

“A Small Explorer mission to understand how the solar atmosphere is energized”
<http://iris.lmsal.com/>

NASA Student Solar Spectrograph Competition

Montana Space Grant Consortium

Angela C. Des Jardins
Director

Randy M. Larimer
Deputy Director

Principal Investigator
Project Manager

Alan Title
Gary Kushner

Partners

Lockheed Martin Solar and Astrophysics Laboratory
Lockheed Martin Sensing and Exploration Systems
NASA Ames Research Center
Montana State University
Smithsonian Astrophysical Observatory
Stanford University



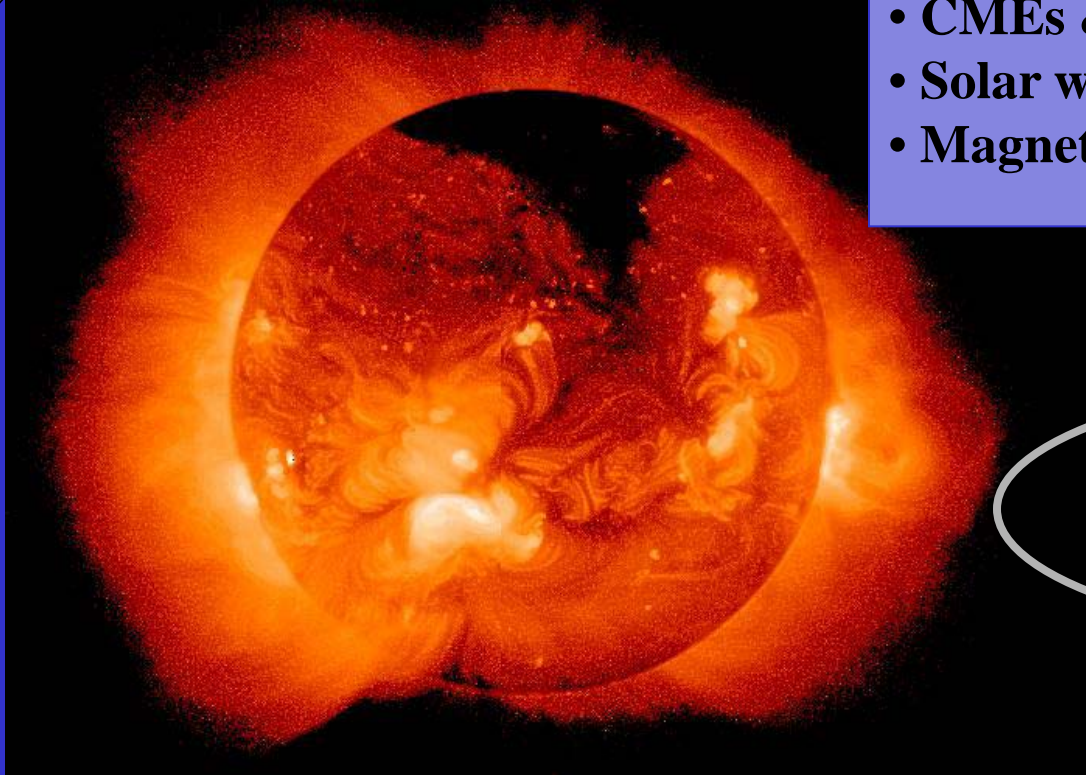
Education and Public Outreach

IRIS MSGC E/PO – Student Solar Spectrograph Competition How to get involved

- **Get the word out to your affiliates (the application will be simple)**
- **Sponsor a team – this is a great way to partner with an MSI if you don't have an MSI in your state!**
- **Timeline**
 - Advertise to SG institutions in Fall 2010 and early Spring 2011
 - Applications available February 1, 2011
 - Applications for 1st round build awards due April 30, 2011
 - Teams Announced and 1st build awards distributed in June 2011
 - 1st competition begins Sept 2011
 - 1st competition ends in April/May 2012
 - 1st travel awards and scholarships in 2012
 - Repeat for 2nd year – through 2013
 - See <http://www.spacegrant.montana.edu/iris.html/>
 - Comments or Questions to Randy at rlarimer@ece.montana.edu

Education and Public Outreach

The Solar Atmosphere



Big mysteries:

- Heating of the atmosphere
- CMEs & Flares
- Solar wind acceleration
- Magnetic fields

Corona, $\sim 10^6$ K

Transition region, $\sim 10^5$ K

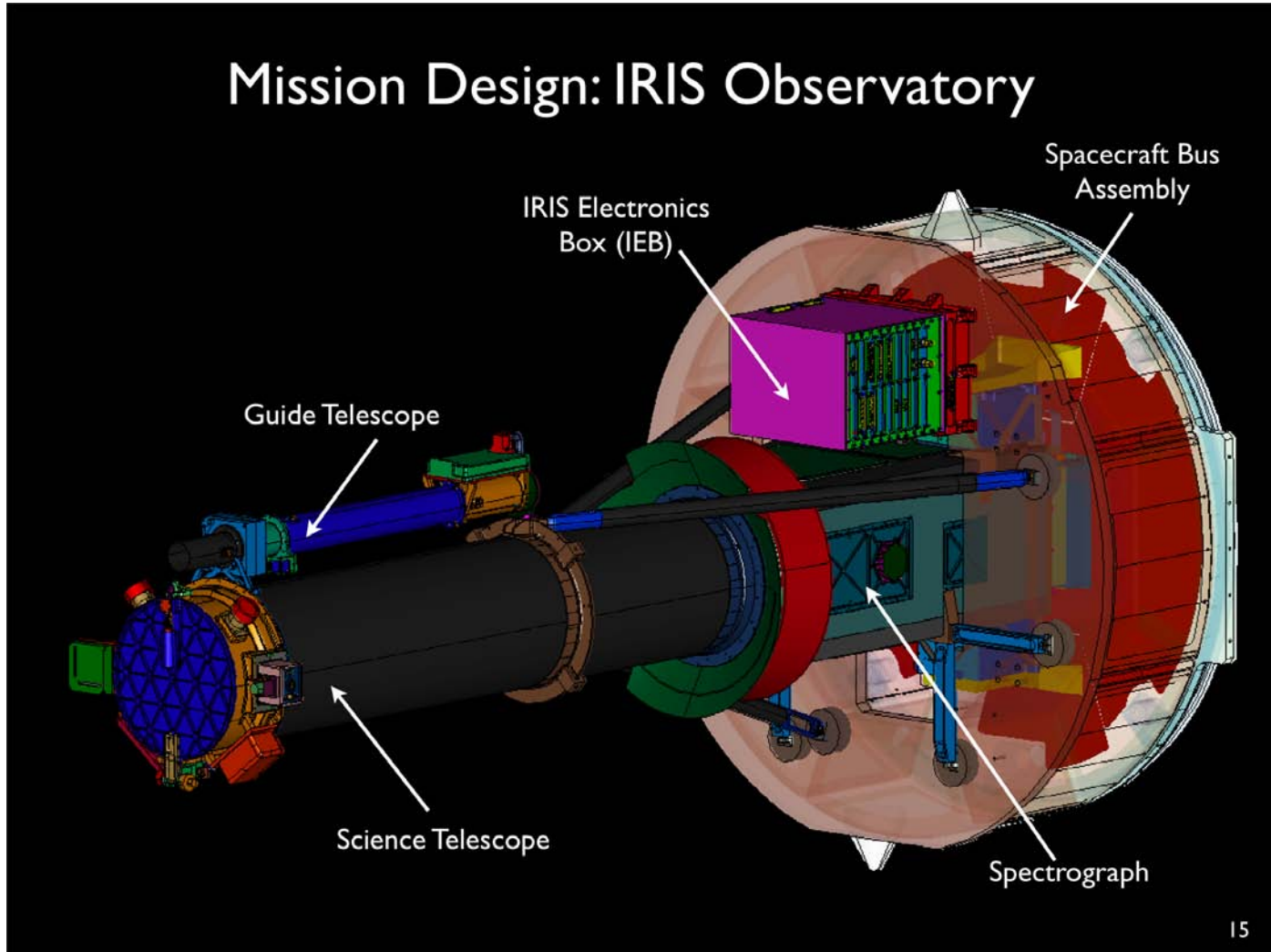
Chromosphere, $\sim 10^4$ K

Photosphere, 5800 K

IRIS will observe the chromosphere and TR.



Education and Public Outreach

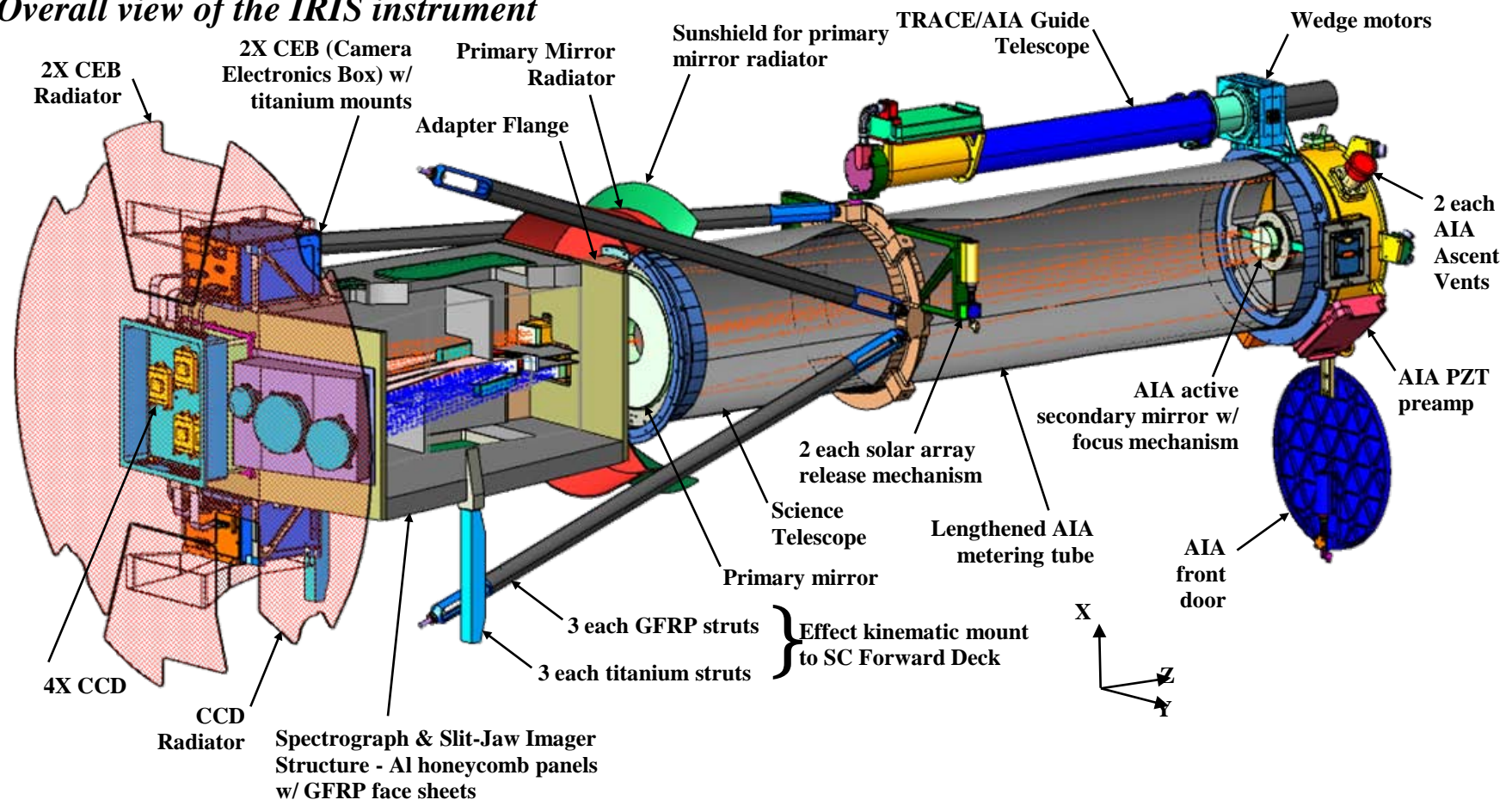


Wednesday, June 3, 2009



Education and Public Outreach

Overall view of the IRIS instrument





Education and Public Outreach

Montana State University/SSEL/MSGC Role

- **Spectrograph & Slit Jaw Imager**
 - Breadboard prototype (Phase A, complete)
 - Spec, procure, test custom flight optics
 - Support design, integration, test, calibration
 - Science / data analysis
- **Education and Public Outreach (DesJardins)**

PI: Charles Kankelborg
Larry Springer
Christy Dunn
Stefan Eccles
Ehson Mosleh
Joseph Shaw
Nathan Pust
Angela DesJardins
Randy Larimer



Education and Public Outreach

- IRIS E/PO program will include participation by LMSAL, Stanford University, Montana State University, Smithsonian Astrophysical Observatory, NASA Ames
- Program will build on the success of the SDO AIA E/PO program
- Goal is to engage formal and informal audiences through projects ranging from classroom curriculum modules to social media



Education and Public Outreach

- **National Science and Engineering Student Competition**
 - Utilize the national Space Grant network of over 350 colleges and universities across the country
 - Teams are judged on the basis (1) engineering, (2) science observations, (3) presentation of results
 - Awarded teams will be invited to NASA Ames and Lockheed Martin for tours and talks related to IRIS



Education and Public Outreach

Space Grant National Science and Engineering Solar Spectrograph Competition

- Similar to an engineering senior design competition, but open to all classes of undergraduates
- Fulfills the workforce development focus of the NASA Small Explorer Announcement of Opportunity
- Team tasks
 - design and build a working solar spectrograph
 - demonstrate the capabilities of the spectrograph by making pre-defined observations of the solar spectrum (e.g., identify absorption lines, measure line profiles).
- Teams can win in 4 categories: Best Design, Best Build, Best Science Observations, and Best Presentation of Results



Education and Public Outreach

Space Grant National Science and Engineering Solar Spectrograph Competition

Overview

- Two separate sets of build awards and competitions for academic years 2011-12 and 2012-13, with scholarships to follow in 2012-13 and 2013-14.
- Build funds for 28 build teams/year at \$2,000/team, plus \$300 solar telescope for 20 home institutions
- Student travel for 4 winning teams per year, 4 students per team - 54 travel awards (i.e. to IRIS launch)
- Scholarships for 4 winning teams per year, 4 students per team at \$3,000/student - a total of \$96,000 in scholarships
- Priority for build funds will be given to MSIs and institutions with less aerospace activity (e.g. not MIT)



Education and Public Outreach

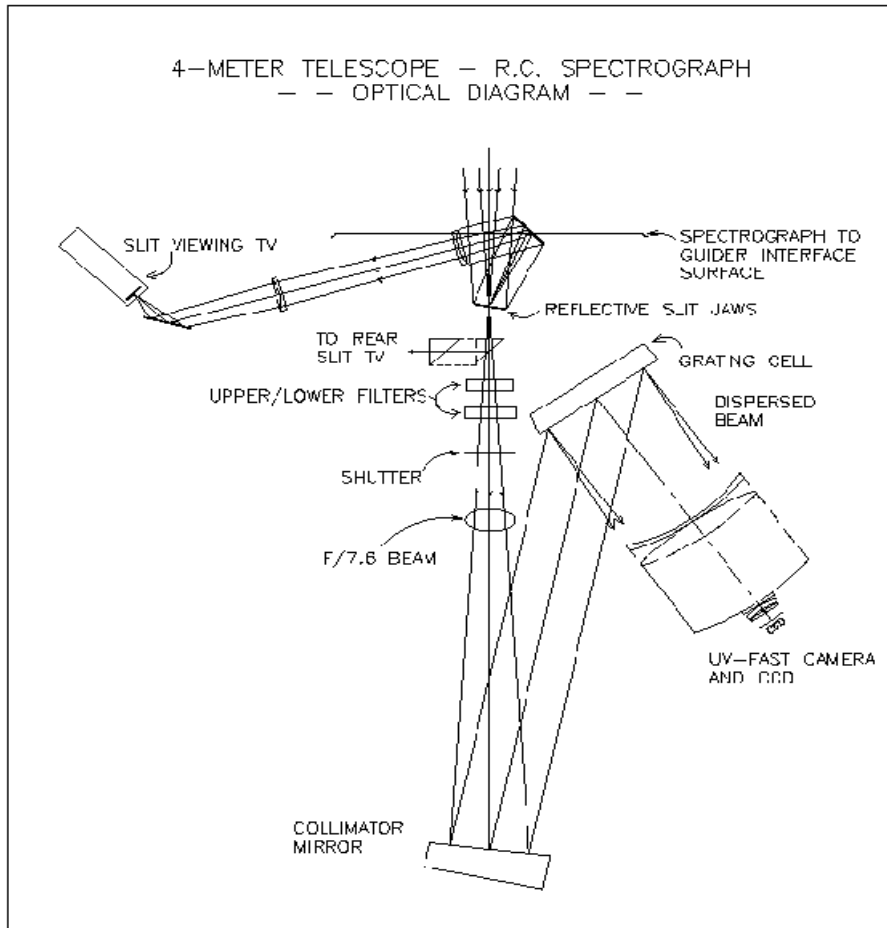
IRIS MSGC E/PO –

“Pilot” Student Solar Spectrograph Competition

- Begins early September 2010
- Will help MSGC “work out the bugs” prior to National Competition
- Design, Build and Use a Ground-Based Solar Spectrograph
- Undergraduate students (Sophomores, Juniors or Seniors in Fall 2010) will participate on two teams each consisting of 1-CS, 1-EE, 1-Physics and 1-ME (or related fields)
- Paid positions 8 hours per week at \$9.00 per hour (not paid if used for Senior Design Project)
- 14 weeks per semester for both Fall 2010 and Spring 2011
- Funding for Supplies
- Student Details on MSGC Website <http://www.spacegrant.montana.edu>

Education and Public Outreach

IRIS MSGC E/PO – “Pilot” Student Solar Spectrograph Competition



Parts of a spectrograph:

- Telescope
- Slit
- Imaging optics
- Diffraction grating
- Detector
- Mounting hardware



Education and Public Outreach

IRIS MSGC E/PO –

“Pilot” Student Solar Spectrograph Competition Teams

- **Montana State University Team**
 - Undergraduates consisting of students from Computer Science, Electrical Engineering, Physics and Mechanical Engineering
- **Salish Kootenai College Team (Tribal College)**
 - Undergraduates consisting of students from Computer Engineering, Industrial Engineering Technology and Forestry
- Each team will have a faculty advisor
- Faculty and Student Details on MSGC Website

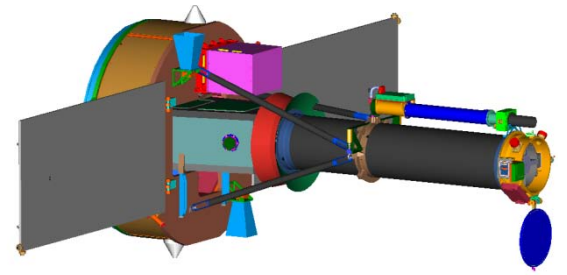
<http://www.spacegrant.montana.edu/IRIS.html>



Education and Public Outreach

IRIS MSGC E/PO – “Pilot” Student Solar Spectrograph Competition Teams

- **Montana State University Team**
 - Faculty Advisor- Dr. Kevin Repasky
Department of Electrical and Computer Engineering
 - Team Members:
 - Kevin Lalli - Physics
 - Page Bailey - Mechanical Engineering
 - Geoff Whitt- Electrical Engineering
 - Tyler Huffman – Computer Science

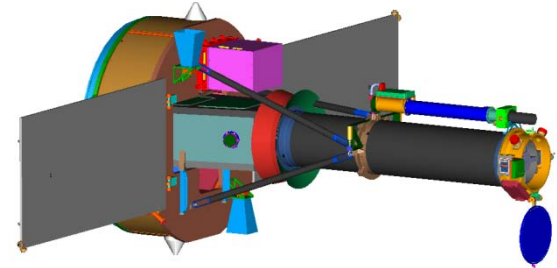




Education and Public Outreach

IRIS MSGC E/PO – “Pilot” Student Solar Spectrograph Competition Teams

- **Salish Kootenai College Team**



- Faculty Advisor – Dr. Tim Olson
Information Technology
and Computer Engineering Department
- Team Members:
 - Mathew Friedlander – Computer Engineering (3rd year, student lead)
 - Sean Shriner – Computer Engineering (4th year)
 - Joni Buckman – Computer Engineering (2nd year)
 - Robert Sanchez – Computer Engineering (2nd year)



Education and Public Outreach

IRIS MSGC E/PO –

“Pilot” Student Solar Spectrograph Competition

Specifications and Team Tasks

- Funding of \$2K/team for project materials
- Spectrograph to use a 4 inch aperture
- Can use laptop for measurements (does not count towards the project materials)
- The project goal is to design and build a working solar spectrograph and demonstrate the capabilities of the spectrograph by making pre-defined observations of the solar spectrum. Demonstrate the resolution and sensitivity of the device by observing absorption lines in the visible spectrum and resolve as many lines as possible. (e.g., identify absorption lines, measure line profiles).
- Demonstrate the use of your spectrograph to measure or “figure something out.” A couple of examples are: measure line width, quantitative measurements of wavelengths (calibration).



Education and Public Outreach

IRIS MSGC E/PO – “Pilot” Student Solar Spectrograph Competition Judging

- Areas that will be considered in the judging of the project will be: Budgets, project management, milestones, project documentation, testing, calibration, functionality, craftsmanship, creativity and ease of use.
- Three Judges will evaluate the Student Solar Spectrograph projects based on four categories: best design, best build, best science observations, and best presentation of results.
- The overall score used by the judges will be 70% of the score is performance based and 30% is open ended or creativity based.



Education and Public Outreach

IRIS MSGC E/PO –

“Pilot” Student Solar Spectrograph Competition

Judges

1. **Dr. Christopher Palmer**,
Senior Director and General Manager
Richardson Gratings, Newport Corporation



Christopher Palmer is Senior Director and General Manager of Richardson Gratings (a Newport Corporation business), a world leader in the design and manufacture of diffraction gratings for the analytical instrument, semiconductor and telecommunications markets, as well as for research and education. Chris received a BS in physics from St John Fisher College (Rochester, NY) and an MA and PhD in physics from Bryn Mawr College (Bryn Mawr, PA). He has published a number of papers on grating imaging theory and grating and spectrometer design, and authored the most recent editions of the *Diffraction Grating Handbook*. Chris is a member of APS, OSA and SPIE.



Education and Public Outreach

IRIS MSGC E/PO –

“Pilot” Student Solar Spectrograph Competition

Judges

- 2. Dr. Charles Kankelborg**
Co-Investigator on NASA IRIS Mission
Associate Professor of Physics
Montana State University



Charles Kankelborg is Associate Professor of Physics at Montana State University. His research interests include ultraviolet instrumentation, observation and modeling of the solar transition region and corona, and solar magnetic fields. Dr. Kankelborg is Principal Investigator of the Multi-Order Solar EUV Spectrograph, a rocket-borne instrument for simultaneous imaging and spectroscopy of the solar atmosphere. He is a Co-Investigator on the NASA IRIS mission. He has received the Wiley Award for Meritorious Research (2010), Presidential Early Career award (2008), and Outstanding Graduate Level Instructor award (2006).



Education and Public Outreach

IRIS MSGC E/PO – “Pilot” Student Solar Spectrograph Competition Judges

3. TBD –

Requirements:

Spectrograph Background

Three year commitment for judging continuity from year to year

Good Interaction with Students

Willing to travel to Bozeman at specific times



If you know someone that would be qualified and interested, let us know.

Contact Randy at rlarimer@ece.montana.edu



Education and Public Outreach

IRIS MSGC E/PO –

“Pilot” Student Solar Spectrograph Competition

Schedule

- April 23, 2010 Faculty Advisor Informational Lunch
- April 26 Student Focused Email Sent
- May 7 Student Application and Letter of Recommendation Due
- May 14 Decision on Student Participants
- May 17 Notification of Student Participants
- Summer 2010 Long Distance Communication and Brainstorming by Participants
- September 2010 Work (and Pay) Starts First Week of Classes
- April 28, 2011 Pilot Ends – Judging, Awards and Lessons Learned



Education and Public Outreach

IRIS MSGC E/PO –

Student Solar Spectrograph Competition

2011-2012 and 2012-2013 Schedule

- February 1, 2011 Applications Available for 2011-2012 Competition
- April 30, 2011 Applications Due
- June 2011 Teams Announced for 2011-2012 Competition
- Sept 2011 2011-2012 Competition Begins
- April/May 2012 2011-2012 Competition Ends
- February 1, 2012 Applications Available for 2012-2013 Competition
- April 30, 2012 Applications Due
- June 2012 Teams Announced for 2012-2013 Competition
- Sept 2012 2012-2013 Competition Begins
- April/May 2013 2012-2013 Competition Ends



Education and Public Outreach



IRIS MSGC E/PO – Student Solar Spectrograph Competition Resources

[Diffraction Grating Handbook](#)

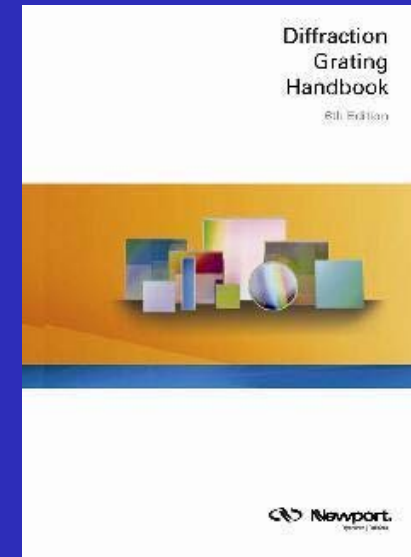
[IRIS mission](#)

[MSGC Website](#)

[The solar photosphere](#)

[The solar chromosphere](#)

[Wikipedia article on Fraunhofer lines](#)



Thank you to Chris Palmer at Richardson Gratings/Newport for supplying each student with a handbook.



Education and Public Outreach

IRIS MSGC E/PO –

Student Solar Spectrograph Competition

How to get involved

- **Get the word out to your affiliates (the application will be simple)**
- **Sponsor a team – this is a great way to partner with an MSI if you don't have an MSI in your state!**
- **Timeline**
 - Advertise to SG institutions in Fall 2010 and early Spring 2011
 - Applications available February 1, 2011
 - Applications for 1st round build awards due April 30, 2011
 - Teams Announced and 1st build awards distributed in June 2011
 - 1st competition begins Sept 2011
 - 1st competition ends in April/May 2012
 - 1st travel awards and scholarships in 2012
 - Repeat for 2nd year – through 2013
 - See <http://www.spacegrant.montana.edu/iris.html/>
 - Comments or Questions to Randy at rlarimer@ece.montana.edu