The Sun is a centerpiece of astronomy and our nearest star available for detailed study. Our understanding of the Sun’s interior, atmosphere, and evolution has advanced rapidly over the last century. We have developed a detailed understanding of the solar interior and nucleosynthesis, and we have an emerging but spotty understanding of the solar dynamo, the 11-year solar cycle, the energy sources and acceleration of solar wind, the evolution of solar magnetic fields, release of coronal mass ejections, and acceleration of flares and other energetic particles accelerated at shocks near the Sun and in the interplanetary medium. We have begun the process of connecting our remote observations of the Sun with in situ measurements from spacecraft on orbits in geospace and throughout the solar system. The coming decades promise to continue our rapid advances in understanding the Sun, generation of solar wind and transient events, its influence over geospace and the planetary environments, and our solar wind’s interaction with the local part of the galactic medium that surrounds our solar system.

AS786 covers the fundamentals of Solar and Heliospheric Physics including observational methods, measurement techniques, theory and approaches, and outstanding problems. Solar topics include the Sun’s internal structure, atmosphere, transition region, chromosphere, corona, magnetic fields, solar wind sources, flares and coronal mass ejections. Heliospheric topics include solar wind acceleration and composition, turbulence, shocks, particle acceleration, solar energetic particles, the termination shock, anomalous and galactic cosmic rays. The course also makes the connection from the Sun to other stars, and from the heliosphere to other astrospheres.

Prerequisites:

GRS AS 701, Introductory Astrophysics
GRS AS 703, Introduction to Space Physics
GRS AS 712, Radiative Processes in Astrophysics
GRS AS 713, Astronomical Spectroscopy
GRS AS 726, Cosmic Gas Dynamics
GRS AS 727, Cosmic Plasma Physics

Or, consent of instructor

Instructor:

Nathan Schwadron, nathanas@bu.edu, CAS Bldg, Room 515, (617) 358-4365
Office Hours: (times – 3 hours) and by appointment

Lecture: Monday 2:30-4 PM and Wednesday, 1-2:30 PM
Discussion TBD
Course Requirements
Attend all lectures
Complete problem sets

Complete project proposal on a topic of your choice, approved by instructor
1. Project pre-proposal: a brief description of the topic, with an initial annotated bibliography of the relevant literature
2. Research proposal
3. Class presentation

Course Credits and Grading:
Project Pre-Proposal 5%
Presentation and Draft Proposal 20%
Final Research Proposal 25%
Homework Sets 50%


Books in Library Reserve:
Lecture and Topic Schedule:

<table>
<thead>
<tr>
<th>Section I <em>Solar Physics</em></th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Solar Observations: Goals, Instruments Theory and Approach</td>
</tr>
<tr>
<td>Week 2</td>
<td>Internal Structure Dynamo &amp; Magnetic Field</td>
</tr>
<tr>
<td>Week 3</td>
<td>Atmosphere Transition Region Chromosphere</td>
</tr>
<tr>
<td>Week 4</td>
<td>Corona Coronal Magnetic Fields Coronal Heating and Solar Wind Sources</td>
</tr>
</tbody>
</table>
| Week 5  | Flares Coronal Mass Ejections | *Astrophysical Quantities (AQ): Ch. 14 The Sun: Ch 9*  
               |  | *Astrophysical Formulae, Ch. 4* |
| Week 6  | The Sun as a Star | *A@: Ch. 15 Selected Reading* |

<table>
<thead>
<tr>
<th>Section II <em>Heliospheric Physics</em></th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 7</td>
<td>Heliospheric Observations: Goals, Instruments Theory and Approach</td>
</tr>
<tr>
<td>Week 8</td>
<td>Solar wind acceleration &amp; composition Heliospheric Magnetic Fields Turbulence</td>
</tr>
<tr>
<td>Week 9</td>
<td>Interplanetary Coronal Mass Ejection Shock Acceleration</td>
</tr>
<tr>
<td>Week 10</td>
<td>The Interstellar Interaction Galactic Cosmic Rays</td>
</tr>
<tr>
<td>Week 11</td>
<td>The Termination Shock Anomalous Cosmic Rays</td>
</tr>
<tr>
<td>Week 12</td>
<td>Particle Radiation Implications for Human and Robotic Exploration</td>
</tr>
</tbody>
</table>
NOTES

Student Presentations:

All students must present their proposal to the class. Students should include background, design, rationale and justification for funding of their study. Students must meet briefly with the instructor prior to the submission of their pre-proposal to ensure that the topic is appropriate for the course.

Lectures:

Lectures are considered to be the core of the course. They are designed to introduce the import concepts in solar and space physics, and help clarify information presented in the text and supplementary readings. Failure to attend regular and guest lectures will seriously compromise opportunities for gaining the full benefits of this course and will likely affect student performance on exams.