# Roy T. Smart

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## INTERESTS

- EUV instrumentation (imaging and spectroscopy)
- Solar transition region explosive events
- Optics modeling and tolerancing
- Machine learning
- Software engineering
- High-performance numerical simulation

## EDUCATION

**Ph.D. Candidate in Physics** **Aug 2015 - Present**
Department of Physics, Montana State University

**B.S. in Physics, Minor in Computer Science** **Aug 2011 - May 2015**
Department of Physics, Montana State University

## WORK EXPERIENCE

**Department of Physics, Montana State University** **Jan 2016 - Present**
Graduate Research Assistant for Professor Charles Kankelborg Bozeman, MT

- **ESIS instrumentation.** The EUV Snapshot Imaging Spectrograph (ESIS) is a NASA sounding rocket mission designed to measure solar transition region spectral line profiles with high spatial, spectral and temporal resolution over a wide field of view.
  - **Data analysis.** Implemented a convolutional neural network to recover spectral line profiles from ESIS observations.
  - **Optical modeling.** Developed a custom raytrace model in Python to calculate the distortion, vignetting, point-spread function, etc. of the ESIS optical system.
  - **Optics testing.** Measured the wavefront error and roughness of the ESIS primary mirror and gratings using phase-shifting interferometry.
  - **Alignment and focus.** Developed procedures to align and focus the ESIS optics using a Zemax model of the instrument.
  - **Baffle design**. Developed an automated procedure to generate apertures for the ESIS baffles using a Zemax model of the instrument.
  - **Launch campaign.** Operated the ESIS instrument during integration, testing, and flight operations at White Sands Missile Range, NM.
- **FURST optical modeling.** Used Zemax to validate and characterize the optical design for the Full-Sun Ultraviolet Rocket Spectrometer (FURST), a NASA sounding rocket mission designed to measure the vacuum ultraviolet spectrum of the Sun as a star with high resolution.
- **IRIS Planning.** Organized observation schedule for the Interface Region Imaging Spectrograph (IRIS), a NASA Small Explorer mission that observes the solar ultraviolet spectrum with high spatial, spectral, and temporal resolution.

**Department of Physics, Montana State University** **Aug 2015 - Dec 2015**
Graduate Teaching Assistant for Professor Nicholas Childs Bozeman, MT

- **Undergradute Physics I.** Assisted with conducting the labs, test proctoring, and grading.

**Department of Physics, Montana State University** **Sep 2012 - Aug 2015**
Undergraduate Research Assistant for Professor Charles Kankelborg Bozeman, MT

- **MOSES instrumentation.** The Mulit-Order Solar EUV Spectrograph (MOSES) is the predecessor to ESIS and is also a NASA sounding rocket mission designed to measure solar transition region spectral line profiles with high spatial, spectral and temporal resolution over a wide field of view.
  - **Flight software.** Developed and tested software to control the cameras on MOSES and downlink the images.
  - **Data analysis.** Developed a convolutional neural network to process observations from the MOSES instrument.
  - **Launch campaign.** Operated the MOSES instrument during integration, testing, and flight operations at White Sands Missile Range, NM.

## TECHNOLOGY SKILLS

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|---|---|
| **Design Software** | Zemax |
| **Programming Languages** | Python, C/C++, IDL, LaTeX, CUDA C/C++, Java, Mathematica |
| **Frameworks and libraries** | Numpy, Scipy, Astropy, Sunpy, Numba, Pandas, Keras, Sphinx |
| **Office Accessories** | Word, Powerpoint, Excel, Project, Visio |

## AWARDS

**NASA Earth and Space Science Fellowship (NESSF)** **Sep 2017 - Sep 2020**
"Neural Networks for Computed Tomography Imaging Spectroscopy"

## PUBLICATIONS

- Parker, J. D., **Smart**, **R. T.**, Kankelborg, C. C., Winebarger, A. R., & Goldsworth, N. (2022). First Flight of the EUV Snapshot Imaging Spectrograph. *ApJ*, Accepted
- **Smart**, **R. T.**, Courrier, H. T., Parker, J. D., Kankelborg, C. C., Winebarger, A. R., Kobayashi, K., Beabout, B., Beabout, D., Carrol, B., Cirtain, J., Duffy, J. A., Gullikson, E., Johnson, M., Rachmeler, L., Springer, L., & Windt, D. L. (2022). The EUV Snapshot Imaging Spectrograph, In preparation

## PRESENTATIONS

- **Smart**, **R. T.**, Kankelborg, C. C., & Parker, J. D. (2020). Convolutional Neural Networks for Tomographic Imaging Spectroscopy of the Solar Atmosphere. *AGU Fall Meeting Abstracts*, *2020*, Article SH048-0003
- Parker, J. D., **Smart**, **R. T.**, Goldsworth, N. C., Kankelborg, C. C., Winebarger, A. R., Kobayashi, K., & Rachmeler, L. (2020). Doppler Measurements of Transition Region Transient Events at 630 Angstroms from the ESIS Sounding Rocket. *AGU Fall Meeting Abstracts*, *2020*, Article SH048-0004
- **Smart**, **R. T.**, Kankelborg, C. C., Parker, J. D., Courrier, H., Winebarger, A. R., Kobayashi, K., & Rachmeler, L. (2019). A Neural Network-based Data Analysis Technique for the EUV Snapshot Imaging Spectrograph. *AGU Fall Meeting Abstracts*, *2019*, Article SH31C-3321
- Kankelborg, C. C., Parker, J. D., **Smart**, **R. T.**, Winebarger, A. R., Kobayashi, K., Rachmeler, L., & Courrier, H. (2019). First Flight of the EUV Snapshot Imaging Spectrograph. *AGU Fall Meeting Abstracts*, *2019*, Article SH33A-05
- **Smart**, **R. T.**, & Kankelborg, C. C. (2018). Machine Learning Techniques for Computed Tomography Imaging Spectroscopy of the Solar Atmosphere. *AGU Fall Meeting Abstracts*, *2018*, Article SH23A-05
- Johnson, M. A., Kankelborg, C. C., Meuchel, R., & **Smart**, **R. T.** (2018). Confocal microscopy for high-precision non-contact optical measurements. *Optical System Alignment, Tolerancing, and Verification XII*, *10747*, Article 107470A. https://doi.org/10.1117/12.2319597
- **Smart**, **R. T.**, Kankelborg, C. C., Bonham, N., & Courrier, H. (2017). Measuring Plasma Flows in Transition Region Loops Using the MOSES Instrument. *AAS/Solar Physics Division Abstracts*, *48*, Article 106.10
- Kankelborg, C., Philip, J., Winebarger, A. R., Kobayashi, K., & **Smart**, **R. T.** (2017). VUV Spectroscopy of the Sun as a Star. *AAS/Solar Physics Division Abstracts*, *48*, Article 110.01
- **Smart**, **R. T.**, Courrier, H., & Kankelborg, C. (2016). Preliminary Results of the MOSES II 2015 Flight. *AAS/Solar Physics Division Abstracts*, *47*, Article 309.01

## REFERENCES

Dr. Charles Kankelborg
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Bozeman, MT
Tel: 406-994-7853
Email: kankel@montana.edu
Relation: Supervisor & course teacher

Dr. Jacob Parker
Research Astrophysicist
NASA Goddard Space Flight Center
Greenbelt, MD
Tel: 208-520-2807 (cell)
Email: jacob.d.parker@nasa.gov
Relation: Colleague

## PERSONAL INTERESTS

- Alpine skiing
- Whitewater rafting
- Open-source software development
- Amateur astronomy