

Curriculum Vitae

Edward Belbruno
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Areas of Interest Celestial Mechanics, Dynamical Systems, Astrodynamics, Low Energy Transfers, Regularization Theory, Astrophysics, Cosmology

Education

University	Graduation Date	Field	Degree
Courant Institute (New York University)	6/80	Mathematics	Ph.D.
New York University	6/73	Mathematics	B.S.
Mitchell College	6/71	Physical Science	A.S.

Doctoral Advisor - Jürgen Moser

New Methodology of Space Travel using Low Energy Pathways: Rescue of a Japanese Lunar Mission and A New Transfer to Mars

Developed a new approach to travel in space by finding low energy pathways using unstable chaos called weak stability boundary theory(1986-1990). In 1991 a new type of low energy route to the Moon was developed from this approach in order to rescue a Japanese lunar mission and bring it to the Moon on October 2 of that year. This provided an experimental verification of the theory. It has also been applied to several space missions: SMART-1 of the European Space Agency in 2004 and NASA's GRAIL in 2011. Recent work in 2009-12 has shown interesting dynamical and mathematical connections of this theory.

Developed a new low energy transfer to Mars in June 2104. A mission to Mars demonstrating this transfer being studied by NASA for possible launch in 2018.

Results in Astrophysics, Cosmology, and Astrodynamics

Published 4 papers from 2011-2015 with significant results, in completely different areas:

1. New approach to understanding big bang singularity (Jan. 2013) (A new generalization published in Feb. 2015)
2. New type of route to Mars (March 2015)
(This result appeared in *Scientific American* in Dec. 2014)
3. Origin of Life on Earth and validation of the Lithopanspermia Hypothesis (Sept. 2012)
(This result was reported on in *Time Magazine* in October 2012 in a major story, with cover mention)

4. New approach to understanding dynamics about a Schwarzschild black hole (Feb. 2011)

Origin of the Moon and STEREO Mission

Theory on the origin of the Moon, now called the Theia Hypothesis, published in 2005 (with JRGott III). NASA redirected 2 spacecraft of the STEREO mission to investigate regions of space predicted by theory.

Television and Movies

Feature documentary by Jacob Okada on my life and work, entitled, *Painting the Way to the Moon*. Completion date August 2014. Has won 3 Best Documentary awards in major film festivals in 2014-15. Played at Princeton Garden Theater, March 2015

Work on origin of life and rescue of Japanese spacecraft, as well as art, will appear on show *Cosmic Front* of the Japanese Broadcasting Corporation, in June 2013.

Appeared on GBTV (Glen Beck Television) in 2011, interviewed about work on routes to Moon and results in astrophysics.

Appeared twice on NBC's Today Show on Feb. 1, 2 2003 to discuss Columbia space shuttle disaster.

Books

See Publications

Awards and Honors

Listed as one of the 'top 10 most influential space thinkers', historically, by *New Scientist* in the 40th anniversary issue (2620) on September 5, 2007.

April 21, 1999: Laurels Award (sponsored by Aviation Week Space and Technology Magazine) for the salvage of Hughes satellite HGS-1 in May 1998 using the Moon.

Key Press Releases

1. Princeton University, Office of Communications

Slow Moving Rocks Better Odd that Life Crashed to Earth from Space, Sept. 24, 2012
(<http://www.princeton.edu/main/news/archive/S34/82/42M30/>)

2. NASA Headquarters, Washington, DC

STEREO Hunts for Remains of of an Ancient Planet Near Earth
(http://science.nasa.gov/science-news/science-at-nasa/2009/09apr_theia/)

Professional Affiliations

Princeton University

Department of Astrophysical Sciences (2/2005-)

Department of Mathematics (9/98-9/2004)

(Program in Applied and Computational Mathematics)

Title: Visiting Research Collaborator

Activities: Conduct research.

New York University

Courant Institute of Mathematical Sciences (1/2011-2013)

Title: Adjunct Faculty; Visiting Scholar(from June 2011 - 2013)

Activities: Teach graduate courses, conduct research

Innovative Orbital Design, Inc. (5/97 - present)

Title: President and Founder

Activities: Conduct research. Apply low energy trajectories for missions to the Moon and other planets for NASA, the European Space Agency, Boeing, and other aerospace organizations, both commercial and government. Conduct research on applying dynamical systems to astrodynamics and astrophysics. Organize international conferences for NASA on astrodynamics and dynamical astronomy. License patents.

Universidad Sergio Arboleda

Bogota, Colombia

Departments of Mathematics and Engineering (10/2007 - 2011)

Title: Visiting Research Professor of Mathematics and Engineering

Activities: Lead a research program in celestial mechanics. Organized a yearly international conference in mathematics in the field of applied dynamical systems.

Geometry Center at the University of Minnesota (5/92 - 8/98)

Title: Associated Researcher

Activities: Perform research in celestial mechanics, astrodynamics and dynamical systems. Explore use of visualization and animation to simulate trajectory dynamics. Organize conferences related to work, and give lectures.

Pomona College at the Claremont Colleges (8/90 - 8/91)

Title: Visiting Associate Professor of Mathematics

Jet Propulsion Laboratory, California Institute of Technology (1/85 - 8/90)

Title: Astrodynamist and Mission Design Engineer

Activities: Performed trajectory analysis for the Galileo mission to Jupiter, Magellan to Venus, Ulysses to the Sun, Mars Observer; Developed theory of ballistic lunar capture and enabled the spacecraft Hiten of Japan to reach the Moon. Performed numerous studies for missions throughout the solar system including

those using electric propulsion.

Boston University (9/79 - 12/84)

Title: Assistant Professor of Mathematics

Consultation and Contracts

I have held regular grants and contracts with NASA HQ's Office of Space Science (Science Mission Directorate) since 1999. Have on going contract with Boeing, in the Space Exploration division. Also, have held grants with NASA at Goddard Space Flight Science, and the Jet Propulsion Laboratory. I have also had several grants and contracts with a number of space companies: Excaliber, t/Space, Space Adventures, LunarTrans, SpaceHab, Moon Memorials

Selected Invited Visiting Positions

Department of Mathematics, Sergio Alboleta University, Bogota, Colombia October 2006, February 2007
LAC-INPE (Laboratory of Computational Mathematics-National Institute of Space Research), Sao Paulo, Brazil, April 2005

Yangzhou University, China, Department of Mathematics, November 29-December 28 2003

University of Rome, Italy, Departments of Mathematics and Aerospace Engineering, October-November 2002 & May-June 2001

NASA - Goddard Space Flight Center, Title: Faculty Fellow; June-August 2001 & 2002

NASA - Goddard Space Flight Center, Title: Dean of NASA Academy; June-August 2001

University of Rome, Italy, Department of Aerospace, February-March 1999

Queen Mary and Westfield College, Univ. of London, Division of Mathematical Sciences, March-April 1999

Princeton University, Department of Mathematics. Invited by John Mather, Fall semester 1996

Polytechnic University of Turin, Italy, October/November 1995

Institute of Mathematical Science, SUNY-Stony Brook, N.Y. Invited by John Milnor, March 1995

Center de Recerca Matematica, Institut D'Estudis Catalans, Barcelona, Spain, October 1994

Recent International Conference Organization

Main organizer of a series of six recent international conferences, sponsored by NASA HQ, Wash. D.C.-

Topic: On the use of new methods to applying nonlinearly sensitive/chaotic motions to astrodynamics, dynamical astronomy, and mathematically understanding these motions using dynamical systems theory. Also covered- navigation, propulsion, space policy.

June 2011; *New Trends in Astrodynamics VI*

Location: Courant Institute, New York University

Papers from conference published in September 2012 by the journal

Celestial Mechanics and Dynamical Astronomy.

June 30-July 2, 2008; *New Trends in Astrodynamics V*

Location: Politecnico di Milano, Milan, Italy

Proceedings published in December 2009 by the journal

Celestial Mechanics and Dynamical Astronomy.

June 16-18, 2007; *New Trends in Astrodynamics IV*

Location: Department of Astrophysical Sciences, Princeton University

Proceedings published in 2008 by *Advances in Space Research*, volume 42, number 8.

August 16-18, 2006; *New Trends in Astrodynamics III*

Location: Department of Astrophysical Sciences, Princeton University

Proceedings published in 2007 by the American Institute of Physics, *AIP Conference Proceedings Series* number 886

June 3-5, 2005; *New Trends in Astrodynamics II*

Location: Department of Astrophysical Sciences, Princeton University

Proceedings published in May 2005 by the New York Academy of Sciences in the *Annals of the New York Academy of Sciences*, Volume 1065, entitled *Astrodynamics and Applications*.

January 20-22, 2003; *New Trends in Astrodynamics I*

Proceedings published in May 2005 by the New York Academy of Sciences in the *Annals of the New York Academy of Sciences*, Volume 1017, entitled *Astrodynamics, Space Missions and Chaos*.

Organized a Symposium at the Annual AAAS Conference on Feb. 18, 2006, St. Louis, entitled, *Astrodynamics, Space Missions, and Chaos*.

Presentations and Interviews

Give approximately 20 professional lectures per year within academia, space agencies, industry. In 2009-2014, some of these lectures included: several lectures at the Institute of Advanced Study, Princeton, NASA HQ, Boeing, Columbia University, Rutgers, US Coast Guard Academy, Courant Institute, NASA-AMES in Sunnyvale, CA, a series of lectures at the University of Paderborn, Germany, in September 2009, a lecture at the Hayden Planetarium/Rose Center in July 2009 for the anniversary of the landing on the Moon, a lecture at the HQ of the Mathematical Association of America in Washington, DC, in April 2009, a lecture at the Division of Dynamical Astronomy at Virginia Beach in April 2009.

I conduct many interviews per year on my work, both on line and on radio. The recent result I had in 2012 on the origin of life attracted a lot of interest. I was interviewed by the following(in part): Princeton University Communications Office for a press release (Oct. 2012), Time Magazine(Oct. 2012), National Geographic Magazine(Nov. 2012), MIT Graduate School(Dec. 2012).

Professional Affiliations

Regular reviewer for several journals including *Celestial Mechanics*, *Journal of Mathematical Physics*, *Physics Review Letters*, *Journal of Guidance, Control and Dynamics*, *Astronomical Journal*.

Membership in- New York Academy of Sciences, AIAA, AAAS

Personal

Date of Birth- August 2, 1951 Place- Heidelberg, Germany

Country of Citizenship - United States

Other career: Art-Painting

Publications See Attached

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