



FACULTY
OF MATHEMATICS
AND PHYSICS
Charles University

doc. RNDr. Mirko Rokyta, CSc.
Studijní oddělení
Ke Karlovu 2027/3
121 16 Praha 2
Czech Republic

Supervisors report on the PhD Thesis of P. Ševeček

The PhD thesis of Mgr. Pavel Ševeček “Simulations of asteroid collisions using a hybrid SPH/N-body approach” consists of an 80-page introduction on methods/tests/experiments and 3 papers: Ševeček et al. (2017, published in *Icarus*) on impacts to 10-km asteroids, Ševeček et al. (2019, in *A&A*) on rotating asteroids, and Vernazza et al. (2020, in *NA*) on observations of (10) Hygiea -- to which Pavel Ševeček (as the 2nd author) contributed the key interpretation of Hygiea’s round shape, which makes it similar to dwarf planets.

First, let me mention that Pavel is an excellent programmer (in C++). In the course of time, as we needed more-and-more complex collisional models (incl. self-gravity, rotation, friction, shapes, ...), he developed an extremely useful code (called *Opensph*), with state-of-the-art physics, rheology, methods, algorithms, parallelisation, and also visualisation. The only limitation, I am aware of, is the parallelisation using Openmp (threads), but not MPI (message-passing interface), because there are serious geometrical problems with balancing. He can be very self-confident in this context. At the Astronomical Institute, he prepared selected lectures on numerical solution of partial differential equations (in fall/winter 2019).

Therefore, we could spent `hours' discussing astrophysical subjects, which are of primary

Astronomical Institute
Charles University
V Holešovičkách 2, 182 00 Praha 8
Czech Republic
phone: +420 22191 2572
fax: +420 22191 2577
e-mail: mfau@mbox.troja.mff.cuni.cz

interest, interpretation of results, implications, etc. I learned a lot of `new' physics (and also informatics) myself in these discussions. Of course, I was very proud of him, when he collaborated with M. Jutzi (Univ. Bern), P. Vernazza (Aix Marseille Univ.), T. Maindl (Univ. Wien), or K. Walsh (SWRI, Boulder). Pavel subsequently moved from more general simulations to interpretation of individual asteroids, observed with the VLT/SPHERE adaptive-optics (AO) instrument. His work is indeed timely; for example, he was able to compute shape oscillations of (10) Hygiea just two weeks after the AO images were acquired.

These days I use the Opensph code myself, e.g., to study impacts on irregularly-shaped asteroid (216) Kleopatra, with complex gravity field and critical rotation. We plan to study collisions of protoplanets embedded in gas, to describe formation of giant-planet cores within a protoplanetary disk. I really appreciate Pavel's contribution, help, and long-time friendship.

I may only recommend a courage to undertake a postdoc "as far as possible", which would open Pavel more doors -- for future research, collaboration and discoveries!

I strongly support the application of Pavel Ševeček and I recommend his PhD thesis for defense.

With kind regards

doc. Mgr. Miroslav Brož, Ph.D.

In Prague, Aug 14th 2021