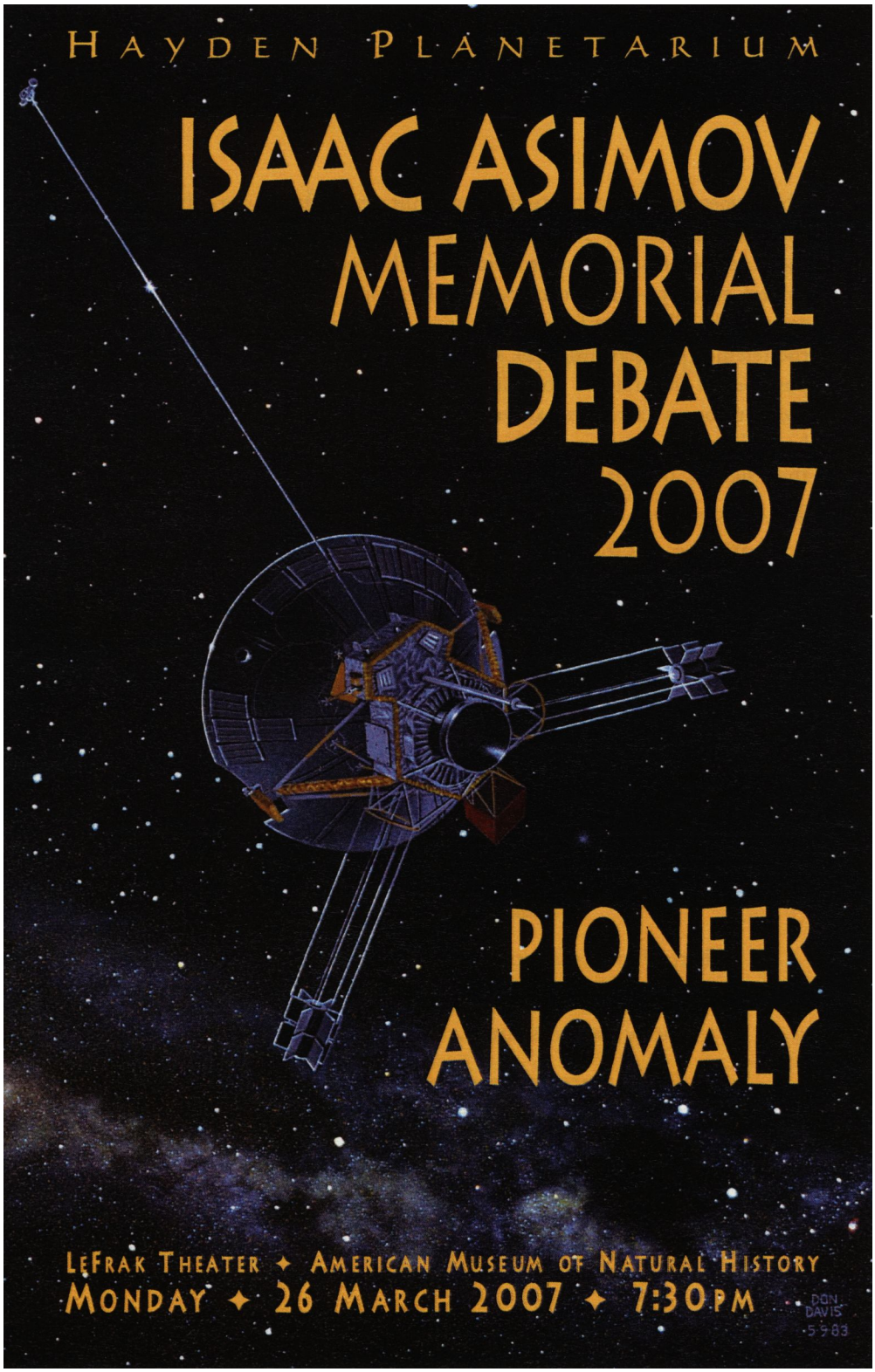
HAYDEN PLANETARIUM
ISAAC ASIMOV MEMORIAL DEBATE 2007
PIONEER ANOMALY
LEFRAK THEATER ✦ AMERICAN MUSEUM OF NATURAL HISTORY
MONDAY ✦ 26 MARCH 2007 ✦ 7:30PM
DON DAVIS 5-9-03

The Pioneer spacecraft, two identical unmanned planetary probes, were launched in the early 1970s on trajectories that would send them past the outer planets and onward with enough speed to leave the Solar System entirely — a first in space exploration. While attempting to account for all known forces that act on these craft, scientists analyzed the telemetry signals from the craft and found an inconsistency. The positions of the craft do not match the scientists' predictions. There seems to be an extra force at work, not included in the analysis, which has affected the motion of these craft across decades of monitoring their signals, from launch until their last contact.

The big questions are:

What is this force?

Is it an unforeseen glitch of spacecraft design?

Is it a sign of the discovery of new physics?
or a new understanding of gravity?

Or is this pointing to something
in our present knowledge of physics
that has simply been overlooked?

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for more information about this remarkable dilemma,
we recommend reading...

http://www.planetary.org/programs/projects/
pioneer_anomaly/update_20050510b.html

http://www.issibern.ch/teams/Pioneer/

http://www.space.com/scienceastronomy/
mystery_monday_041018.html

http://physicsweb.org/articles/world/17/9/3

THE EVENING'S PROGRAM

Welcome & Introduction of Panelists

Opening Questions to Panelists

Directed Free Debate Among Panelists

Questions from the Audience

Closing Remarks

Adjourn

Book Sale / Book & Program Signing

Hall of Northwest Coast Indians

ABOUT THE PARTICIPANTS

PANELISTS

JOHN D. ANDERSON has worked on numerous science teams associated with NASA space missions since the early 1960s. He currently serves on the Radio Science Team for both the Cassini mission to Saturn and the Rosetta mission to Comet 67P Churyumov-Gerasimenko (with a planned arrival and rendezvous in 2014). He acted as Gravity Science Team Leader for Galileo and Co-Investigator on the Stardust Comet Sample Return, and has begun work on the new Juno mission to Jupiter, set to launch in 2011. Since being selected for the Pioneer science team in 1969, he has maintained nearly continuous involvement with various NASA missions. He received his Ph.D. in Astronomy from UCLA in 1967. In 1974, Anderson was honored with the NASA Medal for Exceptional Scientific Achievement, and he was elected a Fellow of the American Geophysical Union (AGU) in 1999.

ED BELBRUNO received his doctorate in mathematics from NYU's Courant Institute, specializing in theoretical celestial mechanics. He currently holds the position of Visiting Research Collaborator in Princeton University's Department of Astrophysical Sciences. Previously, he worked at NASA's Jet Propulsion Laboratory (JPL), serving as a trajectory designer for many missions, including Cassini, Galileo, Magellan, Ulysses, and Mars Observer. His research led to the first application of chaos theory to space travel, finding revolutionary new low-energy routes to the Moon and other places. In 2004, he published the first technical textbook on the subject, *Capture Dynamics and Chaotic Motions in Celestial Mechanics.* The just-published popular version is entitled *Fly Me to the Moon: An Insiders Guide to the New Science of Space Travel.* Also, Belbruno's artwork has appeared in numerous one-person exhibitions, in locales as varied as Paris, Rome, Los Angeles, Washington D.C., New York, and Minneapolis.

GARY KINSELLA has worked as a thermal engineer for over 22 years at NASA's Jet Propulsion Laboratory (JPL). He has supported both spacecraft engineering subsystems and science instruments for many NASA flight projects during that time. These missions included Cassini, Galileo, Mars Observer, Mars Exploration Rover, MIRO, Deep Space 1, and TOPEX — just to name a few. He has served as the supervisor of the Spacecraft Thermal Engineering and Flight Operations Group in the Thermal and Cryogenics Engineering Section for the past two years. Occasionally, he supports unexpected tasks such as the Pioneer 10 anomaly work, for which he presently serves as a Co-Investigator. He appeared on the History Channel's *Modern Marvels* program and addressed the role of the Cassini spacecraft multi-layer insulation blankets. Kinsella earned his B.S. and M.S. degrees in Mechanical Engineering from UCLA.

IRWIN SHAPIRO is the Timken University Professor at Harvard University and a Senior Scientist at the Smithsonian Institution, and was the Director of the Harvard-Smithsonian Center for Astrophysics (CfA) for more than 21 years. A graduate of Cornell University, he received his Ph.D. in Physics from Harvard University. He has authored or co-authored nearly 400 papers on scientific research and education, primarily in astrophysics, geophysics, planetary physics, and in tests of theories of gravitation. He also was a Principal Investigator on two NASA missions. Shapiro has received awards for his research from seven professional societies and institutions.

SLAVA TURYSHEV is a research scientist at NASA's Jet Propulsion Laboratory (JPL); he is also the Principal Investigator of the recently-initiated NASA study of the Pioneer anomaly using all available Pioneer 10 and 11 mission data. He leads and directs the multi-disciplinary science investigation performed at JPL and also coordinates activities of the international Pioneer Anomaly Collaboration — a large international group of scientists and engineers working to solve this great mystery. Turyshev is an expert in gravitational physics, who received his Ph.D. in theoretical astrophysics from Moscow State University in 1990. Since joining JPL in 1993, he has worked on various aspects of a number of NASA missions, including Pioneer 10 and 11, Galileo, Ulysses, SIM PlanetQuest, Laser Astrometric Test of Relativity, lunar laser ranging, and others. He has authored or co-authored more than 120 research publications in the areas of classical general relativity, relativistic celestial mechanics, precision spacecraft navigation, and high-accuracy gravitational experiments.

HOST & MODERATOR

NEIL DEGRASSE TYSON is the Frederick P. Rose Director of the Hayden Planetarium. Born and raised in New York City, Tyson attended the Bronx High School of Science and later earned his B.A. in Physics from Harvard and his Ph.D. in Astrophysics from Columbia. He has served on national commissions to study the Future of the U.S. Aerospace Industry and the Implementation of the U.S. Space Exploration Policy, and he currently serves on NASA's Advisory Council. In addition to professional publications, Tyson writes essays for *Natural History* magazine, some of which have been collected in the New York Times Bestseller, *Death by Black Hole and Other Cosmic Quandaries.*

Isaac Asimov,
one of the most prolific
and influential authors
of our time,
was a dear friend and supporter
of the American Museum of Natural History.
In his memory,
the Hayden Planetarium is honored
to host the annual
Isaac Asimov Memorial Debate
— generously endowed by
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to debate pressing questions
on the frontier of scientific discovery.

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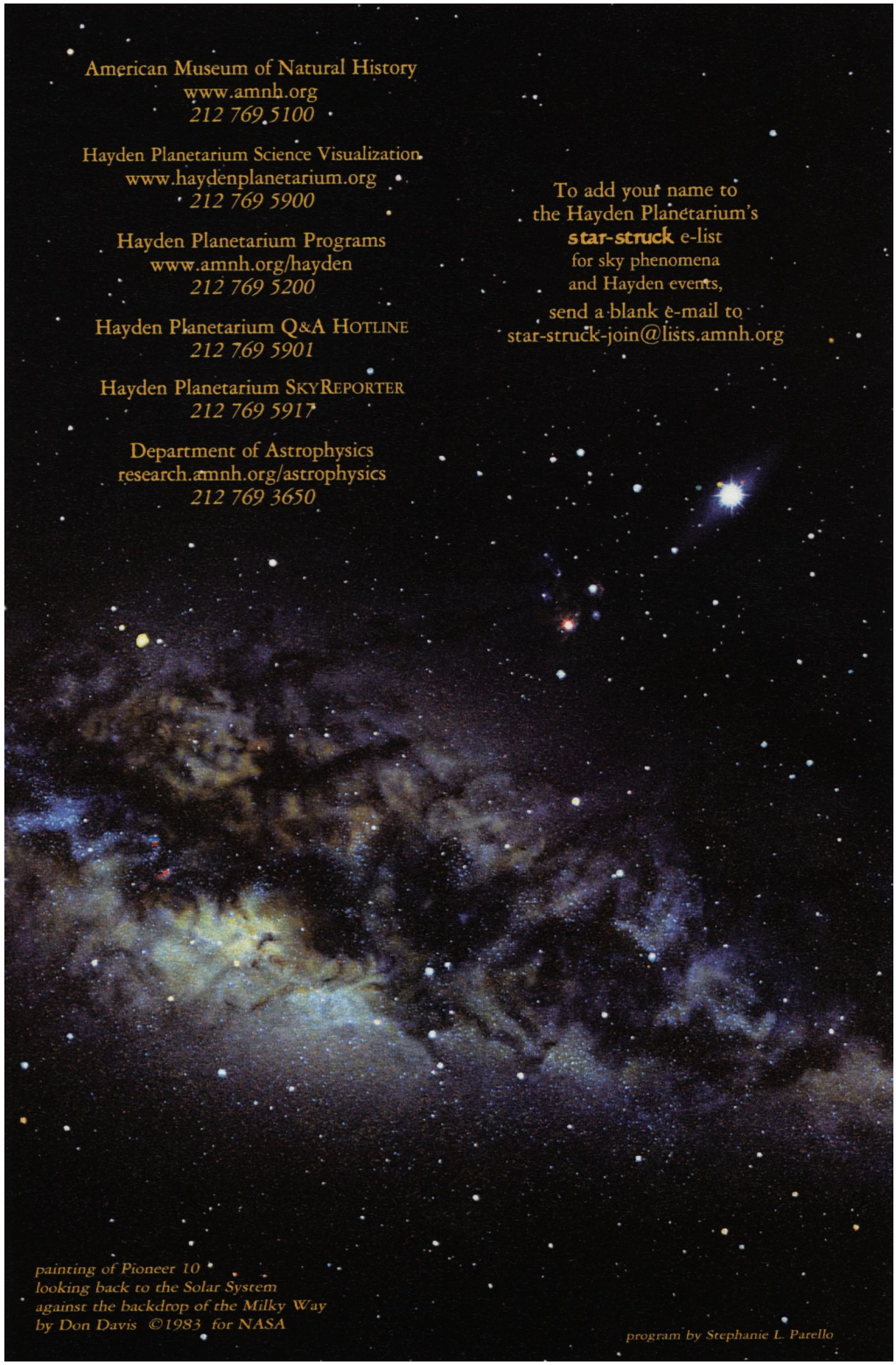
of the Hayden Planetarium.

Isaac Asimov Memorial Debate

2001 Theory of Everything
2002 Search for Life in the Universe
2003 Big Bang
2004 Dark Side
2005 Enigma of Alien Solar Systems
2006 Universe: One or Many?
2007 Pioneer Anomaly



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painting of Pioneer 10
looking back to the Solar System
against the backdrop of the Milky Way
by Don Davis ©1983 for NASA

program by Stephanie L. Parello