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Calculated dynamical evolution of the nucleus of comet Hartley 2

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The nucleus of comet Hartley 2 has a relatively regular dumbbell shape with unequal heads. The narrow part of elongated shape contains a relatively smooth region whose covering material is highly different in its shallow structure compared to other parts of this celestial body. The surface of crudely spherical parts of the nucleus is different from the surface of the “neck”, which implies a hypothesis that the shape of the nucleus of Hartley 2 is indicative of destruction of this celestial body occurring in our days. The nucleus rotates around its axis passing through the center of mass, and centrifugal forces arise. This process is hindered by gravitation between parts of the nucleus and gradual slowing of rotation due to body lengthening because of the increase in the moment of inertia (proportional to R2) and due to friction losses in the neck material. We posed the task to determine centrifugal and gravitational forces in the neck (and, respectively, the strains of stretching and compression), the moment of inertia of the body and supply of its rotational energy E, the volume of the nucleus and its average density, and the position of the barycenter and center of rotation. It can be assumed that these forces cause slow but progressive lengthening of the neck which should eventually result in fragmentation of the nucleus. Centrifugal forces can be found as a result of summation of forces produced by parts of the body. According to the calculation model, the total stretching forces in the section passing through the narrowest cut of the neck are 1.21E6 N. The corresponding compression forces in the section passing through the narrow section are 1.04E6 N. The comparison of these values indicates a paradoxical result: stretching strains dominate in the neck, while compressions are dominant in the section passing through the common center of mass. The excess of stretching strains in the neck is 11%. The inference is as follows: the right part of the neck and the right head are only held together by small friction forces in the neck. If they were not there, fragments would separate and move away. One can estimate also how far away they will move. Some part of the rotational energy of the nucleus will be spent to overcome friction forces arising in the material of the neck. This value is unknown, so energy losses on friction are considered to vary between 0 and 50%. The friction losses 50% yields the path needed for the nucleus to completely exhaust its supply of rotational energy 316 m, and 922 m without losses.