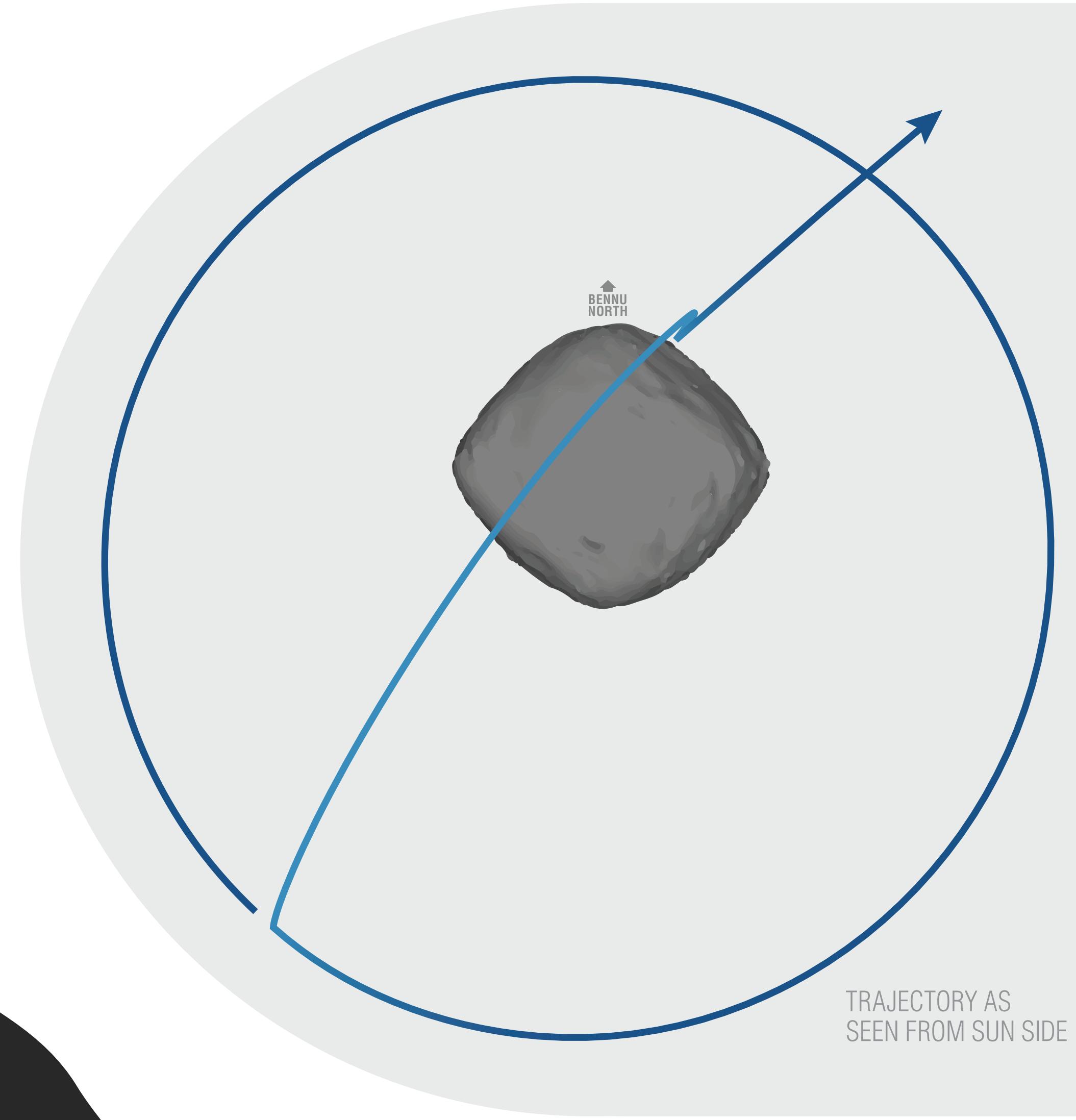
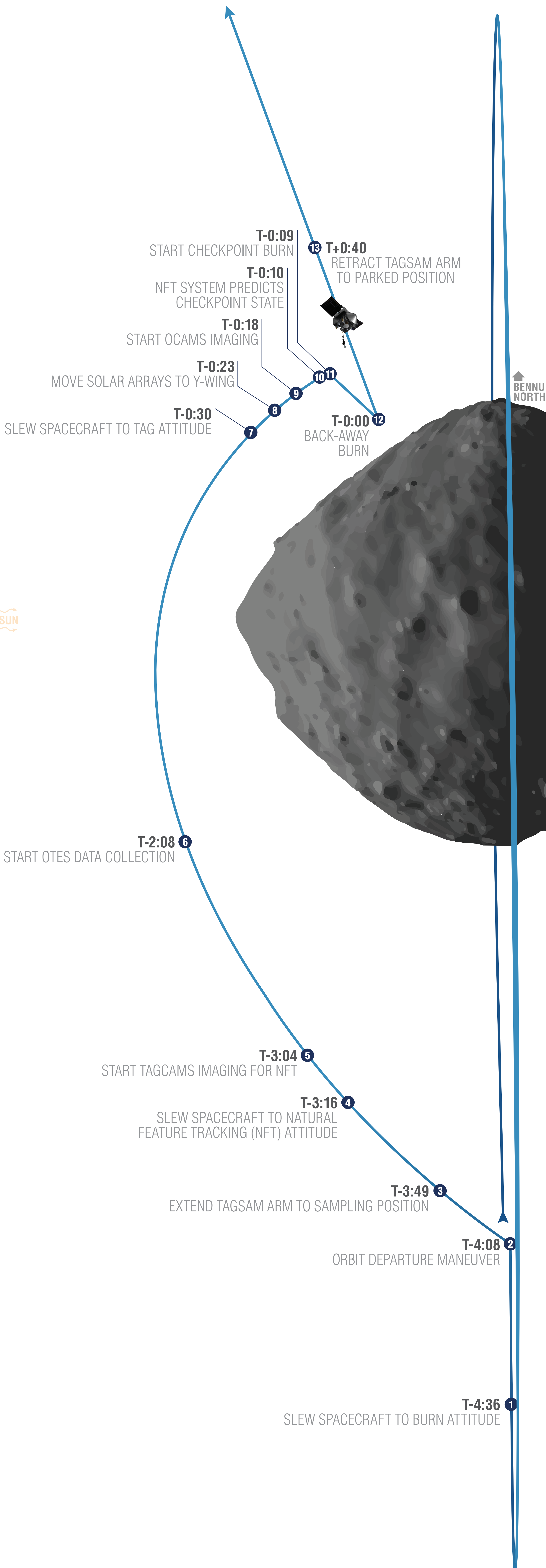




CHECKPOINT REHEARSAL

TAG OPERATIONS PLAN • 14 APRIL 2020

The primary goal of Checkpoint rehearsal is to practice the first steps of the sample collection event, including navigating the spacecraft through the Checkpoint maneuver, exercising the Natural Feature Tracking (NFT) guidance system, and confirming that the spacecraft's imaging and navigation systems operate as expected during the first part of the descent sequence.



SPACECRAFT ACTIVITIES DURING CHECKPOINT REHEARSAL:

- 1 T-4:36: Rotates to point the spacecraft's thrusters into position for the orbit departure maneuver.
- 2 T-4:08: Fires Attitude Control System (ACS) thrusters to leave the 0.6-mile (1-km) safe-home orbit.
- 3 T-3:49: Slowly extends the sampling arm – called the TAGSAM (Touch-and-Go Sample Acquisition Mechanism) – into sample collection position.
- 4 T-3:16: Performs a second slew, rotating to point the navigation cameras toward Bennu. The spacecraft needs a good view of Bennu's landmarks to collect navigation images for use by the Natural Feature Tracking (NFT) guidance system.
- 5 T-3:04: Over the course of the rehearsal, captures images for NFT navigation guidance. The spacecraft will compare these real-time images to an onboard image catalog of Bennu's features to autonomously update its location.
- 6 T-2:08: The OSIRIS-REx Thermal Emission Spectrometer (OTES) begins collecting data to measure surface temperature and mineral composition, which will provide the team with a high-resolution analysis of Bennu's thermal inertia.
- 7 T-0:30: Slews to point the TAGSAM arm and navigation camera toward Bennu's surface. This is the spacecraft's final TAG attitude.
- 8 T-0:23: Begins the 10-minute process to position the spacecraft's solar arrays in the "Y-wing" configuration. This configuration safely positions the arrays up and away from the asteroid's surface.
- 9 T-0:18: The OSIRIS-REx Camera Suite (OCAMS) begins collecting images to document the rehearsal's activities and the spacecraft's view as it approaches and backs-away from Bennu.
- 10 T-0:10: Before reaching the Checkpoint, the NFT navigation system predicts the spacecraft's future position and speed at the time of Checkpoint. The NFT system onboard the spacecraft autonomously adjusts the Checkpoint and Matchpoint burns to re-target the TAG location.
- 11 T-0:09: Fires ACS thrusters for 3 seconds to execute the Checkpoint burn, placing the spacecraft on a trajectory down toward Bennu for an additional 9 minutes.
- 12 T-0:00: Performs a back-away burn at an altitude of approximately 75 meters above the surface.
- 13 T+0:40: Returns the TAGSAM arm to the folded, parked position.