

# Exploration of Asteroids and Comets: Engineering Challenges and Solutions

Stephen Broschart  
California Institute of Technology, Jet Propulsion Laboratory  
Pasadena, CA

On January 1, 1801, the Italian astronomer Giuseppe Piazzi made the first recorded observation of an asteroid. This space rock came to be known as “Ceres”. Today, over 460,000 asteroids are known to exist in our solar system. Together with nearly 3000 known comets, these objects are referred to as “small bodies”. Scientists believe that these objects are made of material from the proto-planetary disk that was not gravitationally drawn into one of the planets. This material is thought to have been essentially unaltered for the past 4.5 billion years. Small bodies are thus of considerable relevance to questions about the beginnings of our solar system.

In general, scientific questions about small bodies and their composition are best addressed with /in situ/ observations; i.e., by sending a well-instrumented spacecraft to the object. However, operating a spacecraft near a small body is very different from operating near a planet. This talk will describe some of the engineering challenges associated with conducting a robotic space mission to a small body. Select technologies, mission concepts, and areas of research being developed to address these challenges at JPL, universities, and space centers around the world will be discussed.

Stephen Broschart is a guidance, navigation, and controls engineer at NASA's Jet Propulsion Laboratory in Pasadena. He received his Ph.D from the University of Michigan in 2006 for his work on trajectory and control law design for spacecraft operations near small bodies. He has authored over 30 journal papers, conference papers, and technical reports in various areas of small-body research including trajectory and control law design, in-situ measurements and filtering, mission concepts, and radar shape modeling.