COSMOLOGY AND GRAVITATIONAL RESEARCH GROUP

BETWEEN 1965 -- 2007

Building 20 wing C and F

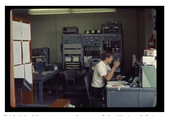
Building 20 wing F

Entrance to building 20 wing F

Machine shop and electronics shop of the Cosmology and Gravitational Research group

CBR spectrum experiment on ASCEND II

First CBR spectrum experiment transported to test

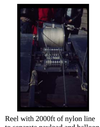


Dirk Muehlner in control room of the National Scientific Balloon Facility, Palestine, Texas

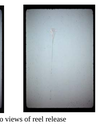
A great horned toad in the launch field. It has excellent inertial sensors

Dirk Muehlner and the CBR anisotropy experiment

Rainer Weiss and CBR anisotropy experiment



Reel with 2000ft of nylon line to separate payload and balloon

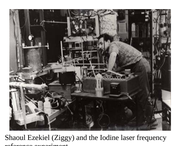


Launch sequence: lift off followed by two views of reel release

Termination with package on parachute

Landing in West Texas

National Scientific Balloon Facility recovery crew



Shaoul Ezekiel (Ziggy) and the Iodine laser frequency reference experiment

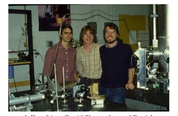
Richard Benford

D. Kingston Owens

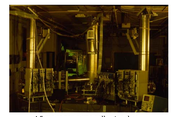
Edward (Ned) Wright and David Shoemaker with the COBE FIRAS prototype instrument

Daniel Dewey

Jeffrey Livas



Jeffrey Livas David Shoemaker and Daniel Dewey with completed 1.5 meter prototype



1.5 meter prototype collecting data

Edward, Anne and Georgia Daw

Michael Zucker and the 5 meter prototype

David Shoemaker at the LIGO Hanford site aligning a test mass

MIT LIGO Research group 2005. **Front row**: David Shoemaker, Nergis Mavalvala, Keith Bayer. **Second row**: Marie Woods, Laura Cadonati, Keisuke Goda, Ken Mason, Gregg Harry, Joseph Betzwieser. **Third row**: Rainer Weiss, David Ottaway,Julien Sylvestre, Peter Fritschel, Stefan Ballmer, Michael Zucker, Richard Mittleman. **Back row**: Erotokritos Katsavounidis, Ryan Lawrence, Myron MacInnis, Jameson Rollins

Caltech LIGO Group 2002. **Outermost ring** begin front:David Beckett, Phil Lindquist,Hareem Tariq, Steve Vass, Yoichi Aso, Phil Ehrens, Isaac Salzman, Eric Black, Thomas Frey, Ken Libbrecht, Ed Jasnow, Riccardo DeSalvo, Virginio Sannibale, Hiro Yamamoto, Cindy Akutagawa, Cleveland Mak, Bill Tyler, Garilynn Billingsley, Kent Blackburn, Ruth Brambila, Eric McWhorter, Ash Khan, Philip Charlton, Florence Kaufman, Sander Liu, Ken Mailand, Hongyu Ding, Jay Heefner, Bill Kells, Don Webber, Biplab Bhawal, Dan Kozak, Kip Thorne, Dennis Coyne, Mike Fine. **Second ring** begin front: Mary Lei, Irena Petrac, Robert Taylor, Lee Cardenas,Melody Araya, Helena Armandula, Janeen Romie, Todd Etzel, ?, Erika D'Ambrosio, Sydney Meshkov, Gary Sanders, Albert Lazzarini, Irene Baldon, Stuart Anderson, Massimo Tinto, Al Wilson, Maria Barnes, Ed Maros, Phoung Hoang, Fred Mann, Charles King, Barry Barish. **Third ring** begin front: Jim Covington, Dennis Ugolini, Linda Turner, Flavio Nocera, Rich Abbott, Ryan Tischler, Rita Torres, Ben Abbott.

Rana Adhikari explaining to grade school students

Rainer Weiss and Peter Saulson in 1999

Michael Zucker at the inauguration of the LIGO Science Outreach Center in Livingston

LIGO Livingston site vacuum chambers

LIGO Livingston, Louisiana site

LIGO beam tube

LIGO Hanford, Washington site

Stephan Meyer and Andrew Jeffries on Mauna Kea

Edward Cheng and Stephan Meyer

Stephan Meyer, Jeffrey Livas, Gregory Tucker, Elizabeth Busch, Peter Saulson

David Shoemaker

Mr Electronics and Peter Saulson

Michael Burka

Lyman Page

Andrew Cumming

COBE Science Working Group. Front row: Nancy Boggess, Sam Gulkis, Philip Lubin. Second row: David Wilkinson, Tom Murdock, Charles Bennett, Robert Silverberg, Harvey Moseley, Michael Hauser, Rainer Weiss. Tom Kelsall. Back row: Edward Cheng, Rick Shafer, Stephan Meyer, Michael Janssen, John Mather, Edward Wright, George Smoot. Missing: Eli Dwek

The COBE payload

Richard Benford at the proposed Cherryfield, Maine LIGO site

Concept for LIGO at the Cherryfield, Maine site

Sharon Salveter and Stephan Meyer

Virginie Landre and David Shoemaker

Nergis Mavalvala and Yaron Hefetz

Joseph Kovalik and the thermal noise jewel

Michelle Eisgruber Stephens and the double suspension

Nelson Christensen and Michelle Eisgruber Stephens

Editorial Note
The timeline of the Cosmology and Gravitational Research Group was assembled in September 2007. Although the student theses and the times associated with laboratory members are consistent with MIT records, there could well be errors. Furthermore, the pictures are not complete. I would very much appreciate receiving better pictures or missing pictures. The poster can be found at http://emvogil-1.mit.edu/~weiss/group_poster/group_poster.pdf . Please send new information to weiss@ligo.mit.edu

Edward Hildum BS 1979
An Experimental Evaluation of a Free-Floating Superconducting Solenoid as a Low Level Accelerometer

Hisashi Harada SB 1978
Photon Statistics of Thermal Light in an Intensity Interferometer

Gary Mamon BS 1978
A Study of Solar Variability

Margaret Frerking PhD 1977
Heterodyne Detection of Infrared Molecular Lines
Supervised by Dirk Muehlner

Jonathan Lettvin BS 1976
Quick and Dirty Parabolic Reflectors for the Miser

Mark Halpern and **Zachary Levine** BS 1976
Design and Construction of Composite Bolometers

Michael Feder BS 1976
Gravitational Radiation from the Sun

John Anderson and **Andrew Szymkowiak** BS 1976
Far Infrared Diffraction Around Cylinders
Supervised by Dirk Muehlner

Frederick Yung-Fung Wu PhD Aero/Astro 1976
Measurement of the Spectrum of Resonance Fluorescence Induced by a Monochromatic Fields
Supervised by Shaoul Ezekiel

D. Kingston Owens PhD 1976
A Sky Survey at Millimeter and Submillimeter Wavelengths

George Doerre BS 1975
A Fringe-Tracking Michelson Interferometer

David Trivett BS 1974
Studies of an Electrostatic Suspension

Fred Ore BS 1974
The Gravitational Lenard-Wiechert Potentials and Applications

David Little BS 1974
A Demonstration of Classical Physics Relevant to an Understanding of Nuclear Magnetic Resonance

Rosalind Waldron BS 1973
The Use of Cross-Correlation of Seismic Data to Detect Gravitational Radiation from Pulsars

Michael Gordon BS 1973
Detection of Rapid Fluctuations in the Earth's Magnetic Field

Daniel Morris BS 1973
Transmission of Far-Infrared Radiation by Indium Antimonide Crystal

Norbert Pierre MS 1973
Parametric Up-Conversion of Far-Infrared Radiation in Cadmium Sulfide

Frank Wentz BS 1971
The Optical Properties of a Far-Infrared Radiometer

Miles Wagner BS 1971
Rotation and Translation Sensitivity of a Spherical Mirror Cavity

Noah Bass and **Gordon Legge** BS 1971
A Far-Infrared Interferometer and its Use in Solar Absorption and Sky Emission Studies

D. Kingston Owens BS and MS 1971
A Sensitive Inter-Cavity Polarization Interferometer

Andrew Mazzella BS 1970
An Investigation of the Properties of a Spherical Mirror Fabry-Perot Interferometer

Alan Huber BS 1970
The Rowland Disk

Gerald Blum MS 1970
Non-Linear Thomson Scattering

Patrick Wallen BS 1970
Photon Clumping in the Helium-Neon Laser at Threshold

Dirk Muehlner PhD 1970
A Measurement of the Background Radiation in the Far Infrared

Britton Girard BS 1970
Normal Modes of Non-Radial Pulsations of a General Relativistic Stellar Model

Edwin Jacobs BS 1965
Design and Construction of a Tilt Meter

Richard Sramek BS 1965
An Interferometric Linear Strain Seismometer

Thomas McDonough BS 1966
Analysis of a Theory of Jupiter's Decametric Radio Emissions

Thomas Seddon BS 1966
An Optical Gas Cell as an Interferometric Path Length Modulator

Jearl Walker Jr BS 1967
Change in Magnetization on Ferrimagnetic Resonance Absorption: Preliminary Work on the Einstein de Haas Effect

Michael Wandzilak BS 1967
Studies in Electrical Suspensions

Philip Chapman ScD Aero/Astro 1967
Theoretical Foundations of Gravitational Experiments in Space
co-supervised Walter Wrigley, Felix Villars

Eric Sweetman BS 1968
Observation of Metastable Helium in an Atomic Beam

Peter Van Sickle BS 1968
Optical Mixing in Quartz: a Preliminary Study

Michael Blitch MS 1968
The Feasibility of a Gravitational Clock to Test the General Theory of Relativity

Shaoul Ezekiel PhD Aero/Astro 1968
A Molecular Beam Primary Reference for Long Term Laser Frequency Stabilization

Richard Johnson BS 1968
Investigation of the Einstein de Haas Effect Using Ferrimagnetic Resonance Absorption

Terrance Jach BS 1969
Laser-Saturated Iodine Absorption at 5145A

Clifford Avey BS 1980
Time Dependencies of Gravitational Lens Phenomena

David Shoemaker MS 1980
A Fourier Transform Spectrometer for Millimeter and Submillimeter Wavelengths

Patricia Downey PhD 1980
The Low Temperature Conductivity of Ion Implanted Silicon and its Application in a Cryogenic Far-IR Monolithic Bolometer

Bruce Allen BS 1980
An Intensity Interferometer for the Cosmic Background Radiation

Bruce Straub BS 1980
Topics on the Harmonic Oscillator

Jeffrey Livas BS 1981
An Amplitude Noise Reduction System for a Laser

Marc Fischer BS 1981
Emissivity Dependence of Photon Noise Power

Christopher Lozinski BS 1982
An Active Seismic Isolation System

Lynne Deutsch MS 1983
Design and Construction of Interference Filters for the Far Infrared

Mark Halpern PhD 1983
Measurement of the Anisotropy of the Cosmic Background Radiation at Millimeter Wavelengths

Andrew Jeffries PhD 1983
Angular and Spatial Distortions of the Cosmic Background Radiation

James Hordern Jr BS 1984
The Transfer Functions of Fabry-Perot Interferometers and Their Application to One Proposed Gravitational Wave Detection Scheme

Martin Offutt BS 1985
Vibrational Quality of Sapphire Rods in Modes of Flexure
Supervised by Peter Saulson

Seth Finkelstein BS 1985
An Investigation into the Fluctuation-Dissipation Theorem

Gregory Tucker BS 1985
High Frequency Vacuum Pressure Fluctuations

Daniel Zachary BS 1985
Force Displacement Physics for a Finned Plate Capacitor System

Robert Kusner BS 1986
The Temperature and Electric Field Dependence of Variable Range Hopping in Ion Implanted Silicon
Supervised by Stephan Meyer

Daniel Dewey PhD 1986
A Search for Astronomical Gravitational Radiation with an Interferometric Broad Band Antenna

John Evans BS 1987
Output Intensity Fluctuations of a Continuous-Wave Nd-YAG Laser
Supervisor Andrew Jeffries

Jeffrey Livas PhD 1987
Upper Limits for Gravitational Radiation from Some Astrophysical Sources

Andrew Cumming PhD 1988
A Study of the Dynamics of an Electronic Oscillator Circuit with Three Competing Frequencies
Supervised by Paul Linsay

Daniel J. Connelly BS 1988
A Magnetic Suspension for Vibration Isolation

Heather Patrick BS 1988
Reduction of Amplitude Fluctuations in a Laser Diode Pumped Nd:YAG Ring Laser
Supervised by Andrew Jeffries

Ron Dagostino BS 1989
Development of a Velocity Sensor for a Fourier Transform Spectrometer
Supervised by Stephen Meyer

Lyman Page PhD 1989
A Measurement of the Cosmic Microwave Background Radiation Anisotropy
Supervised by Stephan Meyer

Tae Hong Joo PhD EE 1989
Detection Statistics for Multichannel Data
Co-supervised by Alan Oppenheim

John Mruz Jr BS 1989
Coupling of Single-Mode Optical Fibers at 1.064 Microns Using Graded Index Lenses
Supervised by Andrew Jeffries

Brian Lantz PhD 1999
Quantum Limited Optical Phase Detection in a High Power Suspended Interferometer

Peter Csatorday MS 1999
LIGO Photodiode Characterization and Measurement of the Prestabilized Laser Intensity Noise

Brett Bochner PhD 1998
Modeling the Performance of Interferometric Gravitational Wave Detectors with Realistically Imperfect Optics

Sarah Veatch BS 1998
VLF Magnetic Field Correlation Measurements Between LIGO Sites

Partha Saha PhD 1997
Noise Analysis of a Suspended High Power Michelson Interferometer

Nergis Mavalvala PhD 1997
Alignment Issues in Laser Interferometric Gravitational Wave Detectors

Casey Ann Inman PhD 1996
A Measurement of the Cosmic Background Radiation (CMBR) Anisotropy at the Half Degree Angular Scale
Supervised by Stephan Meyer

Joseph Giaime PhD 1995
Studies of Laser Interferometer Design and a Vibration Isolation System for Interferometric Gravitational Wave Detectors

Jason Pachalla PhD 1995
Measuring Cosmic Microwave Background Radiation Anisotropy on Medium Angular Scales
Supervised Stephan Meyer

William Barnes PhD 1994
A Model of Galactic Dust and Gas from FIRAS
Supervised by Stephan Meyer

Joseph Kovalik PhD 1994
A Study of Thermal Noise

Brian Lantz BS 1992
Frequency Shifting of Laser Light Using Single Sideband Modulation and Carrier Suppression

Peter Fritschel PhD 1992
Techniques for Laser Interferometer Gravitational Wave Detectors

Eri Izava BS 1992
The Behavior of a LIGO Proportioned Cylindrical Mirror
Supervised by David Shoemaker

Yaser Abdel Rehem BS 1991
Small Angle Scattering from Rough Surfaces

Meng Yong Goh PhD 1991
Radiometric Stability of the Far Infrared Absolute Spectrophotometer (FIRAS)
Supervised by Stephan Meyer

Michelle Eisgruber Stephens PhD 1991
Issues in the Detection of Gravitational Radiation

Nelson Christensen Jr PhD 1990
On Measuring the Stochastic Gravitational Radiation Background with Laser Interferometric Antennas

Boris Golubović BS 1990
A Fourier Transform Spectrometer System for Measurement in the Far Infrared Spectral Region
Supervised by Stephan Meyer

Julien Sylvestre PhD 2002
Upper Limits for Galactic Transient Sources of Gravitational Radiation from LIGO First Observations

Blair Connelly BS 2003
Enhancements of the Scanning Methods of a Phase Sensitive Heterodyne Camera
Supervised by Nergis Mavalvala

Ryan Lawrence PhD 2003
Active Wavefront Correction in Laser Interferometric Gravitational Wave Detectors

Andrew Thomas BS 2004
Characterization of an Advanced LIGO Quadruple Pendulum System
Supervised by Nergis Mavalvala

Jameson Rollins MS 2004
Intensity Stabilization of a Solid State Laser for Interferometric Gravitational Wave Detectors

Rana Adhikari PhD 2004
Sensitivity and Noise Analysis of 4km Laser Interferometric Gravitational Wave Antennae
Co-supervised by Peter Fritschel

Elizabeth Bullard BS 2005
High Efficiency Photodetection Below the Quantum Noise Limit
Supervised by Nergis Mavalvala

Stefan Ballmer PhD 2006
LIGO Interferometer Operating at Design Sensitivity with Application to Gravitational Radiometry
Supervised by Erotokritos Katsavounidis and Peter Fritschel

Shourov Chatterji PhD 2006
The Search for Gravitational Wave Bursts in Data from the Second LIGO Science Run
Supervised by Erotokritos Katsavounidis

Nickolas Fotopoulas MS 2006
Searching for Chaotic Gravitational Waves Using Co-located Interferometric Detectors
Supervised by Erotokritos Katsavounidis

Jason Pelc BS 2006
Radiation Pressure Effects in a Suspended Fabry-Perot Cavity
Supervised by Nergis Mavalvala

Brett Shapiro MS 2007
Modal Control with State Estimation for Advanced LIGO Quadruple Suspensions
Supervised by Nergis Mavalvala

Keisuke Goda PhD 2007
Development of Techniques for Quantum Enhanced Laser Interferometric Gravitational Wave Detectors
Supervised by Nergis Mavalvala

Joseph Betzwieser PhD 2007
Analysis of Spatial Mode Sensitivity of a Gravitational Wave Interferometer and a Targeted Search for Gravitational Radiation from the Crab Pulsar
Supervised by Nergis Mavalvala

Robert Bennett BS 2001
Thermally Adaptive Optics for LIGO II

Phil Marfuta BS 2001
Testing Dynamic Thermal Compensation of Optics for Use in LIGO II

Administrative Support

Elizabeth Busch	1984 - 1986
Susan Merullo	1988 - 1995
Jennifer Holder	1998 - 2001
Marie Woods	2001

Computer Support

Tom Evans	1986
Keith Bayer	2001 - 2006
Fred Donovan	2007

Technical Support

Charles Summers	1966 - 1968
Tom Evans	1986
Edward Kruzel	1994 - 1998
Ralph Burgess	1995 - 2003
Matthew Smith	1997 - 2000
Myron MacInnis	1998
John Allen	2003 - 2006
Robert Laliberte	2006