James R. Houck

October 5, 1940 – September 18, 2015

James R. Houck the Kenneth A. Wallace Professor of Astronomy and one of the pioneers of modern infrared astronomy passed away on September 18, 2015 after an extended illness.

Jim was born on October 5, 1940 to Elsa and James M. Houck in Mobile, Alabama, but spent most of his youth in Pittsburgh, Pennsylvania where his father was an engineer for Alcoa. Jim obtained a BS in Physics at Carnegie Institute of Technology in 1962 where he met his future wife, Elaine Vezzani. They were married in 1965 and remained so until her death in 2011. Jim earned his Ph.D. in solid state physics at Cornell University in 1967 and soon after began working with Professor Martin Harwit's group in Cornell's department of Astronomy developing the first liquid-helium-cooled rocket-borne telescopes for infrared astrophysics. Jim's solid state physics background was ideal for these experiments leading to the improvements in instrument design and reliability that were necessary for the first real successes. Rocket experiments were grand month-long campaigns at the White Sands Missile Range in New

Mexico. Weeks were spent preparing the instrument payload for the launch which returned 5 minutes of astrophysical data. The next flight would typically occur in one year's time. These were truly exciting times. Their sounding rocket based science discoveries included the first measurements of the far-infrared "glow" of interstellar dust heated by starlight in the Galactic Center, and the far-infrared detection of the faint dust cloud which lies in the plane of our solar system, the "zodiacal dust cloud". The luminosity of the zodiacal dust was much more luminous than expected which indicated the dust grains are surprisingly black in the visible. These discoveries were later confirmed by NASA's IRAS and COBE satellites.

Jim was soon hired as an Assistant Professor, starting his own very successful research group that continued to pioneer infrared astrophysics through a series of ground based, airborne, and space borne instrumentation over the next 45 years. In the 1970's and early 1980's Jim built spectrometers for NASA's Convair 990, Lear Jet, and Kuiper Airborne Observatories making many of the first observations of the far-infrared fine-structure lines that are important coolants and physical probes of the gas in planetary nebula and HII regions. Jim's group was one of the most successful on the airborne observatories creating and testing new technologies that would enable the first space missions, and making the first science discoveries that would illustrate the science promise of these missions. A remarkable result from the early Convair 990 experiments was the discovery of an infrared absorption band at 2.85 m due to water bound in a rocky substrate on the surface of Mars, amounting to "about one percent by weight of the surface material". This discovery, reported in a paper led by Jim in 1973

was confirmed by the Mars Rover Curiosity through *in situ* experiments undertaken 40 years later.

Jim's skills with infrared instrumentation were legendary and recognized early on. He was a key member of the science team of NASA's first major infrared space mission, IRAS (1982-1983). IRAS was a liquid helium cooled telescope that performed the first all sky survey in the far-infrared. Shortly before launch, an electrical short disabled the 25 m band, one of the four "colors" necessary for astrophysical success. Jim realized that a clever, but simple rework of the warm electronics would save this array. The fix was implemented, and the mission launched with only a few days delay. As a result, IRAS was an extremely successful mission. Discoveries included the presence of debris disks – analogous to our zodiacal dust disk, but far more massive – around nearby stars. These debris disks were some of the first evidence for extrasolar system planetary systems, or at least comet and/or asteroid clouds. IRAS also revealed a population of dusty infrared bright "star burst galaxies" that are forming stars at hundreds of times the rate of our Milky Way galaxy, and the ultraluminous infrared galaxies (ULIRGs) with luminosities of a trillion suns who's starlight is mostly absorbed by obscuring dust and remitted in the far-infrared bands. The IRAS discoveries were the cornerstone for a series of very successful NASA and ESA space missions that followed, including and especially, the Spitzer Space Telescope.

Spitzer, launched in 2003, was the final mission in NASA's Great Observatories Program (which included the Hubble Space Telescope, the Gamma Ray Observatory and the Advanced X-ray Astronomy Facilities). Jim was the Principal Investigator on one of the three science instruments on Spitzer, the Infrared Spectrometer (IRS). The IRS was an

elegantly simple, but extremely powerful design that Jim would frequently declare was “too dumb to fail”. It was even more successful than prelaunch predictions. The IRS science program brought a large, extremely talented team of young infrared astrophysicists to Cornell in the early 2000’s, and the wonderful combination of sensitivity and reliability the IRS delivered has led to more than 1100 citations to Jim’s Spizer instrument paper to date – more than 1100 science papers!

Spitzer had a rocky road to its launch. Originally conceived in the 1970’s to be mounted in the Space Shuttle as the Shuttle Infrared Telescope Facility (SIRTF), there were ups and downs based on scientific and programmatic factors leading to the decision to make the mission a free-flyer in the same year the science and instrumentation teams were selected, 1984. Despite a top ranking by the 1990 Decadal Review, the SIRTF concept suffered a near death due to drastic reductions in NASA’s space science budget shortly thereafter. Jim was a critical person in the rescue of SIRTF. He chaired the NASA Astrophysics Advisory Committee at the time and provided the extraordinary technical expertise and advocacy that was necessary for SIRTF to achieve a “new start” with critical redesign that could meet the new, much-reduced, mission cost cap.

SIRTF was launched in 2003, and renamed the Spitzer Space Telescope. The first science papers for Spitzer appeared in a special edition of the *Astrophysical Journal* in 2004. About 27 of these were based on IRS data. Spitzer IRS enabled many exciting fields of inquiry from planets in the solar system to protogalaxies in the distant Universe, but perhaps one of the most exciting result was a spectrum taken of a young protostar that was saturated with dozens of emission lines water.

The water is literally “raining” down onto a dense gaseous disk that will likely form a planetary system. Jim was interested in all science applications of the IRS, but he primarily focused on uncovering the source of the tremendous energies found in the UILRG galaxies – star formation or black hole accretion – and on revealing the properties of dust and gas in extreme low metallicity galaxies in the local Universe. These studies provide the framework from which others have gone on with new facilities to explore the star formation processes in galaxies in the earliest times. The legacy of the Spitzer IRS is stored as the “Cornell Atlas of Spitzer IRS Sources” (CASSIS at cassis.sirtf.com) where it continues to be mined for data on sources from the solar system to quasars in the early Universe.

Jim’s excellence was widely recognized among the astronomical community. He was twice awarded the NASA Exceptional Scientific Achievement Medal. First in 2005 "for outstanding contributions to IRAS, including efforts in the rebuilding of the telescope focal plane assembly and continuing scientific analysis.”, and then again in 2008 "for his work on the Spitzer Space Telescope infrared spectrograph.” He also received the prestigious Joseph Weber Award for Astronomical Instrumentation from the American Astronomical society “for his extraordinary contributions over nearly four decades to major instrumentation for infrared astronomy…Dr. Houck's contributions have been seminal to making infrared astronomy among the most exciting in the entire field. It is no exaggeration to say that without Dr. Houck's contributions, modern IR astronomy would never have reached its current level of maturity."

Jim also left a legacy of ground based instrumentation which include a string of successful spectrometers and bolometers that were built for

the Palomar 200” telescope in California. Several of these instruments were initiated as part of a Cornell/Caltech collaboration that Jim started while on sabbatical leave at Caltech. Especially exciting were a pair the “SIRTF test-bed” spectrometers SpectroCam-10 and SCORE, and an adaptive optics spectrometer, PHARO which provided access to new science windows on a major telescope to researchers at both Cornell and Caltech.

Jim was also an inspiring teacher and was recognized as such by receiving the Clark Award for Distinguished teaching by the College of Arts and Sciences. He created the research quality Hartung-Boothroyd Observatory and its 25” reflector on Mount Pleasant just east of Ithaca for the purpose of teaching instrumentation and observational techniques. The telescope has been named the James R. Houck Telescope in his honor. A lasting legacy and testament to Jim Houck is the high esteem in which he is held by the dozens of Ph.D.s, a dozen postdocs, and hundreds of undergraduates who he has mentored in their research or taught in his classes. There are a remarkable number of leading scientists world-wide whose careers were launched under Jim’s mentorship including scientists in industry, academia, and national facilities, many of whom are leaders in their fields.

Jim was enthusiastic about the Steelers, Cornell Hockey, and the Himalaya mountains, where he took a month’s-long sojourn twice. I cannot agree with his enthusiasm for the Steelers, but Jim’s enthusiasm for science was infectious. He had a special ability to make complex physical concepts simple with straight-forward explanations appealing to everyday experience. From the acknowledgements of the Ph.D. thesis of one of his students: “Jim’s insight into physical puzzles has been inspiring

– he has taught me at such a subtle level that it is not uncommon for me to begin solving a problem by first asking myself how he would solve it". A quote was taped to Jim's office door for more than a decade that summed up his positive attitude in a competitive field: "The best way to get even is to have a good life."

Jim was remarkably attentive to the needs of others. He was always available for consultation on a new idea, and ready with helpful comments on your lab work and research proposal. A common refrain was "don't polish a cannon ball". If he thought you were going astray, he would drop everything to help put you back on the right path. In my particular case, what comes to mind was the day 25 years ago that I announced that my wife and I had put in a bid on a house in Ithaca. He asked where it was, then told me that is that was too busy a street for our young children. They will not be able to learn to bike and play safely – "plus the truck traffic at night will drive you crazy". This every busy man, then dropped everything to give me a spontaneous 3 hour tour of Ithaca focusing on houses in low-traffic neighborhoods. I am eternally grateful for the gentle guidance he gave on this and many other issues in life and science. His presence is missed by all.

Jim was predeceased by his wife Elaine in 2011, and is survived by his two sons Chris (Tracy) and Robert (Michelle) and four grandchildren Adriana, Aiden, Joshua and Olivia, and his sister, Sara Horsman of Pittsburgh.

The department of astronomy will hold an international workshop titled "Science Enabled by Novel Infrared Instrumentation" in Ithaca, June 25-29, 2017 to honor the memory of Jim Houck.

Gordon Stacy and Jamie Lloyd