

HISTORY OF THE RESEARCH AT MIT: GRAVITATION AND COSMOLOGY

Rai Weiss 20 March 96

- 1965
 - ›› Jerrold Zacharias and Bob Dicke intellectual fathers
 - ›› Military support in Research Laboratory for Electronics
 - ›› Experimental space in building 20
- 1965 - 1970 Scalar/ tensor theory of gravitation
 - Absolute stabilization A+ laser with molecular iodine reference
 - Earth normal mode scalar wave detection
 - Electrostatic force balance gravimetry
 - Tired photons - Poisson limited interferometry
- 1967 - 1994 Cosmic Background Radiation
 - ›› Balloon borne measurements
 - CBR spectrum and angular anisotropy
 - sub-millimeter astronomy - dust
 - ›› Cosmic Background Explorer (COBE)

GRAVITATIONAL RESEARCH AND COSMOLOGY

- 1971 -- Interferometric detection of gw
 - ›› initial noise analysis 1971 - 1972
 - length could provide astrophysically interesting sensitivity
 - ›› 1.5 meter demonstration interferometer 1972 - 1986
 - interferometry with suspended components
 - servo systems to hold system at operating point and damp
 - rf techniques to split fringes to Poisson limit
 - light storage techniques
 - diagnostic procedures to determine limiting noise sources
 - develop data analysis algorithms
 - ›› Study of a two site large baseline system 1980 - 1983
 - noise sources, scaling relations, astrophysical sources
 - initial estimate of costs , site availability
 - Joint MIT/Caltech presentation of results to NSF

GRAVITATIONAL RESEARCH AND COSMOLOGY

- ›› Caltech / MIT LIGO project established 1984
 - steering committee, joint development of LIGO facilities, independent research programs
 - prescription for failure
 - project office at Caltech, continuing JPL studies
- ›› Improvement in Bldg 20 space: HVAC, high bay 1986
- ›› 5 meter system 1986 --
 - develop long baseline subsystems
- ›› Panel on Interferometric Detection of GW 1986
 - Recommended reorganization: single director, unified research and development program
- ›› Project reorganization: R. Vogt, Director 1987
 - Unified proposal for LIGO and coordinated R&D
 - MIT subcontractor to Caltech

GRAVITATIONAL RESEARCH AND COSMOLOGY

- Research program since 1988
 - ›› Interferometer configurations
 - optically recombined Fabry - Perot/ Michelson interferometer
 - power recycled interferometer
 - analysis and modeling
 - ›› Vibration isolation
 - vacuum compatible elastomer system for prototypes
 - active isolation system
 - ›› Thermal noise
 - material loss
 - off resonance excitation
 - ›› Scattering and large aperture optics
 - modeling of the effects of perturbed optics
 - noise due to scattering

GRAVITATIONAL RESEARCH AND COSMOLOGY

- ›› Interferometer alignment
 - wavefront discrimination

GRAVITATIONAL RESEARCH AND COSMOLOGY

- CURRENT PROGRAM
- INITIAL DETECTOR IMPLEMENTATION AND R&D
- Interferometer Sensing and Control
 - ›› Length sensing and control
 - R&D : Phase noise interferometer
 - ›› Alignment Sensing and Control
 - R&D: Fixed Mirror Interferometer
- Environmental monitor system
- FACILITIES
 - ›› Vacuum equipment scientific liaison
 - ›› Beam tube scientific liaison
- FACILITY/DETECTOR INTERFACE
 - ›› Scientific support to systems integration

EDUCATIONAL STATISTICS

	Gravitational Research 1965 - 1996	Cosmology 1967 - 1994
Undergraduates UROP	39	41
Master Theses	2	4
PhD Theses	9	8
PhD employment		
Government laboratory	3	3
Industry	1	2
University laboratory	4	
Academic position	1	2
Out of physics		1