Observing Rings and Small Satellites with JWST

Planetary rings are of prime importance as accessible natural laboratories for disk processes, as clues to the origins and evolution of planetary systems, and as shapers as well as detectors of their planetary environments. The retinue of small moons accompanying all known ring systems are intimately connected as both sources and products, as well as shepherds and perturbers, of the rings. The James Webb Space Telescope (JWST) offers four major ways to investigate ring-moon systems with unprecedented sensitivity: Discovering new rings and moons, Probing ring structure with occultations, Probing ring composition with spectroscopy, and Time-domain science.

Discovering New Rings and Moons

- Small moons and faint rings trace a system’s past and present workings
- At Uranus, the past was eventful, per discoveries by Hubble:
  - Moons lie in closely-packed orbits
  - Dusty rings with no apparent source
- JWST will improve upon Hubble with:
  - Comparable spatial resolution
  - Infrared coverage of fundamental absorption features and thermal emission
  - Greater sensitivity for deep searches

Discovering New Moons of Neptune

NIRCam will provide very sensitive imaging that could yield new discoveries around Neptune (Left) and Uranus (Right), and improve our understanding of those systems.

Time-Domain Science

- JWST is well suited to observe objects that are
  - Faint
  - Recently discovered
  - Known to be changing
- Capturing systems in motion yields insights into
  - How and why they operate
  - System origins
  - Interactions w/ environment
Occultations

- JWST can observe the flickering of a star as it passes behind rings, revealing fine details of ring structure
- For Uranus and Neptune, JWST will greatly exceed the sensitivity of Voyager occultations
- Multiple occultations can build up a “CAT scan” of ring microstructure

Unprecedented Spectroscopy

- Compositions of rings and small moons in Uranus and Neptune systems
  - Very little is known from Voyager
  - Must be very different from Saturn
  - May hold clues to system origins
- IR spectroscopy of faint targets is JWST’s strong suit!