In the late hours of July 3, 2005, Mike A’Hearn was sitting in front of a computer screen, staring intently at images of a comet. This was hardly an uncommon activity for one of the world’s leading comet scientists, but on this occasion Mike’s emotions, and his location, were anything but normal. Mike was in the Deep Impact (DI) mission Operations Center at NASA’s Jet Propulsion Laboratory in Pasadena, California, waiting for the next image to be downloaded from the DI spacecraft so he could look for signs that the impactor had hit its target, comet 9P/Tempel 1. When the confirmatory image finally appeared—a massive cone of ejecta rising from a cratered plane on the surface of the nucleus—it was a more spectacular result than anyone had dared hope for. With the pressure off, Mike roamed around the room accepting congratulations and thanking the engineers, managers, and NASA officials who had been essential to the mission’s success, but he was still anxious. The impact represented a climactic end for some DI participants, but Mike saw it as really just the beginning. At that moment, he was anxious to return to the Mission Support area, sit down with the science team, look at the details revealed in the images, and start to figure out what these data would teach us about comets. As usual, with Mike it was all about the science.

History

Michael Francis A’Hearn was born November 17, 1940 in Wilmington, Delaware. He grew up in Braintree, MA, where his ancestry and upbringing instilled in him a strong Irish identity that persisted throughout his life. He graduated from Boston College in 1961 with a B.A. in Physics and then attended the University of Wisconsin, Madison, where he received his PhD in Astronomy in 1966. Early in life, he developed an innate ability to visualize a problem and perform rapid, but accurate, back-of-the-envelope estimates in his head. This ability served him well throughout his life and often astonished people who checked his work with more extensive calculations and computer routines only to confirm his estimates. In 1963, Mike married Maxine Ramold A’Hearn, a graduate student at the University of Wisconsin, and together they would raise a family of three boys, Brian, Kevin, and Patrick. They moved to University Park in 1970, and Mike joined the faculty in the Department of Physics and Astronomy at the University of Maryland (partly due to its proximity to the ocean), where he would spend more than 50 years. He died on May 29, 2017 of pancreatic cancer, leaving behind a legacy that encompasses the past and present and, in many ways, extends into the future.

Science

The most prominent element of Mike’s legacy is his massive body of scientific studies and publications. His doctoral thesis, “The Polarization of Venus,” reflected one of his early interests, and he spent several years exploring how polarimetry and spectroscopy could be used in different astronomical fields. Although he had published two papers on comets during his graduate studies, it was not until the mid-1970s that he returned to the topic, but when he did, it was with great enthusiasm and comets became the focus of his work. Throughout his career, Mike always considered himself to be an observer, and he lived up to that characterization, obtaining a wealth of data of many different types, beginning with ground-based telescopes, progressing to space-based observatories, and, ultimately, to in situ spacecraft. From these data came a multitude of published papers and paradigm-shifting results that often dramatically changed our views of comets.

In his quest to understand how comets work, he pushed the envelope in all directions, quickly embracing new observational facilities, instrumentation, and methodologies. He was an early pioneer in using narrowband filters for measuring comets’ gas production rates and for mapping the structure of the gas and dust in their comae. Comparative studies with these filters produced the first chemical classification system, based on carbon chain molecules, developed for comets, as well as the enigmatic quantity, Aρ, which is now widely used for characterizing and comparing dust production rates, to the confusion of many upon encountering it for the first time (units of centimeters? What?). He was at the forefront in expanding studies into the ultraviolet, infrared, and radio wavelength regimes to increase the inventory of atomic and molecular species that illuminate a comets’ composition and evolutionary history. In the spirit of this work, he led a comprehensive study...
of the primary volatile species in comets (CO, CO$_2$, and H$_2$O) and showed that both Jupiter family comets and long-period comets likely formed in overlapping regions between the CO and CO$_2$ snow lines—a result with significant implications on the origins of comets and the evolution of the solar system.

Mike also played a part in many cometary spacecraft missions, beginning with his encouragement of an unrealized U.S. investigation of comet 1P/Halley and ending as a Co-I on Stardust-New Exploration of Tempel 1 (NExT) and on two instruments on European Space Agency’s Rosetta spacecraft.

Mike’s signature scientific achievement was his role as the Principal Investigator on NASA’s DI mission. DI was not your typical flyby mission; it was one of the first active interplanetary experiments, designed to probe the subsurface properties of comet 9P/Tempel 1. The two-part spacecraft consisted of an impactor that would excavate a 150 m crater on the nucleus, while the flyby portion recorded the impact process and studied the ejecta. DI was first proposed in 1996 with Mike Belton as the PI and Mike A’Hearn as the deputy. In 1998, Mike A’Hearn took the reins on the effort to revise the concept that was ultimately selected by the NASA Discovery program. Mike’s leadership and tenacity ushered DI through a number of threats and problems to ensure its success. The DI spacecraft was originally scheduled to be decommissioned after its primary mission, but it was recognized that it still had value as a unique observing facility and was granted an extended mission and re-branded as EPOXI. In its second life, the flyby spacecraft became a multipurpose tool that would observe exoplanet transits (led by Drake Deming), discover and map the temporally changing water distribution on the moon, act as an interplanetary communications relay system, and fly past a second comet, 103P/Hartley 2. DI was continuing its scientific observations, remotely measuring the production rates of H$_2$O, CO$_2$, and CO in bright comets (Garradd and ISON), when, in 2013, the spacecraft was lost due to a programming artifact that did not account for DI’s lifetime beyond the prime mission. The DI mission in its entirety contributed to hundreds of published papers and scientific talks. Through Mike’s leadership, the DI spacecraft became history’s most traveled deep-space comet hunter, and DI mission data are still being analyzed today with the promise of even more interesting results.

**Community**

Although the list of his achievements is very long, Mike would have been the first to admit that they were not accomplished in isolation. His work was possible because of the collaborations, partnerships, and personal connections that he formed throughout his life. This synergy that he inspired in the community is the second element of his legacy.

Science provided the thread that guided these interactions, but it was Mike’s jovial and human nature that defined their tone. He was always curious about new and interesting ideas, and he honestly expressed the same fascination, whether he was discussing a new graduate student’s first results or a Nobel Prize winner’s lifetime of work. He also had the natural ability to draw people out and make them feel comfortable talking to him, allaying any fear or nervousness that might arise due to his imposing stature and eminent reputation.

Because of his outgoing personality, wide-ranging interests, and big-picture understanding of the small body population, he seemed to know everyone in the comet and asteroid communities. These connections served him well in his many activities and made him a natural choice for organizing large-scale projects. He was one of the primary drivers of the International Halley Watch (IHW), a worldwide undertaking designed to collect and preserve observations of comet Halley during its 1986 return. As part of this effort, a standardized set of narrowband comet filters, based on Mike’s earlier filter work, was designed and distributed.
to IHW participants—the first of several such filter sets widely used to study hundreds of comets over the years. Mike then led the comet campaign to observe and characterize the impacts of comet Shoemaker-Levy 9 into Jupiter. These efforts foreshadowed the DI observing campaign (led by Karen Meech) where dozens of telescopes worldwide (and in space) were focused on comet Tempel 1 to study the effects of Mike’s man-made impact. He was also selected as vice-chair for a National Academy of Sciences/National Research Council report on the risk analysis of space-borne hazards, and in this capacity in 2013, he testified before Congress to explain the need for surveying the small body population and exploring mitigation strategies for potential impacts.

The respect that Mike showed to others reflected back on him, as illustrated in numerous recognitions of his work, including the AAS-DPS Gerard P. Kuiper Prize (2008) that recognizes a scientist’s lifelong body of work and NASA’s Exceptional Public Service Medal (posthumously in 2017) for exceptional contributions to NASA initiatives.

**Future**

In science, as well as in many other aspects of his life, Mike always looked toward the future, which defines the third element of his legacy. Throughout his life, he played a significant role in defining the direction of cometary science, not only through his early adoption of new and different technologies, but also via his influence with younger generations. Through his teaching, he introduced many undergraduate students to the wonders of physics and astronomy, and through his advising, 18 graduate students received their PhDs. He hosted numerous postdoctoral researchers in support of their early studies, and was known for encouraging promising young scientists, actively engaging them in discussions at meetings, and including them in all aspects of his work.

Mike’s forward-thinking mentality is also reflected in his archival work. During the organization of the IHW, it was recognized that most data was obtained, analyzed, and then put into storage, where it tended to be inaccessible and ultimately lost. As part of the IHW project, the team felt that the data should not only be obtained and analyzed but also preserved and made available to others. This was the birth of the IHW archive, which would eventually lead Mike to become the PI of the Small Bodies Node (SBN) of the Planetary Data System. Under his guidance, the SBN, which began with a few small data sets, grew to become a practical research tool, currently containing not only data from every U.S. spacecraft mission to a small body (and several international ones) but also ground-based observations, collections of published survey results, and tools for searching, displaying, and accessing the collections. As a strong proponent of the archive system, Mike helped to ensure that a wealth of data will be available to future generations, who will use new and innovative analysis techniques to extend our understanding of these bodies.

**Memories**

In August of 2019 the University of Maryland hosted a meeting, “New Cometary Insights from the Close Approach of 46P/Wirtanen: A Symposium in Celebration of Mike A’Hearn” to recognize his contributions to cometary science. More than 70 friends and colleagues from around the world attended this three-day workshop to present recent results about comets and talk about Mike (and dozens more sent regrets for not being able to attend).

This focus issue represents the tangible result from the symposium and the Planetary Science Journal was selected, in
part, to honor Mike’s service on the AAS Publications Board (as a member from 2001 to 2004 and chairman from 2005 to 2008). The diversity of papers that were submitted reflects the wide range of topics that were presented at the symposium. Most of the entries focus on comet Wirtanen, presenting results from a number of different observation types. Imaging studies throughout the apparition reveal the comet’s general behavior (Ivanova & Marcus 2020, in preparation), investigate the rotational dynamics and production rates (Farnham & Knight 2020, in preparation), and show that the comet experienced a number of outbursts (Kelley 2020, in preparation). Results from spectroscopic measurements at visible (Cochran 2020, in preparation), infrared (Bonev, McKay, Protopapa 2020, in preparation), and radio (Milam 2020, in preparation) wavelengths show interesting phenomena in the different gas species. A number of spacecraft observed Wirtanen remotely, with analyses from the Hubble Space Telescope (Noonan & Venkaturamani 2020, in preparation), Near-Earth Object Wide-field Infrared Survey Explorer (Bauer 2020, in preparation), and Swift (Bonamente 2020, in preparation). Another group of papers broadens the focus to present comparative studies of H₂O, OH, and other species in multiple comets (Combi, Lovell, Pierce 2020, in preparation), while others present big-picture discussions of hyperactivity in comets (Sunshine 2020, in preparation) and the diversity in properties of Jupiter family comets (Bonev 2020, in preparation). Finally, an assortment of papers covers a variety of other topics, including the activity levels of comet Hale-Bopp (Womack), an inventory of volatiles in comet Hartley 2 (Feaga 2020, in preparation), general outbursts (Fink 2020, in preparation), volatile-rich asteroids (Nuth 2020, in preparation), data from amateur astronomers (Usher 2020, in preparation), and data archiving (Raugh 2020, in preparation).

At the symposium, participants were also encouraged to share personal memories of “Uncle Mike,” and almost everyone took the opportunity to tell at least one story about his broad knowledge of the field, his encouragement of young scientists, his love of sailing and cold weather, his pleasant smile and booming laugh, or his unique personal style—ubiquitous Birkenstocks (with socks), fanny pack, and a bundle of jingly keys. But the recurring theme that resounded throughout the meeting was his humanitarian nature and how he influenced so many people to not only excel in their own work but also to model their own personal interactions after Mike’s example.

His spirit lives on in the people he inspired.

ORCID iDs

Tony L. Farnham © https://orcid.org/0000-0002-4767-9861
Jessica M. Sunshine © https://orcid.org/0000-0002-9413-8785
Lori M. Feaga © https://orcid.org/0000-0002-4230-6759