EPSC Abstracts
Vol. 13, EPSC-DPS2019-1269-2, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

Impact fluxes on 2014 MU69 and Pluto and their variations over secular timescales

Youngmin JeongAhn (1,2), Renu Malhotra (3) and Mauricio Reyes-Ruiz (2)
(1) Korea Astronomy and Space Science Institute, Daejeon, South Korea (jeongahn@kasi.re.kr), (2) Instituto de Astronomía, Universidad Nacional Autónoma de México, Ensenada, BC, México, (3) Lunar and Planetary Laboratory, The University of Arizona, Tucson, AZ, United States

Abstract

We calculated the impact flux on 2014 MU69 and on Pluto. We found that 2014 MU69 has 1.6 times higher impact flux than Pluto.

1. Introduction

The New Horizons visited two Trans-Neptunian Objects (TNOs), 134340 Pluto and 2014 MU69, which belong to two important dynamical groups, the Plutinos and the Cold Classical Kuiper Belt Objets (CCKBOs), respectively. Estimating the impact fluxes on these two bodies is urgently needed to interpret the surface ages of these bodies from the New Horizons images.

2. Method

For the TNO projectile population, we adopted CFEPS-L7 synthetic model [6] together with the model of Kaib et al. for the scattered disk [5]. We also included minor resonant sub-populations which were not considered in previous studies [1], [2]. These models provide distributions of the semi-major axis, eccentricity and ecliptic inclination of the TNO population based on dynamical simulations calibrated with observational surveys. Assuming a size-independent orbital distribution, we generated 100 clones of each model TNO which have orbital elements of those synthetic orbits while angular parameters are randomly assigned. We then used an improved Öpik-Wetherill method [3], [4] to calculate impact flux on Pluto and on 2014 MU69 and its variation over secular timescales.

The orbits of Pluto and 2014 MU69 were numerically integrated backward in time up to 7.5 million years, then the orbital elements of each body were recorded every 5 hundred thousand years to be used as 16 representative values. This time span is roughly two times the Kozai-Lidov (KL) cycle of Pluto and also approximately two times the secular variation timescale of 2014 MU6.

3. Results

We found that the impact flux on 2014 MU69 is 1.6 times higher than on Pluto. We found that 76% of impacts on 2014 MU69 come from CCKBOs while this fraction is only 35% for Pluto. We also found 5:3 Neptune resonant population also contributes about 3% of impacts on Pluto. Over secular timescales, the impact flux contribution of CCKBOs on Pluto varies by a factor of 7 due to the variation of Pluto's heliocentric nodal distance, which accounts for a factor of 2 total impact flux variation of Pluto over time. The temporal variation of the impact flux on 2014 MU69 is order of 10% for most sub-populations as its eccentricity and inclination are small. One exception is the classical inner population which shows a factor of 10 temporal variation of impact flux on 2014 MU69, but its contribution to total impacts is negligible (<0.1%). The result for the impact flux on Pluto agrees in general with [1] with some difference in impact contributions from sub-populations.

Acknowledgements

We acknowledge that [2] independently studied the impact flux on 2014 MU69 and found similar results on the average impact flux and the contributions from sub-populations.

References

[1] Greenstreet, S., Gladman, B., and McKinnon, W. B.: Impact and cratering rates onto Pluto, Icarus 258, 267-288, 2015.

[2] Greenstreet, S., Gladman, B., and McKinnon, W. B., et al.: Crater Density Predictions for New Horizons Flyby Target 2014 MU69, ApJ, 872, L5, 2019.

[3] JeongAhn, Y., and Malhotra, R.: The current impact flux on Mars and its seasonal variation, Icarus, 262, 140-153, 2015.

[4] JeongAhn, Y., and Malhotra, R.: Simplified Derivation of the Collision Probability of Two Objects in Independent Keplerian Orbits., AJ, 153, 235, 2017.

[5] Kaib, N. A., Roškar, R., and Quinn, T.: Sedna and the Oort Cloud around a migrating Sun, Icarus, 215, 491-507, 2011.

[6] Petit, J.-M., Kavelaars, J. J., Gladman, B. J. et al.: The Canada-France Ecliptic Plane Survey—Full Data Release: The Orbital Structure of the Kuiper Belt, AJ, 142, 131, 2011.