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Report for the Habilitation thesis of Dr. Josef Ďurech

Except for the very largest bodies in the main belt, nearly all asteroids are irregular in shape and marked by impact craters and surface features, such as boulders. The irregular shape of asteroids has important consequences on their dynamical evolution. Non-gravitational forces such as the YORP effect may increase (or, possibly, decrease) the rotation period of a given asteroid, and change their spin obliquity pushing it toward extreme values, like 0° or 180°. By acting in conjunction with the Yarkovsky effect, these two non-gravitational forces may produce the observed V-shape in the (a,H) plane of evolved asteroid families, like the Flora family discussed by the author in his Sect. 3.1.4. While the theoretical understanding of the nature of the Yarkovsky and YORP effects has significantly improved in the last years, much still needs to be understood. Obtaining reliable shapes of large samples of asteroids, of their pole orientations, of their periods, and of important physical properties affecting the strength of the Yarkovsky effect, such as the surface thermal conductivity, geometric albedo, and mean and surface density, is vital for correctly modeling the orbital evolution of asteroid families, and for obtaining reliable estimates of their ages and original ejection velocity fields.

The applicant of this thesis, Dr. Josef Ďurech, has made, in my opinion, outstanding contributions to these and other research areas. Among the main results of his work, that in his thesis is presented in 15 published papers, I would like to emphasize his results on the problem of shape modeling of asteroids from light-curves and disk integrated data. The convex inversion method to obtain asteroid shapes has been originally proposed by Kaasalainen et al. (1992a,b). The applicant modified and significantly improved the method in several published works. He made the code and results of its application available in the DAMIT (Database of Asteroid Models from Inversion Techniques) database, that is currently a reference for researchers in the field.

The author is also responsible for the Asteroids@home (http://asteroidsathome.net) computing project, built on the Berkeley Open Infrastructure for Network Computing (BOINC). Sparse photometry data is divided into small units that are distributed among volunteers. The results are then cross-validated and joined together. As a result, models of asteroids are then published in peer-reviewed journals (Ďurech et al. 2016). Asteroids@home is currently one of the top-ten active distributed computing projects.

Other contributions of the applicant, such as, for instance, the use of thermal infrared data and results from asteroids occultations, are also described in his thesis and further emphasize his important inputs to the field in the last 12 years.

Overall, the applicant has made outstanding contributions in the area of physical modeling of asteroids, in my opinion. I believe that he would make an excellent addition

to the faculty at Charles University, and I am therefore recommending the acceptance of his habilitation thesis and his appointment as an associate professor.

Best regards,

Valerio Carruba

Prof. Valerio Carruba
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