

**LOUIS D. FRIEDMAN
RESUME**

EDUCATION:

B.S. - Applied Mathematics and Engineering Physics – Univ. of Wisconsin, 1961
M.S. - Applied Mechanics - Cornell University, 1963 (minor in Astrophysics)
Ph.D. - Instrumentation (Aeronautics and Astronautics) -- Massachusetts
Institute of Technology - 1971. Area of specialization: Interplanetary guidance,
Astrodynamics; Minor - Optimal Control. Thesis: Extracting Scientific
Information From Interplanetary Spacecraft Radio Tracking Data

PROFESSIONAL EXPERIENCE:

Jan 2014 to present: Co-Leader, Science and Technology to Explore the
Interstellar Medium Study, Keck Institute for Space Studies, Caltech

Jan 2011 to present: Co-Leader, Asteroid Retrieval Mission Study, Keck Institute
for Space Studies, Caltech

Sept 2010 to Mar 2011: Consultant, Moon Express

Sept.1979 to Sept 2010: Executive Director of The Planetary Society; co-
founded new, popularly oriented, non-profit organization with Bruce Murray and
Carl Sagan.

February 1970 to 1980: At Jet Propulsion Laboratory, California Institute of
Technology, Pasadena, CA 91103

Advanced Projects Group of Mission Analysis Division (February 1970 to
October 1975; Supervisor August 1972 to October 1975)

Advanced Technical Studies Division Representative

Flight Projects Planning Office Division Representative

Leader - Venus Orbital Imaging Radar Development Project

Leader - Navigation Systems Study

Navigation Team - Outer Planets Grand Tour Project

- Mariner-Jupiter-Saturn Project

- Mariner-Venus-Mercury Project

Member - Approach Guidance/Science Imaging Committee for Outer
Planets Missions

Leader - Advanced Pioneer Missions Navigation Study

Experiment Representative - MVM '73 Radio Science Team

Assistant Leader - Jupiter Orbiter Study

Member - NASA Inter-center Comet Encke Mission Engineering Panel

Manager of Planetary Studies in Office of Plans and Programs

(October 1975 - October 1976)

Leader - Advanced Planetary Mission Concepts Studies

Representative to Various NASA Advisory Groups

Representative to NASA-European Space Agency Pioneer/Jupiter Orbiter
Science Working Group

Leader - Venus-Earth Gravity Assist Missions Study
 Leader - Solar Probe Study
 Member of NASA 5 Year Plan Committee
 Solar Sail Program Development Leader (October 1976 to August 1977)
 Principle technical leadership for development for solar sailing technology
 readiness for Halley Comet Rendezvous Mission
 Mars Program Leader (September 1977 to August 1978)
 Leader and Originator of International Halley Watch
 AIAA Congressional Science Fellow (September 1978 to September 1979):
 Senate Committee on Commerce, Science and Transportation -- Subcommittee
 on Science, Technology and Space. Staff work included:
 Space Policy Legislation
 Operational Remote Sensing Policy legislation
 NASA Program oversight and budget
 Technology Innovation on the Railroads
 Organizer of Congressional Space Symposium
September 1968 - February 1970: At MIT completing Ph.D. Program
 Gravitation Theory (Relativity) and Experimental testing using spacecraft
 tracking data. Work principally done at MIT Experimental Astronomy
 Laboratory and Lincoln Laboratory.
 Also Teaching Assistant for Feedback Control course.
September 1963 - September 1968: AVCO Corporation, Wilmington, Massachusetts.
 Associate and Senior Engineer (March 1965) - Guidance Analysis and Simulation
 Section
 Mariner and Voyager Planetary Mission Programs - Trajectory and System
 Studies, Development of Error Analysis Programs
 Earth Orbital (classified) Missions Analyses -Re-entry error propagation
 studies, Satellite Dispersions, Lifetime Analysis, Rendezvous and
 Deployment Studies, Error Prediction
 Radio Astronomy Satellite - Mechanical and Dynamical Motion
 Altitude Determination System Design
 Sequential Filtering Program Development
 Classified Aircraft Weapons Implementation Study
Summer 1963: Associate Editor, 1963 Summer Institute of Space Mathematics.
1961 - 1963: Teaching Assistant in Applied Mathematics at University of Wisconsin,
 U.S. Armed Forces Institute and at Cornell University, Engineering Mechanics
 Department

PROFESSIONAL SOCIETIES:

American Inst. Aeronautics Astronautics Fellow
 (previously Technical Committee member)
 American Astronautical Society Member
 (previously Technical Committee Chairman)
 Division of Planetary Sciences - American Astronomical Society

Pi Mu Epsilon (honorary)

Sigma Xi (honorary)

American Association for the Advancement of Science Fellow

British Interplanetary Society Fellow

Explorers Club National Fellow

Corresponding Member, International Academy of Astronautics

PUBLICATIONS:

Friedman, "Potential of Interplanetary Spacecraft Data for Testing Gravitational Theories," Proc. of Conference on Scientific Applications of Radio and Radar Tracking in the Space Program, (April, 1969), JPL TR 32-1475, July 1970.

Friedman, "Applications of Presently Planned Interplanetary Missions to Testing Gravitational Theories," Proc. of Conference on Experimental Tests of Gravitation Theories (Nov. 1970), Ed. R. Davies, November 1971.

Bourke, Friedman, Penzo, Stavro, "Design of Grand Tour Missions," Presented at AIAA 9th Aerospace Sciences Meeting, (January 1971).

Friedman, Hamilton, Stanton, "Estimating Trajectory Correction Requirements for Multiple Outer Planet Missions," reprinted from Journal of Spacecraft and Rockets, (December 1972).

Friedman, Moore, Sohn, "Navigation Requirements for Advanced Deep Space Missions," Journal of the Institute of Navigation, Fall 1972.

Saunders, Friedman, Thompson, "Mission Planning for Remote Exploration of the Surface of Venus," AIAA/ASME/SAE Joint Space Mission Planning and Executive Meeting, (July 10-12, 1973).

Rose, Friedman, "A Design for a Venus Orbital Imaging Radar Mission", AIAA 12th Aerospace Sciences Meeting, (January 30-February 1, 1974). (Also in JSR, February 1975).

Uphoff, Roberts, Friedman, "Orbit Design Concepts for Jupiter Orbiter Missions," AIAA Mechanics and Control of Flight Conference, (August 5-9, 1974). (Also in JSR, June 1976).

Van Dillen, Friedman, Cheng, "Projection of School District Enrollments," AIAA Mechanics and Control of Flight Conference, (August 5-9, 1974).

Friedman, Lewis, "Future Exploration of Venus," Astronautics and Aeronautics (May 1975).

Friedman, Nunamaker, "Mission Design of a Pioneer Jupiter Orbiter," AIAA/AGU Conference on the Exploration of the Outer Planets (September 17-19, 1975).

Burke, Friedman, "To the Outer Planets -- and Onward," AIAA/AGU Conference on the Exploration of The Outer Planets, (September 17-19, 1975).

Friedman, "Planetary Missions -- Possibilities for the Future," International Hall of Fame Dedication Conference, Alamogordo, New Mexico (October 1976).

Ivie, Friedman, "An Outer Planet Exploration Facility," AIAA 15th Aerospace Sciences Meeting (January 24, 1977).

Anderson, Colombo, Friedman, Lau, "An Arrow to the Sun," Convengo: Gravitazione Sperimentale, Pavia, Italy (September 1976).

Friedman, et al. (17 others). "Solar Sailing - The Concept Made Realistic," AIAA 16th Aerospace Sciences Meeting, Huntsville, Alabama (January 1978).

Friedman, Minear : Future Exploration of Mars, Astronautics and Aeronautics, April 1978

Friedman, "Mars -- Is It Time To Return Samples," Presented to the Annual Meeting of the American Astronautical Society, Houston, Texas (November 1978).

Friedman, "A Proposal for a U.S. Initiative -- The International Halley Watch," AIAA 18th Aerospace Sciences Meeting, AIAA Paper 80-0113. (January 1980).

Friedman, "Science and Exploration as Rationale for Space Policy," Presentation to the AAAS Annual Meeting, San Francisco, California (January 1980).

Friedman, "The International Halley Watch," JAF-80 G-287, IAF 31st Congress, Tokyo, Japan (September 1980).

Rahe, Brandt, Friedman, Newburn, "Halley's Comet and Plans for its Observation During its Return in 1986," in Sun and Planetary Systems, Fricke and Teleki (eds.), Reidel, 1982.

Friedman, "Has the Shuttle Killed Space Science?" Science 82, May 1982.

Friedman, "Towards Becoming A Multi-Planet Species," IAF 36th Congress, (October 1985).

Friedman, "The Cost of a Piloted Mission to Mars," IAF 39th Congress, (October 8-15, 1988), Bangalore, India.

Friedman, Starsailing: Solar Sails and Interstellar Travel, John Wiley & Sons, Inc., New York, 1988.

Friedman, Staehle, "Solar Sails in an Interplanetary Economy," Chapter from Project Solar Sail, edited by Arthur C. Clarke, ROC - Penguin Books, April 1990.

Friedman, "Spaceflight and Global Unification: The Benefits of Space Exploration," National Forum: Phi Kappa Phi Journal, 1992, 39ff

Ocampo, Friedman, Logsdon, "Why Space Science and Exploration Benefit Everyone," Space Policy, 14 (1998), 137-143

Friedman, et. al (9 authors) : "Cosmos 1 : The Attempt to Fly the First Solar Sail Mission," International Astronautical Congress, 2002.

Friedman, et. al.(9 authors) :Cosmos 1 : "The World's First Solar Sail Spacecraft," AAS Space Flight Mechanics Conference, 2004

Svitek, Friedman, Nye, Biddy, Nehrenz : "Voyage Continues – LightSail-1 Mission by The Planetary Society," International Astronautical Congress, 2010

Betts et. al (20 authors): "Phobos Living Interplanetary Flight Experiment", Vestnik, 2011

Brophy, Culick, Friedman, "Asteroid Retrieval Feasibility," IEEE Mach 2012

Betts et. al.(6 authors): "The Phobos Life Biomodule," International Astronautical Congress, 2012

Brophy, Culick, Dimotakis, Friedman, "A Safe Stepping Stone into the Solar System," International Astronautical Congress 2012

Friedman, Jones : "A Valuable Stepping Stone for Humans Beyond the Moon", International Astronautical Congress 2013

Friedman, Garber, Heinsheimer: Evolutionary Lightsailing Missions for the 100 Year Starship, JBIS, Jly/Aug 2013

In addition, Dr. Friedman has published many popular articles in The Planetary Report, and op-eds in news publications and has presented many public and professional conference lectures. He has also appeared on numerous television and radio shows and interviews, including Today, Larry King Live, MacNeil-Lehrer and Nightline. .