ROTATINAL PROPERTIES OF TRANS-NEPTUNIAN OBJECTS AND CENTAURS: CURRENT STATISTICS AND PROBLEMS.

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Introduction: Rotational properties of Trans-Neptunian objects (TNOs) and Centaurs are a valuable source of knowledge about the formation and evolution of the Solar System. According to the IAU's Minor Planet Center, as of May 2018 about 2700 TNOs and Centaurs were discovered[1]. However, the rotational periods and brightness lightcurve amplitudes were measured for only less than 6% of them. Moreover, for only a small portion of these bodies the rotational properties were measured with a good precision.

A number of previous works were studying the rotational properties of small distant bodies from the statistical point of view (e.g. [1, 4, 5]). The amount of known rotational properties has grown since the last analysis, and we aim to continue this work with the larger dataset. Here we present the preliminary results on the rotational properties distribution of TNOs and Centaurs, and discuss the main problems that arise.

Distribution of rotational periods: The dataset that was collected in this work has a total number of 163 objects and contains TNOs from all dynamical groups. For 130 of them a rotational period was determined, and for the rest of the objects only lightcurve amplitude is known. Assuming a Maxwellian distribution of the spin rates, the found mean rotational period of TNOs and Centaurs population is 8.40±0.38 hr, and 8.54±0.32 hr for TNOs population alone. This result is similar to the previously derived values. Interestingly, the mean rotational period differs significantly among these groups: Resonant objects, in general, rotate slightly faster than Classical ones and Centaurs, and Scattered-disk objects rotate significantly slower than all of the above.

Discussion: In the case of small outer Solar system bodies, the observational bias causes the lack of smaller bodies with low lightcurve amplitudes and longer rotational periods. In fact, for all TNOs there is a strong correlation (confidence level > 99.9%) between their absolute magnitude and the lightcurve amplitude, and a less strong correlation between the absolute magnitude and the rotational period.

The problem of distinguishing between the single and double-peaked periods should also be taken into account. The standard way to deal with this is by using a certain lightcurve amplitude threshold: lightcurves with amplitudes smaller than ~0.2 mag are associated with a surface heterogeneity whereas lightcurves with larger amplitudes are thought to be produced by elongated bodies. However, the situation when an elongated body has smaller amplitude is also possible. From ground-based observations an elongated body with low amplitude can only be identified by the existence of a lightcurve asymmetry. And indeed, precise photometric observations show this kind of asymmetry for large TNOs, such as (225088) 2007 OR10 [3] and dwarf planet Makemake [2].

Moreover, symmetrical lightcurves, which are prevailing for the observed distant small bodies, and the limited amount of observational data make it difficult to choose not only from single and double-peaked period, but also between other aliases.

Finally, another problem of period determination rises from the rotational period of the Earth. As a result of this periodicity, data taken from the same ground-based telescope would not be randomly spaced in time, and 12-hr aliases will appear [4]. In the case of poor photometric data or low lightcurve amplitude this alias can be confused with the real rotational period of a target. Indeed, there is an exceeding number of objects with 12 hr rotational period in the dataset.

References:

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[1] https://www.minorplanetcenter.net/iau/lists/