Recent disruption of an asteroid from the Eos family

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A key difficulty with searching for partially differentiated asteroids arises from the fact that a crust covers the exterior of the body, and, consequently, should hide the melted interior. This motivates an alternative approach of examining members of asteroid families, i.e., fragments of single large bodies, many of which were in the size regime capable of igneous differentiation, that have been disrupted by catastrophic collisions. Such families could provide a stratigraphic cross section across the interior of the parent asteroid [1].

With more than 10,000 known members, the Eos dynamical family is one of the most numerous and earliest recognized asteroid families [2]. Interestingly, the estimated ∼220-km-diameter parent body [3] is well within the size range capable of differentiation. Thus, existing family members should contain fragments of the deep interior. The Eos family has the highest diversity of taxonomic classes than any other known family [4]. Many members are of K spectral type, which is uncommon outside the family, and is similar to the spectra of CV, CK, CO, and CR carbonaceous chondrites [5]. This diversity leads to the suggestion that the Eos parent body was partially differentiated [4,6]. Thus, the Eos family may not only be a remnant of a partially differentiated parent body, but it could be the source of the CV-CK meteorite group.

Here we report the discovery of a young subfamily of the Eos asteroid family. It may help understanding the mineralogical nature of the Eos asteroid family and of its parent body.

By applying the hierarchical clustering method [7], we find an extremely compact 16-body cluster within the borders of the Eos family. We name the cluster (6733) 1992 EF, after its largest member. The statistical significance of this new cluster is estimated to be above 99%, indicating that its members share a common origin. All members of the cluster are found to be dynamically stable over long timescales. Backward numerical orbital integrations are used to set an upper limit of the age of the cluster to be only 4 Myr.

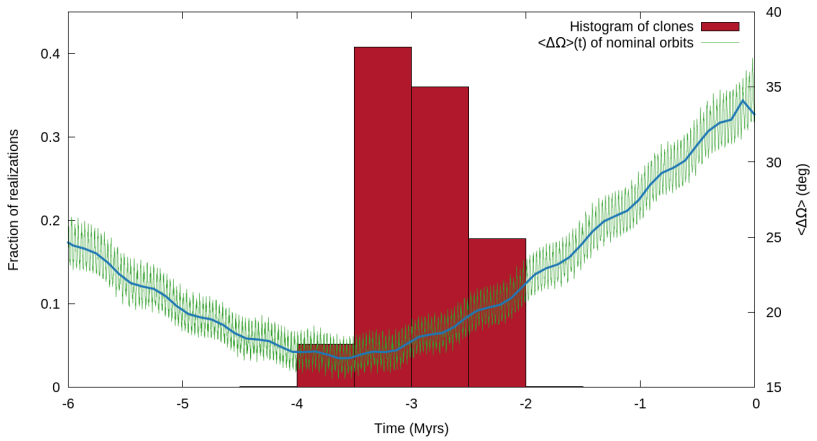

Figure: Estimation of the age of the (6733) 1992 EF cluster using two approaches based on the backward numerical orbital integrations: (1) The green line shows the evolution of the mean differences in the longitude of the ascending node of the nominal members of the cluster. For clarity, a Benzier fit is also shown in blue. (2) The histogram shows the distribution of possible ages obtained from 10^7 combinations of orbital and Yarkovsky clones.

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References: [1] Weiss B.P., Elkins-Tanton L.T., 2013, AREPS, 41, 529. [2] Vokrouhlický D., Brož M., Morbidelli A., Bottke W.F., Nesvorný D., Lazzaro D., Rivkin A.S., 2006, Icarus, 182, 92. [3] Tanga P., Cellino A., Michel P., Zappalà V., Paolicchi P., Dell'Oro A., 1999, Icarus, 141, 65. [4] Mothe-Diniz T, Carvano JM, Bus SJ, Burbine TH., 2008, Icarus, 195. [5] Mothe-Diniz T, Roig F, Carvano JM., 2005, Icarus 174, 54. [6] Burbine TH, McCoy TJ, Meibom A, Gladman B, Keil K., 2002, Asteroids III, pp. 653. [7] Zappalà V., Cellino A., Farinella P., Knezević Z., 1990, AJ, 100, 2030.