted more than once.

Since the useful bandwidth of a typical gravitational wave receiver does not extend to zero frequency, we assume that the signal coming out of the detector is filtered to remove all the low-frequency components below a certain "low-cutoff" frequency. This implies that the pulses which cross a threshold level can not stay above the threshold for an arbitrarily long duration. In the experiments a circuit, which produces a pulse with constant height and duration equal to the duration of the window which opens when the absolute value of the pulse crosses the threshold level with positive slope and closes when the absolute value of the pulse crosses the threshold level with a negative slope, is used. The output of this circuit is then routed to another circuit which produces a pulse with constant height and duration. The duration of this pulse is called the resolving time and it is chosen by the experimenter. This pulse is then used in the subsequent circuits which check for coincidence with another receiver within a coincidence window. The duration of the coincidence window for the coincidence experiments will be twice the length of the resolving time since either of the receivers in a coincidence experiment may detect the pulse first.

From the discussion given above, it follows that the singles accidental rate R'_i at the output of the receiver i is equal to the rate λ_{+T_i} at which the absolute value of the pulse crosses a threshold T_i with positive slope:

$$R'_i = \lambda_{+T_i} \tag{6}$$

Let $\lambda_{\pm T_i}$ be the rate at which the pulse (not its absolute value) crosses a positive threshold T_i

either with positive or with negative slope. In the limit of many threshold crossings during the experiment, the rate at which the pulse crosses the positive threshold T_i with positive slope is equal to one half of $\lambda_{\pm T_i}$. The rate λ_{+T_i} at which the absolute value of the pulse crosses the positive threshold T_i with positive slope is equal to twice the rate at which the pulse (not its absolute value) crosses the positive threshold T_i with positive slope in the same limit. It then follows that:

$$R'_i = \lambda_{+T_i} = 2 \times \frac{1}{2} \lambda_{\pm T_i} = \lambda_{\pm T_i} \tag{7}$$

When the receiver output only consists of band-limited Gaussian noise, the rate $\lambda_{\pm T_i}$ is given in the literature:[4]

$$\lambda_{\pm T_i} = \frac{1}{\pi} \left[\frac{-C_i''(0)}{C_i(0)} \right]^{1/2} \exp[-T_i^{\,2} / 2\, C_i(0)] \tag{8}$$

where $C_i(\tau)$ is the auto-correlation function of the receiver output and $C_i''(0)$ is the second derivative of the auto-correlation function with respect to its argument evaluated at 0.

The auto-correlation function $C_i(\tau)$ is the inverse Fourier transform of the spectral density $S_i(\omega)$ of the noise:[5]

$$C_i(\tau) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} S_i(\omega) \exp[j\, \omega \tau]\, d\omega \quad , \quad j = \sqrt{-1} \tag{9}$$

In order to proceed further, we need information concerning the spectral density of the noise which forms the receiver output in the absence of a signal. The spectral density of the receiver noise will be a function of the filtering employed in the receiver. R. W. P. Drever indicated that, in pulse experiments, one usually uses a special, simple filter consisting of a differentiator followed by a buffer and an integrator. The time constants of the differentiator and the integrator are chosen to be equal. This gives a filter shape which is a "hump" centered on a particular frequency determined by the actual value of the time constants.

If the intrinsic receiver noise is white, a filter with a "hump" shape will cause the spectral density of the output noise to have a similar "hump" shape. We choose a Gaussian shape for the spectral density of the noise at the output of our receivers as a simulation of the filter used in actual experiments. The precise form of the spectral density is given below (Fig. 2):

$$S_i(\omega) = \begin{cases} A_i \exp[-(\omega - \omega_0)^2 / 2\, \omega_1^2] & \text{for } \omega \geq 0 \\ A_i \exp[-(\omega + \omega_0)^2 / 2\, \omega_1^2] & \text{for } \omega < 0 \end{cases} \tag{10}$$

where A_i is an arbitrary amplitude and $\omega_0 \geq 0$ is the center frequency. ω_1 is a parameter which determines the noise equivalent bandwidth $\Delta\omega = 2\pi f_c$ of the filter. We will now derive the relationship between the noise equivalent bandwidth $\Delta\omega$, ω_0 and ω_1.

Let $G_i(\omega)$ be the transfer function of the filter for the receiver i. The filter output $O_i(\omega)$ is related to the input signal $I_i(\omega)$ through the transfer function $G_i(\omega)$:

$$O_i(\omega) = G_i(\omega)\, I_i(\omega) \tag{11}$$

The spectral density of the filter output is then given by the spectral density of the input signal:

$$S_i(\omega) = |G(\omega)|^2 S_{Ii}(\omega) \tag{12}$$

We assume that the intrinsic noise of the receiver i is white noise: $S_{Ii} = A_i$. Then, the squared absolute magnitude of the transfer function $G_i(\omega)$ is given by:

$$|G(\omega)|^2 = \frac{S_i(\omega)}{A_i} \tag{13}$$

The noise equivalent bandwidth $\Delta\omega$ is defined as:[6]

$$\Delta\omega = \frac{1}{2} \int_{-\infty}^{+\infty} |G(\omega)|^2 \, d\omega \tag{14}$$

Using Eqs. (10), (13) and (14), we obtain:

$$\Delta\omega = \sqrt{\frac{\pi}{2}}\, \omega_1 \left[1 + \mathrm{erf}\left[\frac{\omega_0}{\sqrt{2}\,\omega_1} \right] \right] \tag{15}$$

In order to simplify the algebra a little, we will assume that the noise equivalent bandwidth $\Delta\omega$ of the filter is equal to its center frequency ω_0. Such a filter will be "near-optimal" for pulses which have a similar frequency spectrum. Typical gravitational wave pulses are expected to have a large bandwidth which is nearly equal to the dominant frequency in their spectrum. In particular, single-cycle sinusoids satisfy this criterion. This assumption is not critical, the analysis can be carried through with an arbitrary noise equivalent bandwidth.

Using the equation $\Delta\omega = \omega_0$ and Eq. (15), we obtain:

$$\frac{1 + \mathrm{erf}(\alpha)}{\alpha} = \frac{2}{\sqrt{\pi}} \tag{16}$$

where $\alpha = \Delta\omega / (\sqrt{2}\,\omega_1)$. Eq. (16) is a transcendental equation with an approximate solution $\alpha = 1.761153 + \varepsilon_\alpha$ with $|\varepsilon_\alpha| < 5\times10^{-7}$. Using this result, we get:

$$\omega_1 = \frac{\Delta\omega}{\sqrt{2}\,\alpha} \tag{17}$$

Using Eqs. (9) and (10), we obtain the auto-correlation function $C_i(\tau)$ of the output of the receiver:

$$C_i(\tau) = \frac{A_i}{\pi} \int_0^{\infty} \exp[-(\omega - \omega_0)^2 / 2\,\omega^2{}_1] \cos(\omega\tau)\, d\omega \tag{18}$$

This integral can be expressed in closed form as:

$$C_i(\tau)=\frac{A_i\,\omega_1}{\sqrt{2\pi}}\exp[-(1/2)\,\omega_1{}^2\tau^2]\left\{\cos(\omega_0\tau)+\frac{1}{2}\,[\mathrm{erf}(\nu)\exp(i\,\omega_0\tau)+\mathrm{erf}(\nu^*)\exp(-i\,\omega_0\tau)]\right\} \quad (19)$$

where * denotes complex conjugation and ν is given by:

$$\nu=\frac{1}{\sqrt{2}}\left[\frac{\omega_0}{\omega_1}+i\,\omega_1\tau\right] \quad (20)$$

By Parseval's theorem:

$$\int_{-\infty}^{+\infty}|C_i(\tau)|^2\,d\tau=\int_{-\infty}^{+\infty}|S_i(\omega)|^2\,d\omega \quad (21)$$

Since the right-hand side of Eq. (21) is finite by our choice of the spectral density $S_i(\omega)$, we deduce that $\lim_{|\tau|\to\infty} C_i(\tau)=0$.

From Eqs. (16), (17), (18) and (19), it follows that:

$$C_i(0)=\frac{A_i}{\pi}\,\Delta\omega \quad (22)$$

$$C_i''(0)=-\,C_i(0)\,(\Delta\omega)^2\left[1+\frac{1+\exp(-\alpha^2)}{2\,\alpha^2}\right] \quad (23)$$

Using Eq. (8), we obtain:

$$\lambda_{\pm T_i}=\frac{\Delta\omega}{\pi}\left[1+\frac{1+\exp(-\alpha^2)}{2\,\alpha^2}\right]^{1/2}\exp[-T_i{}^2/2\,C_i(0)] \quad (24)$$

Eq. (7) leads to:

$$R'_i=\frac{\Delta\omega}{\pi}\left[1+\frac{1+\exp(-\alpha^2)}{2\,\alpha^2}\right]^{1/2}\exp[-T_i{}^2/2\,C_i(0)] \quad (25)$$

Since $\Delta\omega=2\,\pi f_c$, where f_c is the noise equivalent bandwidth of the filter in Hertz, it follows that:

$$R'_i=K_G\,f_c\,\exp[-T_i{}^2/2\,C_i(0)] \quad (26)$$

where K_G is a constant given by:

$$K_G=2\left[1+\frac{1+\exp(-\alpha^2)}{2\,\alpha^2}\right]^{1/2}\simeq 2.1619 \quad (27)$$

Note that the quantity $C_i(0)$ is equal to the variance $\sigma_i{}^2$ of the filtered receiver noise.

We derived Eq. (26) by choosing a particular spectral density for the output of the receiver in the absence of a gravitational wave. If a different shape is chosen, the result will be different in general. In order to explore the shape dependence of Eq. (26), we will carry out a similar calculation for the "Brick Wall" filter which gives the following spectral density (Fig. 3) at its output when the input is white noise:

$$S_{Br}(\omega)=\begin{cases} A_{Br} & \text{for } \omega_0-\omega_1\leq\omega\leq\omega_0+\omega_1 \\ A_{Br} & \text{for } -\omega_0-\omega_1\leq\omega\leq-\omega_0+\omega_1 \\ 0 & \text{otherwise} \end{cases} \tag{28}$$

where A_{Br} is an arbitrary amplitude and $\omega_0\geq 0$ is the center frequency. ω_1 is related to the noise equivalent bandwidth $\Delta\omega$ of the filter in the following way:

$$\omega_1=\frac{\Delta\omega}{2} \tag{29}$$

Proceeding in a similar manner as in the Gaussian shaped spectral density case, we obtain the auto-correlation function $C_{Br}(\tau)$ for the "Brick Wall" filter:

$$C_{Br}(\tau)=\frac{2A_{Br}\,\omega_1}{\pi}\left[\frac{\sin(\omega_1\tau)}{\omega_1\tau}\right]\cos(\omega_0\tau) \tag{30}$$

Using Eq. (30), we obtain:

$$C_{Br}(0)=\frac{2A_{Br}\,\omega_1}{\pi} \tag{31}$$

$$C''_{Br}(0)=-C_{Br}(0)\,[\omega_0^2+\frac{\omega_1^2}{3}] \tag{32}$$

From Eqs. (8), (31) and (32), it follows that:

$$\lambda_{\pm T_i\,Br}=\frac{1}{\pi}\,[\omega_0^2+\frac{\omega_1^2}{3}]^{1/2}\ \exp[-T_i^2/2\,C_{Br}(0)] \tag{33}$$

The singles accidental rate R'_{iBr} is then given by:

$$R'_{iBr}=\frac{1}{\pi}\,[\omega_0^2+\frac{\omega_1^2}{3}]^{1/2}\ \exp[-T_i^2/2\,C_{Br}(0)] \tag{34}$$

Again, we choose the noise equivalent bandwidth $\Delta\omega$ to be equal to the center frequency ω_0. We then get:

$$R'_{iBr}=K_{Br}f_c\ \exp[-T_i^2/2\,C_{Br}(0)] \tag{35}$$

where K_{Br} is a constant given by:

$$K_{Br}=2\,[1+\frac{1}{12}]^{1/2}=2.082 \tag{36}$$

f_c is the noise equivalent bandwidth of the filter in Hertz and $C_{Br}(0)$ is equal to the variance σ^2_{Br} of the noise filtered with the "Brick Wall" filter.

Comparison of Eqs. (26) and (27) with Eqs. (35) and (36) reveals that the corresponding rate formulas are close to each other when the variances $C_i(0)$ and $C_{Br}(0)$ are equal. This is true if $A_i = A_{\mathrm{Br}}$ and the noise equivalent bandwidths in both cases are chosen to be equal to each other. Our choice of making the noise equivalent bandwidth to be equal to the center frequency of the filter implies that the bandwidths will be the same when the center frequency of each filter are equal. In what follows, we assume that $A_i = A_{\mathrm{Br}}$. Using Eqs. (22), (29) and (31), we then get:

$$\frac{\sigma^2_{\mathrm{Br}}}{\sigma^2_{\mathrm{Gauss}}} = \frac{C_{\mathrm{Br}}(0)}{C_i(0)} = \frac{A_i}{A_{\mathrm{Br}}} = 1 \tag{37}$$

Note that a "Brick Wall" filter is implicitly used in Section II.A. The results obtained using the equations governing the coincidence accidental rate derived in that section should be compared to the results obtained using the equations derived in this section with a "Brick Wall" filter.

We will now compute the coincidence accidental rate R'_{acc} for an observatory consisting of three detectors: two of the detectors are located on the same site, the remaining one is located at a distant site. The resolving time for coincidence experiments between the detectors that are located on the same site is chosen to be:

$$\tau'_1 = \frac{1}{2 f_c} \tag{38}$$

The optimal choice of the resolving time τ'_1 will depend on the expected gravitational wave pulse durations. The choice given by Eq. (38) represents a reasonable value for one millisecond long gravitational wave pulses.

The resolving time for coincidence experiments that are located on separated sites is then given by:

$$\tau'_2 = D + \tau'_1 \tag{39}$$

where D is the maximum time-delay between these sites for the reception of a gravitational wave. Note that τ'_1, τ'_2 and D correspond to t_1, t_2 and L respectively in the first part of this memorandum. For an observatory consisting of three detectors (two of which are located on one site, the remaining one is located at a distant site), the accidental coincidence rate R'_{acc} for the observatory entirely due to the Gaussian noise in the receivers is given by:

$$R'_{acc} = 4 \tau'_1 \tau'_2 R'_1 R'_2 R'_3 \tag{40}$$

Substituting for R'_i, τ'_1 and τ'_2 using Eqs. (26), (27), (35), (36), (38) and (39), we obtain:

$$P'(\sigma_1, T_1) P'(\sigma_2, T_2) P'(\sigma_3, T_3) = \frac{R'_{acc}}{4 K^3 f_c^{\,3} \tau'_1 \tau'_2} \tag{41}$$

where $K = K_G$ or K_{Br} depending on the filter used and $P'(\sigma, T)$ is given by:

$$P'(\sigma, T) = \exp[-T^2 / 2\sigma^2] \tag{42}$$

When converted into the notation used by B. F. Schutz[2], this equation becomes:

$$P'(\sigma_1, T_1)P'(\sigma_2, T_2)P'(\sigma_3, T_3) = \frac{1}{K^3 W' N'_{obs}} \tag{43}$$

where $W' = 2f_c \tau'_2$ is the coincidence window between the separated sites in units of the inverse bandwidth $1/f_c$; $N'_{obs} = f_c / R'_{acc}$ is the total number of data points collected at the rate of f_c during an observation run which is long enough to give one coincidence pulse on the average from the observatory entirely due to the Gaussian noise in the receivers.

C. The computation of the optimum sensitivity

We assume that all receivers in a given observatory are oriented parallel to each other so that the angular antenna patterns are the same. In a further memorandum, we will examine the case of arbitrary orientations of receivers. We consider a case in which a gravitational wave of pulse amplitude h is impinging on the three receivers in the observatory. We will take $h > 0$ without loss of generality. In the presence of the pulse, the output of each receiver is the sum of the gravitational wave amplitude h and the receiver noise Λ_i:

$$x_i = h + \Lambda_i \tag{44}$$

In a series of experiments in which the gravitational wave amplitude h is held constant, the output pulse heights x_i of the receivers containing the gravitational wave pulse of amplitude h will be distributed according to a Gaussian distribution with a mean h and variance σ^2_i:

$$p_h(\sigma_i; x_i) = \frac{1}{(2\pi)^{1/2}\sigma_i} \exp[-(x_i - h)^2 / 2\sigma^2_i] \tag{45}$$

This follows from the fact that the probability distribution of the Gaussian random noise Λ_i with zero mean and variance σ^2_i is given by:

$$p(\sigma_i; \Lambda_i) = \frac{1}{(2\pi)^{1/2}\sigma_i} \exp[-\Lambda^2_i / 2\sigma^2_i] \tag{46}$$

Formally solving for Λ_i from Eq. (44) and substituting in Eq. (46) gives Eq. (45) since h is a constant.

With the assumptions stated above, Eq. (5) or Eq. (43) define a constraint between the thresholds $T_1 = T_2$ and T_3, where we choose to make the threshold levels of two identical receivers with identical noise variances equal. In general, this equation will have many solution triplets (T_1, T_2, T_3).

For any given solution (T_1, T_2, T_3) of Eq. (5) or Eq. (43) with a given accidental coincidence rate, there exists a unique gravitational wave amplitude $h(T_1, T_2, T_3)$ which has a likelihood of 50 percent of being detected by the all three receivers in coincidence. This amplitude $h(T_1, T_2, T_3)$ is a function of the threshold values $T_i, i = 1, 2, 3$. With the gravitational wave present, the probability that the receiver output x_i will exceed the threshold T_i is given by (Fig. 4 and Fig. 5):

$$P_h(\sigma_i; |x_i| > T_i) = 1 - \frac{1}{2}\left[\operatorname{erf}\left[\frac{T_i + h}{2^{1/2}\sigma_i}\right] + \operatorname{erf}\left[\frac{T_i - h}{2^{1/2}\sigma_i}\right]\right] \tag{47a}$$

where $h \geq 0$ and $T_i \geq h$;

$$P_h(\sigma_i; |x_i| > T_i) = 1 - \frac{1}{2}\left[\operatorname{erf}\left[\frac{h + T_i}{2^{1/2}\sigma_i}\right] - \operatorname{erf}\left[\frac{h - T_i}{2^{1/2}\sigma_i}\right]\right] \tag{47b}$$

where $h \geq 0$ and $0 \leq T_i \leq h$.

Using Eqs. (47a) and (47b), we deduce that the gravitational wave amplitude $h(T_1, T_2, T_3)$ which has a 50 percent likelihood of being detected in coincidence by the three receivers of the observatory satisfies the following equation:

$$P_h(\sigma_1; |x_1| > T_1) P_h(\sigma_2; |x_2| > T_2) P_h(\sigma_3; |x_3| > T_3) = 0.50 \tag{48}$$

We will consider three different cases: (i) all of the receivers have the same sensitivity (equal arm-lengths and equal noise variances) (ii) two located on the same site have different arm-lengths (one full-length and one half-length, the root-mean-squared noise level of the shorter one is $\sqrt{2}$ times the noise level of the longer one), and the remaining one has an arm-length and a noise variance equal to that of the longer interferometer on the previous site. The receivers are adjusted so that they produce equal output for equal incoming gravitational wave strain. (iii) As in case (ii), but the root-mean-squared noise level of the half-length interferometer is twice the noise level of the full-length ones.

In the case (i) described above, the detector variances are all equal. We choose the thresholds T_1, T_2, T_3 to be equal to each other. We will call this common value T. Using Eq. (5) or Eq. (43), one can solve for this threshold value T. One then substitutes the value thus obtained into Eq. (48), and one solves for the corresponding gravitational wave amplitude $h(T)$. Note that Eqs. (5), (43) and (48) are transcendental equations which have to be solved numerically.

In the cases (ii) and (iii), we choose the thresholds T_1 and T_2 to be equal (we assume that the receivers 1 and 2 are the full-length receivers). We then minimize the gravitational wave amplitude $h(T_1, T_2, T_3)$ satisfying Eq. (48) subject to the constraint described by Eq. (5) or Eq. (43).

We indicate that whether Eq. (48) has a local minimum depends on the relationship between the variances σ^2_i, $i = 1, 2, 3$. Also, during the minimization procedure, the singles accidental pulse rate at the output of the each receiver will vary. For the minimum value of h (either a local minimum or the absolute minimum in the space of solutions), the singles accidental rate at the output of some of the receivers may be unacceptably high due to practical considerations.

In a previous calculation, B. F. Schutz[2] chose the thresholds in the receivers to scale exactly according to the root-mean-squared noise level in the receivers. This choice simply makes the singles accidental rate at the output of each receiver the same as the others.

Although this is a reasonable choice, it is not shown to be the optimal choice. Our calculations indicate that the choice suggested by B. F. Schutz[2] does not minimize the gravitational wave amplitude h which has a 50 percent likelihood of being detected in coincidence by the three receivers of the observatory.

D. The case of two separated detectors

In the case of an observatory consisting of only two receivers separated by a large distance, an analysis similar to the one given above leads to the following constraint equations:

(a) The method introduced by B. F. Schutz:[2]

$$P(\sigma_1;|x_1|>T_1)P(\sigma_2;|x_2|>T_2)=\frac{1}{W N_{obs}} \tag{49}$$

where $W=2f_c\tau_2$ is the coincidence window between the separated sites in units of the time between the samples, $N_{obs}=2f_c/R_{acc}$ is the total number of data points collected at the rate of $2f_c$ during an observation run which is long enough to give one coincidence pulse on the average from the observatory entirely due to the Gaussian, band-limited white noise in the receivers. R_{acc} is the coincidence accidental rate for the observatory consisting of two receivers. The probabilities $P(\sigma_i;|x_i|>T_i), i=1,2$ are given by Eq. (3).

(b) The method suggested by R. W. P. Drever:

$$P'(\sigma_1,T_1)P'(\sigma_2,T_2)=\frac{1}{K^2 W' N'_{obs}} \tag{50}$$

where $W'=2f_c\tau'_2$ is the coincidence window between the separated sites in units of the inverse bandwidth $1/f_c$; $N'_{obs}=f_c/R'_{acc}$ is the total number of data points collected at the rate of f_c during an observation run which is long enough to give one coincidence pulse on the average from the observatory entirely due to the Gaussian noise in the receivers. R'_{acc} is the coincidence accidental rate for the observatory consisting of two receivers. The probabilities $P'(\sigma,T_i), i=1,2$ are given by Eq. (43). $K=K_G$ or K_{Br} depending on whether a "Gaussian" filter or a "Brick Wall" filter is used at the output of the receivers [see Eqs. (27) and (36)].

The equation governing the amplitude of h of the gravitational wave which has a 50 percent likelihood of detection by the observatory consisting of two receivers is given by:

$$P_h(\sigma_1;|x_1|>T_1)P_h(\sigma_2;|x_2|>T_2)=0.50 \tag{51}$$

The probabilities $P_h(\sigma_i;|x_i|>T_i), i=1,2$ are given by Eqs. (47a) and (47b).

We will again consider three different cases: (iv) all of the receivers have the same sensitivity (equal arm-lengths and equal noise variances) (v) the receivers have different arm-lengths; one is a full-length interferometer and the other is a half-length interferometer. The root-mean-squared noise level of the shorter one is $\sqrt{2}$ times the noise level of the longer one. The receivers are adjusted so that they produce equal output for equal incoming gravitational wave strain. (vi) As in case (v), but the root-mean-squared noise level of the half-length interferometer is twice the noise level of the full-length one.

The method of solution for the resulting set of equations is the same as the method used in the case of the three-detector observatory.

III. RESULTS

A. The assumptions

The separation between the remote sites is taken to be 14.5 milliseconds of light travel time which corresponds to a distance of nearly 2800 miles. The cases (i), (ii), (iii), (iv), (v) and (vi) are examined for bandwidths $f_c = 30$ Hz, 200 Hz and 1 KHz. The coincidence accidental rate from the observatory in all the cases described above is taken to be 1 pulse every ten years. We solve for the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory as a function of the receiver thresholds. These solutions are found using either the constraint equation derived with the method introduced by B. F. Schutz or the constraint equation derived with the method suggested by R. W. P. Drever. In the latter case, we examine both the "Gaussian" filter and the "Brick Wall" filter cases. Since resulting system of equations are transcendental, we wrote a FORTRAN program to find the solutions.

B. The output

The output is organized in the form of tables. The results are given in Tables Ia - If to VIa - VIf. Table VII is a summary of the results.

"D. Tm." (dead time) is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. It is given by:

$$\text{dead time} = \begin{cases} 2\tau_1 R_i & \text{3 detectors, Schutz Method} \\ 2\tau'_1 R'_i & \text{3 detectors, Drever Method} \\ 2\tau_2 R_i & \text{2 detectors, Schutz Method} \\ 2\tau'_2 R'_i & \text{2 detectors, Drever Method} \end{cases}$$

R_i and R'_i are the singles accidental rates for the receiver i; τ_1 and τ'_1 are the resolving times for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.A and II.B); τ_2 and τ'_2 are the resolving times for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Sections IIA, IIB, II.D); Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers.

"Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

"Ratio" is the ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers (one full-length receiver in the two detector case) to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see constraint (b) in part I of this document]. "S. Ratio" is the similar ratio when the thresholds of the receivers scale exactly with the root-mean-squared noise levels in the receivers (Schutz[2] solution). Note that this does not correspond to the lowest possible thresholds with 1 percent dead time, but it results in equal coincidence accidental event rates in all receivers of the observatory.

We find that when the root-mean-squared noise level of the half-length receiver is twice that of the full-length receiver, there is a shallow minimum for the sensitivity. This usually corresponds to too large a dead time on the half-length receiver. The minimum is better pronounced and it is closer to the 1 percent dead time on the half-length receiver when the root-mean-squared noise level of the half-length receiver is $\sqrt{2}$ times that of the full-length receiver. The Schutz[2] solution as defined in the previous paragraph ("S. Ratio" in Table VII) gives smaller dead times on the half-length receiver at the expense of much lower gravitational wave sensitivity for the observatory in all of the cases considered.

IV. CONCLUSION

We developed a method for finding the thresholds and corresponding sensitivities for a LIGO observatory consisting of two or three receivers in two different configurations. We find that choosing the arm-length of one of the receivers on a site with two detectors in a three-detector observatory to be one half of the arm-length of the other receiver reduces the sensitivity of the observatory by only about 9 percent with one percent dead time at the output of the half-length interferometer when the root-mean-squared noise level of the half-length interferometer is $\sqrt{2}$ times that of the full-length ones. This reduction is by about 20 percent with a similar dead time at the output of the half-length interferometer as compared to an observatory with all full-length receivers when the root-mean-squared noise level of the half-length interferometer is twice that of the full-length ones. In a separated, two-detector observatory, the reductions in sensitivity are 15 percent and 33 percent at one percent dead time on the half length receiver when the ratio of the noise level of the half-length receiver to that of the full-length receiver is $\sqrt{2}$ and 2 respectively.

In contrast, a similar computation performed by B. F. Schutz[2] with the choice that the threshold values scale exactly with the root-mean-squared noise amplitudes gives about 20 percent reduction in the sensitivity when $\sigma_{half}=\sqrt{2}\,\sigma_{full}$ and it gives about 65 percent reduction in the sensitivity when $\sigma_{half}=2\,\sigma_{full}$ for a three detector observatory. In a separated, two-detector observatory with similarly scaled thresholds, the reductions in sensitivity are 30 percent and 80 percent at one percent dead time on the half length receiver when the ratio of the noise level of the half-length receiver to that of the full-length receiver is $\sqrt{2}$ and 2 respectively.

V. ACKNOWLEDGEMENTS

We thank R. W. P. Drever for suggesting this problem and the general approach used here. He also predicted that choosing the root-mean-squared noise level of one of the receivers on a site with two detectors in a three-detector observatory to be twice the root-mean-squared noise level of the other receivers reduced the sensitivity of the observatory by about 20 percent.

VI. REFERENCES

[1] M. Abramowitz and I. Stegun, *Handbook of Mathematical Functions*, (Dover, New York, 1972), Eqs. (7.1.22) and (7.1.26).

[2] B. F. Schutz, *Gravitational Wave Data Analysis*, (Kluwer Academic Publishers, Dordrecht, 1989), pages 315-326.

[3] R. G. Brown, *Introduction to Random Signal Analysis and Kalman Filtering*, (John Wiley & Sons, New York, 1983), pages 90-92.

[4] A. Papoulis, *Probability, Random Variables, and Stochastic Processes*, (McGraw-Hill, New York, 1965), pages 492-493.

[5] R. G. Brown, *Introduction to Random Signal Analysis and Kalman Filtering*, (John Wiley & Sons, New York, 1983), page 88.

[6] R. G. Brown, *Introduction to Random Signal Analysis and Kalman Filtering*, (John Wiley & Sons, New York, 1983), pages 128-130.

TABLE Ia. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.A (Schutz Method) is used.

"D. Tm." (dead time) $2\tau_1 R_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R_i is the singles accidental rate for the receiver i and τ_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.A). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $4.227\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.045\,\sigma_{full}$. The common "dead time" for this case is 4.729×10^{-5}.

$\sigma_{half} = \sqrt{2}\,\sigma_{full}$, Bandwidth $= f_c = 1$ KHz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	5.399E-03	8.505	3.628E-09	8.505
3.160	3.155E-03	8.255	1.062E-08	8.255
3.480	1.003E-03	7.697	1.051E-07	7.696
3.780	3.137E-04	7.089	1.074E-06	7.090
4.050	1.024E-04	6.453	1.007E-05	6.480
4.230	4.676E-05	5.971	4.838E-05	6.088
4.320	3.122E-05	5.708	1.085E-04	5.920
4.560	1.024E-05	4.919	1.009E-03	5.609
4.800	3.177E-06	3.948	1.048E-02	5.507
5.030	9.824E-07	2.715	0.1096	5.596
5.230	3.396E-07	1.047	0.9174	5.775
5.300	2.320E-07	3.070E-02	1.965	5.844

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{5.507}{5.045} = 1.091$

TABLE Ib. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.A (Schutz Method) is used.

"D. Tm." (dead time) $2\tau_1 R_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R_i is the singles accidental rate for the receiver i and τ_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.A). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $3.989\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $4.806\,\sigma_{full}$. The common "dead time" for this case is 1.326×10^{-4}.

$\sigma_{half} = \sqrt{2}\,\sigma_{full}$, Bandwidth $= f_c = 200$ Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	5.399E-03	7.765	7.996E-08	7.765
3.040	4.731E-03	7.699	1.041E-07	7.699
3.370	1.503E-03	7.100	1.031E-06	7.100
3.680	4.665E-04	6.435	1.070E-05	6.445
3.960	1.499E-04	5.723	1.036E-04	5.836
3.990	1.322E-04	5.639	1.333E-04	5.777
4.230	4.676E-05	4.898	1.066E-03	5.415
4.480	1.494E-05	3.949	1.044E-02	5.252
4.540	1.126E-05	3.683	1.838E-02	5.246
4.720	4.722E-06	2.744	1.045E-01	5.302
4.940	1.564E-06	1.007	0.9525	5.485
5.010	1.090E-06	3.380E-02	1.961	5.554

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{5.252}{4.806} = 1.093$

TABLE Ic. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.A (Schutz Method) is used.

"D. Tm." (dead time) $2\tau_1 R_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R_i is the singles accidental rate for the receiver i and τ_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.A). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is 3.729 σ_{full} corresponding to a gravitational wave sensitivity of 4.547 σ_{full}. The common "dead time" for this case is 3.837×10^{-4}.

$\sigma_{half} = \sqrt{2}\,\sigma_{full}$, Bandwidth = f_c = 30 Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	5.399E-03	6.926	1.938E-06	6.926
3.250	2.308E-03	6.438	1.060E-05	6.440
3.560	7.418E-04	5.726	1.026E-04	5.774
3.730	3.830E-04	5.273	3.851E-04	5.438
3.850	2.363E-04	4.918	1.012E-03	5.247
4.130	7.259E-05	3.937	1.072E-02	4.989
4.260	4.091E-05	3.378	3.377E-02	4.962
4.380	2.375E-05	2.770	1.001E-01	4.988
4.620	7.682E-06	1.001	0.9577	5.166
4.690	5.469E-06	9.820E-02	1.889	5.234

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{4.989}{4.547} = 1.097$

TABLE Id. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.A (Schutz Method) is used.

"D. Tm." (dead time) $2\tau_1 R_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R_i is the singles accidental rate for the receiver i and τ_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.A). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $4.227\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.045\,\sigma_{full}$. The common "dead time" for this case is 4.729×10^{-5}.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth $= f_c = 1$ KHz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	5.399E-03	12.02	3.629E-09	12.02
3.160	3.155E-03	11.67	1.062E-08	11.67
3.480	1.003E-03	10.88	1.051E-07	10.88
3.780	3.137E-04	10.02	1.074E-06	10.02
4.050	1.024E-04	9.126	1.007E-05	9.126
4.230	4.676E-05	8.444	4.838E-05	8.444
4.320	3.122E-05	8.073	1.085E-04	8.073
4.560	1.024E-05	6.956	1.009E-03	6.994
4.800	3.177E-06	5.583	1.048E-02	6.126
5.030	9.824E-07	3.840	0.1096	5.782
5.120	6.120E-07	2.942	0.2824	5.754
5.230	3.396E-07	1.481	0.9174	5.790
5.300	2.320E-07	4.345E-02	1.965	5.845

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{6.126}{5.045} = 1.214$

TABLE Ie. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.A (Schutz Method) is used.

"D. Tm." (dead time) $2\tau_1 R_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R_i is the singles accidental rate for the receiver i and τ_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.A). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $3.989\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $4.806\,\sigma_{full}$. The common "dead time" for this case is $1.326{\times}10^{-4}$.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth $= f_c = 200$ Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	5.399E-03	10.98	7.996E-08	10.98
3.040	4.731E-03	10.88	1.041E-07	10.88
3.370	1.503E-03	10.04	1.031E-06	10.04
3.680	4.665E-04	9.101	1.071E-05	9.100
3.960	1.499E-04	8.094	1.036E-04	8.094
3.990	1.322E-04	7.975	1.334E-04	7.975
4.230	4.676E-05	6.927	1.066E-03	6.943
4.480	1.494E-05	5.586	1.044E-02	5.968
4.720	4.722E-06	3.881	1.045E-01	5.535
4.850	2.472E-06	2.616	0.3814	5.479
4.940	1.564E-06	1.424	0.9525	5.506
5.010	1.090E-06	4.780E-02	1.961	5.555

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{5.968}{4.806} = 1.242$

TABLE If. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.A (Schutz Method) is used.

"D. Tm." (dead time) $2\tau_1 R_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R_i is the singles accidental rate for the receiver i and τ_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.A). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $3.729\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $4.547\,\sigma_{full}$. The common "dead time" for this case is 3.837×10^{-4}.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth = f_c = 30 Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	5.399E-03	9.796	1.938E-06	9.795
3.250	2.308E-03	9.105	1.060E-05	9.104
3.560	7.418E-04	8.099	1.027E-04	8.098
3.730	3.830E-04	7.457	3.851E-04	7.457
3.850	2.363E-04	6.955	1.012E-03	6.959
4.130	7.259E-05	5.568	1.072E-02	5.815
4.380	2.375E-05	3.918	1.001E-01	5.278
4.550	1.073E-05	2.324	0.4901	5.180
4.620	7.682E-06	1.416	0.9577	5.195
4.690	5.469E-06	0.1388	1.889	5.236

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{5.815}{4.547} = 1.279$

TABLE IIa. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.B (Drever Method) with a Gaussian filter is used.

"D. Tm." (dead time) $2\tau'_1 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and τ'_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.B). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $4.632\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.451\,\sigma_{full}$. The common "dead time" for this case is 4.730×10^{-5}.

$\sigma_{half} = \sqrt{2}\,\sigma_{full}$, Bandwidth = f_c = 1 KHz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	2.401E-02	9.631	1.834E-10	9.630
3.280	9.969E-03	9.258	1.064E-09	9.258
3.610	3.198E-03	8.753	1.034E-08	8.753
3.930	9.572E-04	8.184	1.154E-07	8.183
4.200	3.194E-04	7.628	1.037E-06	7.629
4.470	9.908E-05	6.988	1.077E-05	7.007
4.630	4.784E-05	6.558	4.622E-05	6.639
4.720	3.141E-05	6.296	1.072E-04	6.453
4.960	9.831E-06	5.509	1.094E-03	6.090
5.180	3.222E-06	4.629	1.019E-02	5.947
5.240	2.357E-06	4.350	1.904E-02	5.940
5.400	1.006E-06	3.481	1.044E-01	5.985
5.600	3.349E-07	1.821	0.9431	6.145
5.670	2.257E-07	0.4029	2.075	6.214

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{5.947}{5.451} = 1.091$

TABLE IIb. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.B (Drever Method) with a Gaussian filter is used.

"D. Tm." (dead time) $2\tau'_1 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and τ'_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.B). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $4.404\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.223\,\sigma_{full}$. The common "dead time" for this case is 1.326×10^{-4}.

$\sigma_{half} = \sqrt{2}\,\sigma_{full}$, Bandwidth = f_c = 200 Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	2.401E-02	8.966	4.041E-09	8.965
3.150	1.514E-02	8.757	1.016E-08	8.757
3.500	4.729E-03	8.209	1.042E-07	8.208
3.810	1.523E-03	7.637	1.005E-06	7.636
4.110	4.642E-04	6.987	1.081E-05	6.993
4.380	1.475E-04	6.296	1.070E-04	6.380
4.400	1.351E-04	6.240	1.276E-04	6.337
4.630	4.784E-05	5.535	1.018E-03	5.935
4.880	1.457E-05	4.596	1.097E-02	5.714
4.920	1.197E-05	4.423	1.624E-02	5.700
5.110	4.619E-06	3.455	0.1092	5.714
5.320	1.545E-06	1.782	0.9766	5.866
5.390	1.062E-06	0.4238	2.066	5.934

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{5.714}{5.223} = 1.094$

TABLE IIc. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.B (Drever Method) with a Gaussian filter is used.

"D. Tm." (dead time) $2\tau'_1 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and τ'_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.B). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $4.156\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $4.975\,\sigma_{full}$. The common "dead time" for this case is 3.838×10^{-4}.

$\sigma_{half} = \sqrt{2}\,\sigma_{full}$, Bandwidth = f_c = 30 Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	2.401E-02	8.224	9.800E-08	8.223
3.010	2.330E-02	8.209	1.040E-07	8.209
3.370	7.391E-03	7.629	1.034E-06	7.629
3.700	2.301E-03	6.991	1.066E-05	6.992
4.000	7.252E-04	6.295	1.074E-04	6.331
4.160	3.775E-04	5.866	3.965E-04	5.991
4.270	2.374E-04	5.541	1.002E-03	5.792
4.540	7.228E-05	4.603	1.081E-02	5.479
4.720	3.141E-05	3.810	5.728E-02	5.417
4.780	2.362E-05	3.498	1.012E-01	5.423
5.010	7.662E-06	1.798	0.9627	5.558
5.090	5.115E-06	5.935E-02	2.160	5.634

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{5.479}{4.975} = 1.101$

TABLE IId. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.B (Drever Method) with a Gaussian filter is used.

"D. Tm." (dead time) $2\tau'_1 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and τ'_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.B). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $4.632\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.451\,\sigma_{full}$. The common "dead time" for this case is $4.730{\times}10^{-5}$.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth = f_c = 1 KHz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	2.401E-02	13.62	1.834E-10	13.62
3.280	9.969E-03	13.09	1.064E-09	13.09
3.610	3.198E-03	12.38	1.034E-08	12.37
3.920	9.955E-04	11.60	1.067E-07	11.60
4.200	3.194E-04	10.78	1.037E-06	10.78
4.470	9.908E-05	9.882	1.077E-05	9.882
4.630	4.784E-05	9.274	4.622E-05	9.274
4.720	3.141E-05	8.904	1.072E-04	8.904
4.960	9.831E-06	7.791	1.094E-03	7.802
5.180	3.222E-06	6.546	1.019E-02	6.820
5.400	1.006E-06	4.923	1.044E-01	6.294
5.570	3.960E-07	3.052	0.6746	6.179
5.600	3.349E-07	2.576	0.9431	6.182
5.670	2.257E-07	0.5697	2.075	6.216

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{6.820}{5.451} = 1.251$

TABLE IIe. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.B (Drever Method) with a Gaussian filter is used.

"D. Tm." (dead time) $2\tau'_1 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and τ'_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.B). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is 4.404 σ_{full} corresponding to a gravitational wave sensitivity of 5.223 σ_{full}. The common "dead time" for this case is 1.326×10^{-4}.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth $= f_c = 200$ Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	2.401E-02	12.67	4.042E-09	12.67
3.150	1.514E-02	12.38	1.016E-08	12.38
3.500	4.729E-03	11.60	1.042E-07	11.60
3.810	1.523E-03	10.80	1.005E-06	10.80
4.110	4.642E-04	9.881	1.081E-05	9.880
4.380	1.475E-04	8.905	1.070E-04	8.904
4.400	1.351E-04	8.826	1.276E-04	8.825
4.630	4.784E-05	7.828	1.018E-03	7.831
4.880	1.457E-05	6.500	1.097E-02	6.687
5.110	4.619E-06	4.886	0.1092	6.070
5.310	1.629E-06	2.684	0.8781	5.912
5.320	1.545E-06	2.521	0.9766	5.913
5.390	1.062E-06	0.5993	2.066	5.938

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{6.687}{5.223} = 1.280$

TABLE IIf. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.B (Drever Method) with a Gaussian filter is used.

"D. Tm." (dead time) $2\tau'_1 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and τ'_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.B). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $4.156\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $4.975\,\sigma_{full}$. The common "dead time" for this case is 3.838×10^{-4}.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth $= f_c = 30$ Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	2.401E-02	11.63	9.800E-08	11.63
3.010	2.330E-02	11.61	1.040E-07	11.60
3.370	7.391E-03	10.78	1.034E-06	10.78
3.700	2.301E-03	9.887	1.066E-05	9.886
4.000	7.252E-04	8.903	1.074E-04	8.903
4.160	3.775E-04	8.296	3.965E-04	8.295
4.270	2.374E-04	7.836	1.002E-03	7.836
4.540	7.228E-05	6.510	1.081E-02	6.609
4.780	2.362E-05	4.948	1.012E-01	5.860
5.010	7.662E-06	2.543	0.9627	5.622
5.030	6.930E-06	2.205	1.176	5.621
5.090	5.115E-06	8.390E-02	2.160	5.635

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{6.609}{4.975} = 1.328$

TABLE IIIa. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.B (Drever Method) with a Brickwall filter is used.

"D. Tm." (dead time) $2\tau'_1 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and τ'_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.B). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is 4.624 σ_{full} corresponding to a gravitational wave sensitivity of 5.443 σ_{full}. The common "dead time" for this case is 4.730×10^{-5}.

$\sigma_{half} = \sqrt{2}\,\sigma_{full}$, Bandwidth = f_c = 1 KHz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	2.312E-02	9.607	1.978E-10	9.607
3.260	1.024E-02	9.262	1.007E-09	9.262
3.600	3.192E-03	8.744	1.038E-08	8.744
3.910	9.968E-04	8.194	1.064E-07	8.194
4.190	3.207E-04	7.621	1.028E-06	7.621
4.460	9.976E-05	6.981	1.063E-05	7.000
4.620	4.825E-05	6.551	4.545E-05	6.632
4.710	3.170E-05	6.290	1.052E-04	6.446
4.950	9.947E-06	5.504	1.069E-03	6.082
5.180	3.102E-06	4.579	1.099E-02	5.936
5.230	2.391E-06	4.346	1.849E-02	5.931
5.390	1.022E-06	3.477	1.011E-01	5.976
5.590	3.411E-07	1.819	0.9095	6.135
5.660	2.300E-07	0.4021	1.999	6.204

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{5.936}{5.443} = 1.090$

TABLE IIIb. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.B (Drever Method) with a Brickwall filter is used.

"D. Tm." (dead time) $2\tau'_1 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and τ'_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.B). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is 4.395 σ_{full} corresponding to a gravitational wave sensitivity of 5.214 σ_{full}. The common "dead time" for this case is 1.326×10^{-4}.

$\sigma_{half} = \sqrt{2}\,\sigma_{full}$, Bandwidth = f_c = 200 Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.010	2.244E-02	8.927	4.630E-09	8.926
3.140	1.504E-02	8.746	1.030E-08	8.745
3.490	4.715E-03	8.198	1.048E-07	8.198
3.800	1.523E-03	7.627	1.004E-06	7.627
4.100	4.657E-04	6.978	1.074E-05	6.984
4.370	1.484E-04	6.288	1.058E-04	6.371
4.400	1.301E-04	6.204	1.376E-04	6.308
4.620	4.825E-05	5.527	1.001E-03	5.927
4.870	1.473E-05	4.589	1.074E-02	5.704
4.990	8.154E-06	4.041	3.506E-02	5.680
5.100	4.681E-06	3.448	0.1064	5.705
5.310	1.569E-06	1.774	0.9471	5.856
5.380	1.079E-06	0.3956	2.001	5.924

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{5.704}{5.214} = 1.094$

TABLE IIIc. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.B (Drever Method) with a Brickwall filter is used.

"D. Tm." (dead time) $2\tau'_1 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and τ'_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.B). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $4.146\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $4.966\,\sigma_{full}$. The common "dead time" for this case is 3.838×10^{-4}.

$$\sigma_{half} = \sqrt{2}\,\sigma_{full} \quad , \quad \text{Bandwidth} = f_c = 30 \text{ Hz}$$

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	2.312E-02	8.196	1.056E-07	8.196
3.360	7.360E-03	7.617	1.043E-06	7.617
3.690	2.299E-03	6.979	1.068E-05	6.981
3.990	7.267E-04	6.285	1.070E-04	6.320
4.150	3.789E-04	5.856	3.935E-04	5.981
4.270	2.286E-04	5.500	1.081E-03	5.766
4.530	7.283E-05	4.593	1.065E-02	5.469
4.710	3.170E-05	3.800	5.622E-02	5.407
4.780	2.274E-05	3.433	0.1092	5.415
5.000	7.756E-06	1.783	0.9394	5.548
5.070	5.452E-06	0.6020	1.901	5.615

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{5.469}{4.966} = 1.101$

TABLE IIId. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.B (Drever Method) with a Brickwall filter is used.

"D. Tm." (dead time) $2\tau'_1 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and τ'_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.B). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $4.624\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.443\,\sigma_{full}$. The common "dead time" for this case is 4.730×10^{-5}.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth $= f_c = 1$ KHz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	2.312E-02	13.58	1.978E-10	13.58
3.260	1.024E-02	13.09	1.007E-09	13.09
3.600	3.192E-03	12.36	1.038E-08	12.36
3.910	9.968E-04	11.58	1.064E-07	11.58
4.190	3.207E-04	10.77	1.028E-06	10.77
4.460	9.976E-05	9.873	1.063E-05	9.872
4.620	4.825E-05	9.265	4.545E-05	9.265
4.710	3.170E-05	8.895	1.052E-04	8.895
4.950	9.947E-06	7.783	1.069E-03	7.794
5.180	3.102E-06	6.476	1.099E-02	6.777
5.390	1.022E-06	4.918	1.011E-01	6.285
5.560	4.032E-07	3.049	0.6509	6.169
5.590	3.411E-07	2.573	0.9095	6.173
5.660	2.300E-07	0.5686	1.999	6.206

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{6.777}{5.443} = 1.245$

TABLE IIIe. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.B (Drever Method) with a Brickwall filter is used.

"D. Tm." (dead time) $2\tau'_1 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and τ'_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.B). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $4.395\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.214\,\sigma_{full}$. The common "dead time" for this case is 1.326×10^{-4}.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth $= f_c = 200$ Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	2.312E-02	12.64	4.360E-09	12.64
3.140	1.504E-02	12.36	1.029E-08	12.36
3.490	4.715E-03	11.59	1.048E-07	11.59
3.800	1.523E-03	10.78	1.004E-06	10.78
4.100	4.657E-04	9.868	1.074E-05	9.868
4.370	1.484E-04	8.893	1.058E-04	8.893
4.400	1.301E-04	8.774	1.376E-04	8.774
4.620	4.825E-05	7.817	1.001E-03	7.820
4.870	1.473E-05	6.491	1.074E-02	6.677
5.100	4.681E-06	4.877	0.1064	6.060
5.300	1.654E-06	2.673	0.8517	5.902
5.310	1.569E-06	2.509	0.9471	5.903
5.380	1.079E-06	0.5595	2.001	5.927

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{6.677}{5.214} = 1.280$

TABLE IIIf. The thresholds of the receivers in an observatory consisting of three receivers: two full-length detectors and a half-length detector. The half-length receiver is assumed to be in the same vacuum system with a full-length receiver on one of the observatory sites. The other site which is separated from the first site by 14.5 milliseconds of light travel time, houses the other full-length receiver. The constraint equation derived in Section II.B (Drever Method) with a Brickwall filter is used.

"D. Tm." (dead time) $2\tau'_1 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and τ'_1 is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on the same site (see Section II.B). Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $4.146\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $4.966\,\sigma_{full}$. The common "dead time" for this case is 3.838×10^{-4}.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth $= f_c = 30$ Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	2.312E-02	11.59	1.057E-07	11.59
3.360	7.360E-03	10.77	1.043E-06	10.77
3.690	2.299E-03	9.871	1.068E-05	9.870
3.990	7.267E-04	8.888	1.070E-04	8.888
4.150	3.789E-04	8.281	3.936E-04	8.281
4.270	2.286E-04	7.778	1.081E-03	7.779
4.530	7.283E-05	6.496	1.065E-02	6.595
4.780	2.274E-05	4.855	0.1092	5.829
5.000	7.756E-06	2.522	0.9395	5.611
5.010	7.378E-06	2.358	1.038	5.611
5.070	5.452E-06	0.8514	1.901	5.623

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{6.595}{4.966} = 1.328$

TABLE IVa. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (a) derived in Section II.D (Schutz Method) is used.

"D. Tm." (dead time) $2\tau_2 R_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R_i is the singles accidental rate for the receiver i and $\tau_2 = D + \tau_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.A). D is the light travel time between the sites, and τ_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $5.237\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.780\,\sigma_{full}$. The common "dead time" for this case is 9.761×10^{-6}.

$\sigma_{half} = \sqrt{2}\,\sigma_{full}$, Bandwidth $= f_c = 1$ KHz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	0.1619	9.631	5.879E-10	9.630
3.170	9.147E-02	9.514	1.041E-09	9.513
3.790	9.041E-03	9.025	1.053E-08	9.025
4.320	9.368E-04	8.521	1.016E-07	8.520
4.810	9.066E-05	7.969	1.050E-06	7.970
5.240	9.652E-06	7.404	9.867E-06	7.430
5.250	9.142E-06	7.390	1.041E-05	7.417
5.660	9.105E-07	6.761	1.045E-04	6.954
6.040	9.278E-08	6.080	1.026E-03	6.702
6.300	1.793E-08	5.543	5.311E-03	6.653
6.400	9.362E-09	5.318	1.017E-02	6.661
6.750	8.917E-10	4.418	0.1068	6.809
7.060	1.005E-10	3.413	0.9474	7.066
7.610	1.657E-12	7.530E-02	57.45	7.609

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{6.661}{5.780} = 1.152$

TABLE IVb. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (a) derived in Section II.D (Schutz Method) is used.

"D. Tm." (dead time) $2\tau_2 R_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R_i is the singles accidental rate for the receiver i and $\tau_2 = D + \tau_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.A). D is the light travel time between the sites, and τ_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $4.944\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.487\,\sigma_{full}$. The common "dead time" for this case is 1.038×10^{-5}.

$$\sigma_{half} = \sqrt{2}\,\sigma_{full} \quad , \quad \text{Bandwidth} = f_c = 200 \text{ Hz}$$

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	3.671E-02	8.980	2.936E-09	8.980
3.360	1.060E-02	8.706	1.016E-08	8.705
3.950	1.063E-03	8.175	1.013E-07	8.175
4.470	1.064E-04	7.609	1.012E-06	7.610
4.940	1.063E-05	6.999	1.013E-05	7.032
5.370	1.073E-06	6.339	1.004E-04	6.570
5.780	1.018E-07	5.587	1.058E-03	6.338
5.960	3.441E-08	5.208	3.132E-03	6.314
6.150	1.057E-08	4.767	1.019E-02	6.342
6.510	1.026E-09	3.767	0.1050	6.541
6.840	1.082E-10	2.533	0.9955	6.841
7.200	8.243E-12	6.780E-02	13.08	7.199

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{6.342}{5.487} = 1.156$

TABLE IVc. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (a) derived in Section II.D (Schutz Method) is used.

"D. Tm." (dead time) $2\tau_2 R_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R_i is the singles accidental rate for the receiver i and $\tau_2 = D + \tau_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.A). D is the light travel time between the sites, and τ_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $4.624\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.167\,\sigma_{full}$. The common "dead time" for this case is 1.406×10^{-5}.

$$\sigma_{half} = \sqrt{2}\,\sigma_{full} \quad , \quad \text{Bandwidth} = f_c = 30 \text{ Hz}$$

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	1.009E-02	8.259	1.957E-08	8.258
3.470	1.946E-03	7.862	1.015E-07	7.861
4.050	1.916E-04	7.268	1.031E-06	7.269
4.560	1.914E-05	6.630	1.032E-05	6.661
4.620	1.436E-05	6.546	1.375E-05	6.590
5.020	1.935E-06	5.932	1.021E-04	6.181
5.450	1.887E-07	5.138	1.047E-03	5.959
5.590	8.513E-08	4.839	2.321E-03	5.944
5.840	1.958E-08	4.242	1.009E-02	5.992
6.220	1.866E-09	3.101	0.1059	6.236
6.560	2.021E-10	1.588	0.9776	6.560
6.750	5.558E-11	8.715E-02	3.556	6.749

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\dfrac{5.992}{5.167} = 1.160$

TABLE IVd. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (a) derived in Section II.D (Schutz Method) is used.

"D. Tm." (dead time) $2\tau_2 R_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R_i is the singles accidental rate for the receiver i and $\tau_2 = D + \tau_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.A). D is the light travel time between the sites, and τ_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $5.237\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.780\,\sigma_{full}$. The common "dead time" for this case is 9.761×10^{-6}.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth $= f_c = 1$ KHz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	0.1619	13.62	5.878E-10	13.62
3.160	9.466E-02	13.46	1.006E-09	13.46
3.780	9.412E-03	12.77	1.011E-08	12.77
4.320	9.368E-04	12.05	1.016E-07	12.05
4.810	9.066E-05	11.27	1.050E-06	11.27
5.240	9.652E-06	10.47	9.866E-06	10.47
5.250	9.142E-06	10.45	1.041E-05	10.45
5.660	9.105E-07	9.562	1.045E-04	9.562
6.040	9.278E-08	8.599	1.026E-03	8.611
6.400	9.362E-09	7.521	1.017E-02	7.759
6.750	8.917E-10	6.249	0.1068	7.309
7.000	1.545E-10	5.132	0.6164	7.219
7.060	1.005E-10	4.827	0.9475	7.224
7.610	1.657E-12	0.106	57.45	7.609

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{7.759}{5.780} = 1.342$

TABLE IVe. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (a) derived in Section II.D (Schutz Method) is used.

"D. Tm." (dead time) $2\tau_2 R_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R_i is the singles accidental rate for the receiver i and $\tau_2 = D + \tau_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.A). D is the light travel time between the sites, and τ_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $4.944\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.487\,\sigma_{full}$. The common "dead time" for this case is $1.038{\times}10^{-5}$.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth $= f_c = 200$ Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	3.671E-02	12.70	2.936E-09	12.70
3.360	1.060E-02	12.31	1.017E-08	12.31
3.950	1.063E-03	11.56	1.013E-07	11.56
4.470	1.064E-04	10.76	1.012E-06	10.76
4.940	1.063E-05	9.899	1.013E-05	9.898
5.370	1.073E-06	8.964	1.004E-04	8.964
5.780	1.018E-07	7.902	1.058E-03	7.940
6.150	1.057E-08	6.741	1.019E-02	7.186
6.510	1.026E-09	5.328	0.1050	6.871
6.640	4.287E-10	4.711	0.2514	6.849
6.840	1.082E-10	3.583	0.9956	6.903
7.200	8.243E-12	9.590E-02	13.07	7.199

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{7.186}{5.487} = 1.310$

TABLE IVf. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (a) derived in Section II.D (Schutz Method) is used.

"D. Tm." (dead time) $2\tau_2 R_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R_i is the singles accidental rate for the receiver i and $\tau_2 = D + \tau_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.A). D is the light travel time between the sites, and τ_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $4.624\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.167\,\sigma_{full}$. The common "dead time" for this case is 1.406×10^{-5}.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth $= f_c = 30$ Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	1.009E-02	11.68	1.957E-08	11.67
3.470	1.946E-03	11.11	1.015E-07	11.11
4.050	1.916E-04	10.27	1.031E-06	10.27
4.560	1.914E-05	9.376	1.032E-05	9.375
4.620	1.436E-05	9.257	1.375E-05	9.257
5.020	1.935E-06	8.389	1.021E-04	8.390
5.450	1.887E-07	7.266	1.047E-03	7.341
5.840	1.958E-08	6.000	1.009E-02	6.661
6.220	1.866E-09	4.385	0.1059	6.445
6.560	2.021E-10	2.246	0.9776	6.579
6.750	5.558E-11	0.1232	3.556	6.750

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{6.661}{5.167} = 1.289$

TABLE Va. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (b) derived in Section II.D (Drever Method) with a Gaussian filter is used.

"D. Tm." (dead time) $2\tau'_2 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and $\tau'_2 = D + \tau'_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.B). D is the light travel time between the sites, and τ'_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $5.605\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $6.150\,\sigma_{full}$. The common "dead time" for this case is 9.760×10^{-6}.

$\sigma_{half} = \sqrt{2}\,\sigma_{full}$, Bandwidth $= f_c = 1$ KHz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	0.7204	10.37	1.321E-10	10.37
3.620	9.254E-02	9.973	1.028E-09	9.973
4.210	9.187E-03	9.498	1.036E-08	9.498
4.720	9.423E-04	9.006	1.010E-07	9.006
5.190	9.179E-05	8.473	1.037E-06	8.474
5.600	1.004E-05	7.934	9.477E-06	7.950
5.610	9.501E-06	7.920	1.002E-05	7.937
6.010	9.299E-07	7.309	1.024E-04	7.452
6.380	9.396E-08	6.653	1.013E-03	7.158
6.720	1.013E-08	5.946	9.398E-03	7.067
6.730	9.474E-09	5.923	1.005E-02	7.067
7.070	9.071E-10	5.069	0.1049	7.163
7.380	9.658E-11	4.092	0.9861	7.392
7.920	1.552E-12	0.4717	61.34	7.919

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{7.067}{6.150} = 1.149$

TABLE Vb. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (b) derived in Section II.D (Drever Method) with a Gaussian filter is used.

"D. Tm." (dead time) $2\tau'_2 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and $\tau'_2 = D + \tau'_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.B). D is the light travel time between the sites, and τ'_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $5.322\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.867\,\sigma_{full}$. The common "dead time" for this case is 1.038×10^{-5}.

$\sigma_{half} = \sqrt{2}\,\sigma_{full}$, Bandwidth $= f_c = 200$ Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	0.1633	9.762	6.601E-10	9.762
3.140	0.1062	9.674	1.014E-09	9.673
3.800	1.075E-02	9.188	1.002E-08	9.188
4.370	1.048E-03	8.666	1.028E-07	8.666
4.870	1.040E-04	8.116	1.036E-06	8.116
5.320	1.050E-05	7.529	1.026E-05	7.552
5.740	1.029E-06	6.885	1.046E-04	7.066
6.130	1.017E-07	6.176	1.059E-03	6.795
6.400	1.874E-08	5.602	5.752E-03	6.740
6.490	1.049E-08	5.391	1.027E-02	6.747
6.840	1.018E-09	4.442	0.1059	6.894
7.160	1.083E-10	3.282	0.9948	7.163
7.520	7.714E-12	0.4496	13.97	7.519

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{6.747}{5.867} = 1.150$

TABLE Vc. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (b) derived in Section II.D (Drever Method) with a Gaussian filter is used.

"D. Tm." (dead time) $2\tau'_2 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and $\tau'_2 = D + \tau'_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.B). D is the light travel time between the sites, and τ'_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $5.013\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.558\,\sigma_{full}$. The common "dead time" for this case is 1.406×10^{-5}.

$\sigma_{half} = \sqrt{2}\,\sigma_{full}$, Bandwidth = f_c = 30 Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.010	4.358E-02	9.079	4.535E-09	9.078
3.270	1.926E-02	8.897	1.026E-08	8.897
3.910	1.936E-03	8.365	1.020E-07	8.364
4.460	1.937E-04	7.795	1.020E-06	7.795
4.950	1.931E-05	7.179	1.023E-05	7.201
5.010	1.432E-05	7.095	1.379E-05	7.126
5.400	1.881E-06	6.498	1.050E-04	6.691
5.810	1.890E-07	5.748	1.045E-03	6.425
6.040	4.838E-08	5.252	4.085E-03	6.383
6.190	1.933E-08	4.890	1.022E-02	6.400
6.550	1.951E-09	3.840	1.012E-01	6.583
6.890	1.986E-10	2.367	0.9951	6.890
7.090	4.907E-11	0.1215	4.027	7.089

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{6.400}{5.558} = 1.151$

TABLE Vd. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (b) derived in Section II.D (Drever Method) with a Gaussian filter is used.

"D. Tm." (dead time) $2\tau'_2 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and $\tau'_2 = D + \tau'_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.B). D is the light travel time between the sites, and τ'_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is 5.605 σ_{full} corresponding to a gravitational wave sensitivity of 6.150 σ_{full}. The common "dead time" for this case is 9.760×10^{-6}.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth $= f_c = 1$ KHz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	0.7204	14.67	1.321E-10	14.67
3.620	9.254E-02	14.10	1.028E-09	14.10
4.210	9.187E-03	13.43	1.036E-08	13.43
4.720	9.423E-04	12.73	1.010E-07	12.73
5.190	9.179E-05	11.98	1.037E-06	11.98
5.600	1.005E-05	11.22	9.476E-06	11.22
5.610	9.502E-06	11.20	1.002E-05	11.20
6.010	9.301E-07	10.33	1.023E-04	10.33
6.380	9.398E-08	9.409	1.013E-03	9.411
6.730	9.476E-09	8.377	1.005E-02	8.481
7.070	9.073E-10	7.170	0.1049	7.864
7.380	9.661E-11	5.787	0.9858	7.650
7.450	5.749E-11	5.416	1.656	7.642
7.920	1.552E-12	0.6652	61.36	7.919

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{8.481}{6.150} = 1.379$

TABLE Ve. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (b) derived in Section II.D (Drever Method) with a Gaussian filter is used.

"D. Tm." (dead time) $2\tau'_2 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and $\tau'_2 = D + \tau'_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.B). D is the light travel time between the sites, and τ'_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $5.322\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.867\,\sigma_{full}$. The common "dead time" for this case is 1.038×10^{-5}.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth $= f_c = 200$ Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	0.1633	13.80	6.602E-10	13.80
3.140	0.1062	13.68	1.014E-09	13.68
3.800	1.075E-02	12.99	1.002E-08	12.99
4.370	1.048E-03	12.25	1.028E-07	12.25
4.870	1.040E-04	11.47	1.036E-06	11.47
5.320	1.050E-05	10.64	1.026E-05	10.64
5.740	1.029E-06	9.737	1.046E-04	9.737
6.130	1.017E-07	8.735	1.059E-03	8.745
6.490	1.049E-08	7.624	1.027E-02	7.858
6.840	1.018E-09	6.282	0.1059	7.380
7.090	1.784E-10	5.053	0.6041	7.282
7.160	1.083E-10	4.641	0.9948	7.288
7.520	7.714E-12	0.6358	13.97	7.520

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{7.858}{5.867} = 1.339$

TABLE Vf. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (b) derived in Section II.D (Drever Method) with a Gaussian filter is used.

"D. Tm." (dead time) $2\tau'_2 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and $\tau'_2 = D + \tau'_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.B). D is the light travel time between the sites, and τ'_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $5.013\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.558\,\sigma_{full}$. The common "dead time" for this case is 1.406×10^{-5}.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth $= f_c = 30$ Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	4.491E-02	12.84	4.401E-09	12.84
3.270	1.926E-02	12.58	1.026E-08	12.58
3.910	1.936E-03	11.83	1.020E-07	11.82
4.460	1.937E-04	11.02	1.020E-06	11.02
4.950	1.931E-05	10.15	1.023E-05	10.15
5.010	1.432E-05	10.03	1.379E-05	10.03
5.400	1.881E-06	9.190	1.050E-04	9.190
5.810	1.890E-07	8.128	1.045E-03	8.152
6.190	1.933E-08	6.916	1.022E-02	7.302
6.550	1.951E-09	5.430	1.012E-01	6.926
6.710	6.755E-10	4.583	0.2926	6.888
6.890	1.986E-10	3.348	0.9951	6.937
7.090	4.907E-11	0.1718	4.027	7.090

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{7.302}{5.558} = 1.314$

TABLE VIa. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (b) derived in Section II.D (Drever Method) with a Brickwall filter is used.

"D. Tm." (dead time) $2\tau'_2 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and $\tau'_2 = D + \tau'_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.B). D is the light travel time between the sites, and τ'_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $5.598\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $6.143\,\sigma_{full}$. The common "dead time" for this case is 9.760×10^{-6}.

$$\sigma_{half} = \sqrt{2}\,\sigma_{full} \quad , \quad \text{Bandwidth} = f_c = 1 \ \text{KHz}$$

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.020	0.6532	10.35	1.458E-10	10.35
3.610	9.239E-02	9.965	1.030E-09	9.965
4.200	9.226E-03	9.491	1.032E-08	9.491
4.710	9.512E-04	9.000	1.001E-07	8.999
5.180	9.308E-05	8.468	1.023E-06	8.468
5.600	9.676E-06	7.915	9.842E-06	7.932
5.610	9.148E-06	7.901	1.040E-05	7.919
6.000	9.508E-07	7.305	1.001E-04	7.447
6.380	9.047E-08	6.630	1.052E-03	7.146
6.710	1.043E-08	5.943	9.126E-03	7.059
6.730	9.122E-09	5.897	1.043E-02	7.060
7.060	9.373E-10	5.067	1.016E-01	7.154
7.370	1.001E-10	4.091	0.9512	7.382
7.910	1.617E-12	0.4838	58.89	7.909

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{7.060}{6.143} = 1.149$

TABLE VIb. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (b) derived in Section II.D (Drever Method) with a Brickwall filter is used.

"D. Tm." (dead time) $2\tau'_2 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and $\tau'_2 = D + \tau'_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.B). D is the light travel time between the sites, and τ'_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $5.315\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.859\,\sigma_{full}$. The common "dead time" for this case is 1.038×10^{-5}.

$\sigma_{half} = \sqrt{2}\,\sigma_{full}$, Bandwidth $= f_c = 200$ Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	0.1572	9.746	6.855E-10	9.746
3.130	0.1055	9.664	1.021E-09	9.664
3.790	1.075E-02	9.180	1.002E-08	9.179
4.360	1.054E-03	8.659	1.022E-07	8.659
4.860	1.051E-04	8.109	1.025E-06	8.110
5.310	1.066E-05	7.523	1.010E-05	7.546
5.730	1.050E-06	6.880	1.026E-04	7.059
6.120	1.041E-07	6.171	1.035E-03	6.787
6.390	1.923E-08	5.598	5.603E-03	6.732
6.480	1.078E-08	5.387	1.000E-02	6.738
6.830	1.049E-09	4.438	1.027E-01	6.884
7.150	1.120E-10	3.279	0.9618	7.153
7.510	8.008E-12	0.4474	13.46	7.509

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{6.738}{5.859} = 1.150$

TABLE VIc. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (b) derived in Section II.D (Drever Method) with a Brickwall filter is used.

"D. Tm." (dead time) $2\tau'_2 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and $\tau'_2 = D + \tau'_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.B). D is the light travel time between the sites, and τ'_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $5.006\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.551\,\sigma_{full}$. The common "dead time" for this case is 1.406×10^{-5}.

$$\sigma_{half} = \sqrt{2}\,\sigma_{full} \quad , \quad \text{Bandwidth} = f_c = 30 \text{ Hz}$$

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	4.324E-02	9.069	4.571E-09	9.068
3.260	1.916E-02	8.887	1.031E-08	8.887
3.900	1.938E-03	8.356	1.019E-07	8.356
4.450	1.950E-04	7.787	1.013E-06	7.787
4.940	1.954E-05	7.172	1.011E-05	7.193
5.010	1.379E-05	7.074	1.432E-05	7.106
5.390	1.912E-06	6.491	1.033E-04	6.684
5.800	1.928E-07	5.741	1.024E-03	6.417
6.030	4.948E-08	5.246	3.994E-03	6.374
6.190	1.861E-08	4.859	1.061E-02	6.393
6.550	1.879E-09	3.800	0.1052	6.581
6.880	2.048E-10	2.362	0.9647	6.880
7.070	5.444E-11	0.5278	3.630	7.069

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{6.393}{5.551} = 1.152$

TABLE VId. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (b) derived in Section II.D (Drever Method) with a Brickwall filter is used.

"D. Tm." (dead time) $2\tau'_2 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and $\tau'_2 = D + \tau'_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.B). D is the light travel time between the sites, and τ'_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $5.598\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $6.143\,\sigma_{full}$. The common "dead time" for this case is 9.760×10^{-6}.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth $= f_c = 1$ KHz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	0.6937	14.65	1.372E-10	14.65
3.610	9.239E-02	14.09	1.030E-09	14.09
4.200	9.226E-03	13.42	1.032E-08	13.42
4.710	9.512E-04	12.72	1.001E-07	12.72
5.180	9.308E-05	11.97	1.023E-06	11.97
5.600	9.676E-06	11.19	9.842E-06	11.19
5.610	9.148E-06	11.17	1.040E-05	11.17
6.000	9.508E-07	10.33	1.001E-04	10.33
6.380	9.047E-08	9.376	1.052E-03	9.379
6.730	9.122E-09	8.340	1.044E-02	8.451
7.060	9.373E-10	7.167	1.016E-01	7.857
7.370	1.001E-10	5.785	0.9512	7.642
7.440	5.962E-11	5.415	1.597	7.634
7.910	1.617E-12	0.6842	58.90	7.910

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{8.451}{6.143} = 1.376$

TABLE VIe. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (b) derived in Section II.D (Drever Method) with a Brickwall filter is used.

"D. Tm." (dead time) $2\tau'_2 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and $\tau'_2 = D + \tau'_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.B). D is the light travel time between the sites, and τ'_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $5.315\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.859\,\sigma_{full}$. The common "dead time" for this case is 1.038×10^{-5}.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth $= f_c = 200$ Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	0.1572	13.78	6.856E-10	13.78
3.130	0.1055	13.66	1.021E-09	13.66
3.790	1.075E-02	12.98	1.002E-08	12.98
4.360	1.054E-03	12.24	1.022E-07	12.24
4.860	1.051E-04	11.46	1.025E-06	11.46
5.310	1.066E-05	10.64	1.010E-05	10.64
5.730	1.050E-06	9.730	1.026E-04	9.729
6.120	1.041E-07	8.728	1.035E-03	8.739
6.480	1.078E-08	7.618	1.000E-02	7.851
6.830	1.049E-09	6.277	1.027E-01	7.372
7.090	1.718E-10	4.992	0.6274	7.273
7.150	1.120E-10	4.638	0.9618	7.279
7.510	8.008E-12	0.6327	13.46	7.510

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{7.851}{5.859} = 1.340$

TABLE VIf. The thresholds of the receivers in an observatory consisting of two receivers: a full-length detector and a half-length detector. The half-length receiver is assumed to be separated from the full-length one by 14.5 milliseconds of light travel time. the constraint equation (b) derived in Section II.D (Drever Method) with a Brickwall filter is used.

"D. Tm." (dead time) $2\tau'_2 R'_i$ is the fraction of the time spent by the coincidence circuits dealing with the pulses solely due to the Gaussian noise in the receivers. R'_i is the singles accidental rate for the receiver i and $\tau'_2 = D + \tau'_1$ is the resolving time for coincidence experiments between the full-length receiver and the half-length receiver located on separated sites (see Section II.B). D is the light travel time between the sites, and τ'_1 is the resolving time for coincidence experiments when the detectors are located on the same site. Note that when this fraction is larger than one, the receiver is swamped by noise pulses and it will give coincidence with any pulse coming from the other receivers. "Sens." (sensitivity) is the amplitude of the gravitational wave which has a 50 percent likelihood of being detected in coincidence by the observatory.

All thresholds are expressed in units of the root-mean-squared noise level σ_{full} of the full-length receivers. The threshold level with all full-length receivers with equal noise variances is $5.006\,\sigma_{full}$ corresponding to a gravitational wave sensitivity of $5.551\,\sigma_{full}$. The common "dead time" for this case is 1.406×10^{-5}.

$\sigma_{half} = 2\,\sigma_{full}$, Bandwidth $= f_c = 30$ Hz

Thr. (Full l.)	D. Tm. (Full l.)	Thr. (Half l.)	D. Tm. (Half l.)	Sens.
3.000	4.324E-02	12.82	4.570E-09	12.82
3.260	1.916E-02	12.56	1.031E-08	12.56
3.900	1.938E-03	11.81	1.019E-07	11.81
4.450	1.950E-04	11.01	1.013E-06	11.01
4.940	1.954E-05	10.14	1.011E-05	10.14
5.010	1.379E-05	10.00	1.432E-05	10.00
5.390	1.912E-06	9.181	1.033E-04	9.180
5.800	1.928E-07	8.120	1.024E-03	8.143
6.190	1.861E-08	6.872	1.061E-02	7.277
6.550	1.879E-09	5.374	0.1051	6.912
6.700	6.955E-10	4.575	0.2841	6.879
6.880	2.048E-10	3.340	0.9647	6.927
7.070	5.444E-11	0.7464	3.630	7.070

The ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see the constraint (b) in part I of this document] is: $\frac{7.277}{5.551} = 1.311$

TABLE VII. The summary of the results in Tables Ia - If to VIa - VIf. "Ratio" is the ratio of the sensitivity of the observatory with one half-length receiver and two full-length receivers (one full-length receiver in the two detector case) to the sensitivity of the observatory with all full-length receivers at 1 percent dead time on the half-length receiver [see constraint (b) in part I of this document]. "S. Ratio" is the similar ratio for the Schutz[2] solution. "Ref." is the number of the table where the ratio is computed.

Number of Detectors	$\frac{\sigma_{half}}{\sigma_{full}}$	Bandwidth (Hz)	Method	Filter	Ratio	S. Ratio	Ref.
3	$\sqrt{2}$	1000	Schutz	Brickwall	1.091	1.207	Ia
			Drever	Gaussian	1.091	1.218	IIa
				Brickwall	1.090	1.218	IIIa
		200	Schutz	Brickwall	1.093	1.202	Ib
			Drever	Gaussian	1.094	1.213	IIb
				Brickwall	1.094	1.210	IIIb
		30	Schutz	Brickwall	1.097	1.196	Ic
			Drever	Gaussian	1.101	1.204	IIc
				Brickwall	1.101	1.204	IIIc
	2	1000	Schutz	Brickwall	1.214	1.674	Id
			Drever	Gaussian	1.251	1.701	IId
				Brickwall	1.245	1.702	IIId
		200	Schutz	Brickwall	1.242	1.659	Ie
			Drever	Gaussian	1.280	1.690	IIe
				Brickwall	1.280	1.683	IIIe
		30	Schutz	Brickwall	1.279	1.640	If
			Drever	Gaussian	1.328	1.667	IIf
				Brickwall	1.328	1.668	IIIf
2	$\sqrt{2}$	1000	Schutz	Brickwall	1.152	1.285	IVa
			Drever	Gaussian	1.149	1.292	Va
				Brickwall	1.149	1.291	VIa
		200	Schutz	Brickwall	1.156	1.282	IVb
			Drever	Gaussian	1.150	1.287	Vb
				Brickwall	1.150	1.288	VIb
		30	Schutz	Brickwall	1.160	1.275	IVc
			Drever	Gaussian	1.151	1.282	Vc
				Brickwall	1.152	1.280	VIc
	2	1000	Schutz	Brickwall	1.342	1.811	IVd
			Drever	Gaussian	1.379	1.821	Vd
				Brickwall	1.376	1.822	VId
		200	Schutz	Brickwall	1.310	1.801	IVe
			Drever	Gaussian	1.339	1.814	Ve
				Brickwall	1.340	1.816	VIe
		30	Schutz	Brickwall	1.289	1.792	IVf
			Drever	Gaussian	1.314	1.805	Vf
				Brickwall	1.311	1.801	VIf

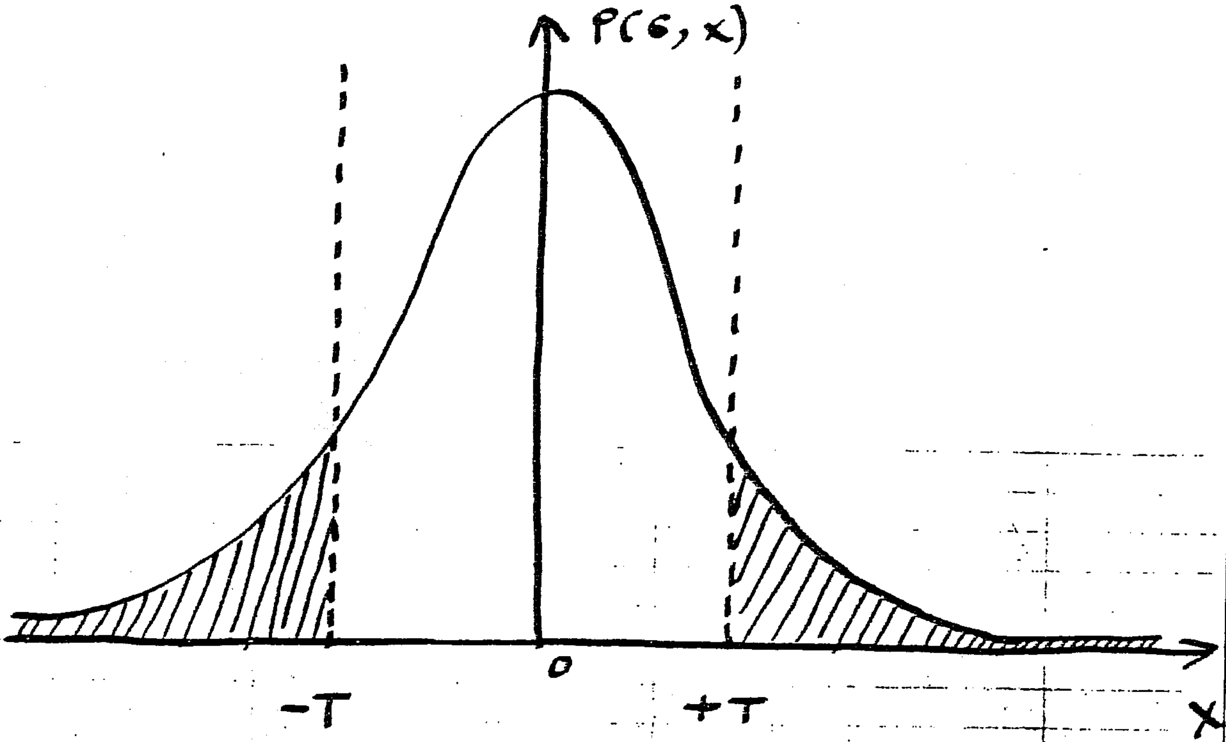

Fig 1. The shaded area is P(σ; |x| > T)

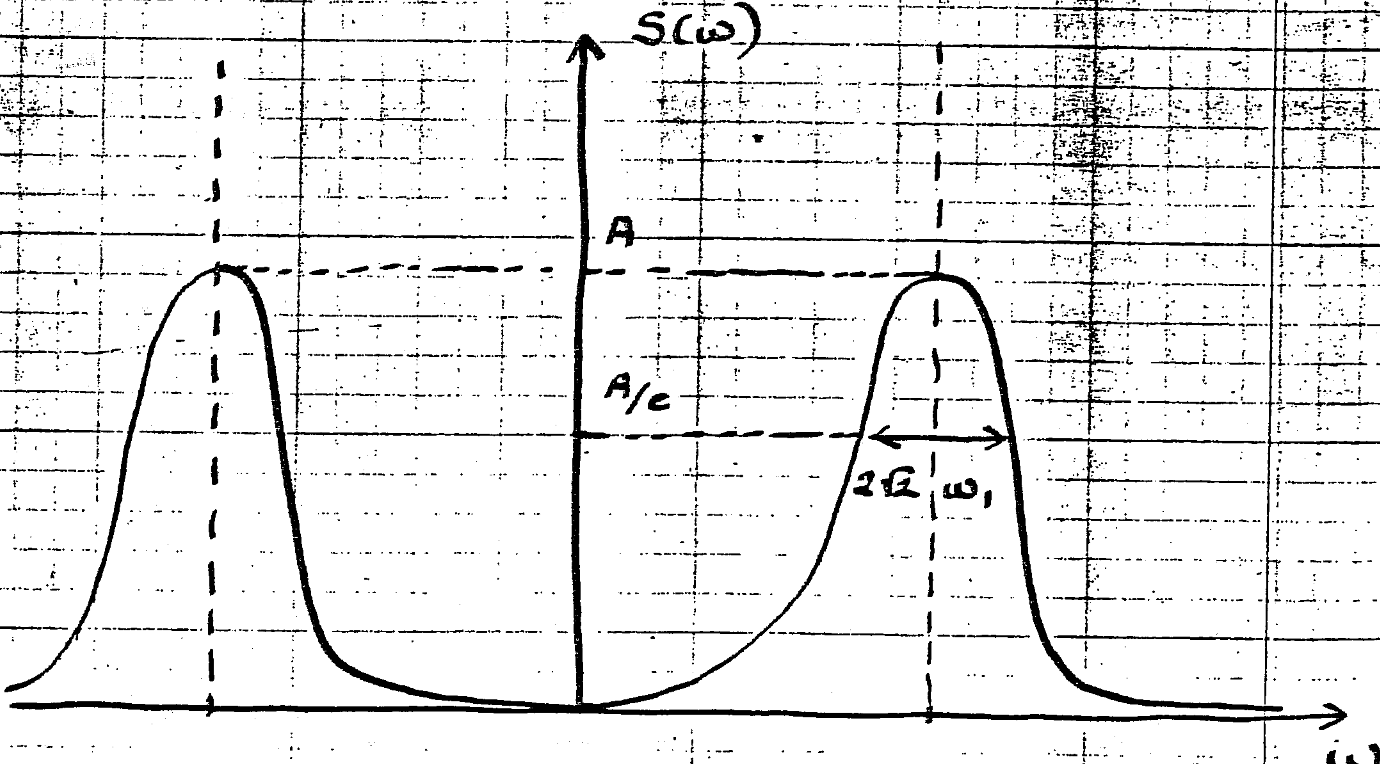

Fig 2. The Spectral Density S(ω) for the "Gaussian" filter.

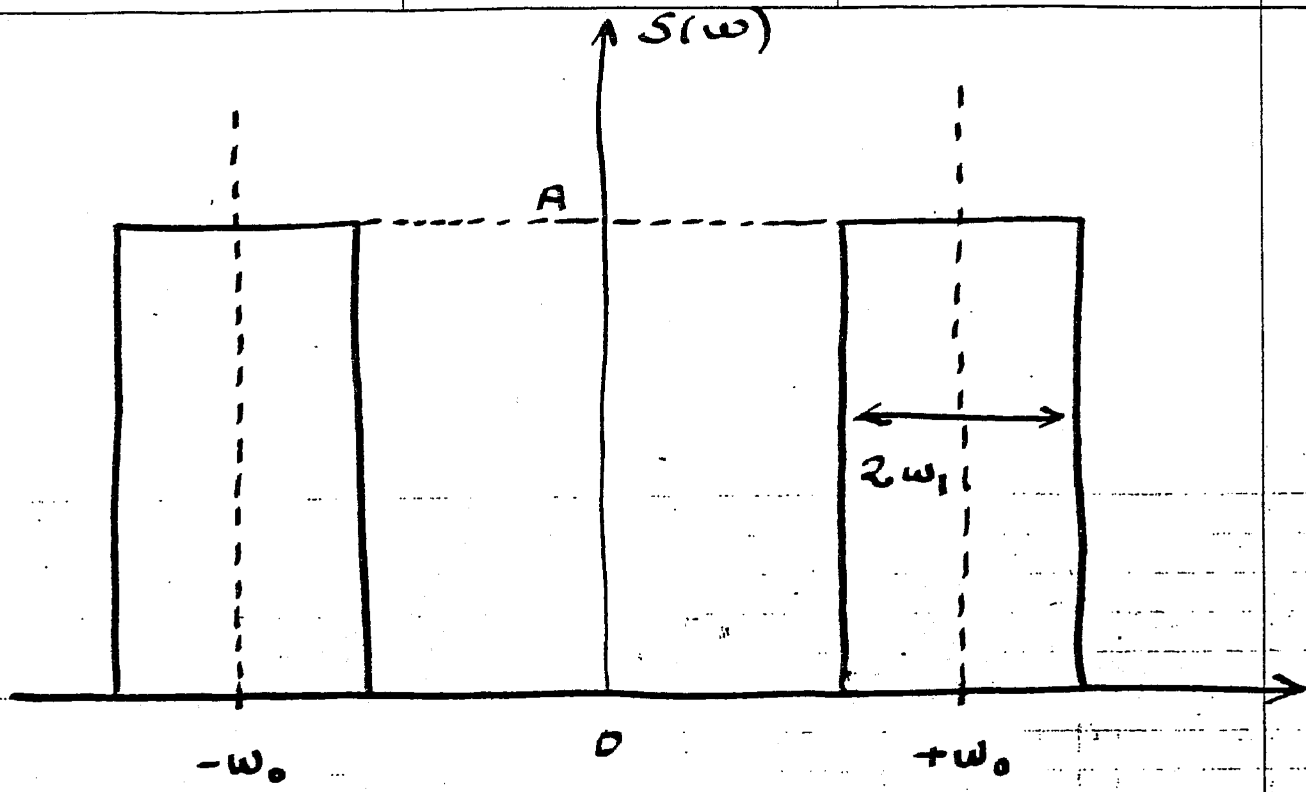

Fig 3. The spectral density S(ω) for the Brickwall Filter

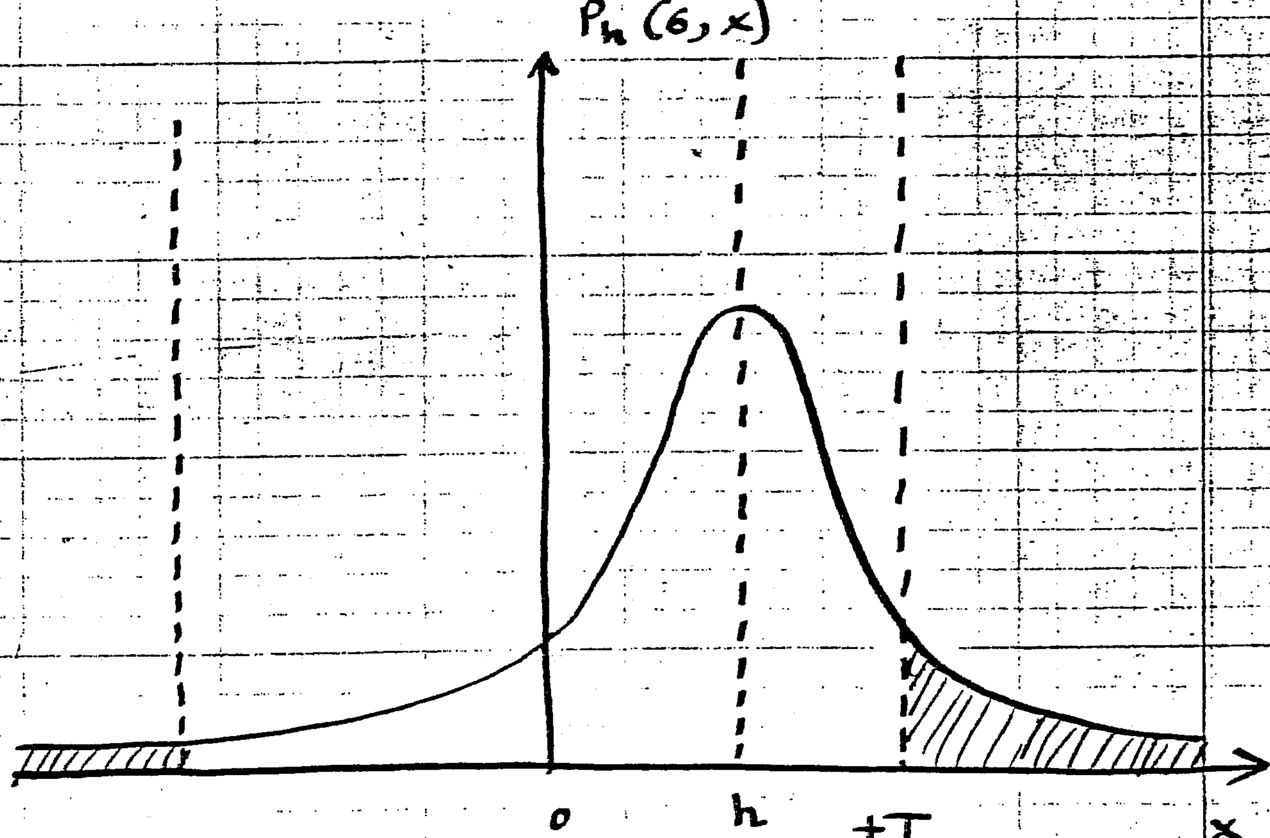

Fig 4. The shaded area is $P_h(\sigma; |x| > T)$ for the case

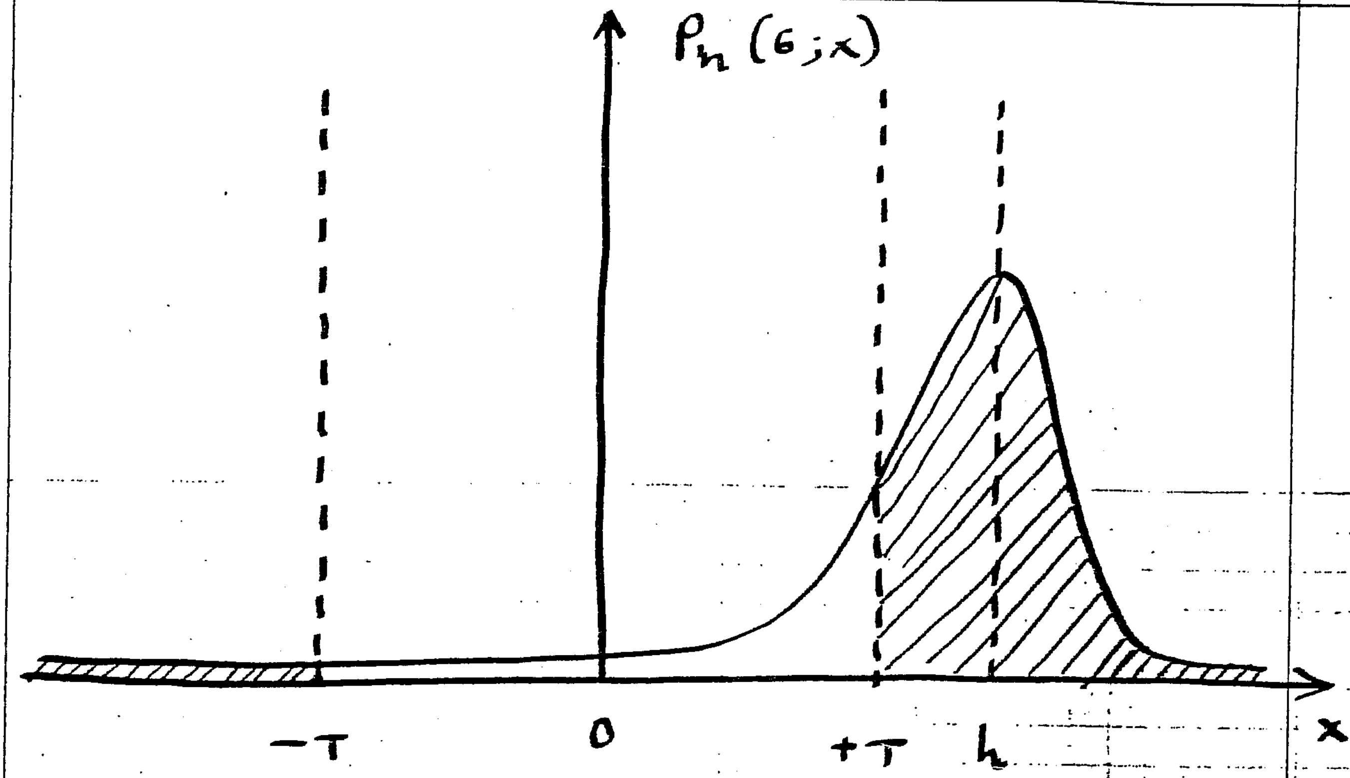

Fig 5. The shaded area is $\rho_h(\sigma; |x|>T)$ for the case $T<h$.