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Supervisor's report on Ph.D. dissertation

Title: Helioseismic inversions of plasma flows and sound-speed perturbations

Student: RNDr. David Korda

The topic of the doctoral project of David Korda was the time-distance helioseismic inversions in the near-surface layers of the solar convective zone. This is a still developing topic of solar research, which has potential consequences for understanding and modelling of solar dynamo. Helioseismology constitutes the only method that provides us with the constraints to models of the solar interior.

The presented doctoral thesis consists of a rather larger introduction on waves in plasma, including the modes important for helioseismology. An overview of helioseismic methods follows. A special chapter is devoted to inverse-modelling methods, which are the principal methods utilised by the student, especially to the Multi-Channel Optimally Localised Averaging method. The remaining principal components of the time-distance pipeline are also well described.

The largest portion of the thesis is then devoted to the presentation of the results. These are presented in three peer-reviewed papers and two chapters containing the original results, which are being prepared for publication. The papers and yet unpublished results have both methodological content and also present the application of the proposed methodology to real solar observations. The publication activity of the student is further supplemented by a lengthy invited review, where David contributed significantly, and the contribution to two more peer-reviewed manuscripts.

I believe that already the presence of two peer-reviewed papers in the thesis, where the student is the first author, clearly proves his scientific erudition. Already in the second year of his Ph.D. studies, David Korda presented the preliminary results of his research at European Solar Physics Meeting and won the prize awarded by European Solar Physics Division to the best student poster.

To further underline that other people think well about David's work, I have to quote from two reports:

- The referee of the paper Korda et al. [A&A 629 (2019) A55] wrote in his/her report: "This is a thorough, careful, and highly useful critique and comparison of several time-distance seismic inversion methodologies as applied to SDO/HMI observations. Of particular utility is the detailed comparison of the different properties and results with respect to the standard

JSOC pipeline inversions. This should be required reading for anyone who has made (or is planning to make) use of the latter JSOC inversion or travel-time products, perhaps even more so than the original description of the pipeline. I recommend prompt publication of this [...]"

- The panelist from the Grant Agency of Charles University reported on project No. 532217 (which was awarded to David Korda) the following words: “Výsledky ukazují na velmi systematickou práci při řešení projektu, která vedla k hodnotným unikátním výsledkům. 3 obsáhlé publikace v prestižním časopise, jedna review kapitola. Celkově hodnotím jako mimořádně kvalitní projekt.” (“The results show a very systematic work in solving the project, which led to valuable unique results. 3 extensive publications in a prestigious journal, one review chapter. Overall, I rate it as an exceptionally good project.”) The project was evaluated as “excellent”.

When David joined this project, he started from scratch, as the focus of his previous work was different. Already in the first year, he had a deep understanding of the problem, he was able to run inversion and travel-time jobs on a local computer cluster and was able to perform non-trivial modification of the codes and pipelines. In the following years, his coding and data-processing and data-mining skills improved dramatically as did his independent thinking on the problem. In the last two years, I only had to serve as a mentor, because most of the scientific work was done by David Korda himself.

Apart from his scholarly work on the problem, he participated in the teaching of Solar Physics I and Advanced Methods in Solar Physics lectures. He co-advised the bachelor’s project of Jiří Wollmann.

Without a doubt, I believe David Korda has grown into an independent young scientist who has all qualities to start a successful researcher carrier. Therefore I strongly recommend that David Korda be awarded a Ph.D. degree after the successful defence.

Michal Švanda