BINÁRY

přechod satelitům

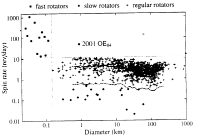

Figure 14.7. Asteroids in the (diameter, spin rate) plane, in logarithmic units. The thick line shows the average spin rate for objects larger than 1 km. The shallow minimum at ≃ 100 km corresponds to the "angular momentum drain" process: when the velocities of the fragments from an impact are near the escape velocity, more objects escape in the prograde sense relative to the rotation of the asteroid, and with their recoil slow down the spin. Full circles below the dashed line, at three standard deviations from the mean, are slow rotators, with unusually long periods, up to a few months. Full squares on the upper left are fast rotators – small near-Earth asteroids with periods as short as a few minutes. The horizontal line at ≃ 12 rev/day, a population boundary above the size of ≃ 150 m, is due to the disruption of loosely bound, faster objects by the centrifugal force; a single exception is the recently discovered 2001 OE_{84}, with a rotation period of 29.19 min and a size of about 900 m. Note that in the population of small bodies, all the near-Earth asteroids observable during a very short window of time, there is a large observational bias toward short periods. Data for nearly 1,000 asteroids kindly provided by P. Pravec.

Only objects with small sizes, which likely are monolithic, can rotate faster. The sub-population of slow rotators is still unexplained; one viable scenario assumes that asteroids undergo braking due to a loss of a close satellite. At smaller sizes, radiation torques may also despin the body (Problem 15.10).

Dactyl OBR
REF?

The accidental discovery by the Galileo spacecraft in 1993 of Dactyl, a small satellite orbiting about the asteroid Ida, opened the investigation of *binary asteroids*. In mid 2002 10 more binary systems in the main belt were known, including one satellite of a Trojan asteroid. These pairs were discovered with very high resolution techniques using adaptive optics and large optical telescopes (including the Hubble Space Telescope). 13 more binary systems were found in the NEO population by optical and radar observations. The orbital

kolik? ~73
NOVÁ STATISTIKA viz Pravec & Harris (2007)

2003 EL61
~~2006 EE~~ ? } TNO charakteristiky, OBR
Pluto

metoda objevu satelitů u planet (Gladman...) – snímkování širokého okolí (Hillovy sféry) & skládání snímků přes sebe motion of binary asteroids yields valuable information about their mass and mean density, typically difficult to access. Current estimates suggest a fraction of a few % of binary systems among the main belt asteroids, but up to 20% among NEOs. The ratio of sizes of the two components ranges between 0.01 and 1, from a primary with a small satellite to a truly double system. The NEO binary systems are characterized by a small separation (not exceeding 10 times the radius of primary) and a small eccentricity of the relative motion (≤ 0.1); there is also indication that the primary always has a short rotation period in the 2 – 3 h range. The origin of binary asteroids, as well as their long-term dynamical stability, is not well known. Some of them might be ejecta that, under favourable conditions, formed during collision of a parent body (as during family formation); another possibility is a capture of ejecta in a non-disruptive cratering event on the primary. In the case of NEOs there might be more possibilities: tidal fission due to close encounter with a planet or rotational fission due to the YORP effect (see Problem 15.10).

Chemical composition of asteroids. In the last few decades an intense observational effort has shed light on the problem of asteroid composition, which has been found to be very diverse. The main source of information is spectral analysis of reflected sunlight, but other techniques, like infrared observations, polarimetry and planetary radar, have been applied as well. These data have then been interpreted by comparing them with the properties of minerals found in different meteorite types.

A clear difference among various types of surfaces is found in the distribution of albedo. When observational biases against darker objects are accounted for, some 75% of the asteroids are found to be very dark, with average $A \approx 0.04$. A distinct group of bodies have a moderate albedo of about 0.15, with few asteroids lying in between and a tail of "bright" bodies with A up to 0.4 and more. A better discrimination is possible if spectrophotometry data are used, yielding the behaviour of the reflection spectrum over a wide wavelength interval (Fig. 14.8). Some absorption bands are unequivocal evidence of silicates, water ice and hydrated minerals, but in many cases these prominent features are lacking, and any inference about the mineral composition must be regarded as conjectural.

Statistical clustering techniques have been applied to sets of observational parameters, potentially relevant for the surface composition of asteroids, in order to define the so called *taxonomic types*. C-type asteroids have a very low albedo and a flat spectrum throughout the visible and the near infrared; they are probably similar in composition to carbonaceous chondritic meteorites, which are primitive mineral assemblages subjected to little, or no, metamorphism after their condensation. D-type objects are also dark, but have very red spectra, suggesting the presence of low-temperature organic compounds. These objects are similar to many low-albedo, reddish small bodies found in the outer

* Walsh & Richardson (2007)

- slapy nestačí na vznik ~ 15% binárních asteroidů NEA
- ovlivňují binární NEA s velkou separací složek