Jet Propulsion Laboratory
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Cassini Science Update

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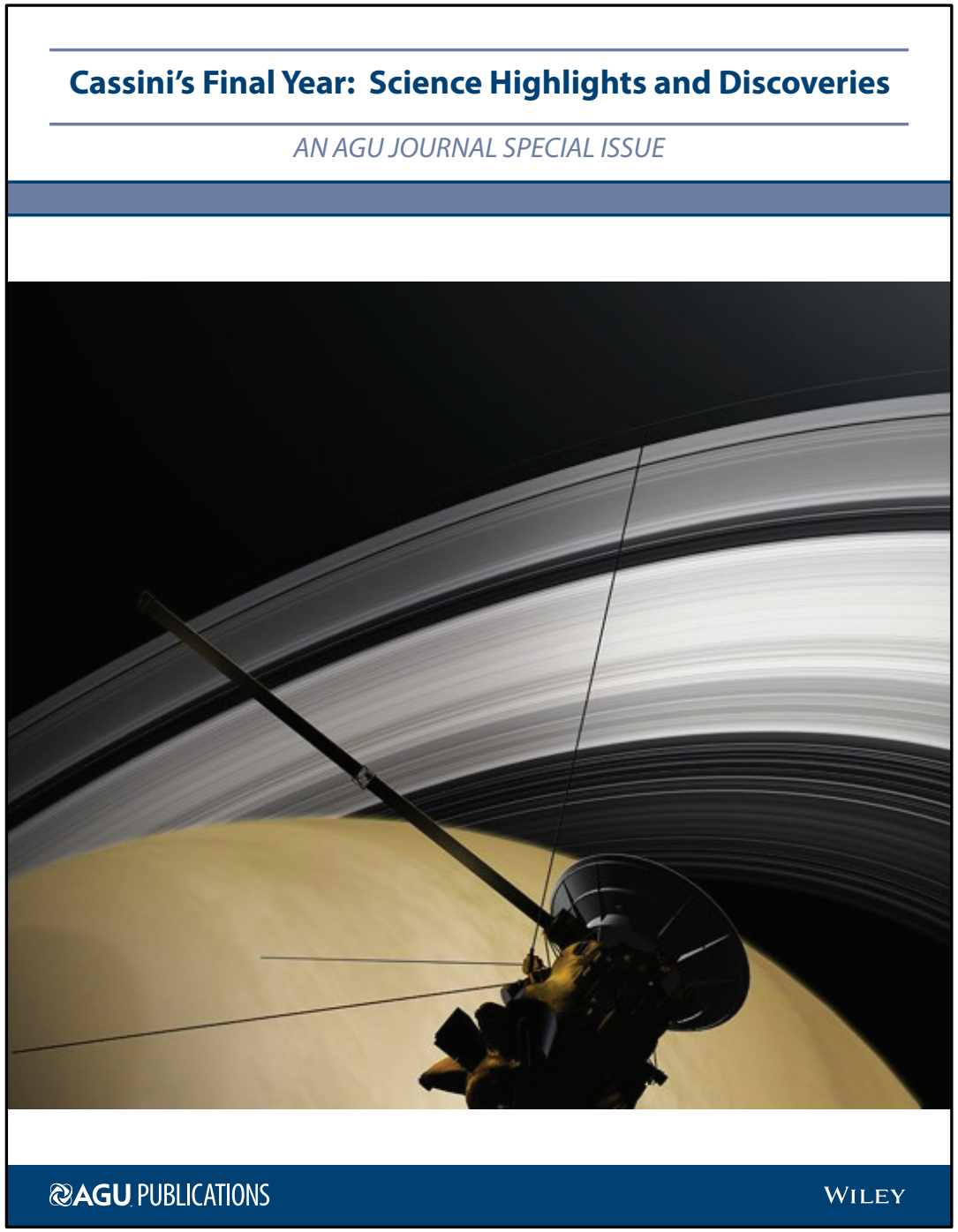
Outer Planets Assessment Group
21 August 2019

Cas Science

- Four Cassini p of Science magazine
- Buratti et al., 2 Pan, Daphnis, Atlas, Pandora, and Ep https://science. 2349
- Iess et al., 201 urn's gravity field and ring mass 364/6445/eaat2965
- Tiscareno et a aturn's rings during Cassini's ring-gr finale https://s 45/eaau1017
- Spilker, 2019, rn system: 13 years of discovery htt 64/6445/1046

Cassini GRL Special Issue: 40 papers

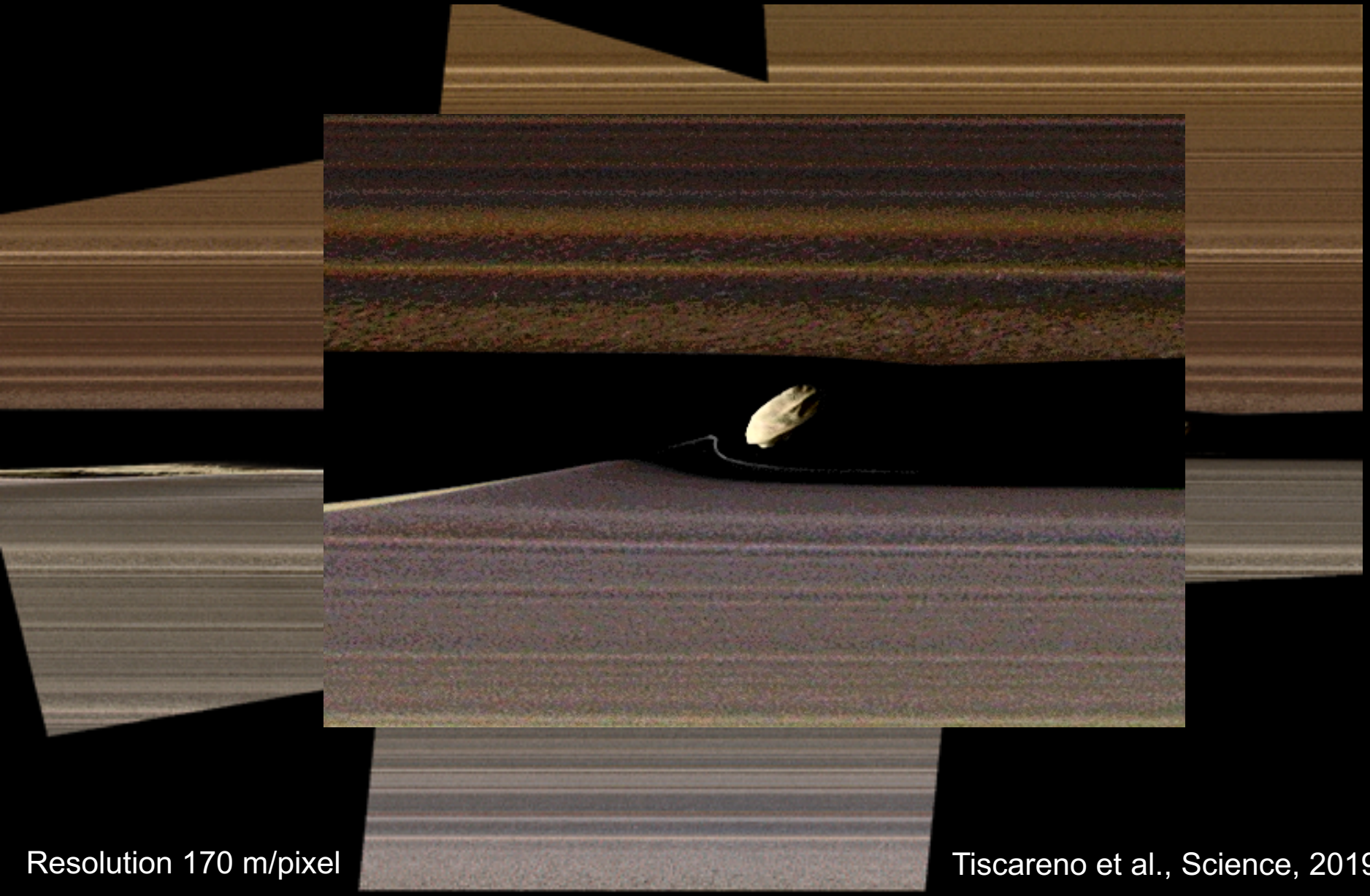
- 40 Cassini papers are on line and will appear soon in the print version of Geophysical Research Letters (GRL)
- Topics include: Saturn's interior, atmosphere, stratosphere, ionosphere, hexagon, aurora, auroral hiss, radio emissions, ring-gap phenomena (electric currents, radiation belts, gap particle composition and behavior, ring rain), rings, icy moons, Titan, and magnetosphere
- Cassini Icarus Special issue will be published in early 2020, 26 papers submitted



Cassini Legacy: Future Plans

- Continue to share new Cassini results at OPAG meetings and other venues
  - Valuable for community to continue to hear about new Cassini results
  - New results may motivate future mission discussions
- Cassini researchers requested to continue to submit accepted papers to Linda Spilker and Gretchen McCartney (Cassini media lead: gretchen.p.mccartney@jpl.nasa.gov) for consideration for press releases
  - JPL media infrastructure exists to continue to support Cassini press activity longer term even though Cassini funding ends in September
- Encourage younger scientists to help continue Cassini's legacy
  - Contact Linda if interested in more details

Embedded moon, Daphnis, sculpts rings



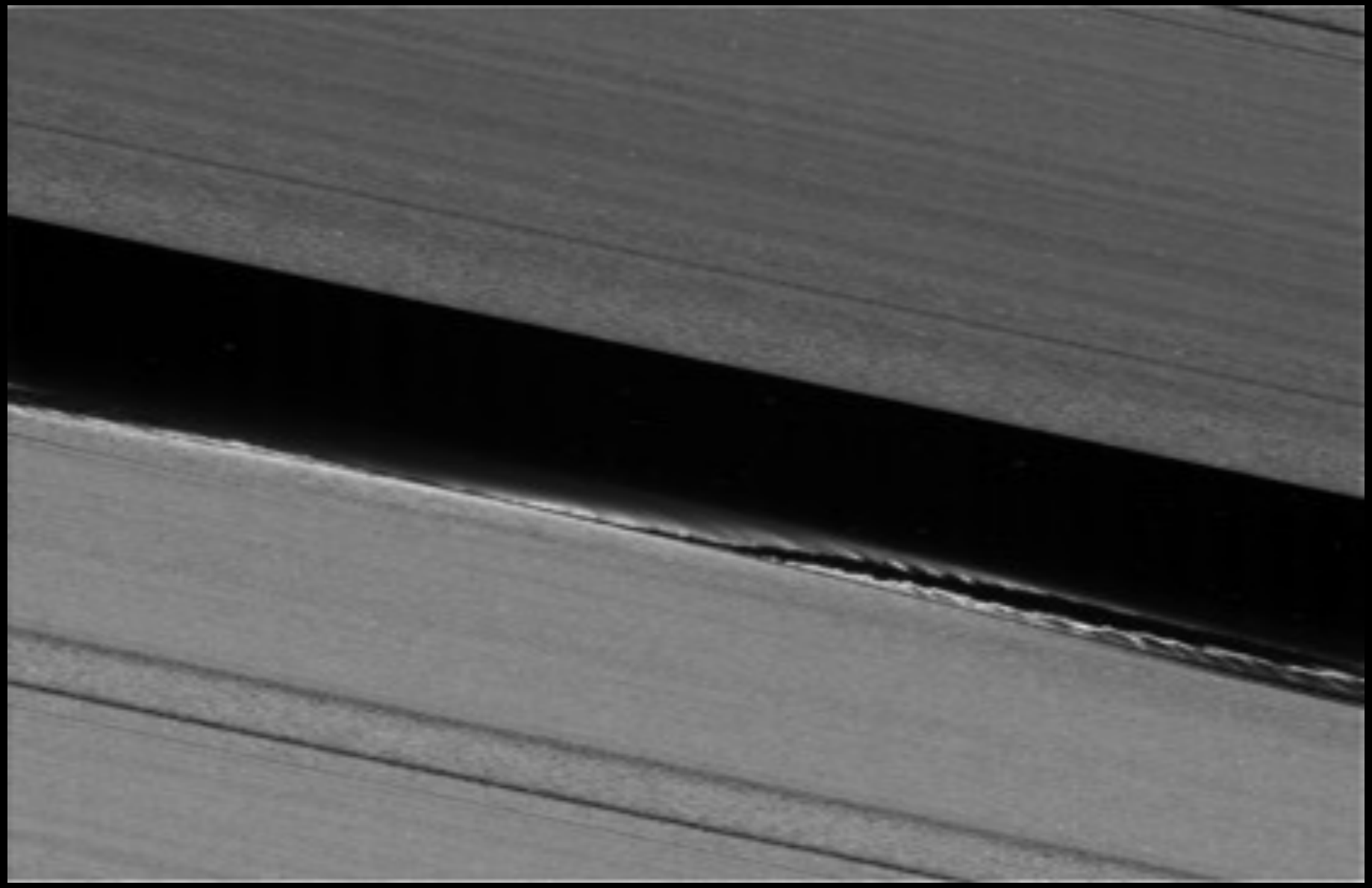
Resolution 170 m/pixel

Tiscareno et al., Science, 2019

- Tiny Daphnis creates edge waves
- Color differences seen on either side of Keeler gap in enhanced mosaic
- Color change probably has more to do with particle properties including size rather than composition changes

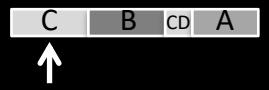
Multiple strands in 3rd wave crest

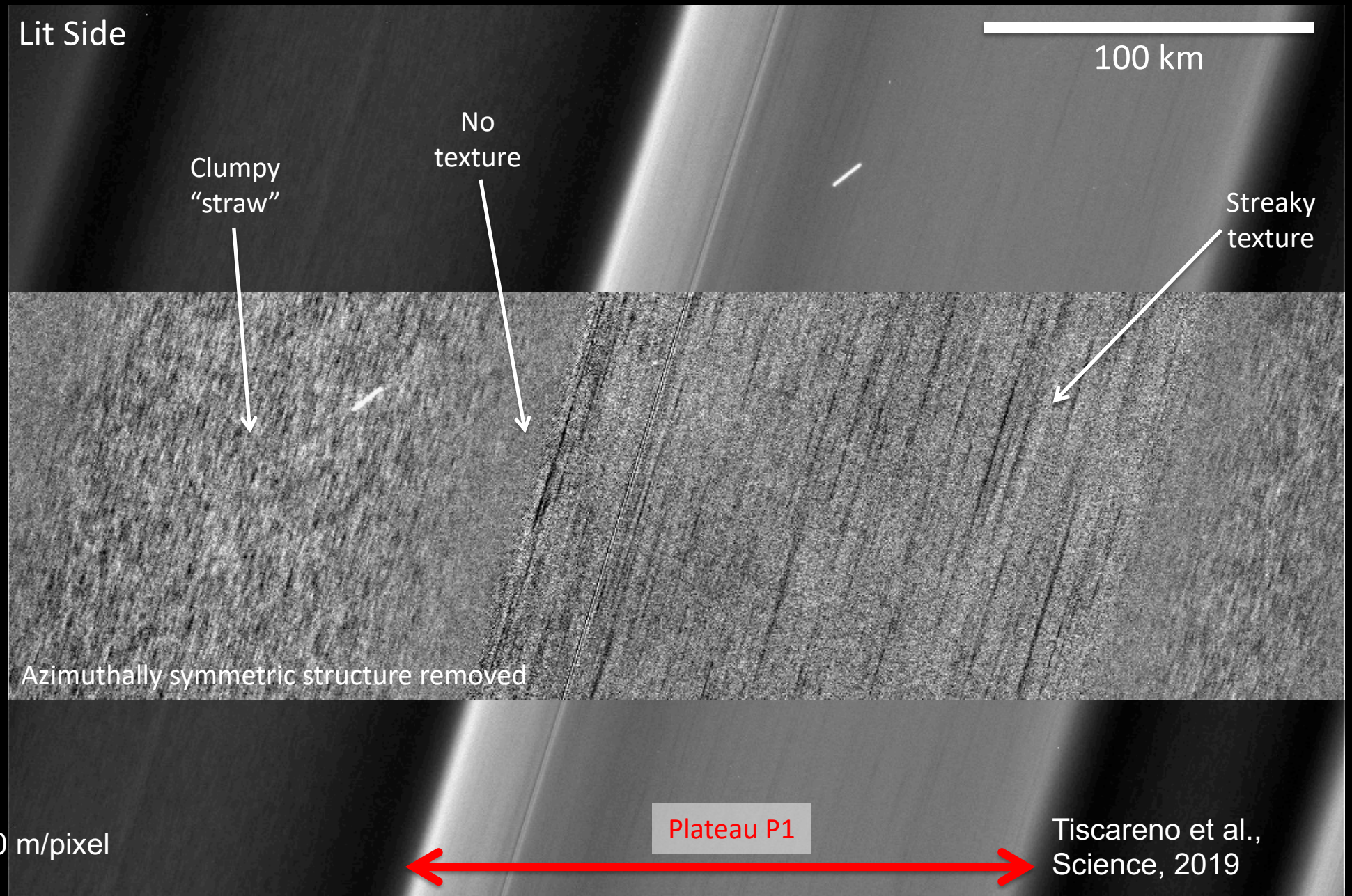
- Ribbon of material soars above and below ring plane
- Ribbon dives below rings on left-hand side and disappears
- Resolution: 230 m/pixel



Tiscareno et al., Science, 2019

Plateau in the C ring

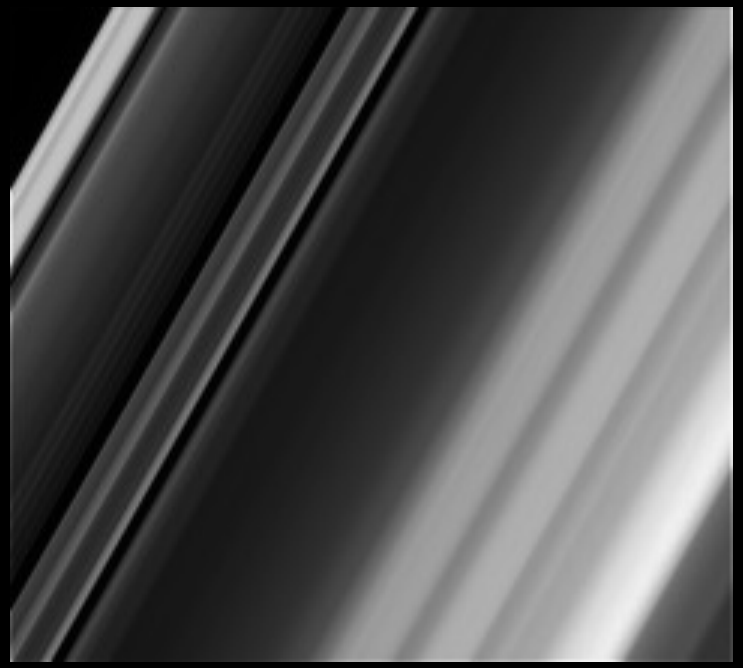


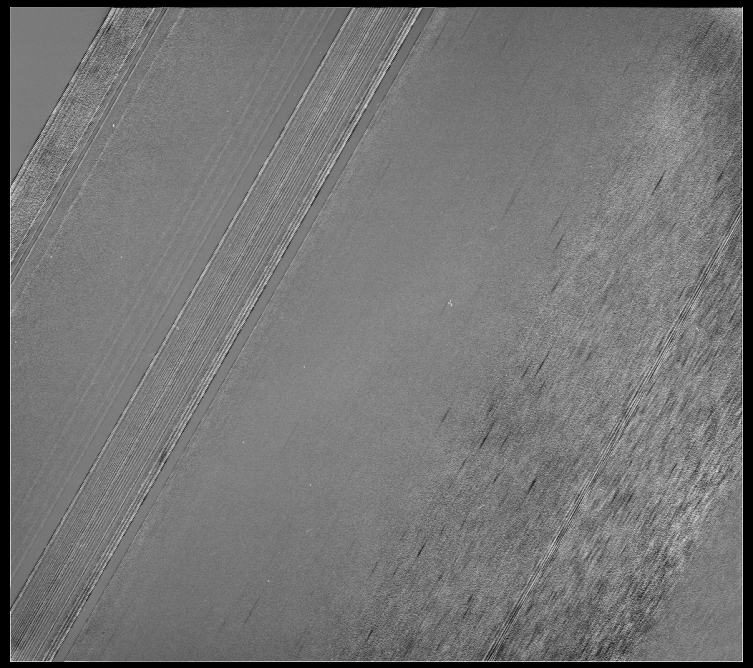


Resolution 330 m/pixel

Tiscareno et al., Science, 2019

Texture in Outer Cassini Division

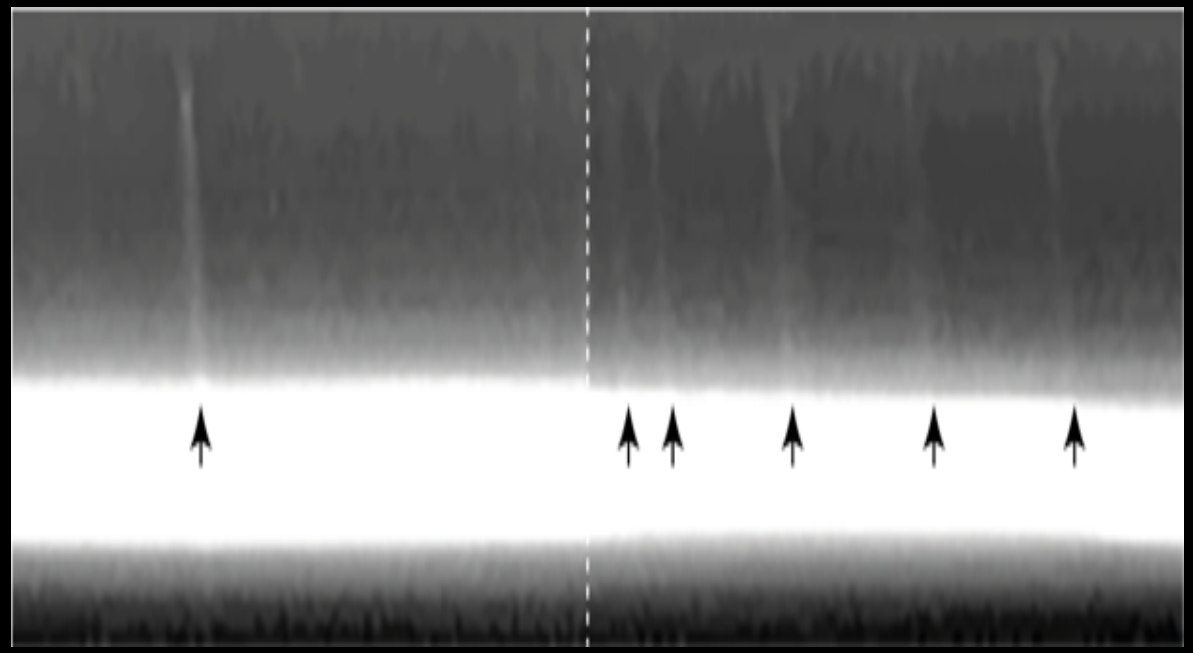




- Feathery texture apparent in 3 brightest regions of Cassini Division, but not in surrounding regions
- Right image filtered to enhance feathery texture
- Resolution 690 m/pixel

Tiscareno et al., Science, 2019

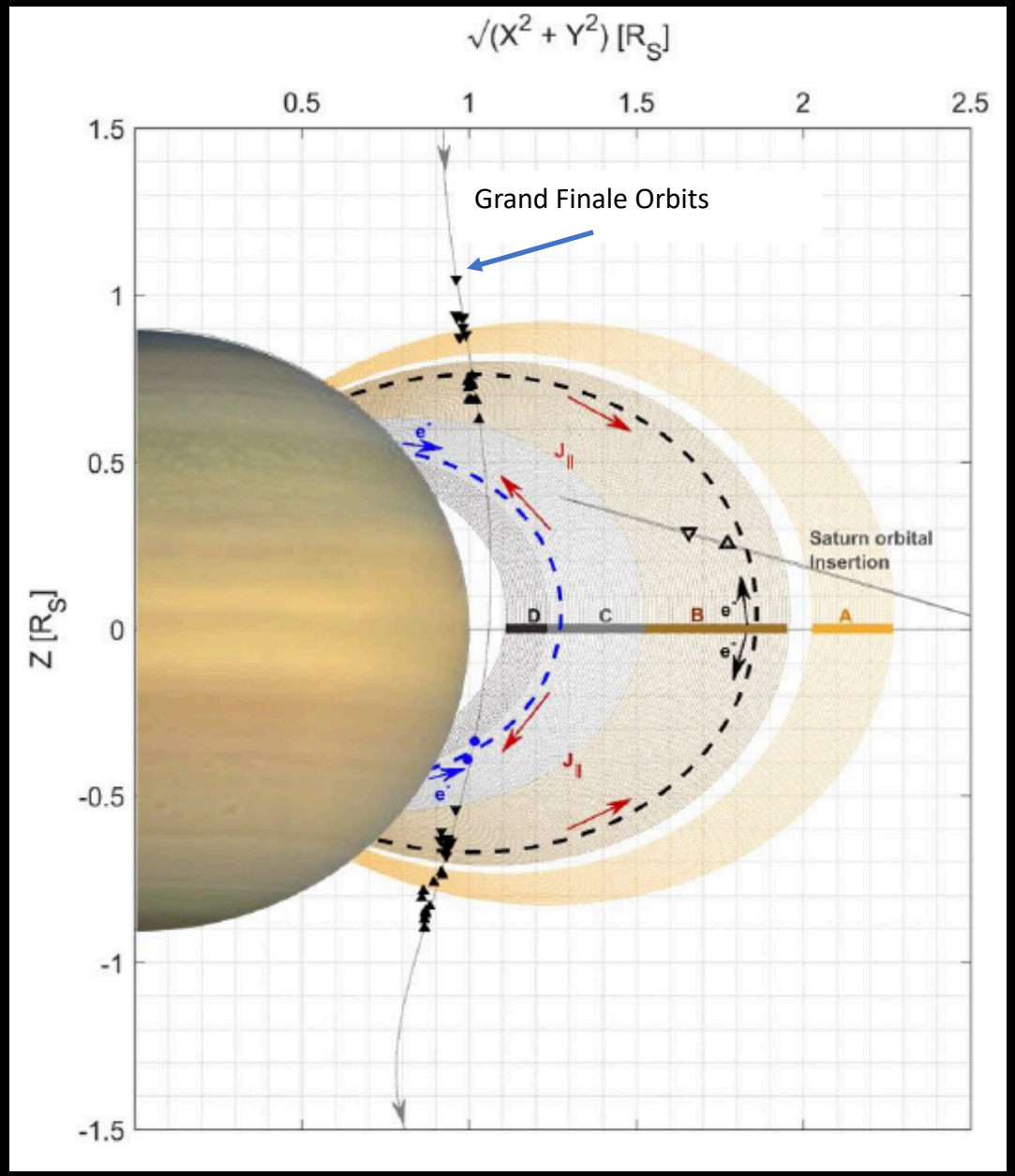
Mini-Jets in Saturn's F ring Formed by Flock of Impactors



- Bright core of F ring is visible and overexposed to make streaks visible
- Streaks of material (see arrows) show evidence for a flock of small objects that impacted F ring at same time, leaving trails about 30 km long.
- Ring is shaped by streams of material that orbit Saturn itself rather than, e.g., cometary debris
- 2 images spliced together along dashed line

Tiscareno et al., Science, 2019

Persistent large-scale electrodynamic coupling between Saturn and its rings

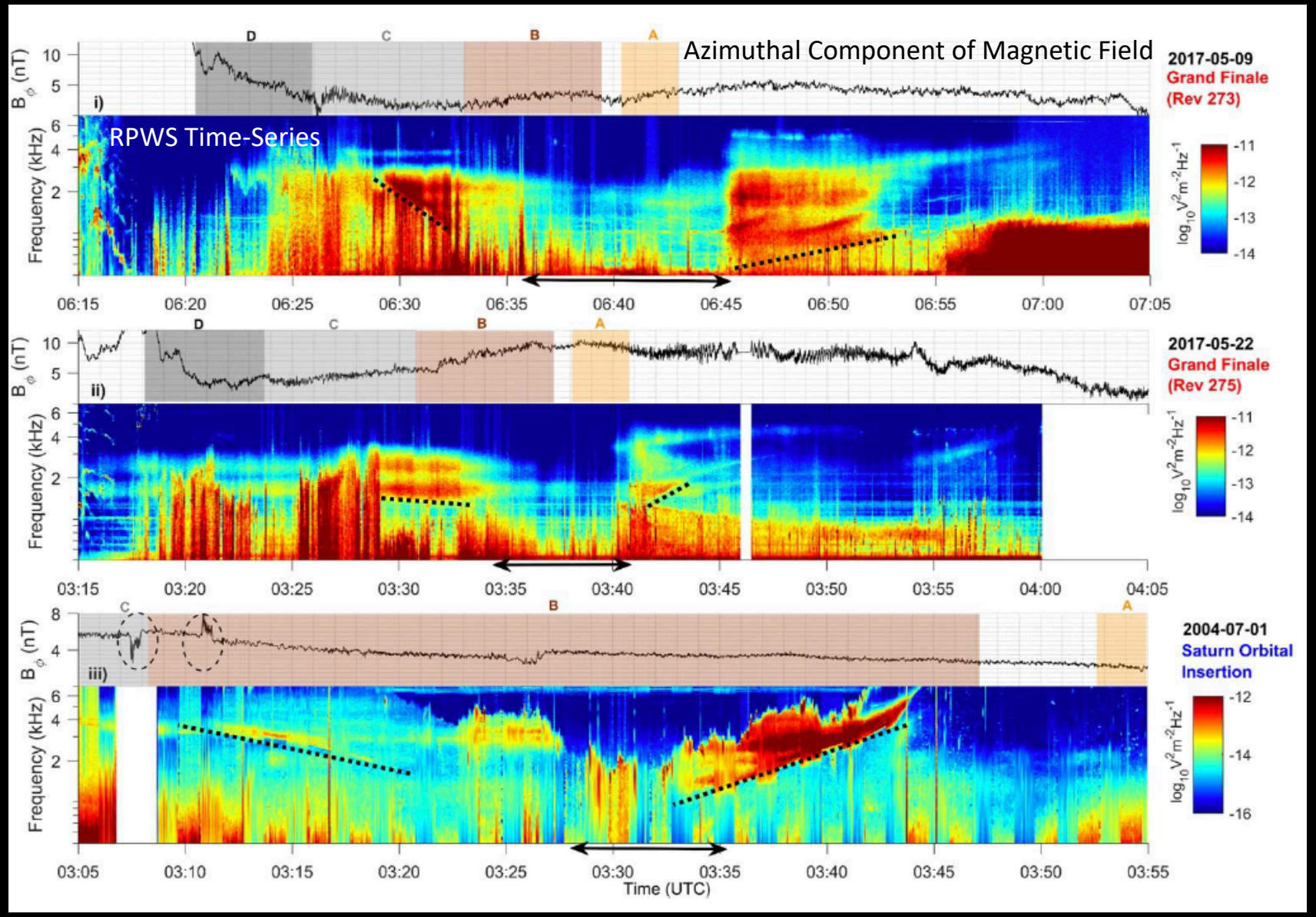


- Saturn's rings are a dynamic system in electromagnetic coupling with Saturn
- During all 22 Grand Finale orbits, the Radio and Plasma Wave Spectrometer (RPWS) repeatedly detected "auroral hiss" emissions on magnetic field lines connected to Saturn's rings
- North and south footprints of ring-connected field lines are at different N/S latitudes, indicating a small northward shift (0.047 R_s) of magnetic equator
  - Blue dots are locations of source magnetic field lines

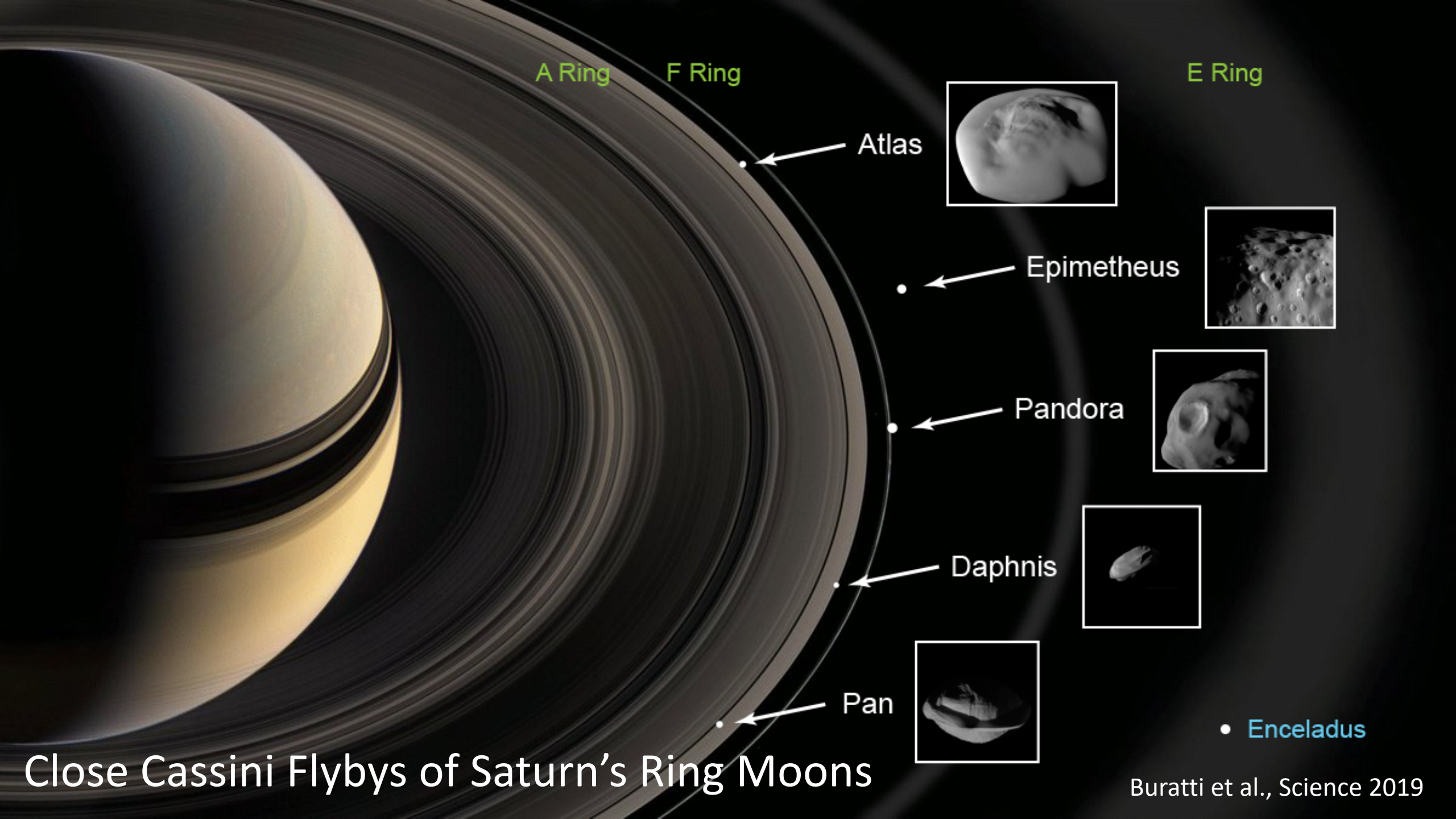
Sulaiman et al., Nature Astronomy, June 2019

Whistler-mode "auroral hiss" emissions in RPWS spectrograms

- Black solid line is Bφ
- Shaded areas correspond to L-shells connected to A, B, C and D rings
- Emissions propagate in whistler mode and exhibit characteristic funnel or V-shape in frequency-time spectrograms (dashed black lines)
- Vertex point (lowest frequency) is coincident with source of magnetic field line

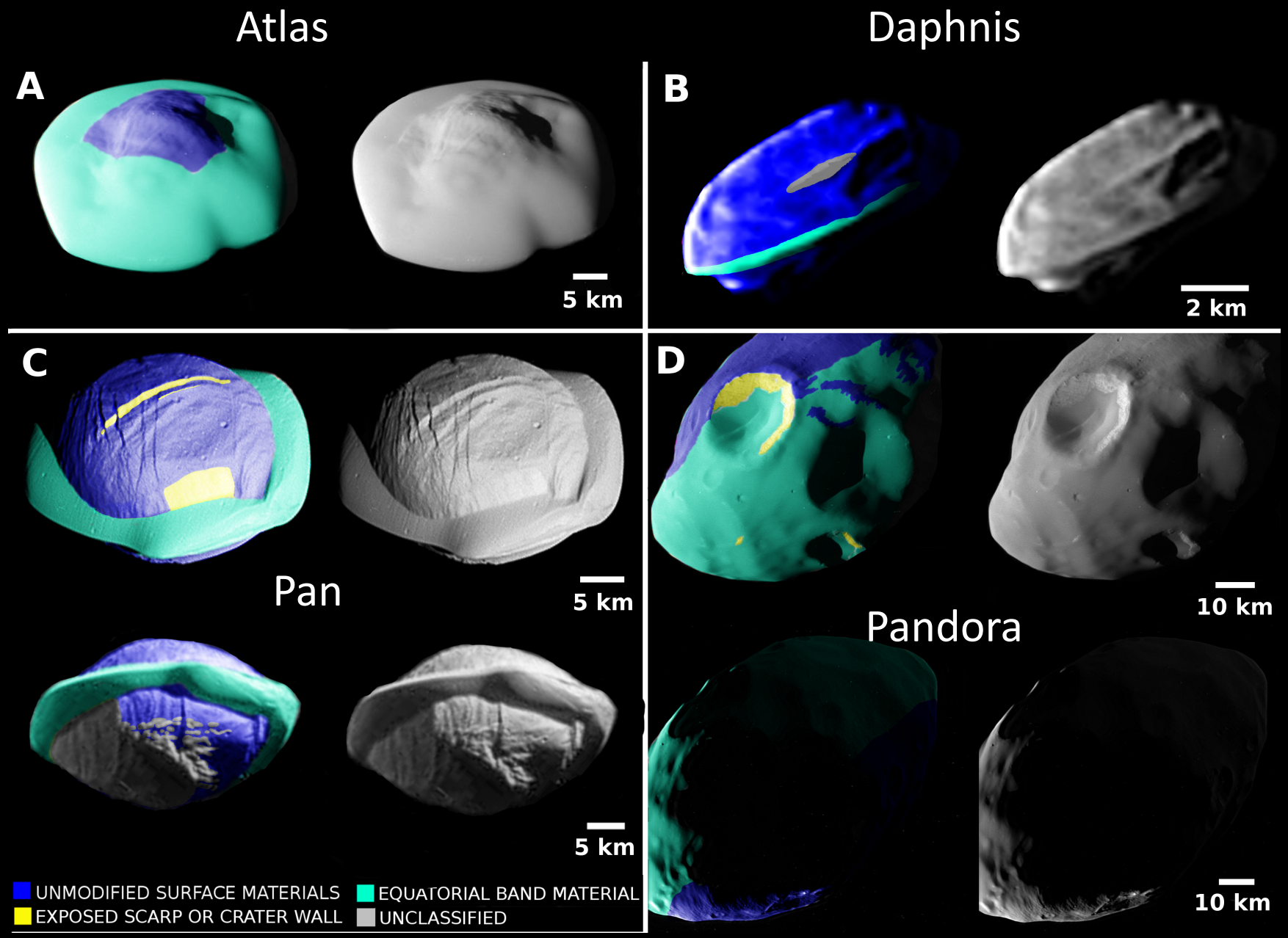


Sulaiman et al., Nature Astronomy, June 2019



Close Cassini Flybys of Saturn's Ring Moons

Buratti et al., Science 2019

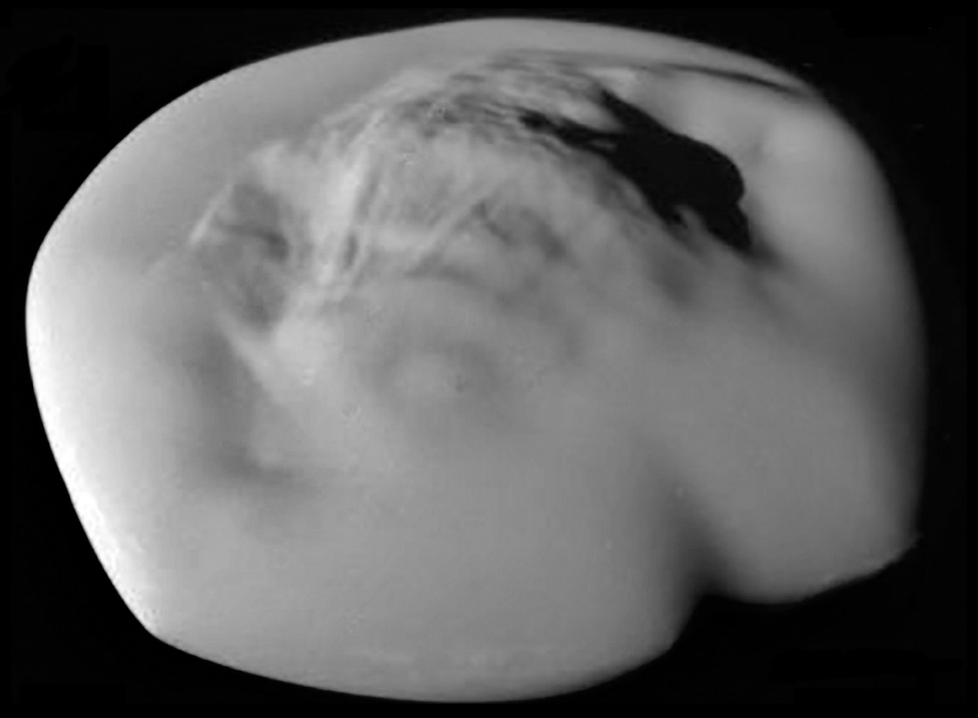


Buratti et al., Science 2019

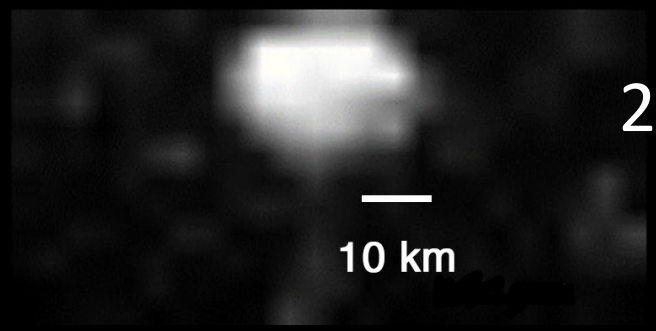
- Moons are highly porous
- Moons near rings have accreted equatorial ridges of ring material
- Ring moons closest to Saturn appear reddest, similar to main rings
- Three main geologic units shown in color
  - Blue: Cratered, unmodified surface
  - Cyan: Smooth terrain
  - Yellow: Exposed substrates

Atlas

A

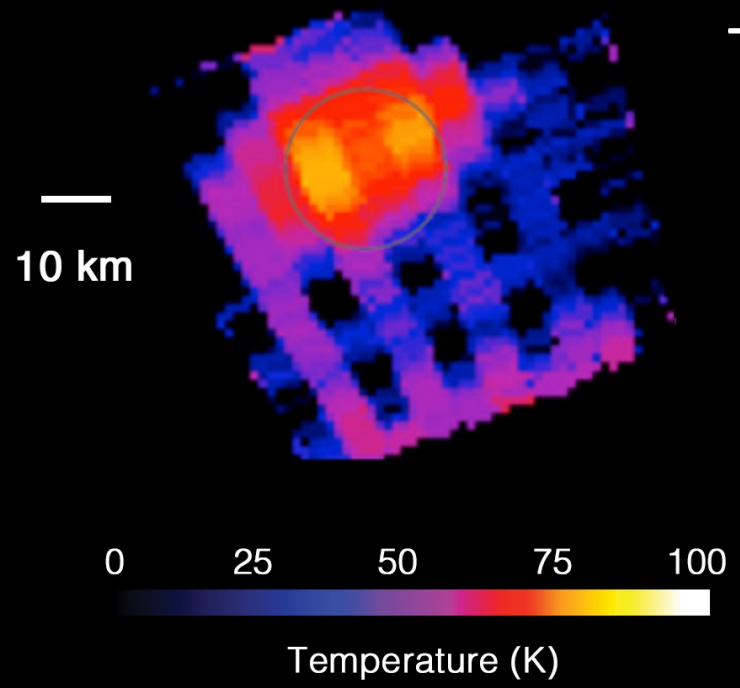


B



VIMS
2.01 microns

C

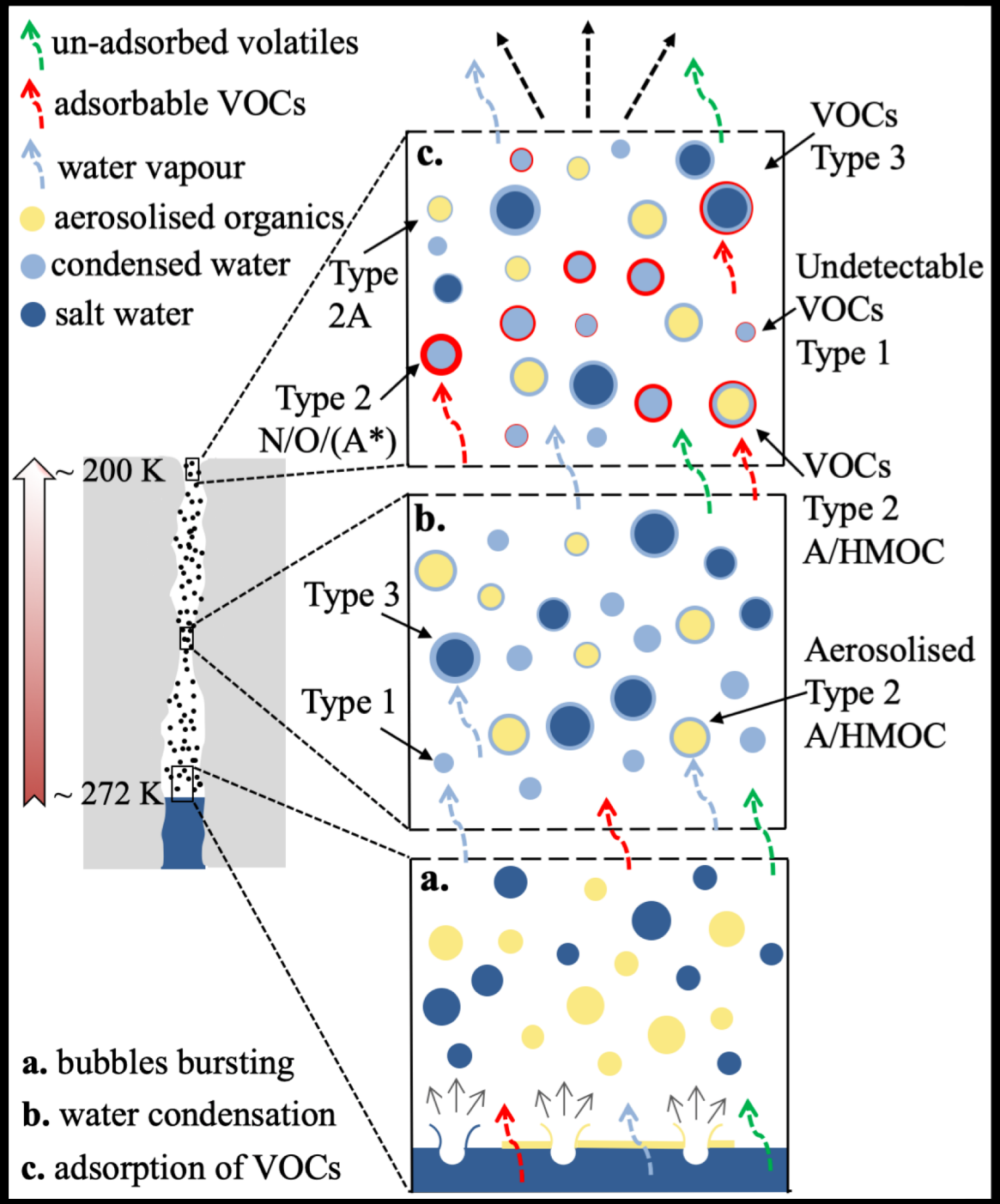


CIRS
Thermal IR

Buratti et al., Science 2019

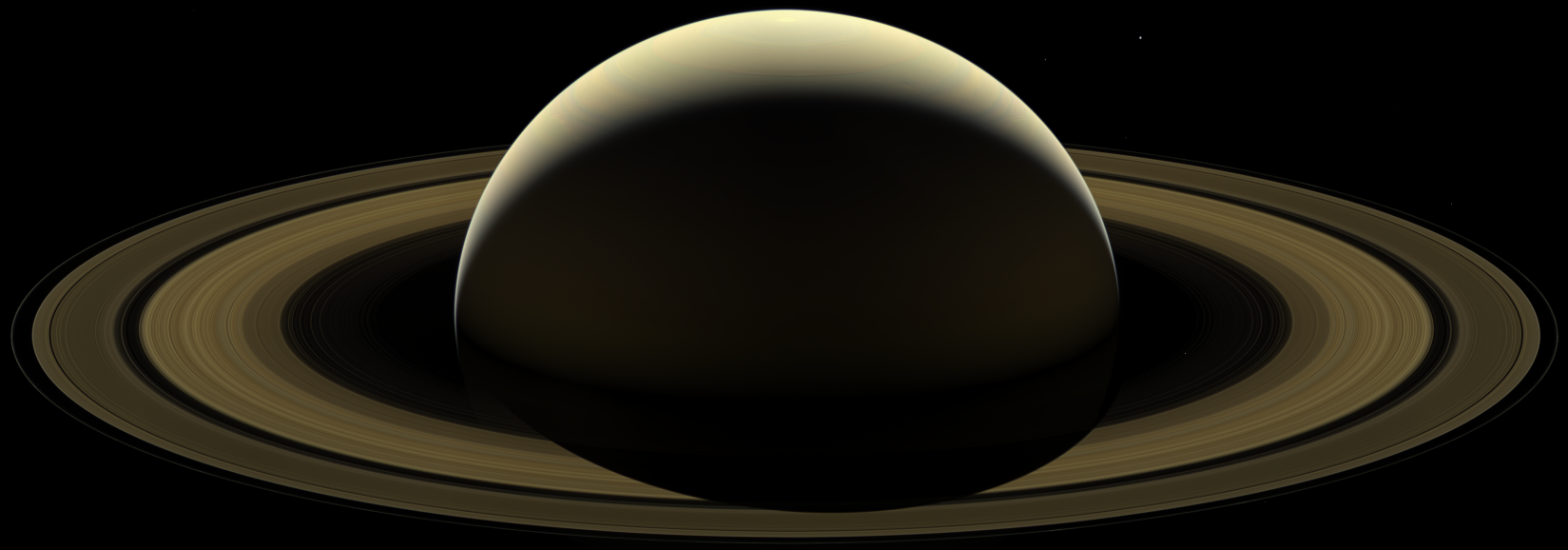
Ice Formation Mechanisms in Enceladus Vent

- Gaseous organic molecules condense onto Enceladus ice grain
- Bubble bursting (a): Creates spray of salt-water aerosols & insoluble organics
- Water condensation (b): Vapor becomes supersaturated; condenses to form almost pure water ice grains & coats other grains
- Adsorption of volatile organic compounds (VOCs): N-& O-bearing VOCs adsorb onto pre-existing grains
  - Volatile gasses with low binding energy & high condensation temperatures leave in gas phase along with uncondensed water vapor



Khawaja et al., MNRAS 2019, accepted

Questions?



Movie