OSIRIS-REx

ORIGINS • SPECTRAL INTERPRETATION • RESOURCE IDENTIFICATION • SECURITY • REGOLITH EXPLORER

Exploring Our Past, Securing Our Future Through Pioneering Asteroid Science

OSIRIS-REx will thoroughly characterize near-Earth asteroid (101955) 1999 RQ36. Asteroids are the direct remnants of the original building blocks of the terrestrial planets. Knowledge of their nature is fundamental to understanding planet formation and the origin of life. The return to Earth of pristine samples with known geologic context will enable precise analyses that cannot be duplicated by spacecraft-based instruments, revolutionizing our understanding of the early Solar System.

RQ36 is both the most accessible carbonaceous asteroid and the most potentially Earth-hazardous asteroid known. Its bulk properties have been well characterized by ground- and space-based telescopes, greatly reducing mission risk and providing strong evidence for the presence of regolith available for sampling.

Study of RQ36 addresses multiple NASA Solar System Exploration objectives to understand the origin of the Solar System and the origin of life, as well as fully addressing asteroid sample return objectives contained in the New Frontiers 2009 AO and NOSSE report. In addition, OSIRIS-REx will provide a greater understanding of both the hazards and resources in near-Earth space, serving as a precursor to future asteroid missions.

Science Objectives

1. Return and analyze a sample of pristine carbonaceous asteroid regolith in an amount sufficient to study the nature, history, and distribution of its constituent minerals and organic material.
2. Map the global properties, chemistry, and mineralogy of a primitive carbonaceous asteroid to characterize its geologic and dynamic history and provide context for the returned samples.
3. Document the texture, morphology, geochemistry, and spectral properties of the regolith at the sampling site *in situ* at scales down to the submillimeter.
4. Measure the Yarkovsky effect on a potentially hazardous asteroid and constrain the asteroid properties that contribute to this effect.
5. Characterize the integrated global properties of a primitive carbonaceous asteroid to allow for direct comparison with ground-based telescopic data of the entire asteroid population.

Mission Overview

- Launch in September 2016, encountering asteroid (101955) 1999 RQ36 in October 2019
- Study RQ36 for up to 505 days, globally mapping the surface from a distance of 5 km to a distance of 0.7 km
- Obtain at least 60 g of pristine regolith and a surface material sample
- Return to Earth in September 2023 in a Stardust-heritage Sample Return Capsule (SRC)
- Deliver samples to JSC curation facility for world-wide distribution

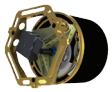
TAGSAM

- Touch-And-Go Sample Acquisition Mechanism (TAGSAM)
  - Elegantly simple sampler head
  - Stardust heritage articulated arm
- On-board N_2 resources support up to three separate sampling attempts
- Vacuum and micro-*g* tests of sampler head consistently demonstrate collection of > 60 g of sample
- Surface contact pads collect fine-grained material

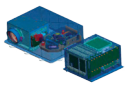
Touch-and-Go Sampling

- Slowly approach surface at 0.1 m/sec
- Contact within 25 m of selected location
- OCAMS documents sampling at 1 Hz
- Collect samples in ~5 sec
  - Direct N_2 annular jet fluidizes regolith
  - Surface contact pad captures surface sample
- Verify bulk sample collection via spacecraft inertia change; surface sample by imaging sampler head
- Sampler head stored in Stardust-heritage SRC and returned to Earth

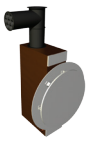
Instrument Suite



- **OSIRIS-REx Camera Suite (OCAMS)**
  Provides long-range acquisition of RQ36, along with global mapping, sample-site characterization, sample acquisition documentation, and sub-mm imaging

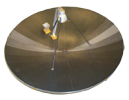


- **OSIRIS-REx Laser Altimeter (OLA)**
  Provides ranging data; global topographic mapping; and local topographic maps of candidate sample sites

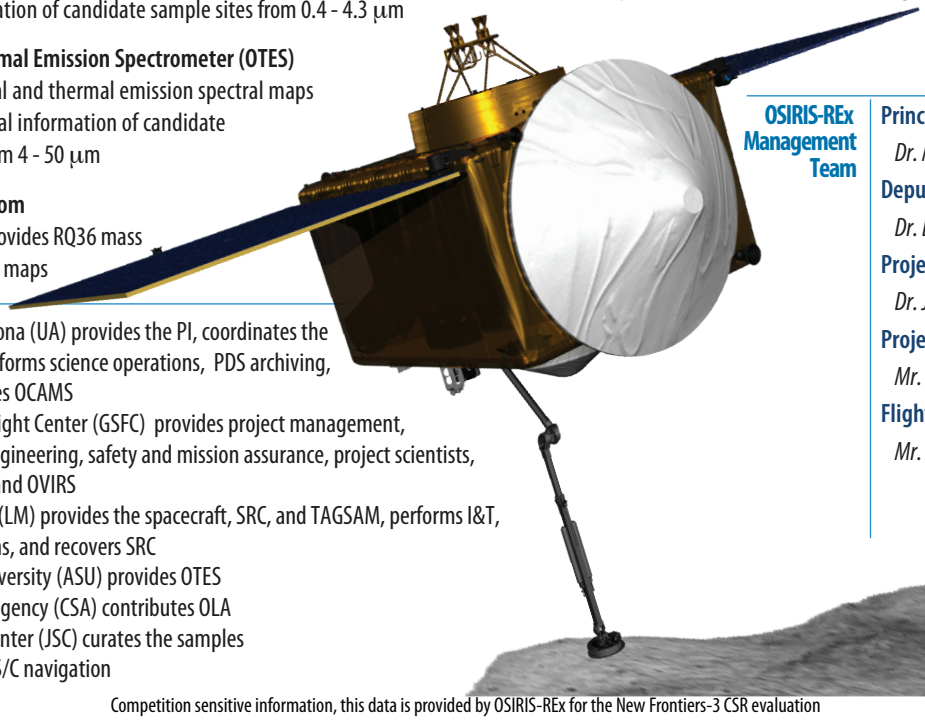


- **OSIRIS-REx Visible and IR Spectrometer (OVIRS)**
  Provides mineral and organic spectral maps and local spectral information of candidate sample sites from 0.4 - 4.3 μm

- **OSIRIS-REx Thermal Emission Spectrometer (OTES)**
  Provides mineral and thermal emission spectral maps and local spectral information of candidate sample sites from 4 - 50 μm



- **Spacecraft Telecom**
  Radio science provides RQ36 mass and gravity field maps



OSIRIS-REx Management Team

Principal Investigator
Dr. Michael Drake (UA)

Deputy Principal Investigator
Dr. Dante Lauretta (UA)

Project Scientist
Dr. Joseph A. Nuth III (GSFC)

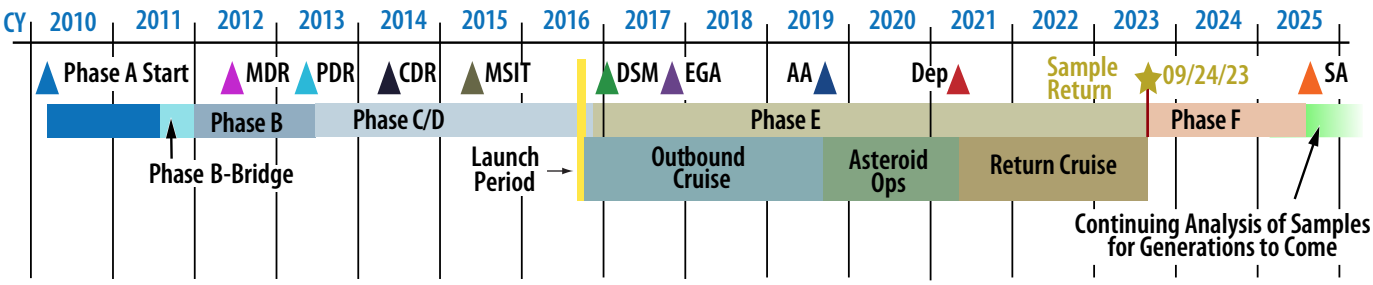
Project Manager
Mr. Robert Jenkens (GSFC)

Flight System Manager
Mr. Joseph M. Vellinga (LM)

OSIRIS-REx Team Assignments

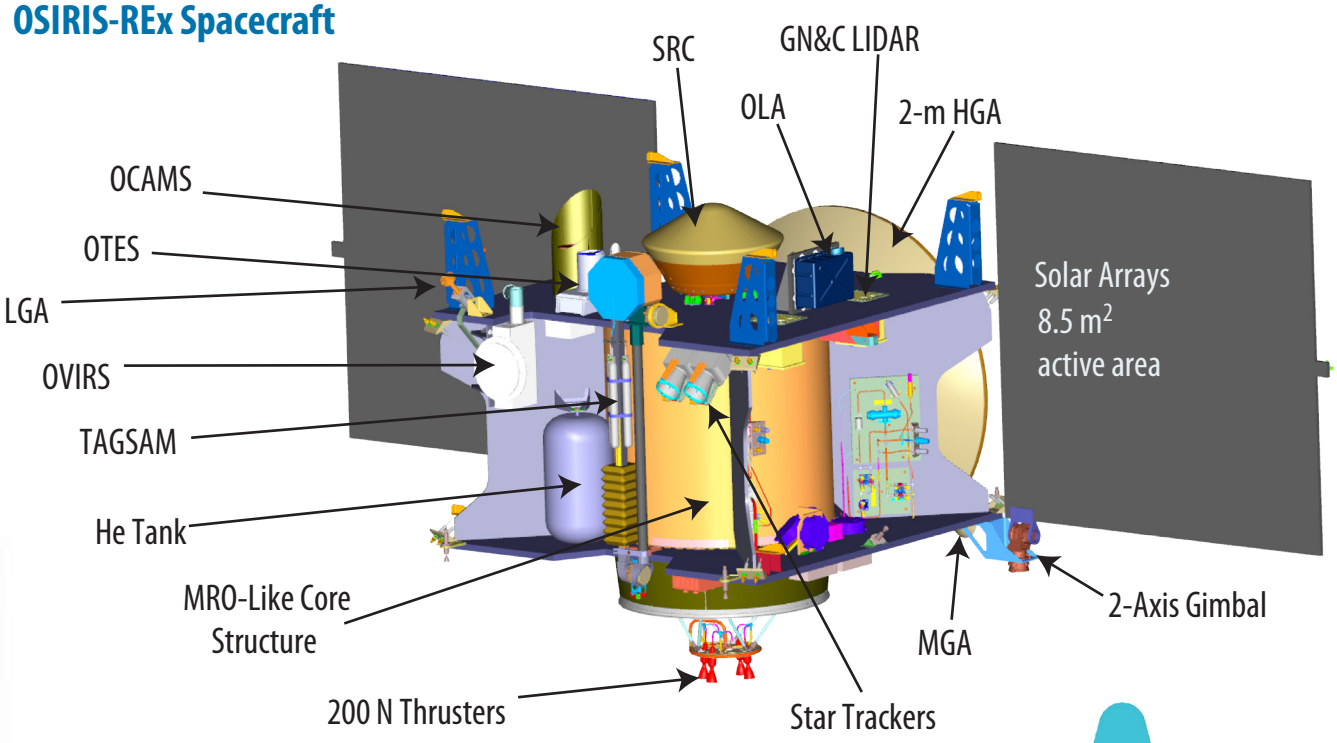
- University of Arizona (UA) provides the PI, coordinates the science team, performs science operations, PDS archiving, E/PO, and provides OCAMS
- Goddard Space Flight Center (GSFC) provides project management, project system engineering, safety and mission assurance, project scientists, flight dynamics, and OVIRS
- Lockheed Martin (LM) provides the spacecraft, SRC, and TAGSAM, performs I&T, mission operations, and recovers SRC
- Arizona State University (ASU) provides OTES
- Canadian Space Agency (CSA) contributes OLA
- Johnson Space Center (JSC) curates the samples
- KinetX performs S/C navigation

Schedule

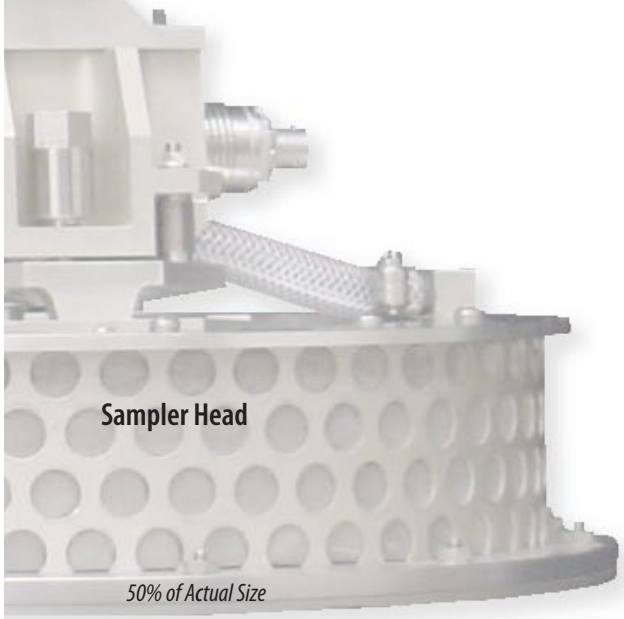


- Phase A Start 02/10
- Mission Definition Review 05/12
- Preliminary Design Review 03/13
- Critical Design Review 04/14
- Mission Systems Integration & Test 03/15
- Deep Space Maneuver 01/17
- Earth Gravity Assist 09/17
- Asteroid Acquisition 10/19
- Asteroid Departure 03/21
- Project Sample Analysis Complete 06/25

OSIRIS-REx Spacecraft



T A G S A M Engineering Design Unit



Atlas V 4 m Fairing