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Proper Elements, Asteroid Families, Resonances and the Origin of Near Earth Asteroids

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ABSTRACT

In order to better understand the dynamical and collisional history of the families of asteroids we have built a large catalog of accurate synthetic proper elements. The purpose is to study the dynamical boundaries and the internal structure of these families and to try to identify mechanisms that transport objects from families to NEO region. The study involves a purely gravitational model, but also reveals the signature of the non-gravitational effects. We consider complex interactions between secular resonances, mean motion resonances, chaotic behavior and Yarkovsky-driven drift in semimajor axis. We thus find occurrence of large scale instabilities, which can remove objects from their initial locations within families. In order to better characterize families and steadily update family memberships, we developed an algorithm to attribute new members to existing families every time new objects are added to the proper elements catalog. The results are available in ASTDyS (<http://hamilton.dm.unipi.it/astdys/>).

In order to better characterize the families, we developed an algorithm to attribute new members to the families every time we have new elements. We use a two stage procedure: in the first step we define core families consisting of bright objects, then

add smaller objects; in the second step we repeat the classification procedure using the sample from which asteroids identified as family members already in the first step are eliminated. Once the families are identified only the attribution is repeated periodically, so that the classification remains up to date.

We also start the identification of asteroids affected by mean motion resonances, by using three criteria: stability of the proper semimajor axis, Lyapunov exponents and actual libration of critical arguments. The purpose is to provide information on the long term transport mechanisms and dynamical evolution.

Finally, we refer on the problems to which we give only partial answers.