NO ACTIVITY ON 13 CENTAURS DICOVERED IN THE PAN-STARRS DETECTION DATABASE.

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Introduction: Centaurs are small bodies in the giant planet region which were scattered inwards from their source populations beyond Neptune. Some members of the population display comet-like activity during their transition through the warmer environment in the inner solar system, the source of which is not well understood. The range of heliocentric distances where the active Centaurs have been observed, and their median lifetime in the region suggest this activity in neither driven by the water-ice sublimation, nor by supervolatiles [1]. Crystallization of amorphous water ice occurring at $7.0 < R_{AU} < 14.0$ has been suggested as the most likely activity driver for Centaurs [2][3][4], given there is no active Centaur known beyond R ~ 13 AU [5]. We present an observational and thermodynamical study aimed at searching for and characterizing possible faint activity and its sources on 13 Centaurs discovered in the Pan-STARRS1 detection database [6], which have a wide range of perihelia across the proposed crystallization zone (Figure 1).

Results: We conclude that none of our targets were active at the time of observations. The analysis of observations taken in r'-band with the GMOS imager at the Gemini N telescope rule out faint activity down to 24.0 mag. arcsec^{-2}. This conclusion is supported by our numerical integrations showing the dynamical stability of our targets over the past 100,000 years. These integrations indicate that none of our target objects have experienced a recent close encounter with a giant planet, or sudden decrease in perihelion distance - processes attributed to sudden outbursts on some previously known inactive Centaurs [7]. Two of our targets – 2014 PQ70 and 2015 BK518 – have been orbiting within the amorphous ice crystallization zone during past 100,000 years, which could lead to the depletion of surface- and sub-surface volatiles and cessation of activity, if any was previously present. Our other targets have been orbiting beyond or near the upper limit of the crystallization zone, and we therefore do not expect to see significant activity.

We used thermo-dynamical modelling [8] to put an upper limit on the volatile production rate as a function of heliocentric distance and size of our targets, and will report on the results of this modeling.

Acknowledgments: This work is supported by NSF grant # 1910275.

References:

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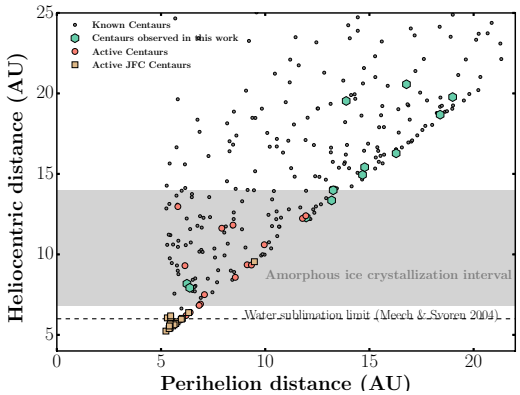

Figure 1: Perihelion distance vs. heliocentric distance of 13 Centaurs studied in this work compared to known active Centaurs and JFCs in the Centaur region, and the known Centaur population as of October 10th 2020. It can be seen that all known active Centaurs reside withing the interval where the crystallization of water ice is possible.