



Department of Physics

College of Letters and Science
Montana State University - Bozeman
P.O.Box 173840
Bozeman, MT 59717-3840

Charles C. Kankelborg
Telephone 406-994-7853
FAX 406-994-4452

kankel@solar.physics.montana.edu
<http://solar.physics.montana.edu/kankel/>

March 9, 2018

To: NESSF Selection Committee

Dear Colleagues,

I am writing to recommend my PhD student, Roy Smart, for renewal of the NASA Earth and Space Science Fellowship he was awarded in 2017. Roy is a highly creative young scientist with a diverse set of talents and a strong work ethic. You will see from his report that he has made significant progress, and is very deserving of renewal.

The idea of developing a neural network to invert MOSES and ESIS sounding rocket data for solar transition region line profile parameters is entirely Roy's idea. It strikes at the heart of a core problem in my own research, which aims to deliver to the community a new approach to imaging spectroscopy: the ability to map line profile parameters such as shifts and broadenings over a wide field of view, in a single snapshot, at EUV and FUV wavelengths. Roy did a lot of background research to convince me of the merit of his neural network approach. Since you have his progress report, I will not attempt to summarize everything he has accomplished in the past year, but he has developed a large training dataset based on IRIS images, built and characterized a neural network to extract Doppler shifts. The results he has so far are worthy of publication, so he will be writing up a first paper very soon. Accomplishing these major tasks required solving a number of thorny technical problems, including the development of fully automated cosmic ray removal for IRIS data (all the best routines out there, including my own contributions to SolarSoft, require some tuning to perform well on a given data set). Roy's work is greatly facilitated by his increasing skill with GPU programming, which allows him to take advantage of the image processing capacity of a high end graphics card—typically two orders of magnitude faster than standard CPU calculations.

Roy continues to be involved in our sounding rocket program, pursuing that in parallel with the neural network development. His experience with our detectors, flight software, and optics continues to sharpen his understanding of instrumentation and data analysis. Real spectrographic data is affected by multiple sources of noise, optical aberrations, charge spreading, imperfect alignment of detector arrays with instrument dispersion, dust on detectors, thermal transients during flight, and a host of other effects. Many scientists working on astrophysical data analysis today have a limited imagination where these effects are concerned, but they are becoming a part of Roy's basic intuition—and to an appropriate degree, they will be built into his training datasets. Consequently, the powerful tools he is developing will be applicable to real world data. The rocket will be launched during the next term of the NESSF fellowship, so only data analysis will remain at that point.

In nearly two decades as a faculty member, I have not seen a graduate student as creative and persistent as Roy Smart. His special skills with software development, neural networks, and GPU programming were acquired at his own initiative. Though he makes every effort to learn from his advisor and other experienced people, he possesses sufficient initiative and self-confidence to explore his own ideas. He is an imaginative problem solver, an effective team member, and a good-spirited person who is bound to make his mark on the field of solar physics. I recommend him highly for renewal of the NESSF Fellowship.

Sincerely,

A handwritten signature in dark ink, appearing to read "Charles C. Kankelborg". The signature is fluid and cursive, with the first name "Charles" and last name "Kankelborg" clearly distinguishable.

Charles C. Kankelborg
Professor of Physics