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Ernest Rutherford Fellowships Peer Review

STFC Reference: ST/X003833/1

Document Status: With Council

Ernest Rutherford Fellowships 2022

Applicant Details

Applicant	Dr Evan Henry Anders	Organisation	University of Exeter

Title of Research Project

Improved magnetoconvection models for precision astrophysics

Review Information

Response Due Date	04/11/2022	Reviewer Reference:	099166620

Research Council Contact Details

STFC Administration Contact:	Email:	Telephone:

Overall Assessment

Please include justification for the scores given above and assess against the criteria stated in the reviewer guidance.

Please include comments on: (1) the excellence of the research achievements of the applicant; (2) the potential of the applicant to lead their research discipline; (3) the capability to maximise the potential of others and the ability to be, or become, a clear communicator and disseminator of knowledge; (4) the excellence, timeliness, feasibility, distinctive vision and importance of the proposed research; (5) strategic value within the STFC programme.

This information will be available in the feedback given to the applicant.

The applicant has made a significant impact upon this field in a relatively short period of time. Their recent publication record is particularly impressive, making a number of important contributions to the field of stellar convection, including notable work on convective penetration that is directly relevant to the proposed project. Their expertise in the use of the Dedalus code (which is the main numerical tool that will be used in this project) is clear. Whilst they are still at a relatively early stage of their research career, the applicant's track record does certainly indicate some degree of research leadership potential and I note that they have successfully applied for competitive fellowships and they are already co-mentoring quite a large number of graduate students. They evidence a strong background in outreach/communication.

In terms of the research project, the applicant is proposing to address a series of research questions relating to stellar

convection, relating specifically to the convective cores of massive stars, magnetoconvection in fully convective low-mass stars and the stellar mass dependence of surface convective blue-shifts (which could have important and timely consequences in terms of enabling the detection of extrasolar planets). These are all very important questions that are certainly of strategic value to STFC. In order to address these questions, they will carry out a range of local and global (hydrodynamic and magnetohydrodynamic) simulations using Dedalus, which is ideally suited to the proposed research, particularly given its ability to simulate flows through the origin of the spherical domain that will be needed for the global models. I would have liked to have seen a few more details in places regarding the proposed simulations, but I have no doubt that interesting results will emerge. Exeter is an excellent choice of host institution - Prof. Baraffe's group has a world-leading reputation in numerical studies of stellar interiors, and there are clear potential collaborative links with Prof. Browning, who is an expert on M-dwarf simulations.

I had a few comments to make regarding feasibility:

1) The proposal indicates that the global models are going to be fully compressible, which is computationally rather challenging (even with an accelerated convergence scheme), particularly for the penetrative calculations that might require lengthy integrations in order to achieve a state of full thermal relaxation. Such global models would normally make an approximation (e.g. anelastic) to filter out sound waves from the system and I wonder whether that might be necessary here in order to achieve the goals set out?
2) I wonder how much computing time is needed in order to achieve these goals? Whilst I may have missed this in the proposal documentation (and apologies if so), I don't think the HPC requirements of this project were set out anywhere. Although I am sure that the Exeter group has local computing resources, is it clear that these will be adequate for this project? Is there an intention to apply for time on DiRAC?

Having said that, my overall assessment is that this is a strong proposal.