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 worldwide distribution**

### 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

### 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

### OSIRIS-REx Team Management

- **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

### Competition sensitive information, this data is provided by OSIRIS-REx for the New Frontiers-3 CSR evaluation
**Schedule**

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Continuing Analysis of Samples for Generations to Come

**OSIRIS-REx Spacecraft**

- **Solar Arrays**: 8.5 m² active area
- **200 N Thrusters**
- **MRO-Like Core Structure**
- **2-Axis Gimbal**

**Atlas V 4 m Fairing**

- **2.72 m**
- **3.1 m**