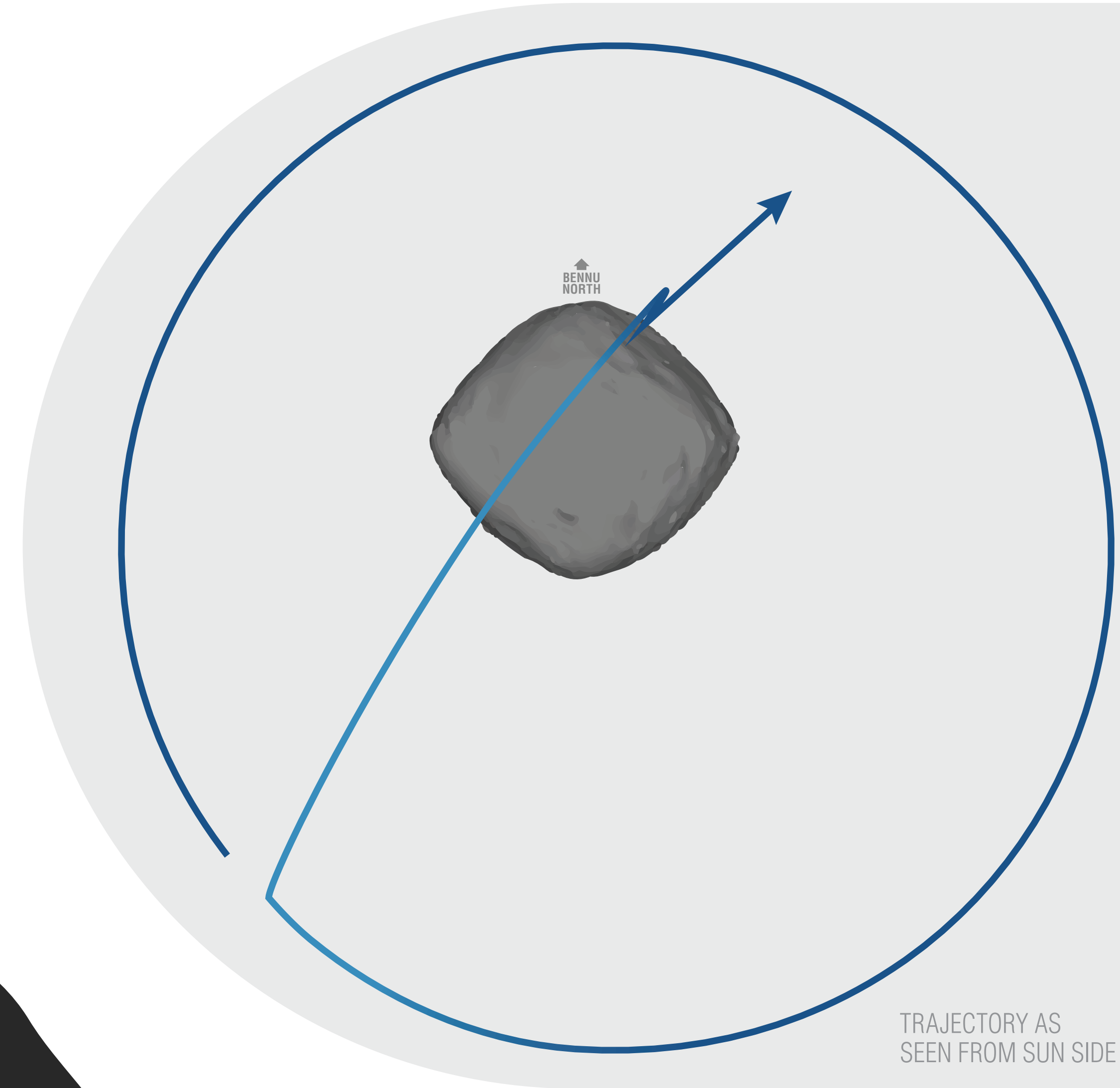
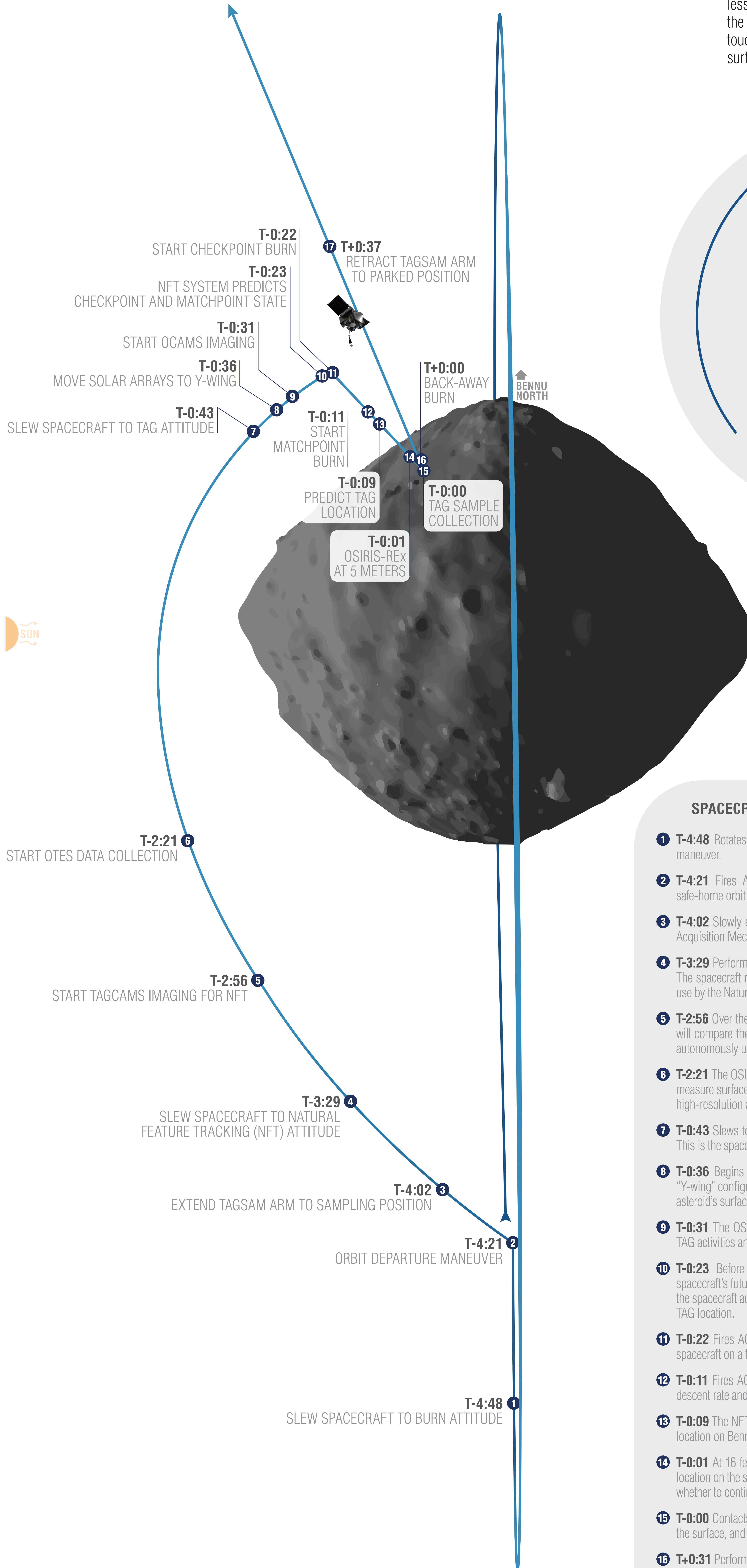




TAG SAMPLE COLLECTION

TAG OPERATIONS PLAN • 20 OCTOBER 2020

During the Touch-And-Go (TAG) sample collection event, the spacecraft departs orbit and performs two burns to descend toward Benu's surface until the sample collector head contacts sample site Nightingale. The collector head touches down for less than 16 seconds, fires a charge of nitrogen gas to disturb the ground and catches the agitated material. After this brief touch, OSIRIS-REx fires its thrusters to back away from Benu's surface and then navigates to a safe distance from the asteroid.



SPACECRAFT ACTIVITIES DURING SAMPLE COLLECTION:

- 1 **T-4:48** Rotates to point the spacecraft's thrusters into position for the orbit departure maneuver.
- 2 **T-4:21** Fires Attitude Control System (ACS) thrusters to leave the 0.6-mile (1-km) safe-home orbit.
- 3 **T-4:02** Slowly extends the sampling arm – called the TAGSAM (Touch-and-Go Sample Acquisition Mechanism) – into sample collection position.
- 4 **T-3:29** Performs a second slew, rotating to point the navigation cameras toward Benu. The spacecraft needs a good view of Benu's landmarks to collect navigation images for use by the Natural Feature Tracking (NFT) navigation system.
- 5 **T-2:56** Over the course of the event, captures images for NFT navigation. The spacecraft will compare these real-time images to an onboard image catalog of Benu's features to autonomously update its location.
- 6 **T-2:21** 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 Benu's thermal inertia.
- 7 **T-0:43** SLEWS to point the TAGSAM arm and navigation camera toward Benu's surface. This is the spacecraft's final TAG attitude.
- 8 **T-0:36** 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-0:31** The OSIRIS-REx Camera Suite (OCAMS) begins collecting images to document TAG activities and the spacecraft's view as it approaches and backs-away from Benu.
- 10 **T-0:23** 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-0:22** Fires ACS thrusters for 66 seconds to execute the Checkpoint burn, placing the spacecraft on a trajectory down toward Benu.
- 12 **T-0:11** Fires ACS thrusters for 10 seconds to execute the Matchpoint burn, slowing the descent rate and matching Benu's rotation.
- 13 **T-0:09** The NFT system calculates the spacecraft's position and speed to predict the TAG location on Benu's surface.
- 14 **T-0:01** At 16 feet (5 m) above the surface, the NFT system estimates the predicted TAG location on the surface and compares it to the hazard map, and then autonomously decides whether to continue and make contact with the surface or to wave-off.
- 15 **T-0:00** Contacts the asteroid surface for around 10 seconds, fires pressurized nitrogen at the surface, and collects the disturbed rocks and dust in the sampler head.
- 16 **T+0:31** Performs a back-away burn.
- 17 **T+0:37** Returns the TAGSAM arm to the folded, parked position.