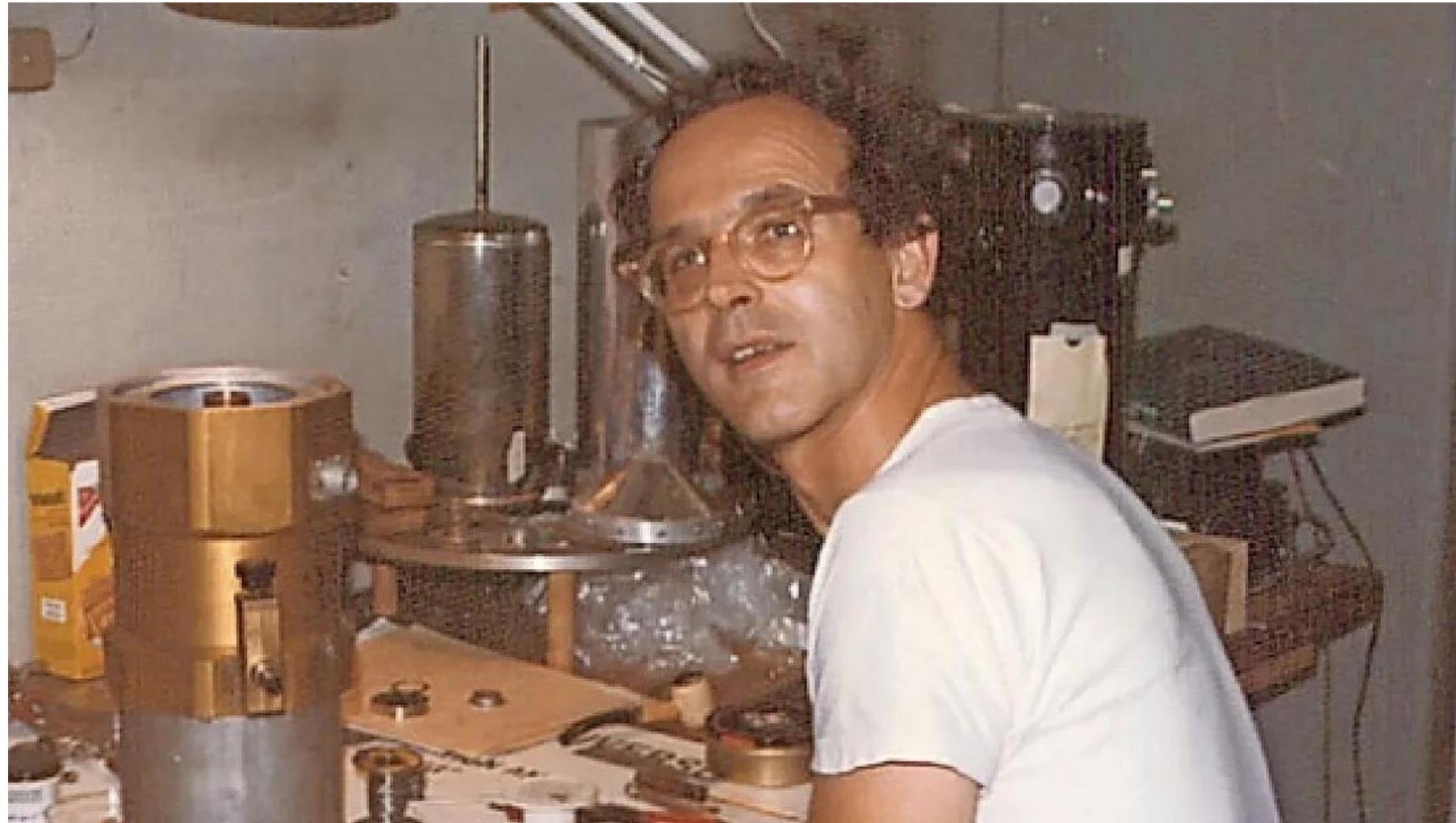
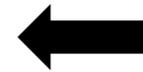
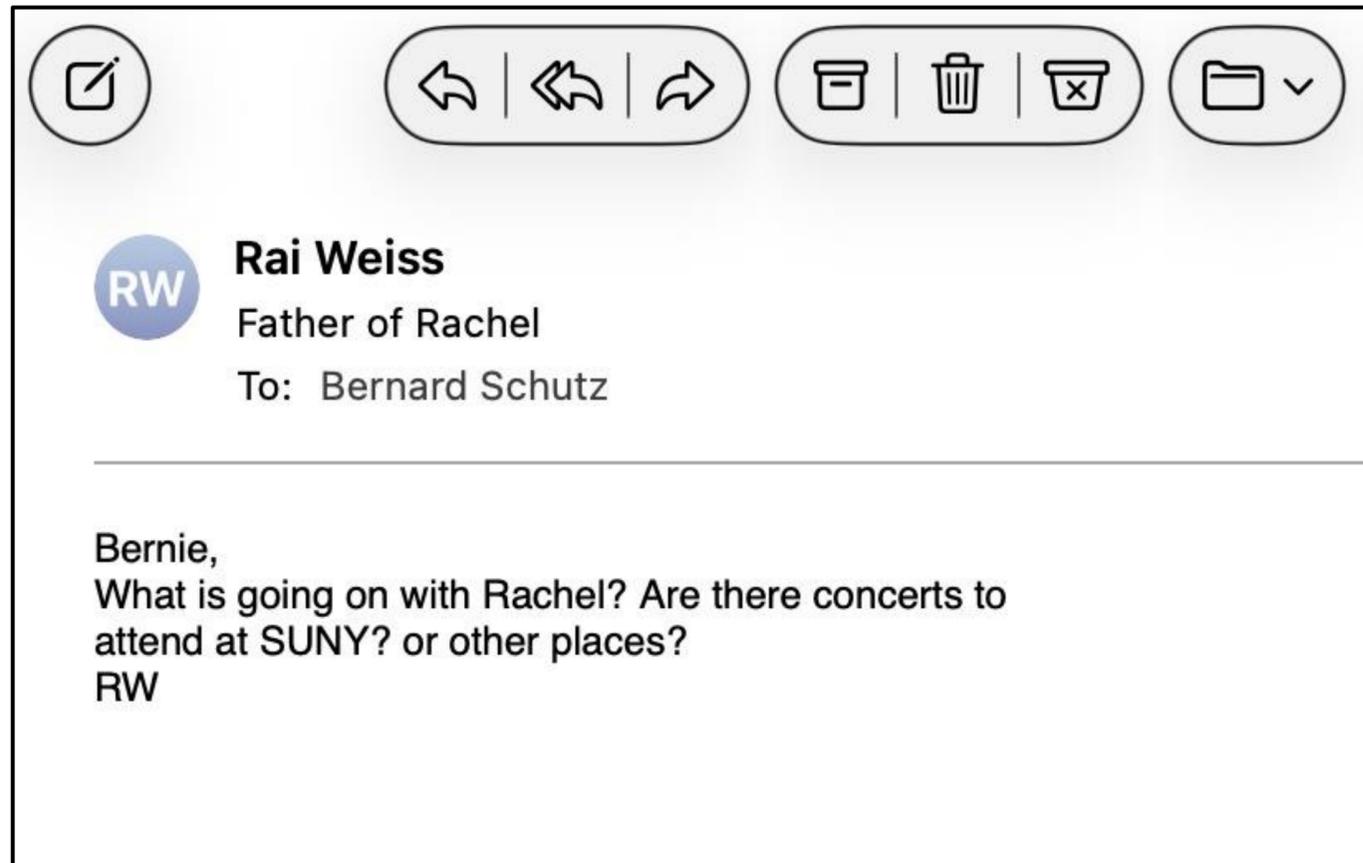
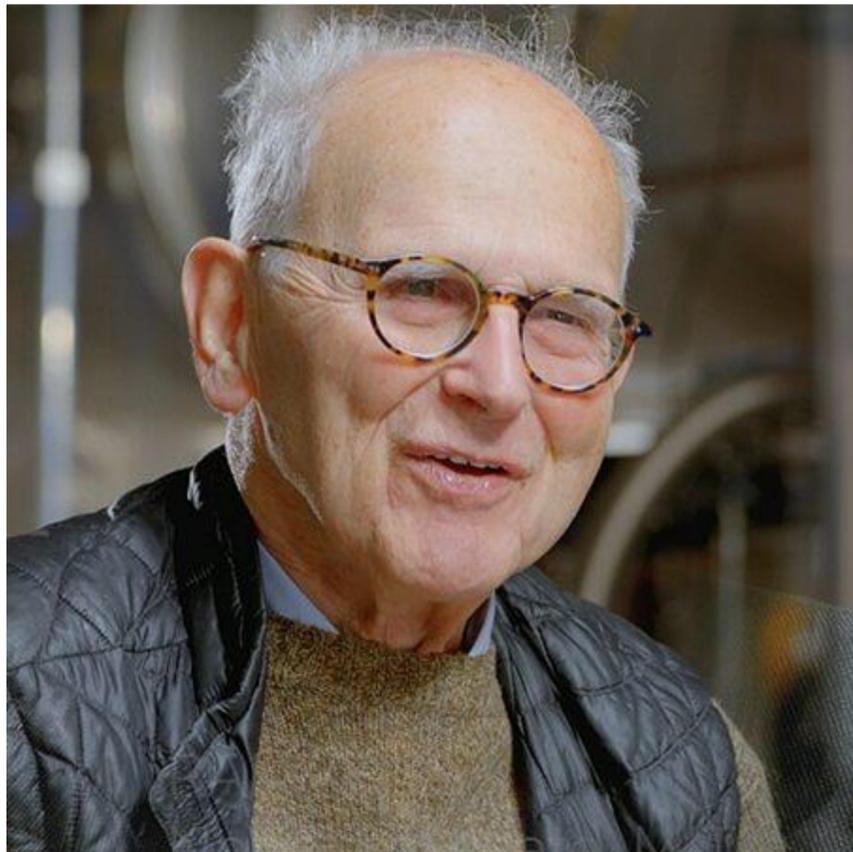
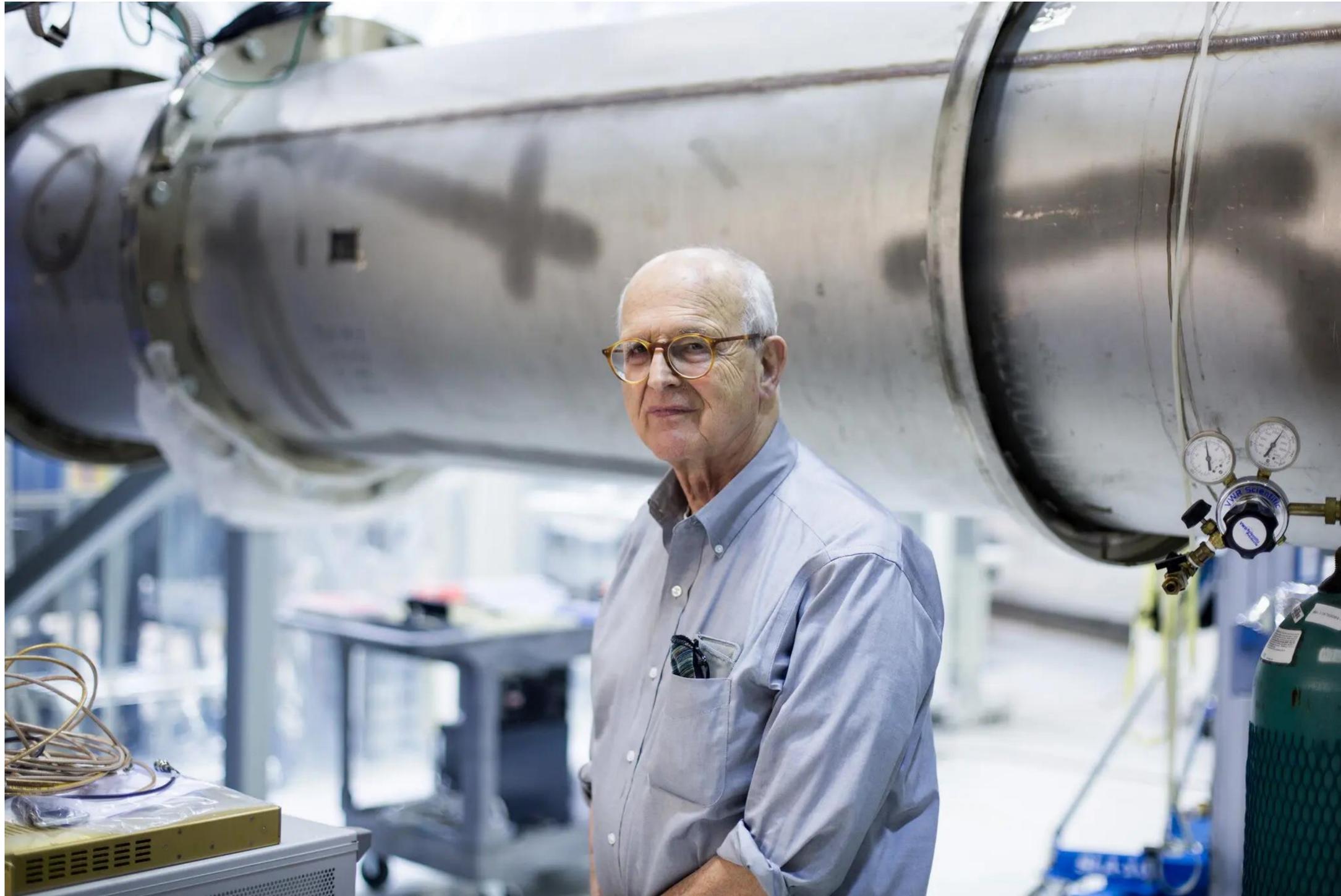


An abundance of binaries: let's make sure we exploit them!









A SEARCH FOR ASTRONOMICAL GRAVITATIONAL RADIATION
WITH AN INTERFEROMETRIC BROAD BAND ANTENNA

by
DANIEL DEWEY

Submitted to the Department of Physics
on January 17, 1986 in partial fulfillment of the
requirements for the Degree of Doctor of Philosophy in
Physics

ABSTRACT

This thesis describes and implements a data analysis scheme designed to detect short, burst-like gravity waves in the output of the interferometric antennas. This represents a first attempt at integrating the astrophysical predictions of expected waveshapes with a data analysis scheme for their detection.

An experimental program was carried out involving the construction of a prototype gravitational radiation antenna, the diagnosis of some of its noise sources, the study of expected astronomical sources of radiation, and the collection and analysis of data from the instrument.

Construction included the implementation of a system to damp the motions of the test masses, the design of a servo system to hold the interferometer to a dark fringe and the assembly of a microcomputer-A/D system to record data and instrument parameters.

Diagnosis of noise sources identified noise due to scattered light as a problem, and methods to suppress this noise through external phase modulation of the input laser beam were devised and implemented.

The results of the analysis are encouraging from an instrument performance perspective; the noise obeys Gaussian statistics to signal-to-noise ratios of 5.5, and the number of events in the non-Gaussian tail is not excessive, ≈ 500 per day.

As a detector of gravity waves, the sensitivity of the prototype is very low due to its size, remaining noise sources, and low light power. Detected burst events with amplitudes of $h_0 \approx 5 \times 10^{-14}$ correspond to the signal expected from an optimistically large source at the distance of Proxima Centauri, the closest star beyond our Sun.

Thesis Supervisor: Dr. Rainer Weiss
Title: Professor of Physics

- 2 -

A SEARCH FOR ASTRONOMICAL GRAVITATIONAL RADIATION
WITH AN INTERFEROMETRIC BROAD BAND ANTENNA

by
DANIEL DEWEY

Submitted to the Department of Physics
on January 17, 1986 in partial fulfillment of the
requirements for the Degree of Doctor of Philosophy in
Physics

ABSTRACT

This thesis describes and implements a data analysis scheme designed to detect short, burst-like gravity waves in the output of the interferometric antennas. This represents a first attempt at integrating the astrophysical predictions of expected waveshapes with a data analysis scheme for their detection.

INTERFEROMETRIC GRAVITATIONAL WAVE DETECTORS

PROGRAMME

Sunday, 16 February, 1986

4.00 p.m. Registration opens at Duffryn House

6.00 Reception

7.00 Dinner

Monday, 17 February, 1986

8.00 a.m. Breakfast

9.15 Dr.C.W.L. Bevan, Principal of University College, Cardiff
Welcoming Remarks

MORNING SESSION

Chairman: D.W.Sciama (Oxford and SISSA)

9.30 K.S. Thorne (California Institute of Technology)
Astronomical Sources of Gravitational Waves

10.15 R.W.P. Drever (California Institute of Technology and Glasgow University)
Laser Interferometers for the Detection of Gravitational Waves

11.00 Coffee

11.30 J. Hough (Glasgow University)
The U.K. Detector Programme

12.15p.m. R.Isaacson (National Science Foundation, Washington DC)
The American Detector Programme

12.45 Lunch

AFTERNOON SESSION

Chairman: R.Weiss (Massachusetts Institute of Technology)

2.15 (W.Winkler) (Max Planck Institute for Quantum Optics, Garching)
The European Detector Programmes

2.45 I.Corbett (Rutherford-Appleton Laboratory)
The Technology of Large-Scale Detectors

3.15 Coffee

3.45 A.Brillet (Laboratoire de l'Horloge Atomique, Orsay)

Laser Technology for Detectors

4.15 B.F. Schutz (University College, Cardiff)
Scientific Observations with Networks of Detectors

4.45 A.M. Cruise (Rutherford-Appleton Laboratory)

Closing Remarks

