

Asteroids, TNOs and SOFIA

Maggie McAdam

To SOFIA Instrument Roadmap Virtual Workshop

June 24, 2020

Positionality

- Main belt asteroid astronomer
- Non-expert in TNOs
 - Consulted my colleague Dr. Silvia Protopapa for insights
- Spectroscopists
 - Silvia is a leading expert in spectroscopy of ices and TNOs
 - My expertise is in infrared spectroscopy, particularly low to medium resolution spectroscopy of rocky materials
- Looking forward
 - Planetary Science Decadal Survey

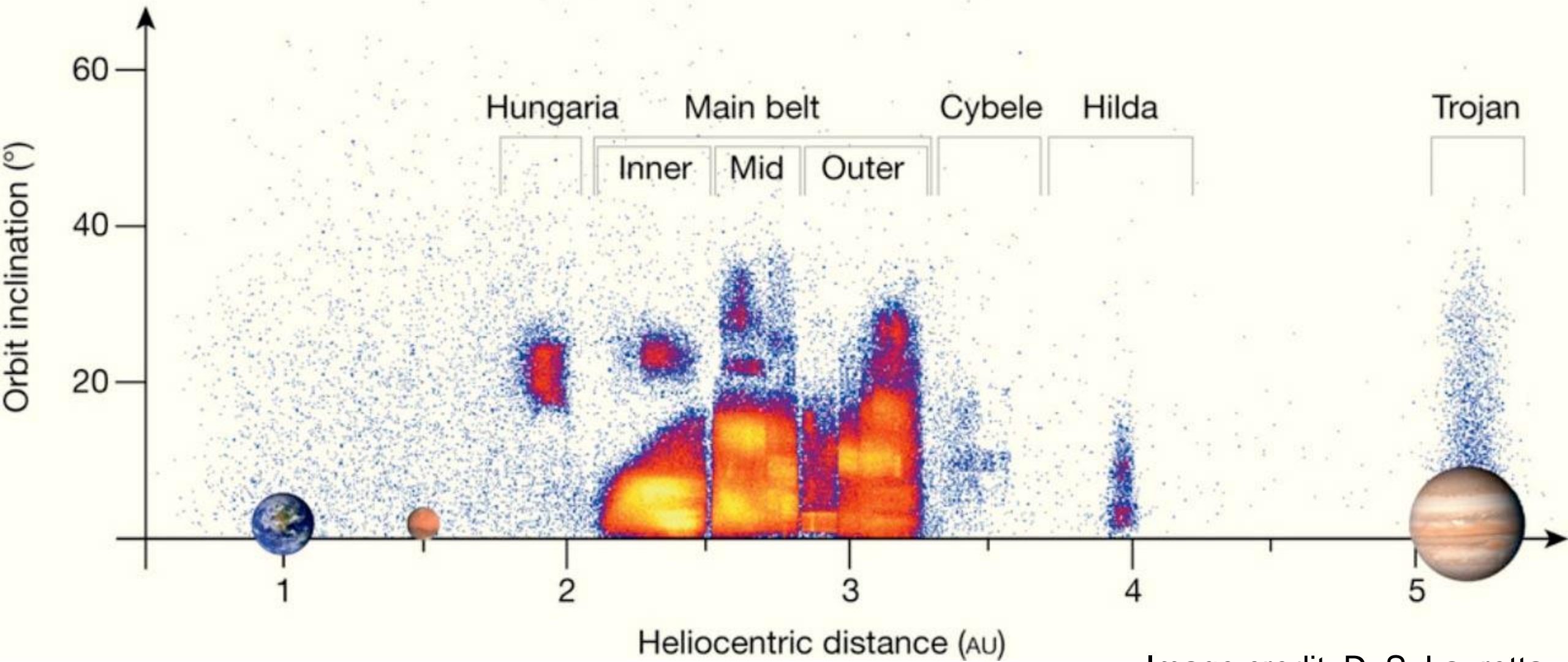
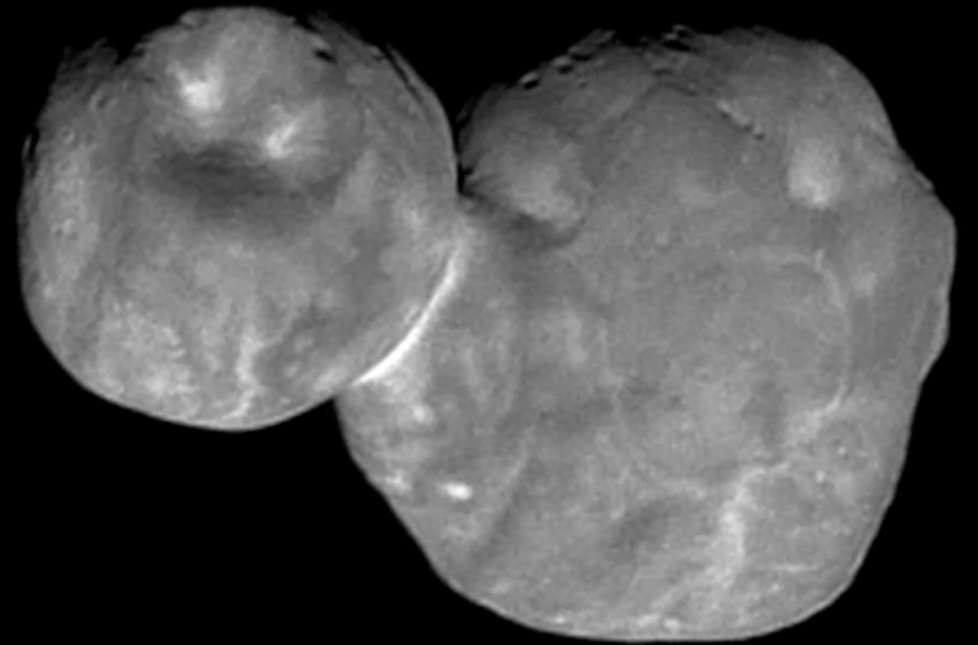


Image credit: D. S. Lauretta



Priorities the coming decade for Asteroids:

Physical
properties and
processes

Composition
and chemical
evolution

Dynamical
Evolution

Priorities the coming decade for Asteroids:

Physical
properties and
processes

- Laboratory studies
- ***Observations, esp. spectroscopy***
- Modeling

Composition
and chemical
evolution

- Missions
- ***Observations, esp. spectroscopy***
- Meteorite studies

Dynamical
Evolution

- Modeling
- ***Surveys***

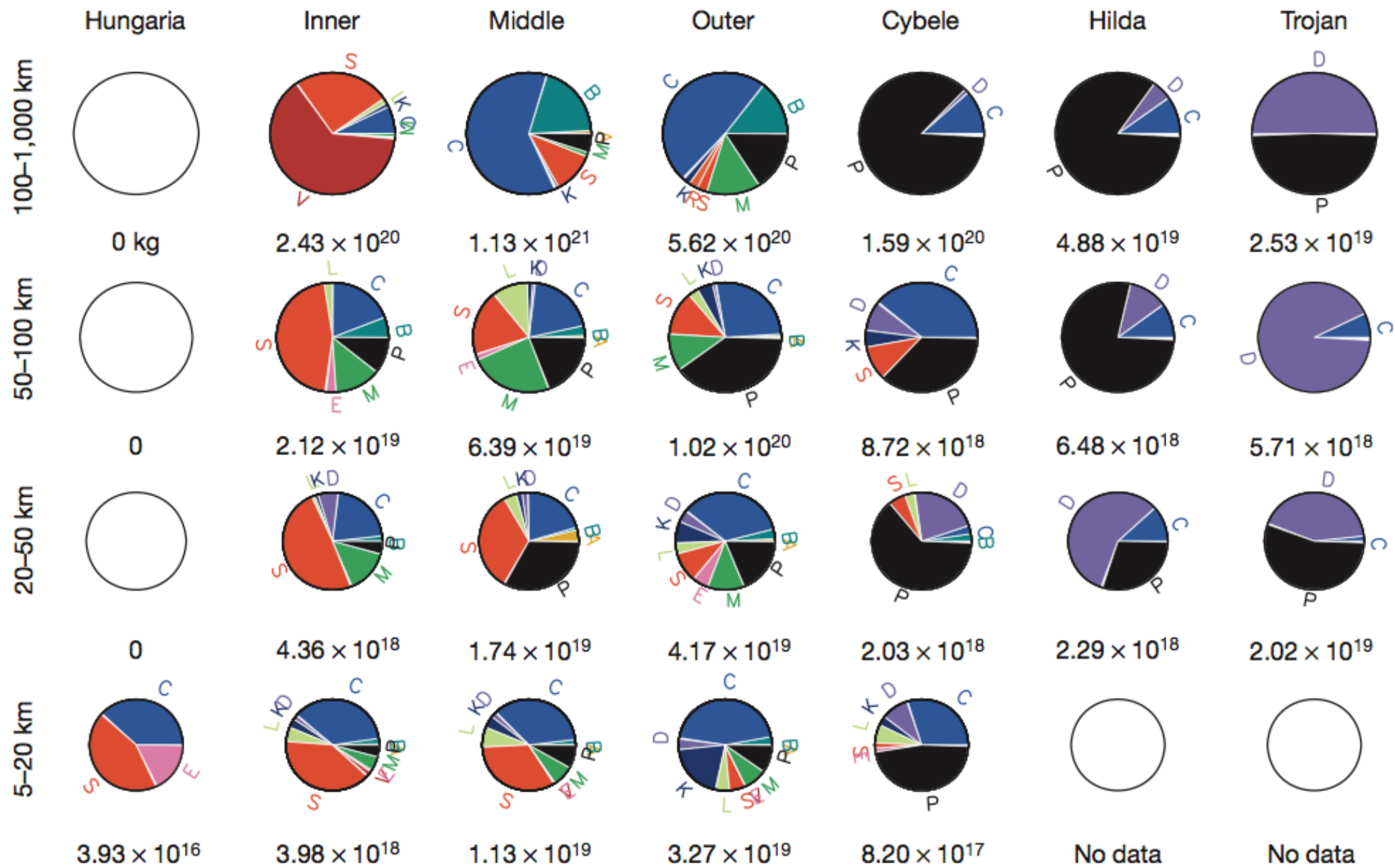


Image credit: F. DeMeo

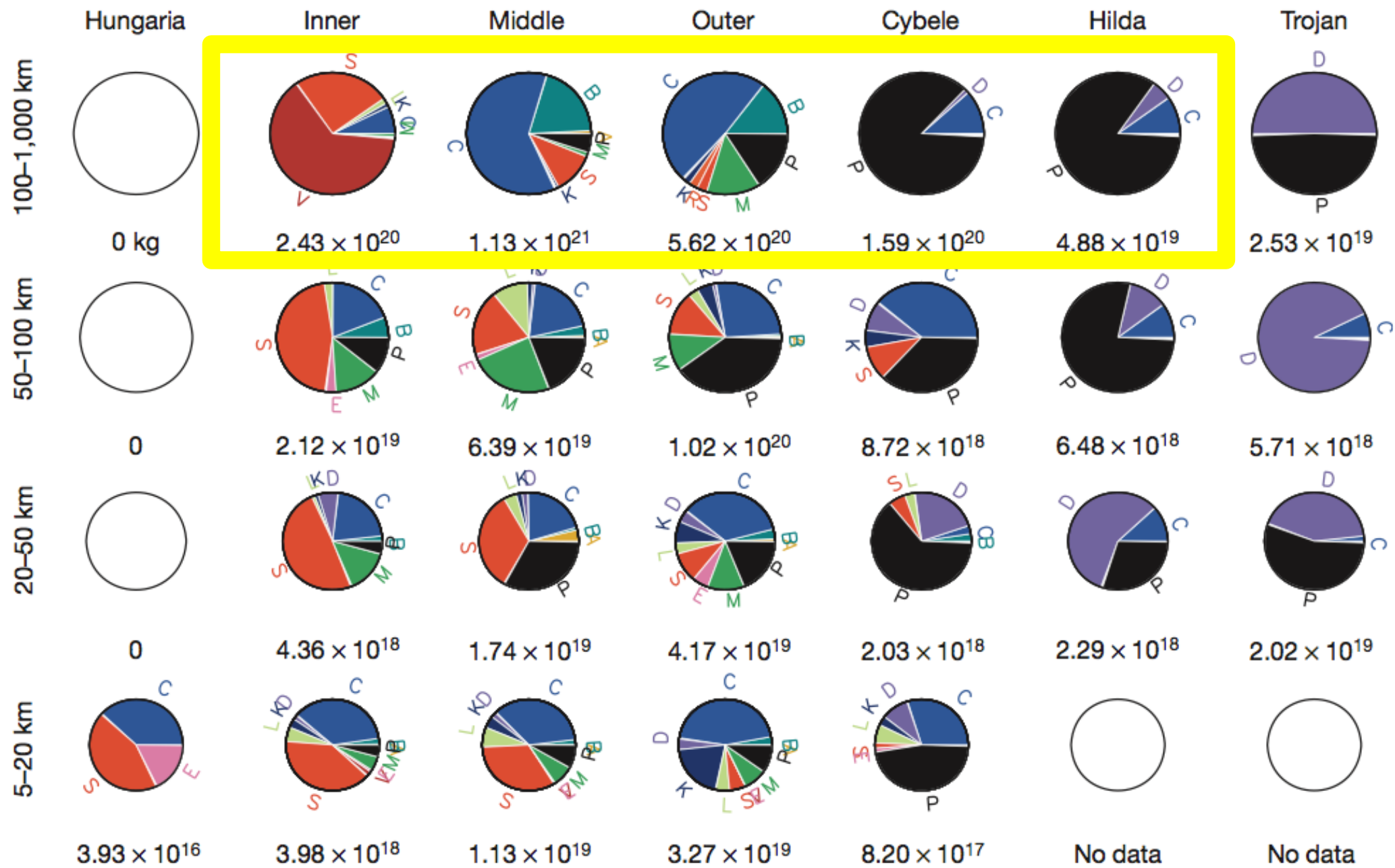


Image credit: F. DeMeo

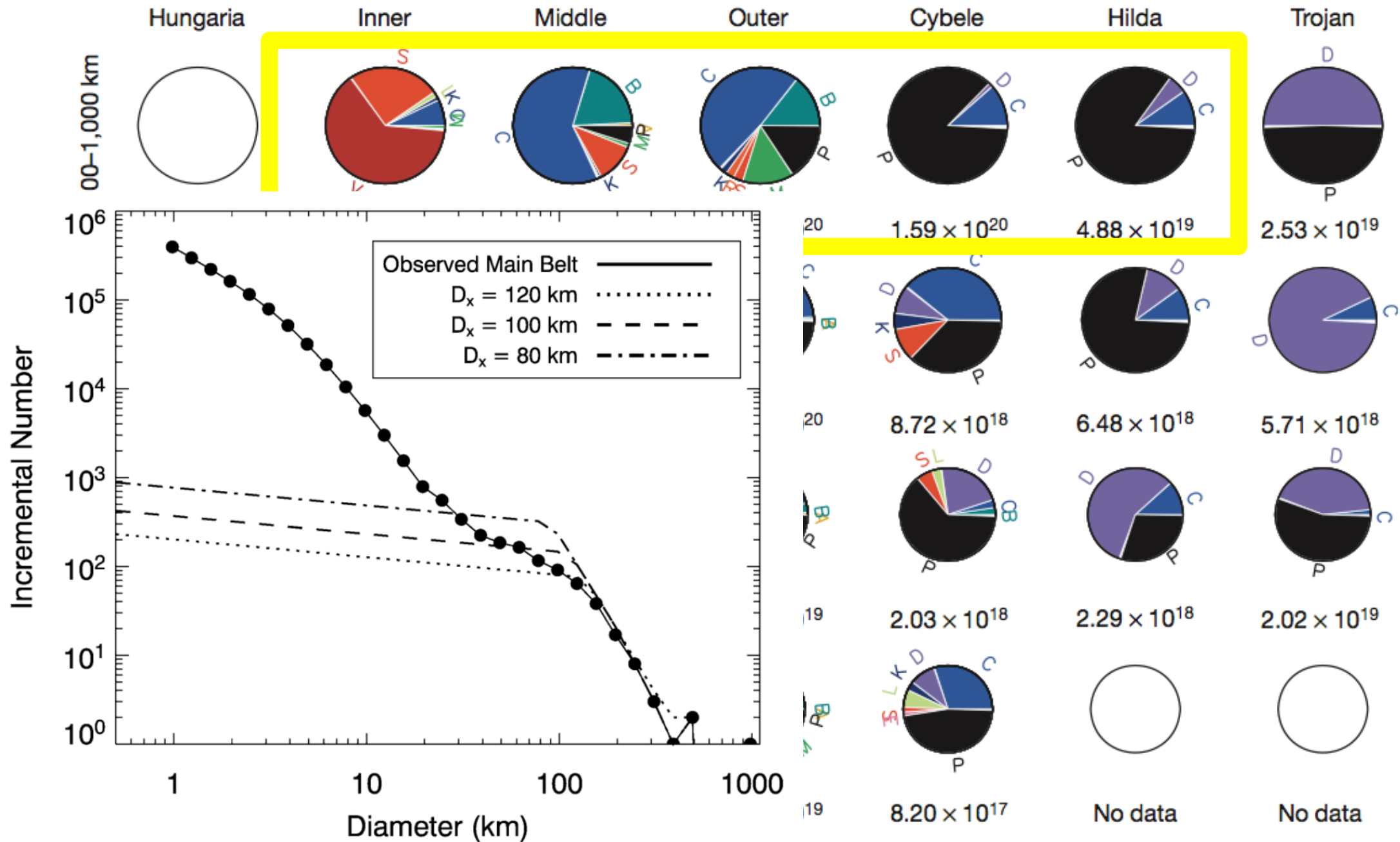


Image credit: F. DeMeo

Resources

LSST

JWST

Ongoing missions:

OSIRIS Rex and Hayabusa-2 (NEAs)

Upcoming missions:

Psyche (MBA) and Lucy (JTAs)

Strengths

JWST

- Sensitivity
- Wavelength coverage

Weaknesses

- Sensitivity
- Limited on NEAs
- Big overheads
- Oversubscription rates

LSST

- Discovery

- Limited capacity to characterize physical properties

Missions

- In depth understanding of one (or a few) asteroids

- Putting mission targets into wider picture

Strengths

SOFIA

Weaknesses

- Nimble – location unfixed
- Spectral coverage

- Sensitivity – limited for observations of small and/or faint targets (e.g., Trojans; KBOs, interstellar objects, potentially)

Support Missions and JWST by using SOFIA's complementary capabilities

SOFIA's role in Asteroid and TNO science:

Asteroids

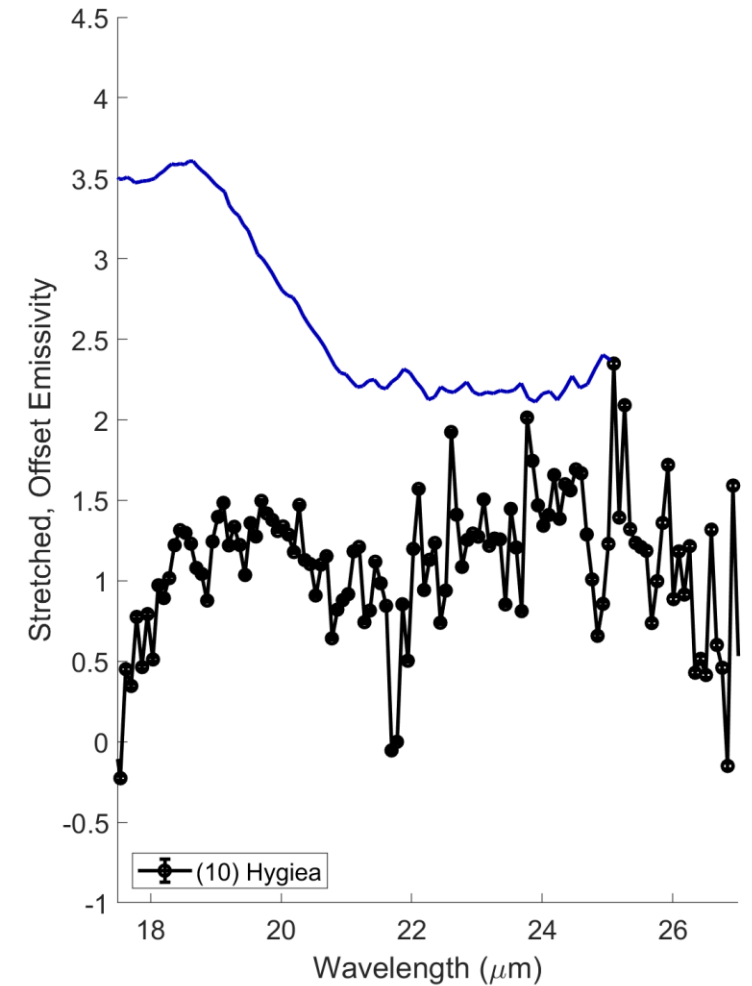
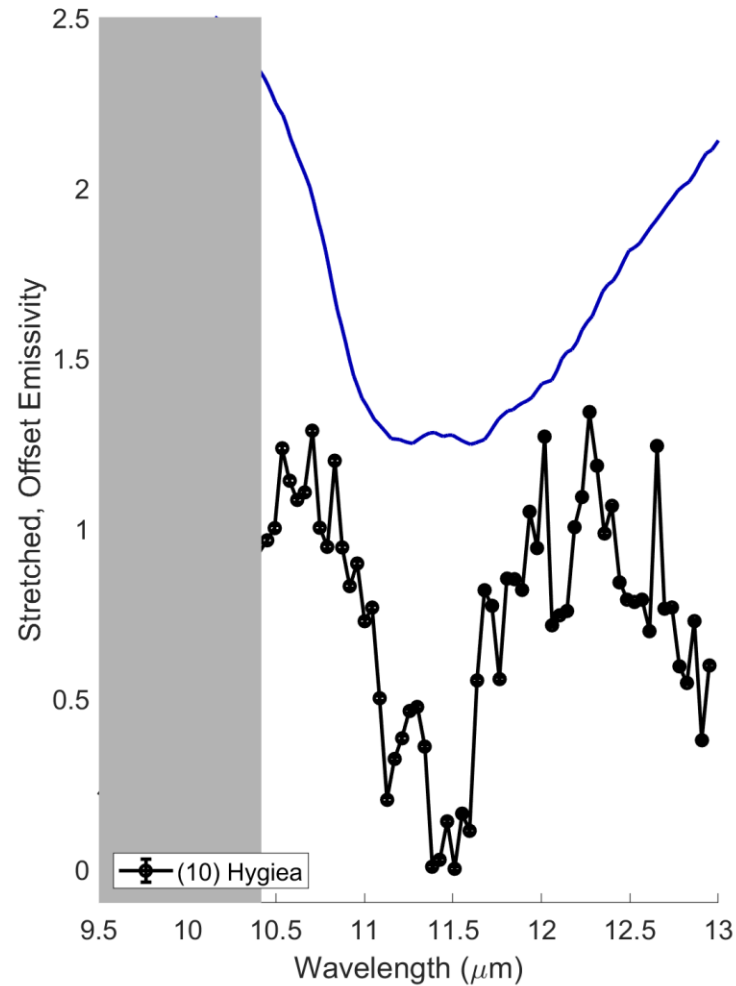
- Focus on studies of large ($D \geq 120$ km) asteroids
 - Fossils; cannot be studied with JWST; supports missions
- Physical properties of asteroid surfaces
 - Polarimetry, thermal properties, composition
- Focus on NEAs especially closer to perihelion
 - Complementary to JWST
- Support studies contextualizing mission targets
- Characterize LSST discoveries when possible

TNOs

- L-band capabilities to compositionally characterize ices on TNOs
 - Particularly important for large and mid-sized TNOs
- Observations of related populations
 - JFCs at aphelion to contextualize TNOs
- Occultations
 - Sizes and shapes of TNOs

Have current instruments advanced your field?

- Yes, occultations of TNOs
 - Observations of Pluto's atmosphere
- Composition of asteroids
- Studying water using 6-micron band



What role can SOFIA play to achieve cutting edge science?

- Continued support FORCAST; potentially upgrades
 - One of the only low resolution, N and Q band instrument
 - MIRSI on IRTF is still in shared risk; VISIR on the VLT
 - FORCAST is the only US supported instrument available
- FPI+ NIR camera – occultations
- L-band capability to advance TNO and asteroid science

What new capability would you like to see for SOFIA

- 3-micron region low to medium spectral coverage ($250 \leq R \leq 1000$)
- Greater sensitivity on FORCAST