Avi Vajpeyi

Gravitational Physics International REU Program *December 14, 2016*

Department of Physics
University of Florida
Gainesville, FL 32611-8440

To whom it may concern,

Recommendation Letters

The contact details for my two recommenders:

1. **Rory J. Smith** roryjesmith@gmail.com
   Senior Postoctoral Researcher in Physics at Caltech
2. **John Lindner** jlindner@wooster.edu
   Chairperson, Professor of Physics and The Moore Professor of Astronomy at the College of Wooster

Projects

1. **Developing a data analysis strategy for detecting continuous wave sources in binary systems:**
   Mentors: Paola Leaci
   Although the first GW detections were from coalescing black hole systems, black holes are difficult to study visually. Pulsars, on the other hand, given the correct orientation, provide a plethora of information with the radio waves they emit. Additionally, we have been able to confirm the existence of four black holes (now two black holes), while we have been able to confirm numerous pulsars. Thus, I think it is important for us to improve our data analysis techniques to detect the GW waves from pulsars. It is because of this that I would be enthralled by the chance of contributing to the development of data analysis strategies to detect continuous gravitational wave signals from such binary systems. Additionally, the computational challenges that this can provide excites me as I am curious about the different types of algorithms that can be implemented to help us detect continuous GW. I would be a good fit for this project as last summer when I worked at LIGO Caltech, I was evaluating the use of Bayesian Statistics as a detection statistic for CBC triggers. This experience may help me understand different approaches that may be considered to develop a data analysis strategy.
2. **Ensemble gravitational wave detections- more than the sum of the parts**
   Mentors: Paul Lasky, Yuri Levin and Eric Thrane
   After trying to parse the information presented in the article attached to the project description (”Detecting Gravitational-Wave Memory with LIGO: Implications of GW150914), I became curious about GW memory. I tried researching more on how ideal detectors experience a permanent displacement after the pasing of GWs and spoke to my GR professor regarding the differnt types of GW memory. Additionally, after having worked through the weak-field regime in class, I understand how challenging and satisfying it is to go through derivations from GR. Hence, the idea of being involved in trying to look for a derivation for unltra-strong gravitational fields and the origins of steller mass black holes sounds very appealing to me.
3. **Robust network detection of unmodeled GW bursts in non-Gaussian glitchy noise:**
   Mentors: Maria Principe, Innocenzo Pinto
   Having used thepyCBC and GSTlal LIGO pipelines my last summer at LIGO to analyse various noise events for GW transients, I gained a basic understanding of how those pipelines work. Being a computer science major, I was very curious about the algorithms on which these piplines were running and spent time with my mentor discussing them. Although I am not as familiar with the cWB pipeline, I would be very excited to work on helping implement the locally optimum detection statistics for the pipeline.

4. **All-sky search of continuous gravitational wave signals:**
   Mentors: Pia Astone
   The first observation run for aLIGO resulted with two detections GWs. Now, there have been even further improvements to aLIGO and Virgo is back in commission. Hence, I think that soon there will be many more chances for detecting GW signals in the strain data. However, to detect the signals, it is necessary that the analysis pipelines do not allow GW strain data to slip by. This is why the scientific collaboration is so thorough at searching through the data. I understand that such thorough searches may result with days worth of noise data which may be useful in creating backgrounds for detection statistics. However, if the noise data can be useful in providing additional information such as the source population, I think that it will be very useful to implement analysis techniques in the pipeline as there is a great abundance of noise data being recorded. I would be very interested in working on developing and implementing such a feature to the analysis software as this work may enhance our understanding of the background, and involves interpreting data that we have an abundance of.
5. **Search of continuous gravitational wave signals from known pulsars:**
   Mentors: Cristiano Palomba
   This project sounds interesting to me as I think that improving the analysis software would greatly help the Virgo/LIGO scientific collaboration. Currently, analysis can take several hours, however if the optimal data analysis method does reduce computational speeds, this may reduce analysis time and thus allow more data to be studied. I am also curious to learn about the optimal data analysis method and its implementation.

Home Institution Mentor

Dr. John Lindner, my second recommender, can act as my mentor in my home institution. He was the professor for my General Relativity Course I took this past semester.

Summer Address

An address to which a check can be securely sent in Summer is:
430 Sterling Place, Apt 2A
Brooklyn, NY 11238
I will be available from May 27th to August 16th.

International Travel Status

I am a Green Card Holder, of Indian nationality. There are no restrictions for travel to any of the host countries for me.

Sincerely,

Avi Vajpeyi

Attached: Curriculum Vitae, Transcript