BENNU'S NATURAL SAMPLE DELIVERY MECHANISM: ESTIMATING THE FLUX OF BENNU PARTICLE METEORS AT EARTH: R.E. Melikyan[1], C.W. Hergenrother[2], B.E. Clark[1], Q. Ye[3], S.R. Chesley[4], and D.S. Lauretta[2]. [1]Ithaca College, Ithaca, NY, rmelikyan@ithaca.edu, [2]Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ. [3]California Institute of Technology, Pasadena, CA, [4]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA.

Introduction: The OSIRIS-REx mission has detected particle ejection events resulting in the release of cm-sized particles from the surface of asteroid (101955) Bennu [1]. While many of these particles return to the surface of Bennu, some are able to escape Bennu's gravitational field. This suggests that there may be a meteoroid stream of Bennu particles following an orbit similar to that of Bennu. These particles may pass close enough to Earth's orbit to produce Bennu meteors [2].

In line with this suggestion, the OSIRIS-REx mission has established a collaboration with the Cameras for Allsky Meteor Surveillance (CAMS) project [3]. The goal is to search the Southern Hemisphere sky for evidence of a Bennu meteor shower in September of 2019 and beyond, during Earth's annual approach to the Orbit of Bennu. In support of this observational search, we estimate the expected flux over the entire Earth and for an observer on Earth (number of meteors per unit time): we are simulating particle ejection and orbit evolution during each annual Bennu orbit crossing.

Data Collection: We simulate Bennu meteoroid streams with the use of the REBOUND orbital integrator software [4]. Included in our simulations are non-gravitational forces, such as the Yarkovsky Effect, that produce non-negligible perturbations on Bennu's orbit [2]. We will accurately model the orbital evolution of Bennu over the interval 1788-2135. Accurate propagations outside this interval are precluded by Earth close approaches. The associated meteoroids will allow us to estimate the potential meteor flux at the present day and beyond.

Observational data of Bennu's particle ejection events obtained since December 2018 shows that Bennu was active over the entire OSIRIS-REx observational time range [1]. Following this trend, it is likely that these ejection events will persist throughout Bennu's entire orbit. The particles we simulate will have a range of densities, sizes, and velocities constrained by the OSIRIS-REx particle ejection observations [1]. These parameters will serve as endmembers in determining the orbital changes incurred between ejection and recapture. Solar radiation forces will be included in this study.

Analysis: The resulting simulations will be developed to accurately represent the statistical particle production rates that we observe, and to appropriately distribute the meteoroid streams in the parameter space of our study. This will allow us to predict the meteor flux that we may see during the annual orbit crossing.

The specific tests we will perform to begin this analysis include:

1) Investigate the timeframe for which ejection event particles would fade into the background meteoroid population [6].

2) Determine significance of ejection direction on orbit evolution results.

3) Observe differences between particles ejected during perihelion and aphelion.

4) Launch endmember particles in the range of observed properties to determine the primary influential parameters.

5) Perform simulations with and without solar radiation and Poynting-Robertson drag forces to understanding the scale of their effect on this timescale.

The results of these test cases could allow for the final simulations to be vastly simplified while retaining realistic conclusions.

Summary and Implications: We are seeing Bennu's MOID drop to zero over the coming century. The results of this study will allow us to predict how dramatically that will affect the future meteor flux at Earth [2].

This work may have broader implications for determining potential meteor activity from a large number of other small NEOs, as there is no reason to suppose the ejection phenomenon is unique to Bennu.

Acknowledgments: This material is based upon work supported by NASA under Contract NNM10AA11C issued through the New Frontiers Program. We are grateful to the entire OSIRIS-REx Team for making the encounter with Bennu possible.

References:

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