SCIENCE OBJECTIVES OF THE EMIRATES MISSION TO EXPLORE THE ASTEROID BELT. H. AlMazmi[1], P. O. Hayne[2], M. E. Landis[2], W. F. Bottke[3], and the Emirates Mission to Explore the Asteroid Belt Science Team [1]United Arab Emirates Space Agency, [2]Laboratory for Atmospheric and Space Physics – University of Colorado Boulder, [3]Southwest Research Institute (h.almazmi@space.gov.ae)

Introduction. The Emirates Mission to Explore the Asteroid Belt is a main belt asteroid tour planned for launch in 2028. Using a suite of remote sensing instruments, the mission will make up-close observations of seven asteroids, including a rendezvous with (269) Justitia, a 54 km diameter extremely red object with possible origins in the distant solar system [1]. Among the flyby targets are (623) Chimaera, the largest remnant of the primitive C-type *Chimaera* family, and members of the *Baptistina, Eos, Erigone*, and *Euterpe* families [2]. Five of the seven targets are C-complex, allowing the mission to characterize a diverse set of carbonaceous bodies, some potentially rich in phyllosilicates, that form a key piece of the puzzle of early solar system formation and its subsequent dynamical evolution [3]. Here, we describe the overall science goals of the mission and the planned science instruments.

Background and Mission Design. The Emirates Mission to Explore the Asteroid Belt's spacecraft has heritage from the Emirates Mars Mission's Hope probe built in partnership with LASP at U. Colorado. That bus will be modified for main belt travel by including larger solar arrays and solar electric propulsion. Following launch in early 2028, the spacecraft performs a series of flyby/gravity assists at Venus, Earth, and Mars before the first asteroid flyby in early 2030. A sequence of six asteroid flybys will be performed through mid-2033, culminating in a rendezvous with (269) Justitia in April 2034. Proximity operations are planned to fully image and characterize the surface composition, geology, and gravity field of Justitia through multiple orbits of varying altitude and solar geometry.

Science goals and objectives. The primary science goal is to probe the origin and evolution of water-rich asteroids, with a focus on three main questions:

1) Where did the volatile-rich asteroids form?
2) Are these asteroids linked to specific meteorites?
3) What does their chemical inventory and volatile abundances tell us about main belt evolution?

To answer these questions, the mission will perform science investigations based on the following objectives:

A) Determine the geologic history and volatile content of multiple main belt asteroids, and investigate the interior structure of the rendezvous target.
B) Determine temperatures and thermophysical properties on multiple asteroids to assess their surface evolution and volatile histories.

In addition, the mission will collect remote sensing data on a representative suite of C-complex bodies to better characterize their potential as resource depots for future deep space exploration.

Payload. The mission payload consists of a suite of remote sensing instruments, including: 1) Visible narrow-angle camera (NAC), 2) Mid-wave infrared spectrometer (MWIR), 3) Thermal IR spectrometer (TIR), and thermal IR camera (IR-cam). Each of these instruments acquires data during asteroid flyby observations and during rendezvous and proximity operations with (269) Justitia. The MWIR instrument, MIST-A, is provided by the Agenzia Spaziale Italiana (ASI) in partnership with the Italian National Institute for Astrophysics (INAF) and Leonardo S.p.A. [4]. The spectral coverage of the multiple infrared instruments is expected to span ~2.0 to > 100 μm, providing opportunities for detailed compositional and thermophysical analyses. Visible images with few meters/pixel resolution will be acquired for each target, along with thermal infrared images with ~10-100 m/pixel resolution.

Discussion. In situ observations will be used to establish how the spectral character of the asteroid targets is related to their intrinsic surface and internal compositions. Organics and/or the past influence of ices/volatiles on surface materials may provide critical clues to the provenance of different bodies. Temperatures and thermophysical properties will be used to determine the history of surface modification via impacts/space weathering as well as volatile stability in the subsurface.

Conclusion. The mission will provide an unprecedented window into the formation and evolution of volatile-rich asteroids. It will also provide us with insights into planetesimal formation as well as the collisional and dynamical evolution of main belt asteroids. We will glean insights into nature of asteroid families, which are the backbone of the main belt population. Finally, if Justitia indeed formed in the most distant reaches of the solar system, the mission will provide us with a front row seat to what large objects currently residing beyond Neptune are really like and how they may have been modified by their migration to ~2.6 au.

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