

Project number: 016.149.3330

Name applicant:

Title:

You are requested to use box 1 for general remarks. The remaining part of the form (box 2) is to be used to address each reviewer's assessment. In total the rebuttal must not exceed 3 A4 pages (minimum font size 8.5 pt).

General remarks – box 1

I am very thankful to the four referees for their careful reading of my research proposal, their enthusiasm and the excellent marks. I will below happily address the minor concerns that they raised.

Response to reviewers comments – box 2

Referee I:

"The outreach program discussed in the application is fairly standard and part of the existing program at the host institute, which is described in some detail. It is not clear to what extend the applicant is planning to integrate the proposed research with the outreach program and whether or not it is necessary for this."

The outreach program of the Delta-Institute for Theoretical Physics (D-ITP) that I outlined in the proposal is – similar to the institute itself – relatively new and not entirely developed yet. It is great that this initiative exists, and I believe that it is more promising to contribute to such a newly emerging program rather than to start my own isolated outreach activities. The mentioned contributions (profielwerkstuk, public website, public lectures) are in this context very realistic, and in particular the profielwerkstuk will be directly connected to my own research activities.

"The project is crucially dependent on recruiting the right people and having them work together as a unit. It is not clear that this is feasible or that the applicant has the experience in making this selection and supervising the group."

Currently, I am closely supervising two PhD students, one working on indirect searches with the Cherenkov Telescope Array, the other working on the analysis of the cosmology of scenarios with mixed cold+hot dark matter. In the past, I successfully supervised a master and a PhD student. I look happily forward to the challenges and opportunities that leading a small research group will bring in the future. During the current and the previous academic year, I was directly involved in the selection of PhD and postdoc candidates for the GRAPPA institute. For the recruitment of my own personnel I will be able to make use of this existing application framework, which will allow me to select the best candidates from a very large pool of international applicants.

"The proposed research is mainly a natural continuation of the applicant's previous research and does not break new ground in this sense."

With the proposed research project, I plan to further pursue and fundamentally advance a successful research direction with the strength of a small research group. My research will break new grounds in several ways: Cross-correlations between gamma-ray data and galaxy catalogs are a newly emerging and very promising field that is not fully explored at all, and allows an entirely new view at the Fermi LAT data. LOFAR will break new grounds in low-frequency radio astronomy, and the same is expected for dark matter searches with LOFAR if backgrounds can be kept under control. The clarification of tentative gamma-ray signatures in the Fermi LAT sky by a critical reassessment of template based analysis techniques is highly relevant and will constitute important milestones in the indirect search for dark matter. A central part of my research will be the development of new methods and search strategies that will serve the community beyond the boundaries of my own research proposal.

"The proposal focuses on indirect detection signals of dark matter and is thereby missing other possible forefront signals such as direct detection and production at accelerators."

Indirect dark matter searches are an extremely promising avenue to follow in order to probe the freeze-out mechanism that underlies the WIMP paradigm for dark matter. Alternative probes to the WIMP paradigm are collider and direct searches. I am heavily involved in the development of the GAMBIT inference tool, which will be a next-generation global fitting tool that will facilitate the combination of different search strategies and confront them with the most relevant dark matter models. Beyond that, I believe that staying focused at the forefront of one of the main WIMP search strategies does not limit but rather extend the impact of my research.

Referee II:

"Because of space restrictions, did not have enough room to really explain the relevance/complementarity of direct detection and collider searches for dark matter."

Direct detection and collider searches are highly complementary to indirect probes. The reach of direct detection experiments will improve by up to two orders of magnitude in the upcoming years; the upcoming high-energy run of the LHC will allow to test new physics scenarios at increasingly high masses. It is well known in the community that certain model classes for WIMP dark matter can only be fully probed by a combination of these different strategies. Although I will concentrate on indirect searches in the main part of my research, my strong involvement in the GAMBIT collaboration will ensure that the complementarity between different experiments will be fully explored in constraints of specific particle physics scenarios for dark matter.

"As expected, proposed outreach activities are not as innovative as the proposed research itself."

The proposed activities, namely the contribution to a website for the public that presents the current developments in theoretical physics, the opportunity for high school students to perform their profielwerkstuk in my research group, and possibly public lectures, are realistic and useful ways to communicate the ideas of fundamental research to the public.

Referee III:

"...I am therefore tempted to encourage the applicant to think well about the models he wants to scan, and to talk not just to dark matter phenomenologists but also to real model builders with other interests (EW symmetry breaking). I am not sure 25-parameter scans of the MSSM is the most relevant thing to do. In any case, this is a minor criticism as this only reflects a small part of the project."

A statistically sound analysis of the vast parameter space of the MSSM-25 is a yet-not-realized challenge for global analyses codes as well as physically interesting by itself. It is one of the central milestones for the development of the GAMBIT inference tool, and in this sense a natural starting point. However, in principle I am interested in considering a larger number of models, including effective operators, asymmetric dark matter, minimal models with e.g. Z-primes and Higgs-portal, with my central criteria for model selection being simplicity.

Referee IV:

"The applicant is planning to lead a team of three/four people. Although there are no doubts in the applicant's potential concerning this task, to lead two PhD students simultaneously might be too much at this stage of his career, given the fact that until now the applicant has never fully mentored alone a PhD student."

As already mentioned above, I am currently closely supervising two PhD students. This includes everything from defining the project goals, selecting appropriate analysis techniques, recommending the relevant literature, giving detailed advices on code development, providing personal encouragement, having regular meetings, cross-checking results, to drafting the papers. I worked in the same way with an exchange PhD student for one year in the past. Given this experience, leading a research group of three to four people will be a challenging but realistic task.