Attendee and abstract list (7/25/19) Green - Oral Talk Blue - Poster

New Cometary Insights from the Close Approach of 46P/Wirtanen: A Symposium in Celebration of Mike A'Hearn

Attendee	Affiliation	Title	Abstract
Allison Bair	Lowell Observatory	Dynamical Trends of Comets: Results from Four Decades of Observations	We will present results from the 190 comets in our narrowband photometry database, based on their dynamical ages. This is an ongoing project that was begun by Mike A'Hearn in 1976.
James Bauer	University of Maryland	Wirtanen and the CO+CO2 hyper-volatiles as seen by NEOWISE	We will present the evidence of CO+CO2 production by Wirtanen using the NEOWISE observations, as well as place it in the context of existing knowledge of JFC comet CO+CO2 emissions.
Dennis Bodewits	Auburn University	HST, Chandra, and Swift observations of 46P/Wirtanen	I will summarize the extensive observing campaign of comet Wirtanen using HST, Chandra, and Swift. This work is direct progression from the work I did with Mike (HST) on remote observations and space missions, specifically Rosetta and EPOXI.
Boncho Bonev	American University	Comet 46P/Wirtanen from Keck: Volatile Composition and Outgassing	A major upgrade to the NIRSPEC instrument at the Keck 2 telescope was successfully completed in time for near-infrared spectroscopic observations (at high spatial resolution) of 46P/Wirtanen during its close fly-by of Earth in December 2018. This presentation will highlight results on native volatile composition and outgassing sources, as well as reminiscences of Mike A'Hearn since our first meeting at a symposium honoring Armand Delsemme in Toledo some 21 years ago.
Bonnie Buratti	Jet Propulsion Laboratory	Mike A'Hearn and the Rosetta Mission	This talk is an overview of Mike's contributions to the Rosetta Project. In addition to his 51 peer-reviewed papers on the Mission, he worked closely with project scientists and managers to provide the glue that held the international team together. He was an ideal role model and mentor to more junior scientists, and he led the archiving effort on the U.S. side.
Anita Cochran	The University of Texas	Comet 21P/Giacobini-Zinner: The Prototypical Depleted Comet	We report high spectral resolution observations of 21P/GZ. We use these data to explore the C2 band and compare with a typical comet. I will also reminisce about my first encounter with Mike.
Regina Cody	Retired		
Michael Combi	University of Michigan	SOHO/SWAN Observations of Comet 46P/Wirtanen 1997-2018	Water production rates were determined from observations of the hydrogen Lyman-alpha coma of comet 46P/Wirtanen during the 1997, 2002, 2008 and 2018 apparitions made with the SWAN instrument on the SOHO spacecraft. Overall production rate levels have generally decreased over that time period, especially in 2018.
Neil Dello Russo	Johns Hopkins University Applied Physics Laboratory	Emerging trends in the volatile chemistry of comets as measured with high-resolution IR spectroscopy	Discuss the chemical relationship of cometary volatiles measured with high-resolution IR spectroscopy, and put results in context with groundbreaking optical taxonomic studies (e.g. A'Hearn et al. 1995) and recent missions.
		IRTF/iSHELL campaign for comet 46P/Wirtanen	We present an overview of the successful observing campaign to chemically characterize 46P/Wirtanen with the high-resolution IR spectrometer iSHELL at the NASA-IRTF.

Mike DiSanti	NASA-Goddard Space Flight Center	2017-2019: A Golden Age for Short-period Comets	Five ecliptic comets had highly favorable apparitions, with three of these passing to within 0.15 AU of Earth, and two within 0.1 AU. This permitted significant advances in measurements of constituent ices in this traditionally under-represented class of comets. A brief summary will be presented.
Sara Faggi	NASA Goddard Space Flight Center	Compositional studies of comet 46P/Wirtanen: a window on the cosmogonic origin of Jupiter Family Comets	We investigate the origin and evolution of Jupiter-Family-Comet 46P/Wirtanen by performing a detailed characterization of several key cosmogonic indicators as measured with iSHELL/NASA-IRTF, and by comparing these markers to other JFCs. Specifically, we present the quantification of its chemical composition (e.g., HCN, NH3, CO, C2H2, C2H6, CH3OH, H2CO), derived water spin-temperature (e.g., H2O ortho-to-para ratio), and searched for the signatures of ammoniated salts in its IR spectra , obtained from the favorable apparition in the 2018 perihelion passage. The results on comet 46P/Wirtanen will be presented in the context of our extensive database of molecular inventory, with the ultimate goal of establishing new constraints on the origin and evolution of JFCs. We will compare our measurements of primary volatiles with respect to product species measured by A'Hearn and collaborators.
Tony Farnham	University of Maryland	The rotation period of comet Wirtanen	We will discuss the rotation period of comet Wirtanen, as measured from multiple epochs of CN coma morphology observed at Lowell Observatory
Kelly Fast	NASA	Welcome from NASA	
Lori Feaga	University of Maryland	Observing comets across the spectrum: opportuinties Mike afforded me	Mike hired me on as a postdoc with the Deep Impact infrared spectrometer team, shortly after that introduced me to the Rosetta ultraviolet team, and most recently encouraged my hands-on use of DCT, all to observe a plethora of comets, their composition, and their environments across the electromagnetic spectrum. With memories and wisdom from Mike inserted, I will present color morphology of 46P/Wirtanen's coma and the implications for its composition and hyperactivity.
Clément Feller	University of Bern, Switzerland	Unraveling cometary activity further: the CoPhyLab experiments	I will present the Cometary Physics Laboratory project: a european collaboration between Germany (TU Braunschweig), Austria (OAW Graz) and Switzerland (Bern University). This joint-venture seeks to study properties of ices and organics mixtures in a simulated cometary environment. In each institute, experiments are already underway to characterize a selection of materials that will be used in the shared experiments. I first meet and collaborated with Mike on the ROSETTA mission. His cheerfulness and his enthousiasm for comets and space exploration made a lasting impression on me.
Yanga Fernandez	UCF	Some Things We Learned About Cometary Nuclei	I will present a short review of how our view of what cometary nuclei are like changed in the early 1980s -- before that decade's Halley apparition -- thanks to work by Mike A'Hearn and co-workers. I will also give a short personal perspective on how wonderful it was to work on nuclei as one of Mike's students in the 1990s.
Edwin Grayzeck	Cornell Technical Services	Legacy of Mike A'Hearn: Charting the Course of the Planetry Data System	Remembering Mike A'Hearn and the beginning of the Planetary Data System; from the earliest days of the Small Bodies Node and looking to the present

Murthy Gudipati	JPL/Caltech	Is Cometary Nucleus Primordial?	Comets are generally thought to be present-day witnesses of the formation of our solar system from interstellar through protoplanetary to evolved solar system, by carrying in their nucleus interior the primordial material. However, in spite of several missions and observations, we are still unclear about the primordial composition of a comet, particularly those who are more accessible Jupiter Family Comets. I will try to connect the dots from interstellar ice grains to present-day comets and outline how we may be able to address this question, while highlighting my interaction with Mike A'Hearn!
Annika Gustafsson	Northern Arizona University	Water-Ice Distribution in the Coma of 21P/Giacobini-Zinner	We created a near-infrared spectral data cube of comet 21P/Giacobini-Zinner using observations collected with the NIHTS instrument on Lowell Observatory's 4.3-m Discovery Channel Telescope. We have implemented the Planetary Spectrum Generator Tool for improved telluric correction in our data reduction. The observations were made near close approach to better understand the water-ice grain properties of the comet coma in an effort to constrain possible formation mechanisms.
Michael Haken	U.S. Naval Observatory		
Walt Harris	University of Arizona	Chimera: A Gateway to the Centaurs and the Secrets of Small Body Formation	The Centaurs exist in an intermediate evolutionary state between Trans Neptunian Objects and the Jupiter Family Comets. Chimera is a mission concept to study 29P/Schwassmann-Wachmann 1, the most active Centaur and the only planetesimal known to experience frequent, predictable outbursts. In this presentation we will describe the Chimera exploration strategy, expected scientific return, and its connection to previous missions and decadal objectives.
Sue Hoban	University of Maryland, Baltimore County		
Carrie Holt	University of Maryland		
Oleksandra Ivanova	Astronomical Institute of SAS	Photometry, spectroscopy and polarimetry observations of the comet 46P/Wirtanen with small size telescopes	To support the 4P* morphology campaign we used some small size telescopes in wide range of Earth longitudes. We present some results of integrated study of comet 46P/Wirtanen from photometric, spectral, and polarimetric observations between September 16, 2018 and February 6, 2019. We identified emissions belonging to the CN, C2, C3, NH2 molecules. The complex structure of the coma was analysed. Polarization maps of cometary coma were built before and after perihelion passage.
David Jewitt	UCLA	Activity and the Cohesion Bottleneck in C/2017 K2	Comet C/2017 K2 is an object in which the observed coma should not exist given our present understanding of ejection physics. Active at 26 AU, drag forces even from supervolatile ices like CO are too small to overcome interparticle cohesion. I will present the data and suggest non-classical processes that might account for this extraordinary object.
Hideyo Kawakita	Koyama Astronomical Observatory	Complicated organic materials in comet 21P/Giacobini-Zinner	We report mid-infrared low-resolution spectrum of comet 21P/Giacobini-Zinner, that exhibits emission features of not only silicates but also complex organic materials like PAHs.

Horst Uwe Keller	IGEP TU Braunschweig	On the Diversity of Comets	Comets are quite divers in appearance but are their nuclei diverse in composition and if so why? These questions were of major interest for Mike. The observations of 67P/Churyumov-Gerasimenko during the Rosetta mission show that its coma composition changes with season (heliocentric distance). As a consequence some of the previous conclusions will need to be reassessed.
Yoonyoung Kim	Max Planck Institute	Main-Belt Comet P/2018 P3 (PANSTARRS)	Comet P/2018 P3 (PANSTARRS) has a semimajor axis 3.006 AU, eccentricity 0.415, inclination 8.9 deg, placing it in the outer main asteroid belt. We present Hubble Space Telescope observations of P/2018 P3 taken from September to December 2018, as well as archival NEOWISE observations showing P/2018 P3 to have 4.6 um band excess attributable to CO or CO2 gas emission. The presence of CO or CO2 suggests that P/2018 P3 has been recently captured into the main belt from sources in the outer Solar System.
Nikolai Kiselev	Main Astronomical Observatory of the National Academy of Sciences of Ukraine	Remembering Mike	
Matthew Knight	University of Maryland	Mike A'Hearn's early comet work: unpublished results and why it is still relevant today	After Mike's death, I discovered unpublished observations he made of sungrazing comet Ikeya-Seki (1965f) while he was a graduate student at the University of Wisconsin. I will expand on his preliminary analyses of these data and discuss why the topics he was exploring half a century ago – narrowband filters, secular trends in composition, and outbursts – are still relevant to studies of 46P/Wirtanen and other comets today.
Ludmilla Kolokolova	University of Maryland		
Konrad Kossacki	University of Warsaw	Deep Impact experiment – some consequences	The number of known comets is large, but the shapes of their nuclei are known only in few cases and the mechanical strength was determined only for two of them. They are: comet 9P/Tempel 1 of the strength determined due to the Deep Impact experiment led by Mike A'Hearn and comet 67P/Churyumov-Gerasimenko. In this work different mechanisms for the strengthening of material composing comets are discussed.
Cassandra Lejoly	Lunar and Planetary Laboratory	Radial Dust Profiles of Three Close Approach Jupiter Family Comets	We had a unique opportunity to observe three close approach Jupiter Family comets in the last two and a half years, 41P/Tuttle-Giacobini-Kresàk (41P/TGK), 45P/Honda-Mrkos-Pajdusáková (45P/HMP), and 46P/Wirtanen. In our work, we present radial profiles of 46P/Wirtanen and compare them to the radial profiles of the other two comets. Our radial profiles, when combined with radar data obtained at Arecibo, suggest that even if the radial profiles of 46P/Wirtanen and 41P/TGK are similar, the respective dust environments might still be different.

Manuela Lippi	NASA/GSFC	In pursuit of a reliable chemical classification of comets: updated molecular abundances for 16 comets observed with NIRSPEC	We present updated results for rotational temperatures, production rates, and mixing ratios for the main molecular species in 16 comets observed with NIRSPEC since 1999. For this new analysis, we used the latest procedures and fluorescence models. Differences between previous analyses and our results underscore the need to update some of the previous values, especially for comets observed before 2011 (which constitute over half of our cometary database). We can use the updated chemical abundances of each comet to obtain some hints about its origins and investigate what trends and similarities exist for different comet populations; all with the purpose of building a robust comet taxonomy based on volatile composition. This also permits comparison with the rich database on product species detected at optical wavelengths by several groups (e.g., A'Hearn et al. 1995). We will place results from comet 46P/Wirtanen in the context of the new database.
Amy Lovell	Agnes Scott College		
Joseph Marcus	Unaffiliated	Mike's m-Q Anomaly	Comet brightness should scale directly to production rates, i.e., I ~ Q. With total magnitude m1 = -2.5 log I, we should expect log Q = k1 + k2(m1) with k2 = -0.4. To his puzzlement, Mike found instead that k2 = ~ -0.3 for Q[C2], Q[CN], and Q[C3] (AJ 1980; 85, 1528), a result confirmed by subsequent workers who find k2 ~ -0.27 for m1 vs Q[H2O] and Q[CO]. I call this phenomenon magnitude-production rate disproportionation, or more simply, the m-Q Anomaly, and resolve and model it here as a psychophysical artifact of the visual nervous system.
		The Visual Light Curve of 46P/Wirtanen	Total visual magnitude (m1) observations of 46P/Wirtanen from the 2002, 2007-08, and 2018-19 apparitions are intercompared with special attention paid to a potential underestimation of m1 in 2018-19 due the extremely close approach to the Earth (minimum distance = 0.077 AU on Dec. 16.5 UT).
Joel Marks	University of New Haven	Ready to Launch: A'Hearn on Planetary Defense	
Lucy McFadden	GSFC, Emerita		
Adam McKay	NASA GSFC/American University	The Peculiar Volatile Composition of CO-Dominated Comet C/2016 R2 (PanSTARRS)	We will present an overview of our campaign with a number of facilities to characterize the composition of the peculiar comet C/2016 R2 (PanSTARRS), for which the dominant volatile is CO rather than H2O. We will present both results from near-perihelion as well as preliminary results from post-perihelion observations obtained this past June.
Stefanie Milam	NASA/GSFC	A close view of 46P with ALMA	The December 2018 apparition of comet 46P/Wirtanen provided a rare opportunity to observe a Jupiter Family Comet at extremely close geocentric distance (~0.1 au) with ALMA. Our observations included high spatial resolution images of HCN, H2CO, CH3OH and CS, while the extended-flux sensitivity of ALMA's ACA was used to image HNC, CH3CN, and other species (plus dust/debris continuum). Preliminary results of these observations will be presented and some perspective on the physical and chemical state of the inner coma will be highlighted as part of the 46P observing campaign.

Jennifer Miller	Gemini Observatory		
Mark Moretto	University of Colorado Boulder	Mentor Mike	Talk about how Mike mentored me from high school through undergrad and how he helped shape my career path. Probably on the shorter side (5-10 min)
Beatrice Mueller	Planetary Science Institute	Comet 46P/Wirtanen: Initial Results	We will present initial results from our imaging campaign taken at the University of Arizona telescopes.
Michael Mumma	NASA GSFC	A Comparison of Production Rates for Primary and Product Volatiles in comets - from 1P/Halley to 46P/Wirtanen	Mike A'Hearn and his collaborators are renowned for their long-term study of product volatiles in comets. Here, I compare the insights gained from product species with those obtained from direct measurements of primary volatiles at infrared wavelengths.
John Noonan	Lunar and Planetary Laboratory	HST COS and STIS Observations of 46P/Wirtanen In Search of Dissociative Electron Impact Emission	Observations made by the OSIRIS and Alice instruments on board the European Space Agency Rosetta spacecraft revealed the prevalence of dissociative electron impact emission in the near-nucleus coma at large heliocentric distances and during cometary activity. With the close approach of 46P/Wirtanen we proposed to search for similar emission processes using the UV and NUV capability of the Cosmic Origins Spectrograph and Space Telescope Imaging Spectrograph on the Hubble Space Telescope. In this talk we will discuss the observing goals, planning strategies, and current status of the data analysis of the project.
Joseph Nuth	Solar System Exploration Division	New Definition: A Comet is the Active Phase of a Volatile-Rich Small Body	Gravitational interactions between the growing giant planets and the nebular disk caused havoc to the initially orderly progression of dry- to volatile-rich planetesimals with increasing radial distance, sending some dry rocks into the Kuiper Belt and Oort Cloud while moving volatile-rich bodies into the inner solar system. In addition, cometary activity persists for only about 1000 perihelion passages while small bodies in cometary orbits are stable for up to ~500,000 years, thus implying that there are more dormant comets (aka, asteroids) in cometary orbits than active comets. A comet is therefore simply the active phase of a volatile-rich small body.
Takafumi Ootsubo	ISAS/JAXA	Mineralogy of cometary dust with Subaru+COMICS mid-infrared observations	We have made efforts to increase mid-infrared observational samples of comets, mainly for studying the crystalline fraction in silicate grains. We summarize the results of Subaru+COMICS observations, including comets 9P/Tempel and 103P/Hartley, which Deep Impact/EPOXI visited.
Lucas Paganini	NASA HQ		
Ralph Pass	N/A		

Donna Pierce	Mississippi State University	Fragment Species in the Comae of Several Comets Observed with an Integral Field Unit Spectrograph and the Unusual Case of 168P/Hergenrother	Spectra of the comae of three Jupiter Family comets and one long period comet were obtained with a 246-optical-fiber integral field unit spectrograph on the Harlan J. Smith Telescope at McDonald Observatory. The passband of the spectrograph permitted the observation of C2, C3, CH, CN, and NH2 emissions for these comets. In order to facilitate comparison of our data with results from prior surveys of fragment species, the classical Haser model was used to derive production rates and mixing ratios relative to CN for each comet. Our results suggest that the relative abundances of the observed species with respect to CN of these comets vary greatly but are largely consistent with ranges established in prior surveys. However, the notable exception is 168P/Hergenrother, which is extremely depleted in volatiles. These results build upon A'Hearn's characterization of the ensemble properties of comets, the results of decades of narrowband photometry measurements of fragment species in comet comae.
Brynn Presler-Marshall	Lowell Observatory	The CN Jet Morphology of Comet 8P/Tuttle	Cometary CN jets were first discovered by Mike A'Hearn in Comet Halley and have subsequently been observed in numerous comets, including 8P/Tuttle. Observations of Tuttle from the 2007-2008 apparition were modeled to obtain a pole solution and rotational period, as well as to investigate the large pre and post-perihelion asymmetry in gas production rates.
Silvia Protopapa	Southwest Research Institute	Historic close approach of comet 46P/Wirtanen: Is hyperactivity caused by icy grains?	We have conducted an investigation into comet hyperactivity taking advantage of the historic close approach between Earth and comet 46P/Wirtanen (16 Dec 2018, 0.078 au). Using IRTF/SpeX we have looked for water-ice grains in the coma of this comet over a range of heliocentric distances and nucleus rotation phases. We will present a summary of our IRTF/SpeX results in the context of what we know about the physical properties of water-ice and dust in cometary comae.
Anne Raugh	University of Maryland		
Nalin Samarasinha	Planetary Science Institute	4*P Coma Morphology Campaign and Comet 46P/Wirtanen	I will talk on Dr. Mike A'Hearn's influence that initiated and shaped my approach to cometary research followed by a discussion on the 4*P Coma Morphology Campaign and comet 46P/Wirtanen.
David Schleicher	Lowell Observatory	Uncle Mike's Early Contributions to Cometary Science and Their Culmination in Recent Studies of Comet 46P/Wirtanen	Michael F. A'Hearn, known to many as Uncle Mike, moved cometary studies forward on many fronts in his first (baker's) dozen years in the field, beginning with Comet Kohoutek through to Halley's Comet in early 1986. I will discuss these early contributions and then conclude with some of our results, all based on his methods and findings, of Comet 46P/Wirtanen during is exceptional recent apparition.
Colin Snodgrass	University of Edinburgh	Europe's next comet mission: Comet Interceptor	Mike changed how space missions to comets were thought of with Deep Impact, doing great science with a relatively cheap mission. Subsequent 'small' comet missions are an important part of his legacy. I will describe Comet Interceptor, an ESA mission that follows this approach.
Mark Sykes	Planetary Science Institute		
Helen Usher	Open University		

Geronimo Villanueva	NASA Goddard Space Flight Center		
Stuart Vogel	University of Maryland		
Elizabeth Warner	University of Maryland	Dr A'Hearn and the UMD Observatory	A brief history of Dr A'Hearn's involvement, oversight, influence of the UMD Observatory.
Laura Woodney	CSUSB	Orbital evolution of Centaurs and their transition to Jupiter family comets	Memories of Mike intertwined with a recent dynamical study of the evolution of Centaurs to Jupiter Family Comets.