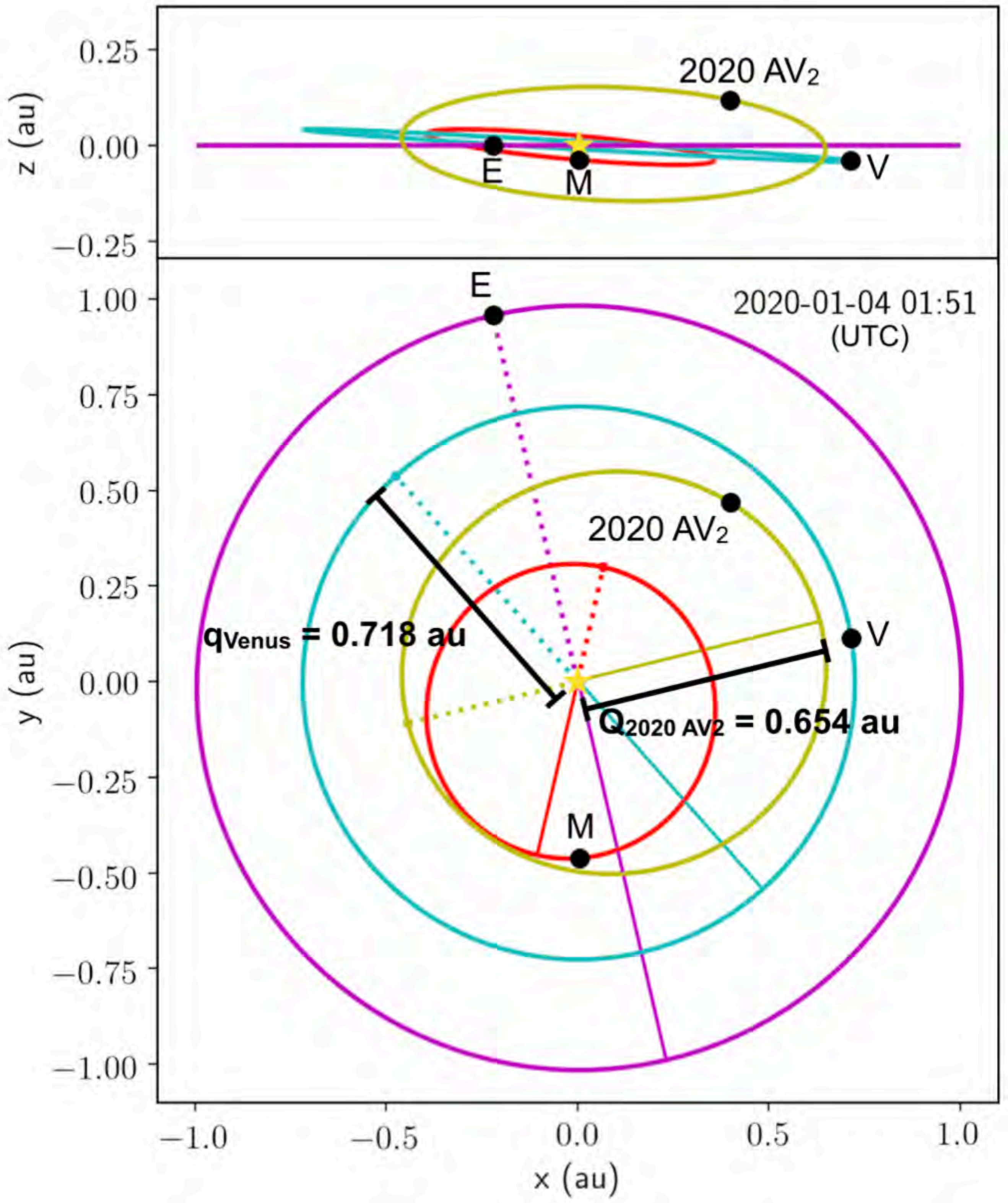
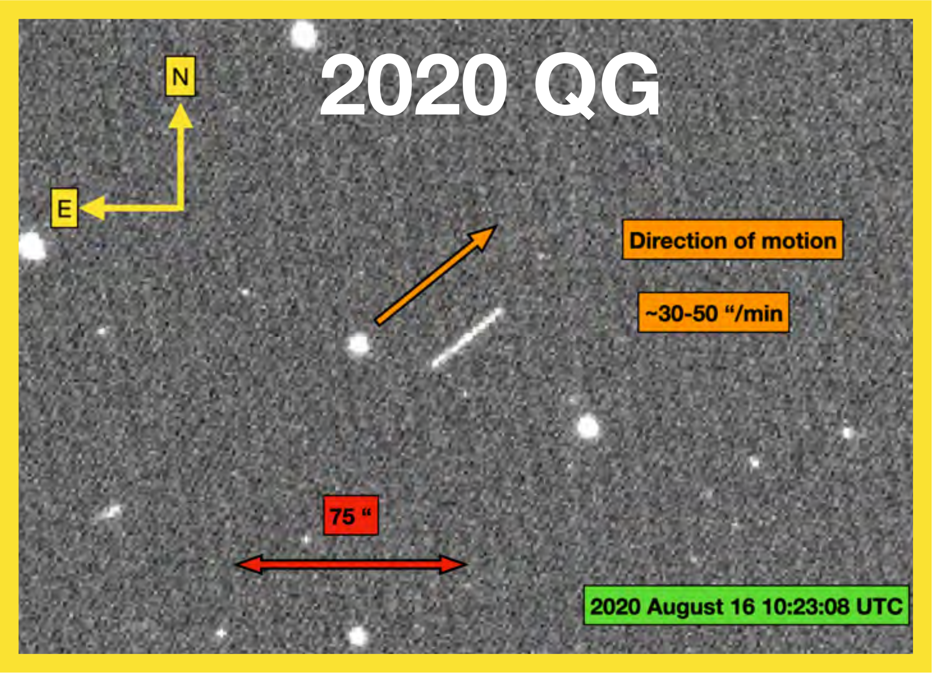
Observations of small Solar System objects with ground and space-based observatories

Bryce Bolin (Caltech/IPAC)

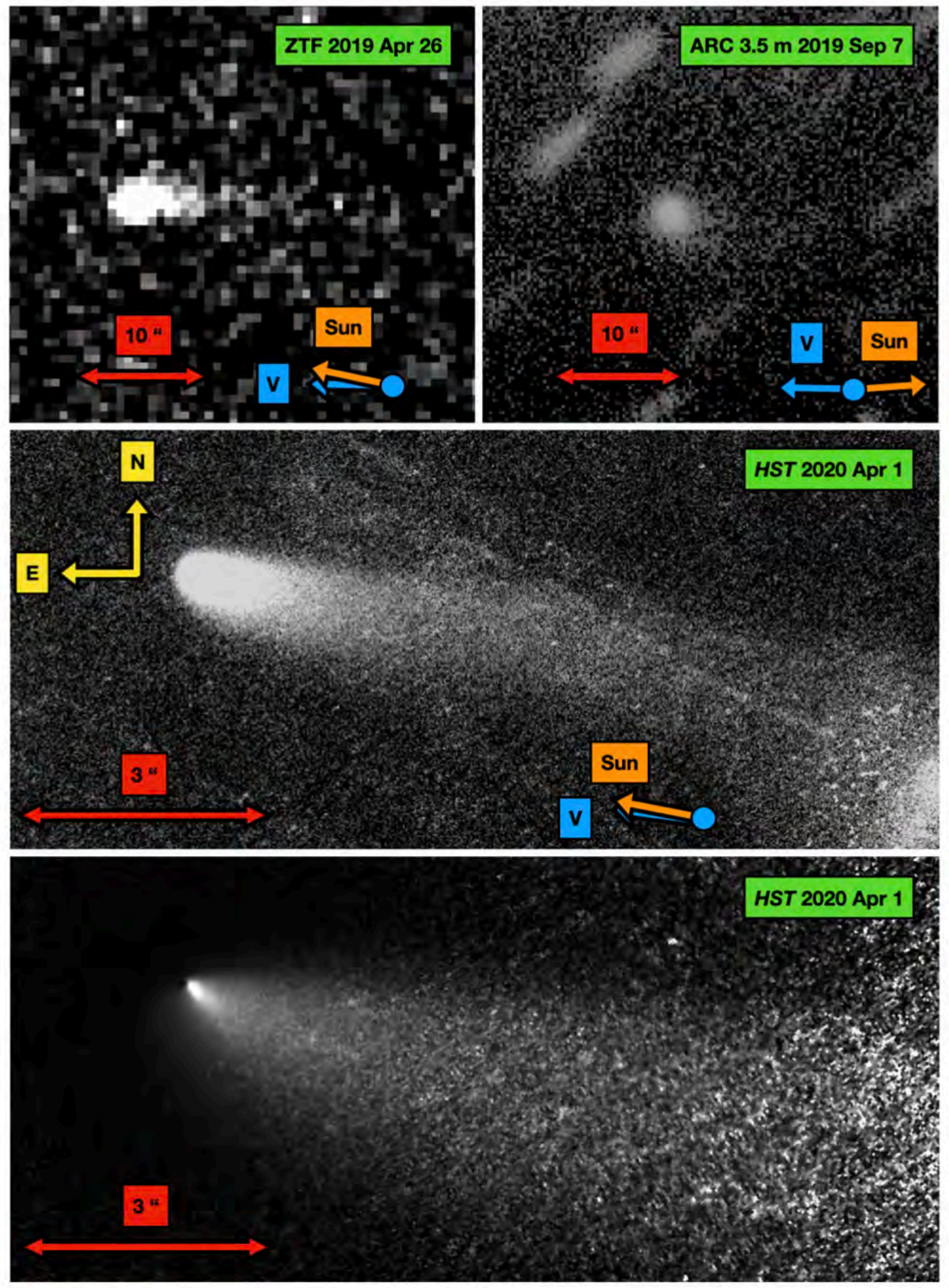
2020 AV2

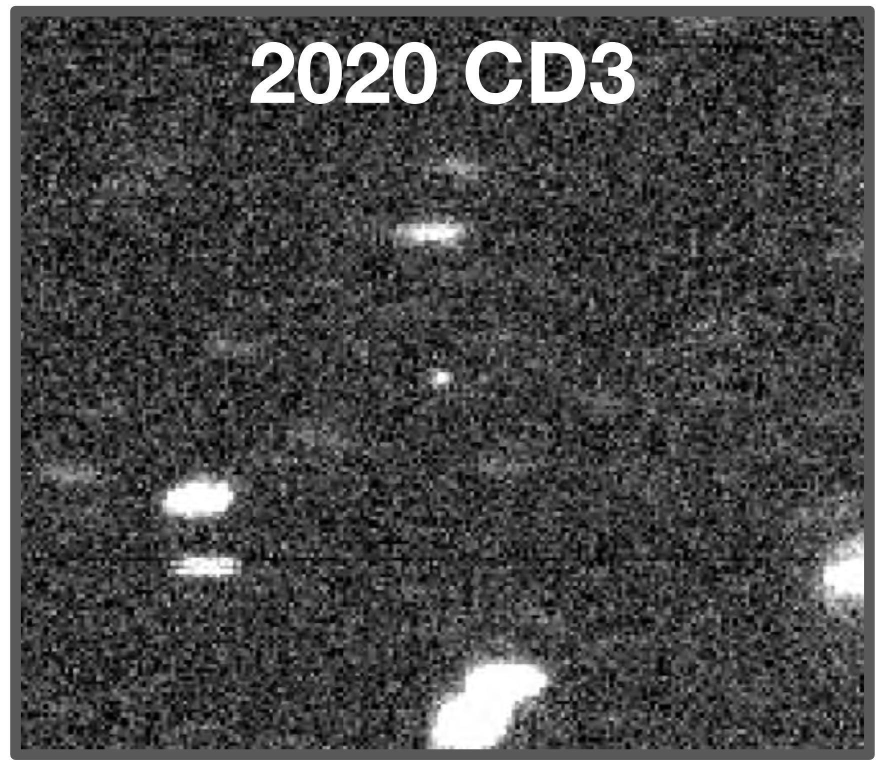




- Zwicky Transient Facility: Large étendue optical, discovered >180 NEOs, ~4 comets since Feb 2018
- Capability of finding inner-Venus and inner-Earth objects (2020 AV2, Bolin et al. 2020, MPEC 2020-A99; Ip, Bolin et al., 2021, Science, in revision)
- Unique capability to discover fast-moving, close-approaching objects (2020 QG, Bolin et al. 2020, MPEC 2020-Q51)
- Keck Spectrophotometry of minimoon 2020 CD3 (Bolin et al., ApJL, 2020, 900, 2, L45)
- Ground (ZTF, Keck, Gemini) and Space (HST, Spitzer) of interstellar comet 2I/Borisov (Bolin et al., 2020, AJ, 160, 1, 26; Bolin & Lisse, MNRAS, 497, 4, 4031-4041)
- Ground and space-based observations of transitioning active Centaur P/2019 LD2 (Bolin et al. 2021, AJ, in press)

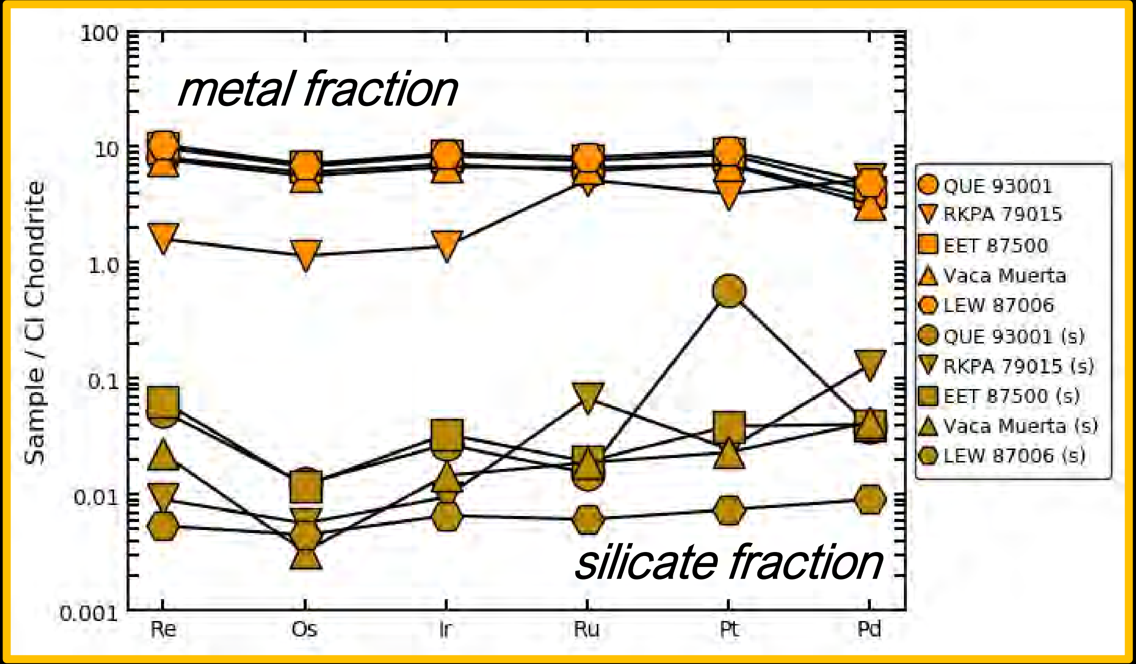
P/2019 LD2 (ATLAS)



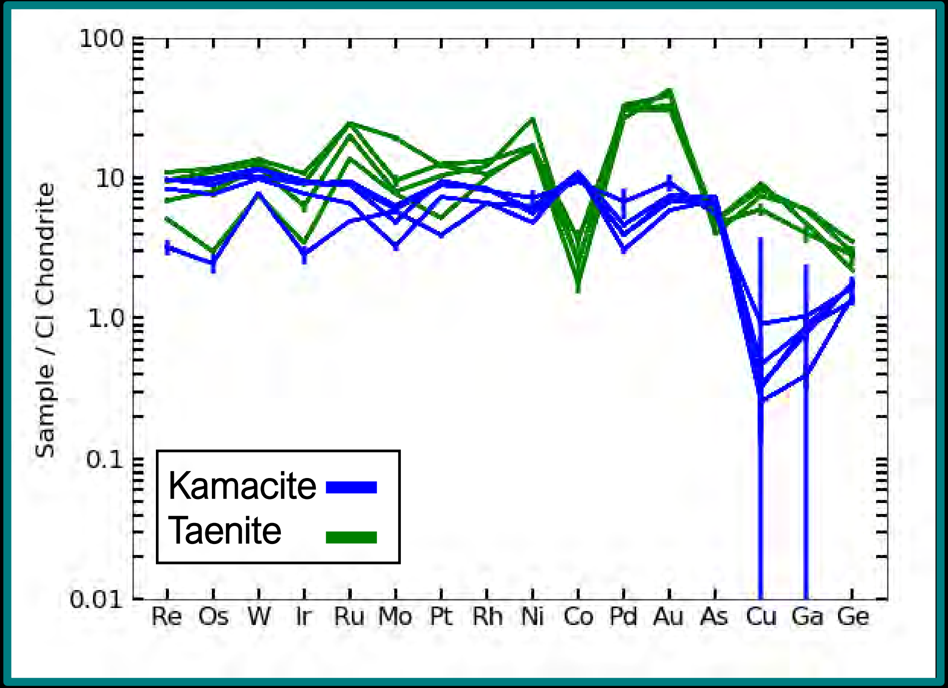


HIGHLY SIDEROPHILE ELEMENTS IN MESOSIDERITES

Jasmeet K. Dhaliwal, Postdoctoral Scholar, UC Santa Cruz



Bulk analyses of HSE abundances in metal aliquots are consistent with earlier work, and support the hypothesis that the metal was molten prior to and at the time of impact, and not the accretion of unique portions of a core that had previously experienced fractional crystallization.



Relative depletions and variability of Cu and Ga are observed for kamacite, while depletions of Co, Ga, and Ge and enrichments of Pd and Au are present in taenite. These trace element abundances are consistent with partitioning between kamacite and taenite.

References: Hazzanzadeh et al. (1990); Shen et al. (1998); Righter et al. (2008); Scott et al. (2001); Corrigan et al. (2009)

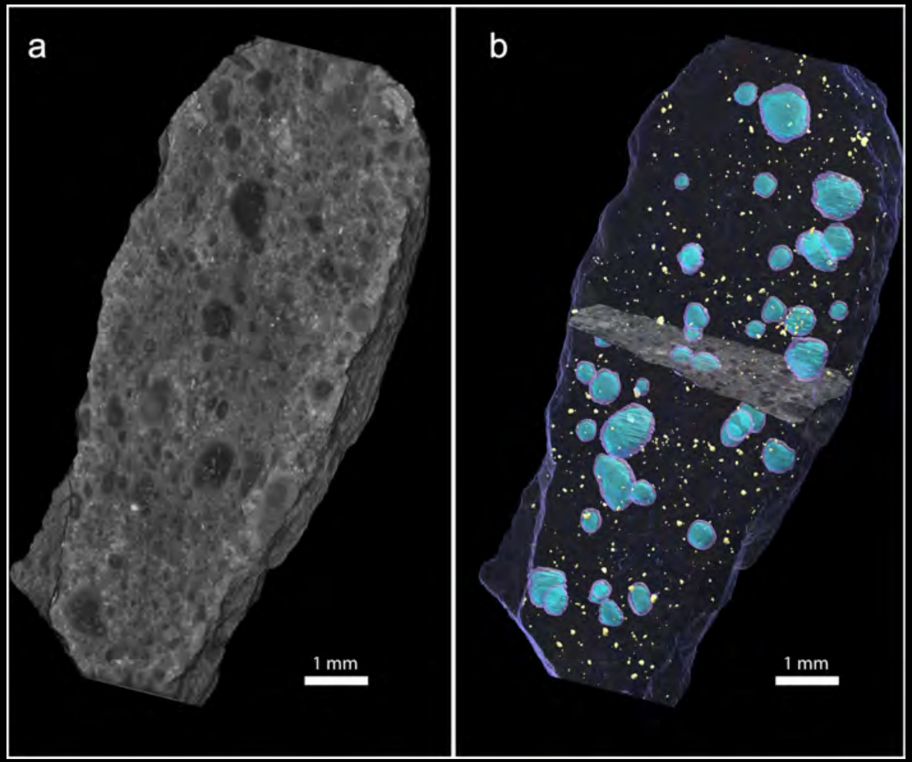
Collaborators: M.F. Horan, R.D. Ash, E.S. Bullock & R.W. Carlson & Acknowledgements: J.F. Kasting, MWG, Smithsonian, ANSMET

Dr. Romy Hanna

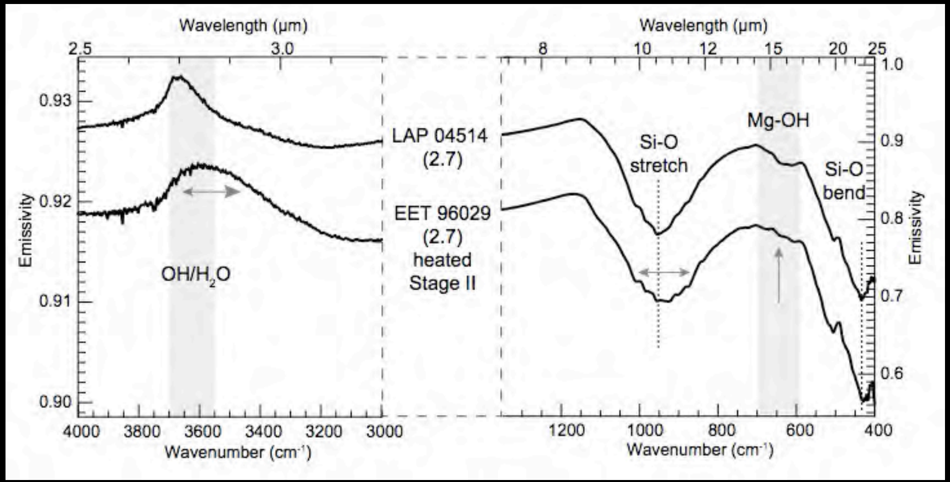
Research Associate (UT Austin)
PhD 2016 UT Austin (advisors R.A. Ketcham and M.E. Zolensky)
M.S. 2006 University of Hawaii (advisor V.E. Hamilton)

Carbonaceous chondrites – nebular/accretion processes and secondary processing (water/heat) on parent body using X-ray CT, electron beam (SEM/EPMA/EBSD), TIR spectroscopy, experimental heating

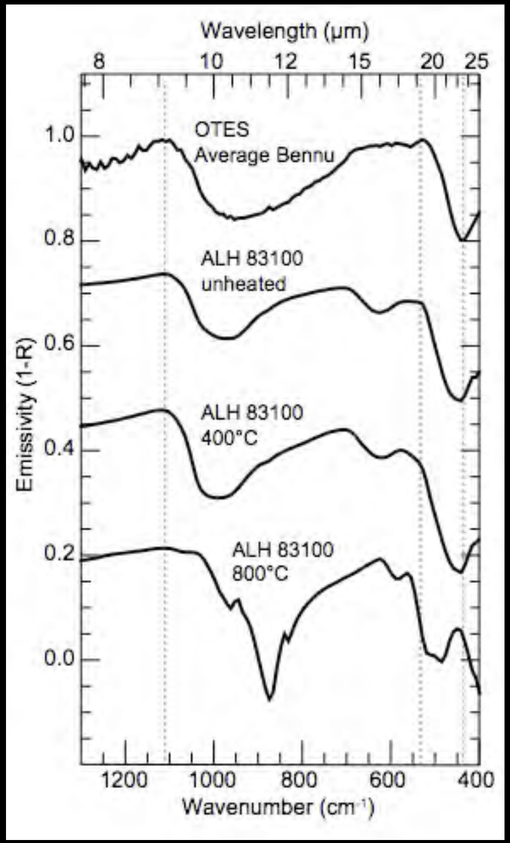
OSIRIS-REx (Participating Scientist)



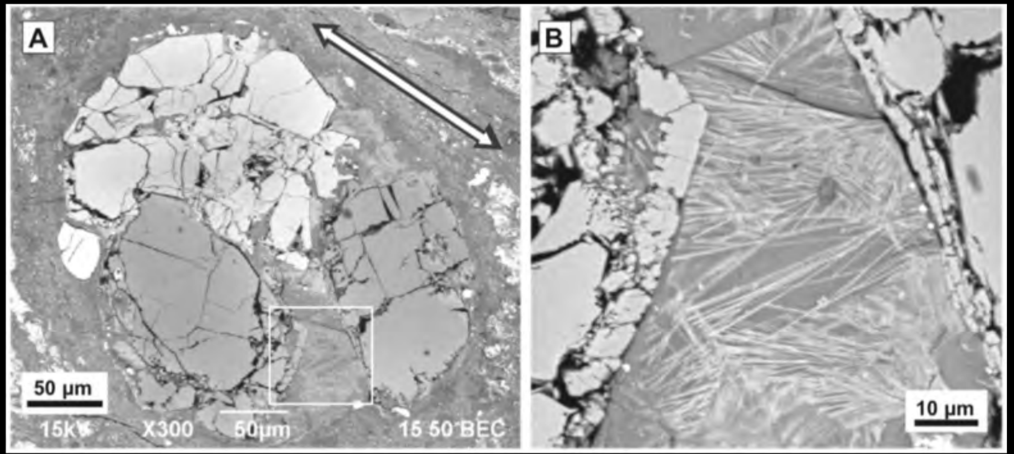
CM Murchison (a) X-ray CT data (b) segmented chondrules and fine-grained rims (Hanna and Ketcham 2017)



TIR spectral differences (grey arrows) between unheated CM LAP 04514 and naturally heated CM EET 96029 (Hanna et al. 2020)



Experimental heating of CM ALH 83100 and comparison to Bennu (Lindgren et al. 2020)

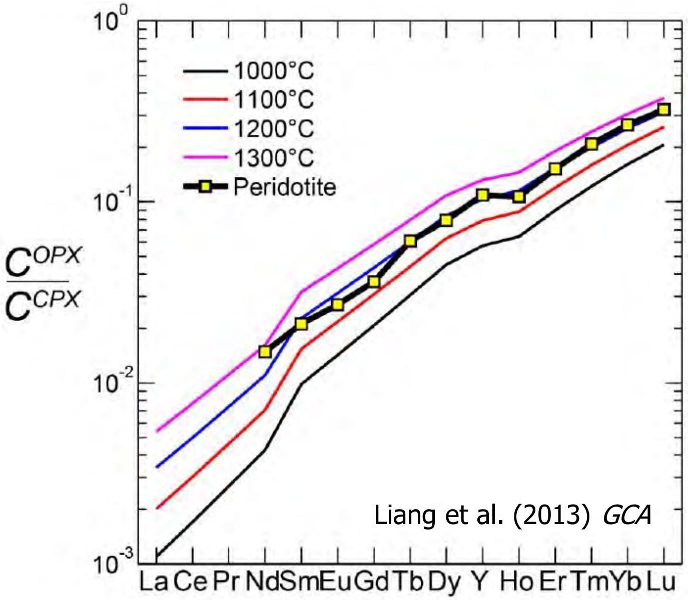


CM Murchison BSE images (a) impact-deformed chondrule with (b) post-deformation serpentine fibers (Hanna et al. 2015)

Using Trace Element Thermometry to Illuminate the Geologic Histories of Meteorite Parent Bodies

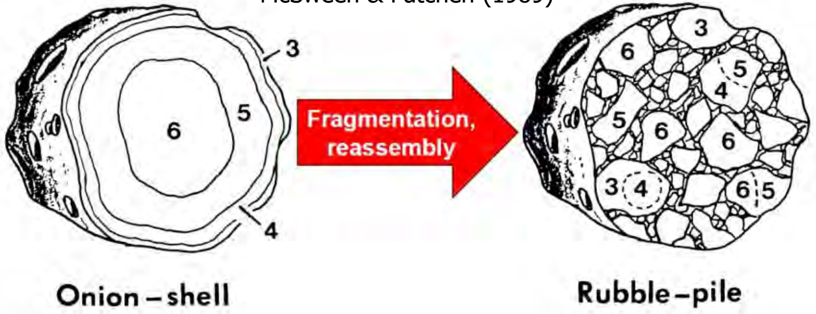
Michael P. Lucas, Department of Earth & Planetary Sciences, University of Tennessee, mlucas9@vols.utk.edu

Trace Element Thermometry

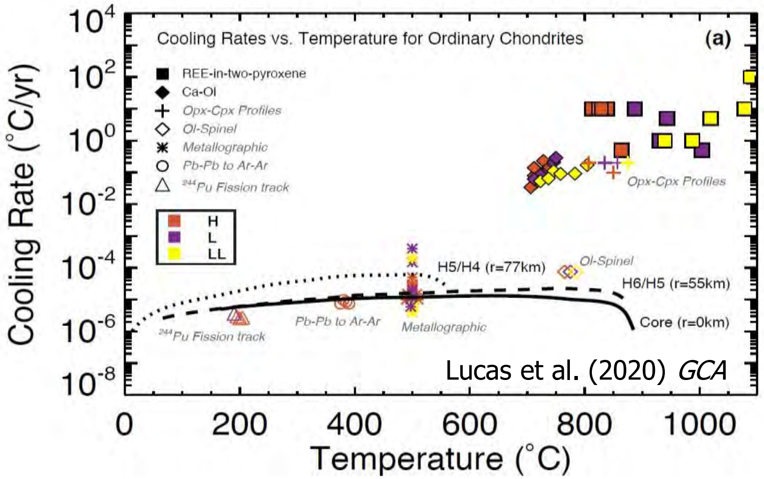


Asteroid Geologic Histories

McSween & Patchen (1989)



Ordinary Chondrite Parent Bodies



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Geochimica et Cosmochimica Acta 290 (2020) 366–390

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Evidence for early fragmentation-reassembly of ordinary chondrite (H, L, and LL) parent bodies from REE-in-two-pyroxene thermometry

Michael P. Lucas[a,*], Nick Dygert[a], Jialong Ren[b], Marc A. Hesse[b,c], Nathaniel R. Miller[b], Harry Y. McSween[a]

Acapulcoite-Lodranite Parent Body

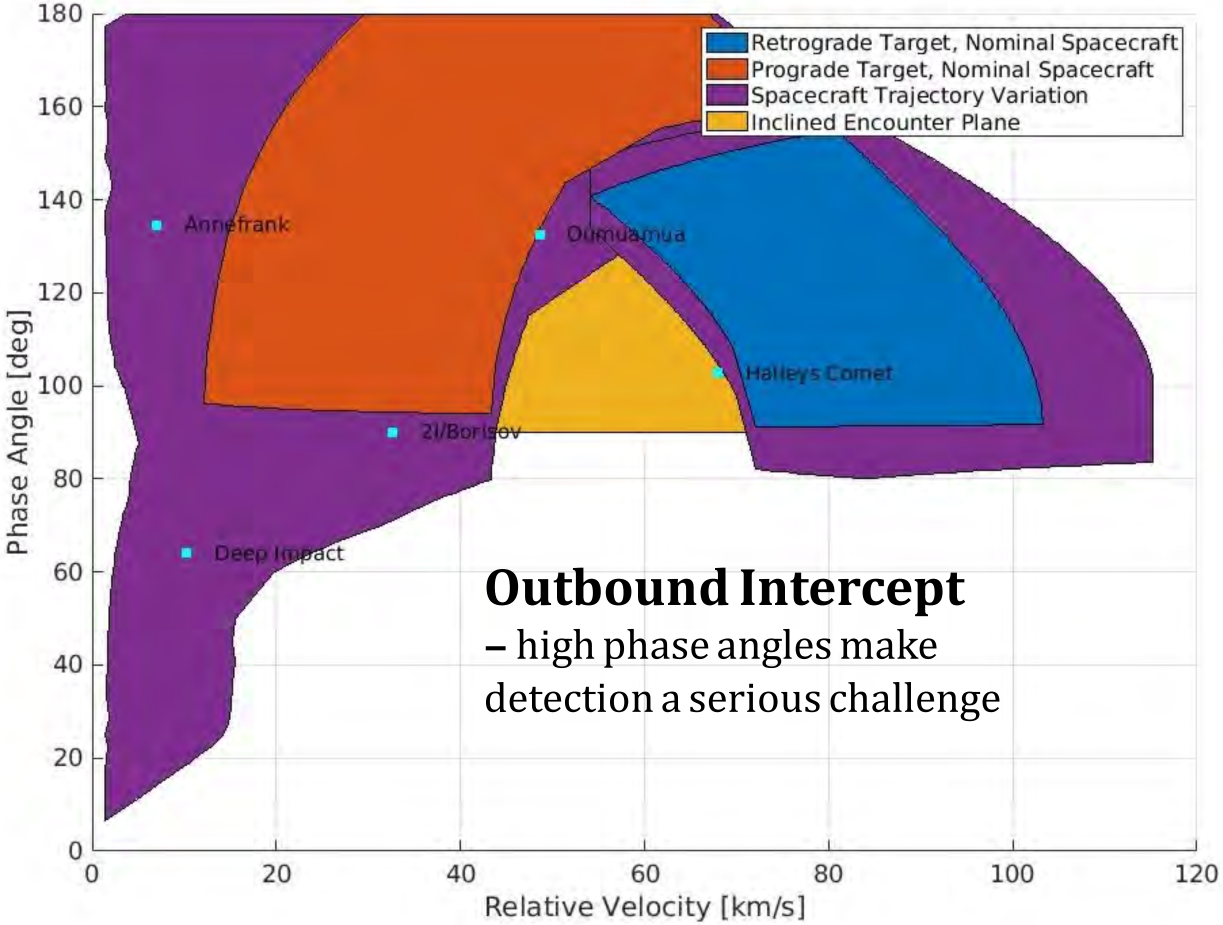
Phases: plagioclase (black), cpx (dark gray), ol and opx (lt. gray), Fe-Fes (white)

New Major and Trace Element Data from Acapulcoite-Lodranite Clan Meteorites: Evidence for Melt-Rock Reaction Events and Early Collisional Fragmentation of the Parent Body
Michael P. Lucas[1], Nick Dygert[1], Nathaniel R. Miller[2], and Harry Y. McSween[1], [1]Department of Earth & Planetary Sciences, University of Tennessee, Knoxville, mlucas9@vols.utk.edu, [2]Department of Geological Sciences, University of Texas at Austin. **(2021)** *LPSC LII*, Abstract #1307

Acknowledgements: NASA #80NSSC19K0030D (SSW)

Navigating ISO/LPC Flyby/Impact Encounters

-Declan Mages, JPL Outer Planet Navigation Group



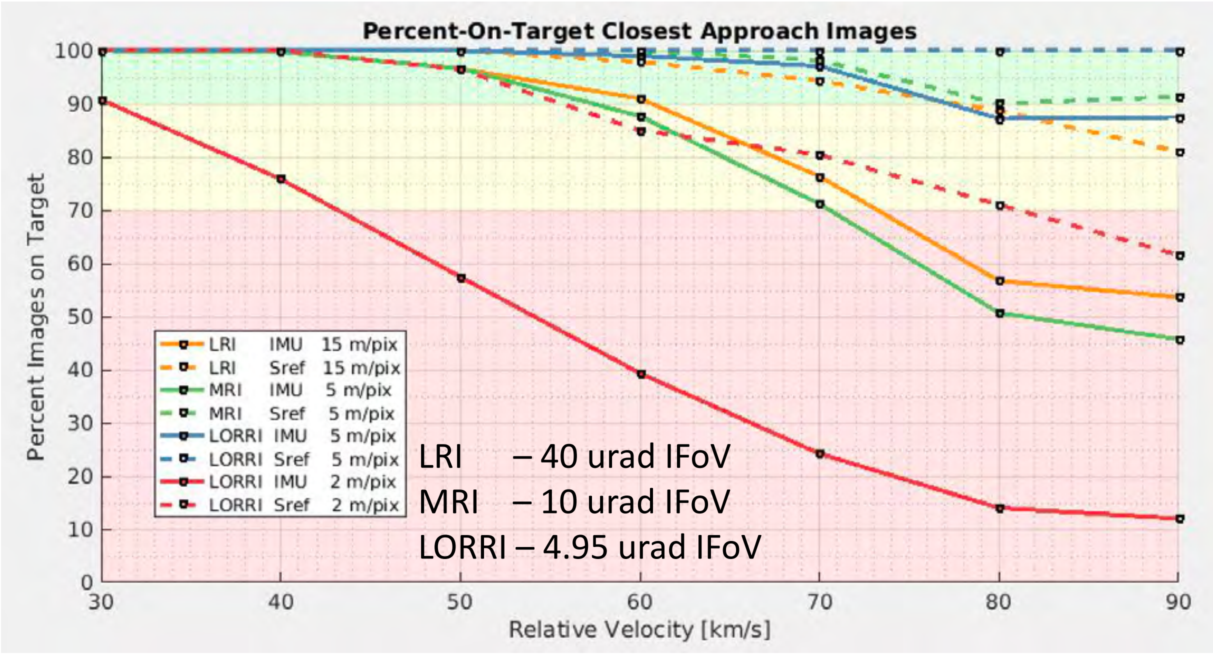
Outbound Intercept

– high phase angles make detection a serious challenge

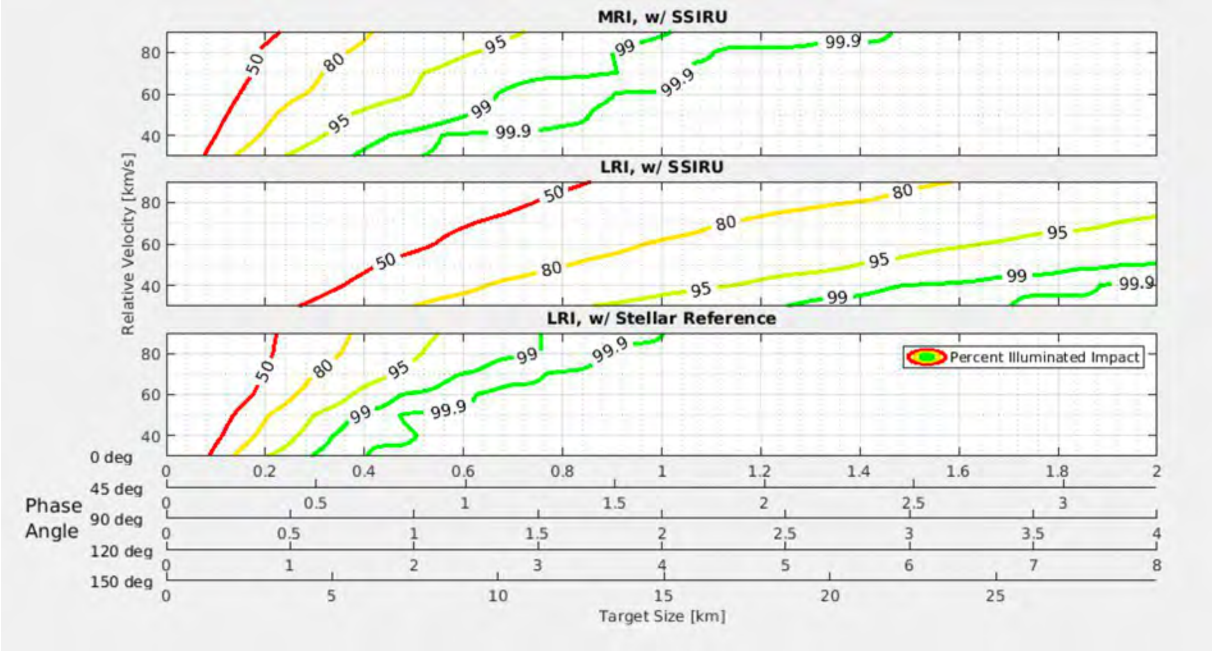
- Even with autonomy, navigating encounters for high resolution imaging / impacting is a challenge
- Attitude knowledge is driving source of error:

Use of IMU vs Stellar Reference (using stars in optical navigation images to determine attitude of observation)

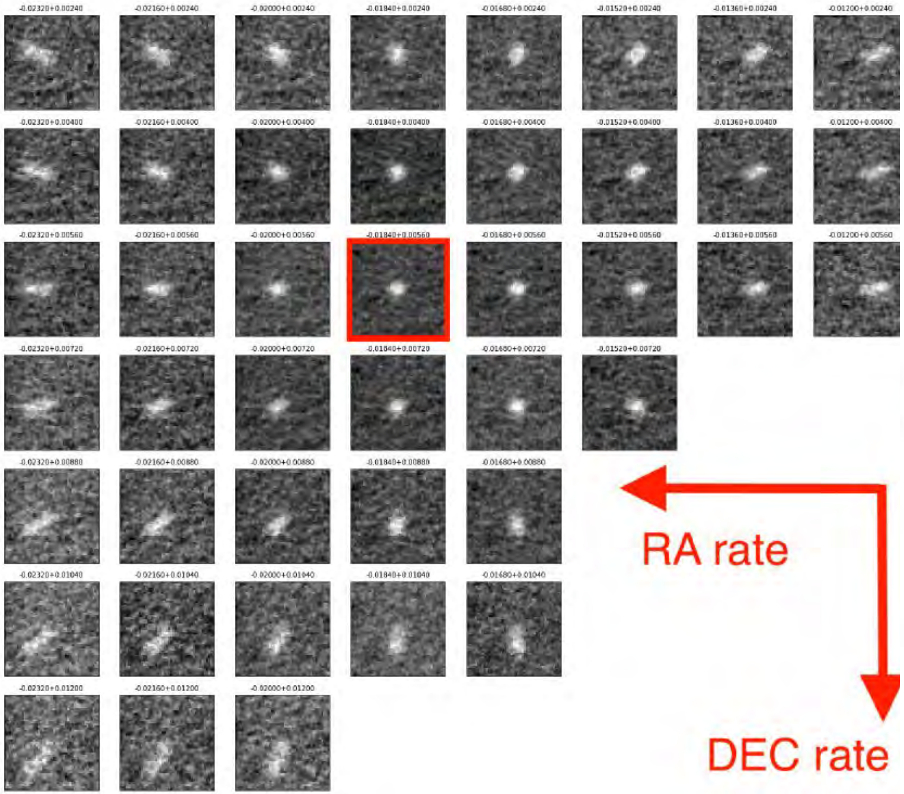
Flyby Tracking

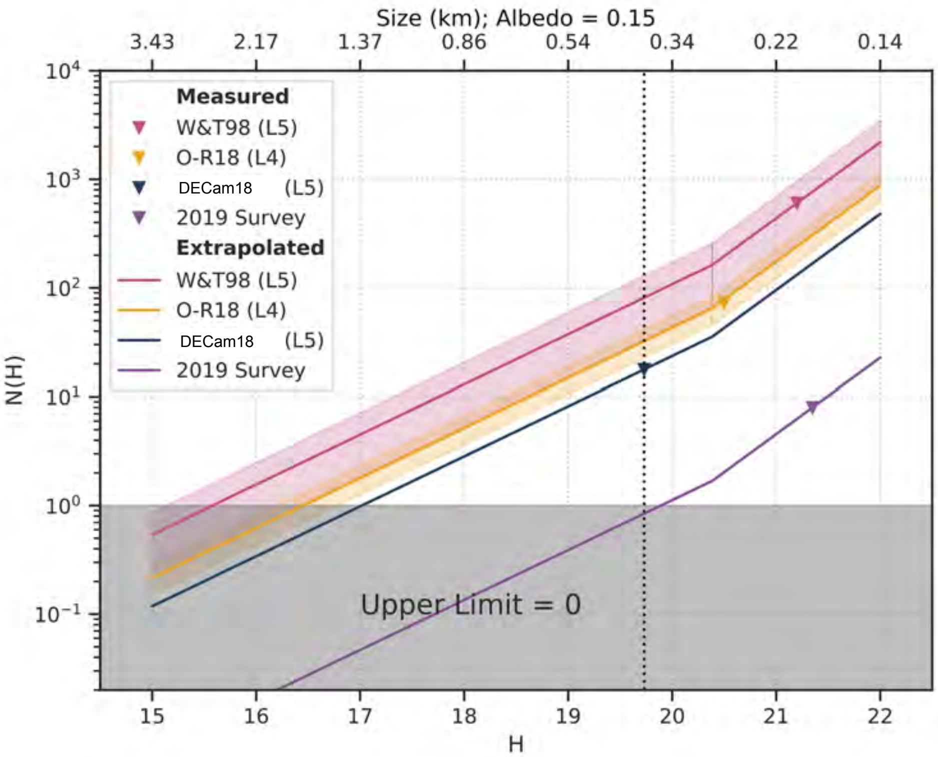


Impacting



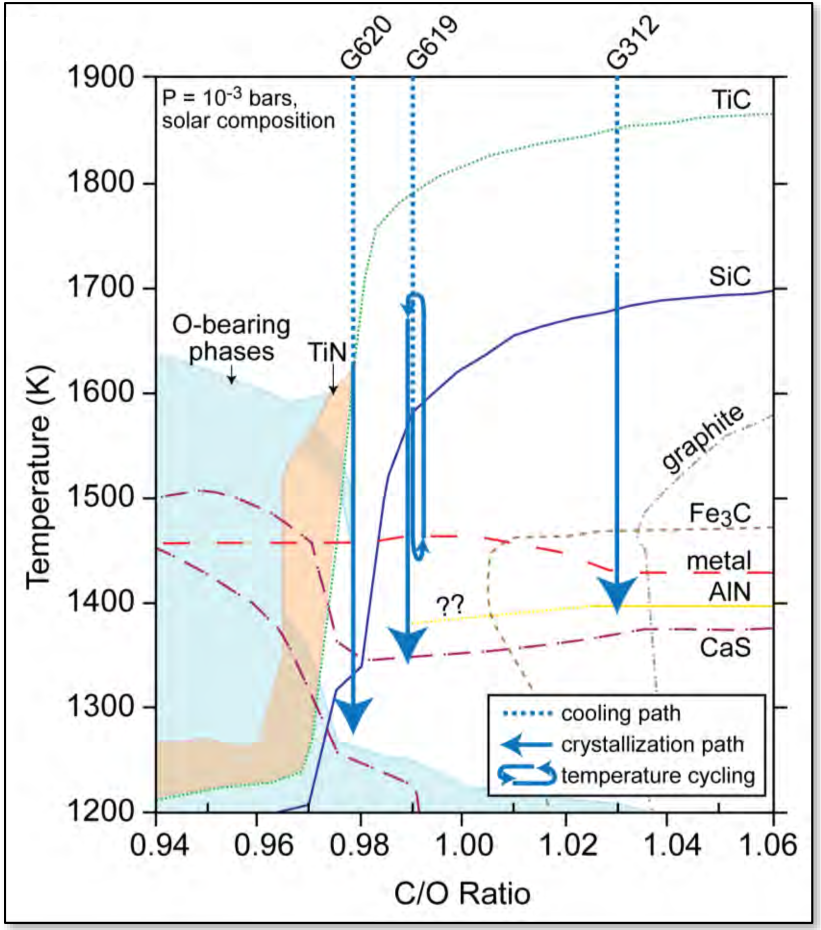
Larissa Markwardt (NSF Graduate Research Fellow): University of Michigan
Thesis: Characterizing Trojan Asteroid Populations Throughout the Solar System

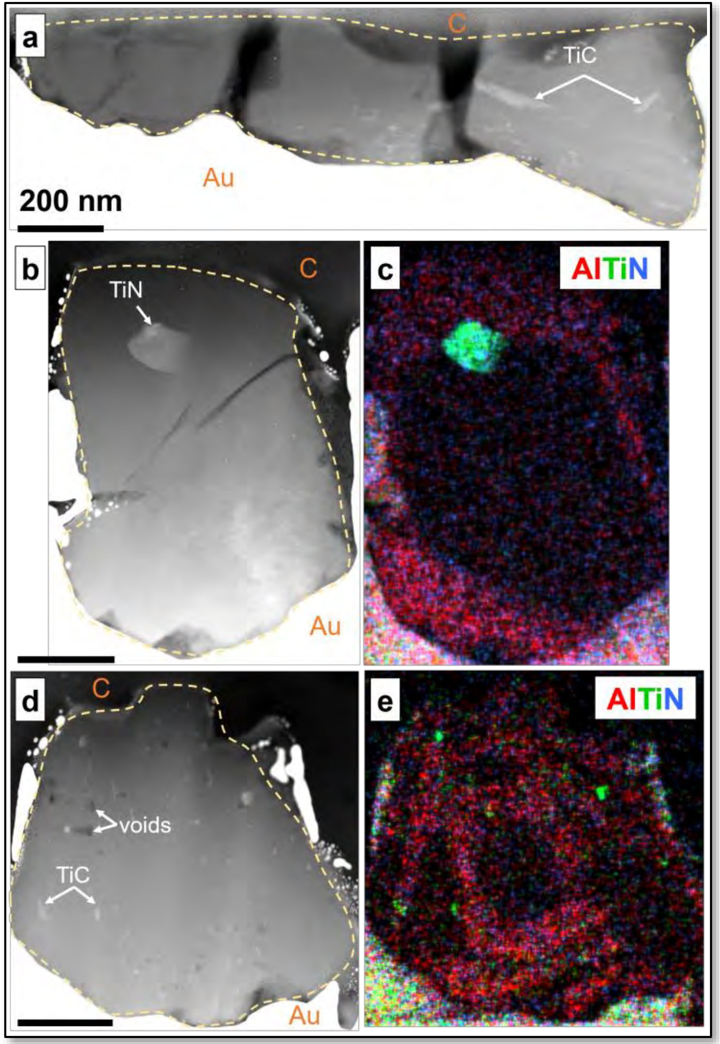




Sheri Singerling

NRC Postdoc, U.S. Naval Research Laboratory

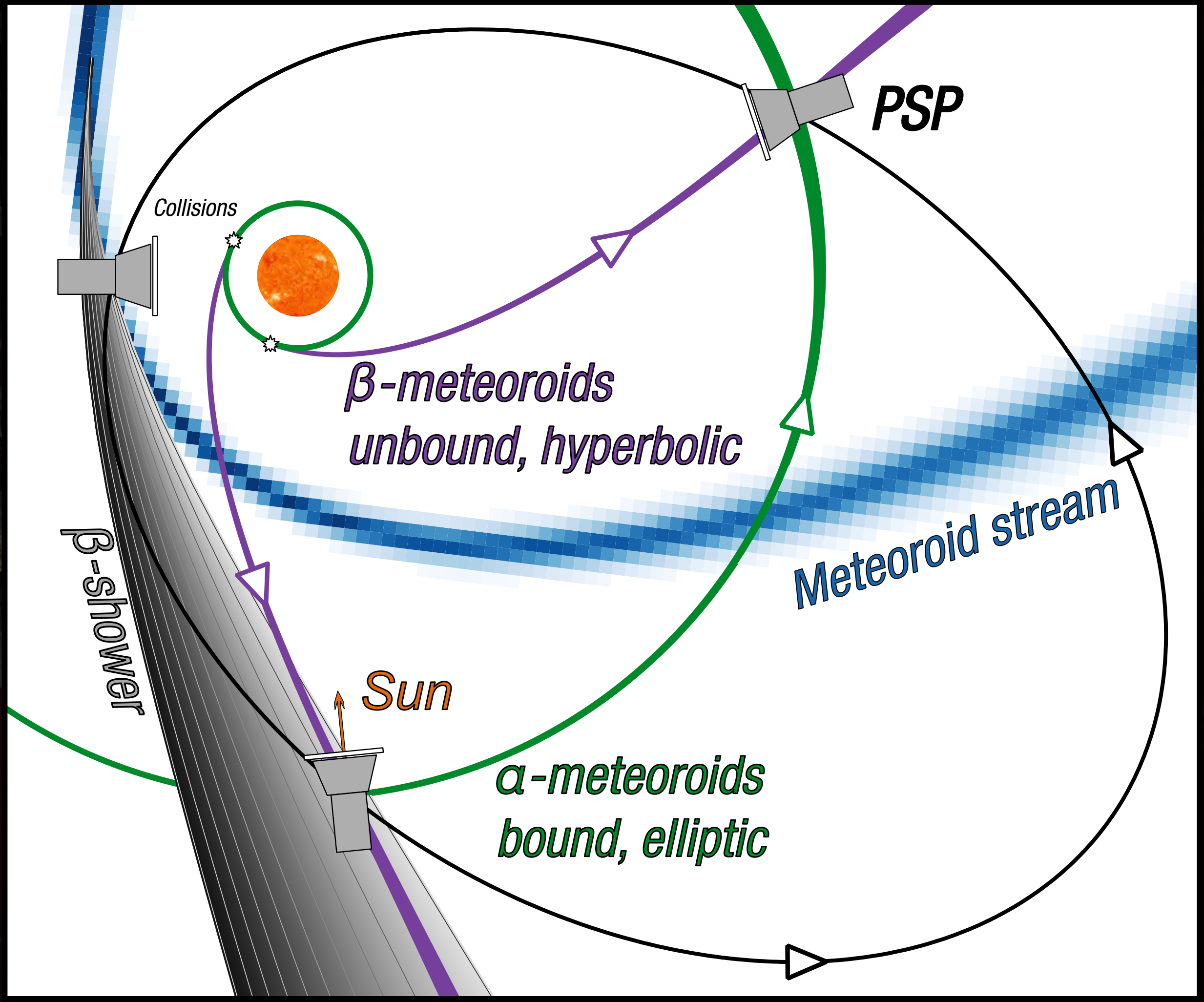




Collisional evolution of the inner zodiacal cloud

Jamey R. Szalay, Princeton University

- Parker Solar Probe visits the innermost region of our zodiacal dust cloud
- Encounters multiple dust populations
- Provides direct observations of the collisional evolution of the inner zodiacal cloud
- Improves our understanding of space weathering at airless bodies due to meteoroid bombardment
- Constrains processes applicable to exozodiacal disks
- Reinforces that a dust compositional analyzer in the inner solar system would provide critical insight into cross-cutting phenomena



PSP dust publications: Szalay et al. (2020); Page et al. (2020); Malaspina et al. (2020); Mozer et al. (2020); Mann and Czechowski (2020)

Crater Ejecta Emplacement on ~~Steroids Asteroids~~ Small Bodies: Parabolic Flight Experiments

Kirby Runyon, Johns Hopkins APL (Co-Is Dan Durda, Con Tsang, Olivier Barnouin, Carolyn Ernst)

- Ejecta emplacement is ubiquitous & a major agent of geomorphic change.
- Understanding granular dynamics and morphology will aid geologic interpretation of remote sensing and returned samples.
- We will use an ejecta catapult on parabolic flights to launch granular media onto granular beds, analyzing the dynamics and resulting morphology from slow-motion video.
- Results applicable to large small bodies, such as Psyche