Intellectual Merit Criterion

Overall Assessment of Intellectual Merit
Excellent

Explanation to Applicant
The applicant poses an interesting project that applies neural networks to machine learning, with potential applications toward a host of n-body systems. The plan for achieving the proposed project is nicely detailed and achievable. The reference letters are glowing. The applicant's academic record is excellent, and his rich research internship experiences and successes are second to none.

Broader Impacts Criterion

Overall Assessment of Broader Impacts
Excellent

Explanation to Applicant
The applicant has the potential to impact the field if, as proposed, deep neural networks can be leveraged to more efficiently solve the time evolution of n-body systems. The proposal would have benefited from a bit more detail on how the Broader Impacts would be disseminated during the fellowship period.

Summary Comments
The research plan is well described and feasible over a three-year period. The overall undergraduate record is very strong, as reflected in the letters of reference. The potential for Broader Impacts is compelling.

Intellectual Merit Criterion

Overall Assessment of Intellectual Merit
Excellent

Explanation to Applicant
This application principally aims to machine learning to N-body simulations. The main scientific goal is to assess if machine learning techniques can deliver predictions on the evolution of N-body systems with an accuracy on par with direct numerical integration. To reach this goal neural networks will be applied to an escalating sequence of systems - from two body Keplerian systems through chaotic gravitational N-body systems to complex systems where other interactions are considered (e.g., hydrodynamics effects). The science results are then to be compared to direct N-body simulations and observations from NSF supported observational surveys. Strengths: Applications of Artificial Intelligence is widely viewed as one of the next great frontiers in astronomy and astrophysics. This proposal plans to advance the field by training state-of-the-art deep learning techniques with mature N-body calculations on graphical processing units. If predictions from such applications of Artificial Intelligence are successful, it would likely be transformative in how we understand the evolution of N-body systems. The activities described build upon existing capabilities, as evidenced by two first-author papers in top-shelf peer-reviewed journals. Weaknesses: The activities described would have benefited from a stronger connection to, and motivation by, the astronomy observations.

Broader Impacts Criterion

Overall Assessment of Broader Impacts
Excellent

Explanation to Applicant

The broader impact activities described include broad relationships electromagnetic N-body systems in biology and chemistry, pulsations of hot subdwarf B stars, the potential discovery of other variable stars, and teaching of master level Python courses. Strengths: Prior results from this line of research have been presented at recent conferences. The education and outreach activities described are specific and actionable. Weaknesses: None.

Summary Comments

This is an excellent proposal with no weaknesses.

Intellectual Merit Criterion

Overall Assessment of Intellectual Merit

Excellent

Explanation to Applicant

the applicant has excellent recommendation and has excellent grades. He has demonstrated a powerful ability of applying computer modeling in several projects and he has published a couple papers on the subject which exhibits his ability in his chosen field of study. He was a recipient of the Goldwater fellowship.

Broader Impacts Criterion

Overall Assessment of Broader Impacts

Very Good

Explanation to Applicant

He has mentored several students at HP and he has worked on several outreach projects to help others develop interest in Astronomy.

Summary Comments

High Point University is a small college and has already produced a few students who have received NSF fellowships.