**OPERATIONS CONCEPT FOR SOLAR SYSTEM OBSERVATIONS WITH THE JAMES WEBB SPACE TELESCOPE.**

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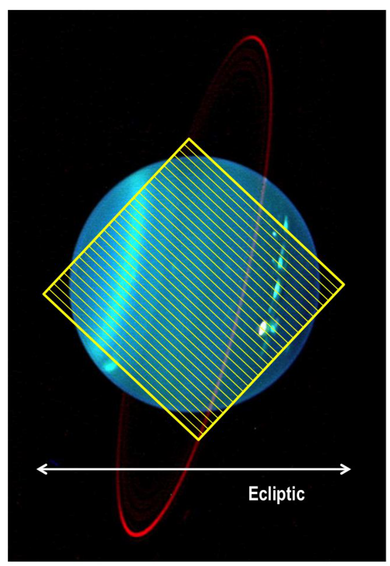
**Introduction:** The James Webb Space Telescope (JWST) will provide breakthrough capabilities to study our Solar System. JWST is a large aperture, cryogenic, infrared-optimized space observatory under construction by NASA, ESA, and CSA for launch in 2018. The high sensitivity and angular resolution capabilities of JWST will enable new studies of the Solar System, exoplanets, and planetary system formation. There are instrument modes specifically designed for observing exoplanet transits. Moving target capability will allow observations of planets, satellites, asteroids, KBOs, and comets beyond 1 AU. JWST will have a 6.5m-diameter segmented primary mirror; the optical system will be diffraction-limited at 2 microns (0.07 arcsec resolution). The JWST observatory will be placed in a L2 halo orbit by an Ariane 5 launch vehicle provided by ESA. The observatory is designed for a 5-year prime science mission, with consumables for 10 years of science operations.[1,2]

**Instrumentation:** The four JWST science instruments provide imaging, coronagraphy, and spectroscopy over the 0.6 – 29 μm wavelength range. (See reference [1] for instrument design details.) Imaging fields of view are ~2x2 arcmin, with pixel sizes of 0.032 arcsec (0.6-2.5 μm), 0.065 arcsec (2.5-5 μm), and 0.11 arcsec (5-29 μm). The spectroscopic capabilities include 1-5 μm multi-object spectroscopy over 3x3 arcmin with 250,000 randomly addressable shutters (each 0.2x0.46 arcsec), integral field spectroscopy covering 1-29 μm with a field of view of 3x3 arcsec or larger, and several long slits. The spectrographs provide spectral resolving powers of ~100 to ~2700 over the 1-29 μm range.

**Moving Target Capability:** JWST is designed to observe Solar System objects having apparent rates of motion up to 0.030 arcseconds/second. This capability includes the planets, satellites, asteroids, Trans-Neptunian Objects, and comets beyond Earth's orbit. Solar System targets can be observed over the full range of JWST's field of regard (solar elongation of 85 to 135 degrees, and a roll range of ±5 degrees about the telescope's optical axis). The size of the field of regard is dictated by the thermal design of the observatory, specifically the 21m x 14m sunshield. The telescope and instruments are passively cooled to T~40 K in the sunshield's shadow.

During the observation of a moving target, the science target is held fixed in the desired science aperture by controlling the guide star to follow the inverse of the target's trajectory. The pointing control software uses polynomial ephemerides for the target generated by JPL's HORIZON system. The JWST guider field of view (2.2x2.2 arcmin) is located in the telescope focal plane several arcmin from the science apertures. The pointing stability specification for moving target observations is 0.017 arcsec (rms).

**Science Aperture Orientation:** The instrument apertures are fixed with respect to the telescope focal plane. Apertures are also fixed relative to the ecliptic due to the Observatory's fixed solar array geometry. The poster will contain tables summarizing the aperture sizes and orientations. For example, the figure below shows the NIRSpec IFU (3x3 arcsec) orientation for an observation of Uranus (Keck Observatory image). The IFU orientation is the same for any observation near the ecliptic.




**Event-Driven Operations:** On-board scripts autonomously control the execution of the JWST science timeline [3]. An *Observation* is a series of exposures with a single instrument to achieve a science objective. A *Visit* is a series of exposures obtained with one science instrument and a single guide star (within the 2.2x2.2 arcmin field of the guider). An *Observation* may be split into more than one *Visit* (the *Visit* is basic unit of scheduling) depending on its duration, distribution of guide stars, and other factors. The scripts respond to actual slew completion or on-board command execution, making operations more efficient. Scripts also respond to an interrupted or a failed Visit, moving on to next valid *Visit*. Visits are scheduled with overlapping windows to provide execution flexibility and to avoid lost time. An observing plan covering about ten days will be uplinked weekly, but plan updates could be more frequent if necessary (for example, to accommodate a Target of Opportunity observation). Event-driven operations are expected to increase observing efficiency by at least 10%, relative to fixed-time scheduling.

The event-driven operations system supports time-critical observations and targets of opportunity (TOO). The minimum response time for TOOs is 48 hours (observation approval to execution).

**Observatory Operations:** JWST will be placed in a halo orbit about the L2 point of the Earth-Sun system. Observatory power comes from an array of solar panels. JWST is in radio communication with the Earth via the Deep Space Network for 4 hours twice a day. Command uplink and data downlink does not interfere with ongoing science operations. The JWST Science & Operations Center is located at Space Telescope Science Institute in Baltimore, Maryland.

**References:**

[1] Gardner, J. P. et al. (2006) *Space Sci. Rev*. 123, 485-606, [2] Rigby, J. R. et al. (2012), Proc. SPIE 8442, [3] Balzano, V. & Zak, D. (2006), Proc. SPIE 6274.