OBITUARIES

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Michael Francis A'Hearn

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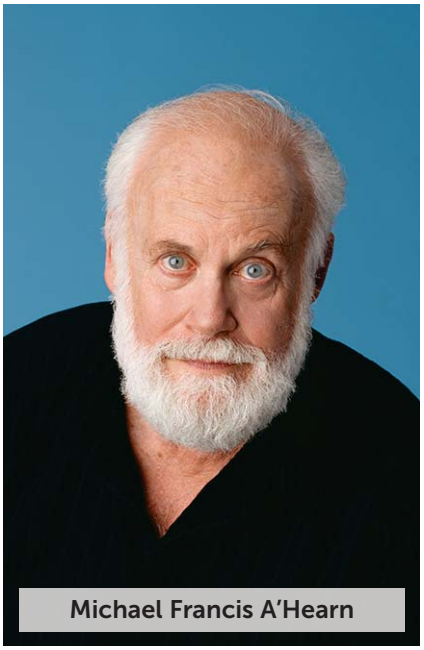

Michael Francis A'Hearn

Michael Francis A'Hearn, Distinguished University Professor Emeritus at the University of Maryland, died on 29 May 2017 at his home in University Park, Maryland, after a short battle with pancreatic cancer. He was a pioneer in planetary astronomy, particularly in the nature and chemistry of comets and their relationship to the cosmogony of the solar system.

Born on 17 November 1940 in Wilmington, Delaware, and raised in Boston and Washington, DC, Mike earned his BS in physics from Boston College in 1961. He received his PhD in 1966, with a thesis on the polarization of the atmosphere of Venus, under the direction of Arthur Code at the University of Wisconsin–Madison. Mike was then hired as a faculty member at the University of Maryland, where he spent his academic career primarily studying solar-system phenomena.

A quote from Mike's last paper, published online at the *Philosophical Transactions of the Royal Society A* on the day of his passing, perhaps best describes his scientific focus: "We outline the key questions about comets that must be answered in order to understand cometary formation in the context of the protoplanetary disc and the role of comets in the formation and evolution of the solar system." Mike came into the cometary-science field when the detailed structure and composition of comets was just being formulated and debated; models, derived from ground-based optical photographic-plate data, ranged from flying sandbanks to discrete kilometer-sized nuclei. His work, which progressed from ground-based telescopic measurements using the first CCDs and single-element bolometers to cometary *in situ* spacecraft observations (now totaling five close flybys and one comet rendezvous), helped show that comets are consolidated, primitive, loosely packed icy mud balls from the dawn of the solar system and building blocks of the planets.

Mike is perhaps best known scientifically for helping to discover the presence of water ice and diatomic sulfur emission in cometary comae, introducing the $Af\rho$ geometry-independent measure of coma dust density, determining the rotation rates of comets by observing their cyanogen jets, and resolving the dark, low-albedo nature of cometary nuclei. He used the Lowell Observatory's compositional survey of 85 comets from the Kuiper belt and the Oort cloud to search for chemical gradients in the protoplanetary disk. With the *International Ultraviolet Explorer* and *Hubble Space Telescope*, he made the first space-based telescopic observations of comets and of water emission from asteroid Ceres.

Mike was the principal investigator for NASA's groundbreaking *Deep Impact* mission. In 2005 *Deep Impact* performed the first-ever excavation and scattering experiment of the nucleus of comet 9P/Tempel 1; that work paved the way for future landers on cometary surfaces and comet sample-return missions. From 2006 to 2013, Mike used the repurposed *Deep Impact* spacecraft, termed *EPOXI*, to obtain some of the first space-based exoplanet light-curve and microlensing measurements and rotationally resolved full-disk, photometric observations of Earth and Mars. In 2010 *EPOXI* made the first *in situ* flyby of a hyperactive carbon dioxide sublimation-driven comet, 103P/Hartley 2. Mike was a coinvestigator of the team of astronomers that used the repurposed *Stardust-NExT* spacecraft to revisit the nucleus of comet 9P/Tempel 1 and identify changes in its surface as it evolved one solar orbit later. He also served on the science teams for the European Space Agency's revolutionary *Giotto* and *Rosetta* comet flyby and rendezvous missions.

Another of Mike's enduring legacies is the wide respect he had from and tremendous influence he had on cometary scientists around the world. In 1984 he helped establish and lead the International Halley Watch, one of the modern era's first international worldwide observing campaigns, to follow the historic return of comet Halley in the mid 1980s, and in 1993 he formed and led a coordinated international team to study comet D/Shoemaker–Levy 9's historic impact into Jupiter. He was the principal investigator of the NASA Planetary Data System's Small Bodies Node, which processes and curates solar-system data sets from spacecraft and ground-based telescopes for use by future generations of astronomers.

Mike's scholarly advice was requested by the most important US science organizations—NASA, NSF, and the National Research Council among them—yet he also made time to discuss science with young researchers he would meet at conferences. He also served his fellow astronomers with stints as chair of the University of Maryland's department of astronomy and the American Astronomical Society's division for planetary sciences (which awarded him the 2008 Gerard P. Kuiper Prize for lifetime scientific

achievement), and as president of the solar-system division of the International Astronomical Union.

Because of his leadership, scientific drive, and generosity, the University of Maryland became a center of the cometary universe. By many counts, he trained, collaborated with, and employed more than 80% of the pre-*Rosetta* generation of cometary astronomers. Mike's students remember him for encouraging them to try new projects and supporting them to actually see them through. His scientific lectures were always pan-disciplinary, well argued, and concise but also illuminating, even to experts in the field.

An avid sailor, celestial navigator, husband, and parent, Mike was well loved by his students and highly respected by the planetary-science community, who will miss his rapier wit and love of logical argument for all things cometary. But if they look up some night, they may see a piece of him in the sky: Asteroid 3192 was named A'Hearn in his honor.

Carey M. Lisse
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Elias Burstein

Elias "Eli" Burstein, Mary Amanda Wood Professor emeritus in the physics department at the University of Pennsylvania, passed away peacefully on 17 June 2017 at his home in Bryn Mawr, Pennsylvania, three months before his 100th birthday.

Born in Brooklyn, New York, on 30 September 1917, Eli majored in chemistry at Brooklyn College and later obtained an MSc in chemistry from the University of Kansas in 1941. From 1941 to 1943, he was in the doctoral program at MIT, but his study was interrupted by World War II. He joined the US Naval Research Laboratory and worked in the physics section of the crystal branch. Within 10 years he was promoted to head of the semiconductor branch.

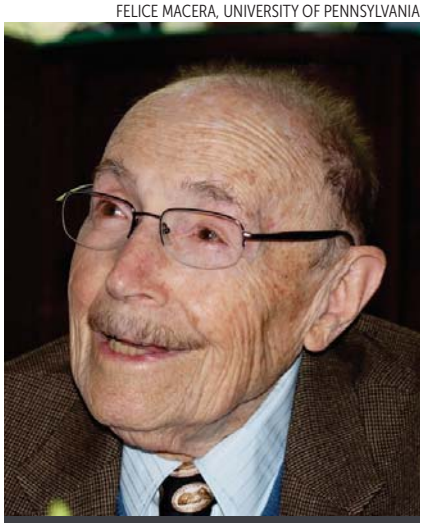
Eli never formally completed his PhD degree, partly because he did not have the time and partly because he did not need to. Widely recognized for his efforts in solid-state physics, he received many honors, including the 1979 John Price Wetherill Medal from the Franklin Institute and the 1986 Frank Isakson Prize for Optical Effects in Solids from the American Physical Society (APS).

In 1958 Eli joined the University of Pennsylvania as a professor of physics. He was named the Mary Amanda Wood Professor of Physics in 1982 and held that chair until his retirement in 1988. Eli helped to build up the physics department into a leader in condensed-matter physics. He was one of the founders of the university's Laboratory for Research on the Structure of Matter.

Eli's main research interests focused on the properties of semiconductors, particularly on their optical properties. He broke ground on many of the techniques used for studying semiconductors, including optical spectroscopy of shallow impurities and inelastic light scattering, also known as Raman scattering.

Eli was among the first to use lasers to study the optical properties of solids. But his interest went well beyond his experimental work. One of his most cited papers, published in *Physical Review* in 1954, explained some anomalous effects due to impurities in the semiconductor indium antimonide. Workers at AT&T Bell Labs had discovered that the onset of absorption in InSb shifted to higher energy when the impurity concentration was increased. That effect was opposite to what had been observed in other semiconductors, such as silicon and germanium. Eli proposed an explanation in terms of the unusually small effective masses of the electronic bands of InSb and the Pauli exclusion principle. The effect has become known as the Burstein shift and the Burstein–Moss shift, since it was also suggested independently by Trevor Moss in the UK.

FELICE MACERA, UNIVERSITY OF PENNSYLVANIA



Elias Burstein

In the field of Raman scattering, Eli's contributions were extensive and influential. Conventionally, Raman scattering was performed on transparent crystals, since the signal was much weaker than the elastically scattered light. Eli pioneered the use of double spectrometers to reject the strong elastic scattering so that weak inelastic-scattering signals from opaque semiconductors could be detected. He demonstrated theoretically that when a crystal strongly absorbs the incident light, the Raman process should be interpreted in terms of inelastic scattering of polaritons. Eli and his coworkers extended the study of Raman scattering to surface polaritons, interface phonons, and two-dimensional plasmons. He also was instrumental in understanding the mechanism for the phenomenon of surface-enhanced Raman scattering, or SERS.

In 1963 Eli became the founding editor of *Solid State Communications*, the first letter-type journal devoted to the field. He remained its editor-in-chief for nearly 30 years. He also was the founding editor of *Comments on Condensed Matter Physics* in 1986 and coeditor of the book series Contemporary Concepts of Condensed Matter Science. He worked tirelessly to help APS's division of condensed-matter physics emerge from the shadow of particle and high-energy physics to become the society's largest division.

A devoted family man, Eli will also be remembered by his 35 PhD students and the many researchers he mentored and treated like family members. He would encourage them to submit papers, including to the journals he edited, and to lecture at conferences, including the numerous ones he organized. Eli will be missed for his warmth as a human being and his deep insights as a physicist.

Peter Y. Yu
Marvin L. Cohen
University of California, Berkeley
Aron Pinczuk
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