New Folder Name Coincedence Sensitivity

LIGO-T900024-00-R

#100

List of 5/23/90

file: vogt050890.txt
to: R. Vogt
from: R. Weiss
concerning: Coincidence sensitivity of detectors at varying distances

Robbie,
In our telephone conversation yesterday you asked about the coincidence sensitivity of interferometer pairs at several separations. I asked Nelson Christensen to pull the answer he has gotten from his thesis. This is given in the enclosed sheet. The formulae and the numbers given require a little explanation. The numbers given in the table are derived from the two expressions (A) and (B) averaged over an isotropic distribution of sources on the sky. Expression (B) is the technique for calculating the coincidence sensitivity by the method of Schutz and Tinto in which the signals from the two interferometers are squared first and then their overlap is calculated. This is a reasonable approach when looking at the coincidence of waveform envelopes. The expression (A) is the actual product of the interferometer signals which does carry a sign and is more useful when looking at the detailed product of waveforms which are bipolar and is essential when searching for a stochastic background. The normalized solutions given in the table are relative to two detectors at the same location with the same orientation. The largest value could therefore be 1. The minimum value is 0.5. This comes about from taking the average over the sky, for any specific source there will be some positions where the overlap is 0 and others where it is close to 1.

Detectors in So.Cal, Maine, and Southern Germany: Nelson Christensen, May8, 1990

Here are the results for my calculation. I have considered placing a detector in Southern California, Maine, and near Munich in Southern Germany. The response of a detector to gravity wave whose incident direction is defined by the angles θ and ϕ, with polarization angle ψ is

$$h = \frac{1}{2}(h_{11} - h_{22}) = F_+(\theta,\phi,\psi)h_0^+ + F_\times(\theta,\phi,\psi)h_0^\times \quad .$$

There are two ways to define the response of two detectors averaged over all angles. Either

$$\int_0^{2\pi} d\phi \int_0^{\pi} \sin\theta \Big[F_{1+}(\theta,\phi,\psi=0)F_{2+}(\theta,\phi,\psi=0) + F_{1\times}(\theta,\phi,\psi=0)F_{2\times}(\theta,\phi,\psi=0)\Big] \quad , \qquad (A)$$

or,

$$\int_0^{2\pi} d\phi \int_0^{\pi} \sin\theta d\theta \; \Big[F_{1+}^2(\theta,\phi,\psi=0)\; F_{2+}^2(\theta,\phi,\psi=0) + F_{1\times}^2(\theta,\phi,\psi=0)\; F_{2\times}^2(\theta,\phi,\psi=0)\Big]. \qquad (B)$$

The following results are normalized to the case where one has two detectors aligned at the same location. The orientations for the detectors were the ones that made an extrema in (A), and a maximum in (B).

Detector Pair	Normalized Solution (A)	Normalized Solution (B)
So.Cal. - Maine	.809	.770
Maine - So.Germany	.625	.594
So.Cal - So. Germany	.503	.502