Measurement Techniques in Aeronomy and Ionospheric Physics

Spring 2013 (Phys 875)

Instructors: M. Larsen, G. Lehmacher, J. Meriwether, J. Oberheide

Fixed Credit Hours: 3 (3.0)

Catalog Description: The course focuses on the physics associated with measurement techniques that are applicable in partially ionized plasma environment that exists in the Earth's mesosphere, thermosphere, ionosphere region, also known as the geospace region. Specifically, the course describes the theory and application associated with electromagnetic radio frequency wave interaction with atmospheric plasma, in situ techniques for measuring neutral and plasma properties in a tenuous, partially-ionized gas, the nature of natural optical emissions and their relationship to physical properties of the emitters, and optical remote sensing of natural atmospheric gases.

Prerequisites: Mechanics, Electricity and Magnetism, Thermodynamics, and Statistical Mechanics at the level of junior and senior physics.

Statement of the need for the course. The measurement techniques used in studies of the upper atmosphere are specialized and closely interrelated with the physical processes in the medium. Students in the field need a broad understanding of the various techniques, as well as an appreciation of the advantages and biases of each technique, both to help them with interpretation of their own data and that used in other studies. Currently no such course exists.

Textbooks: Notes, Powerpoint

Learning Objectives: At the end of the course students will be able to describe and apply the techniques and equations that apply to radio frequency, optical, and in situ instrument interactions with the partially-ionized plasma environment.

Evaluation: Midterm and Final Exam (50%), Problem Sets (50%)
Grading scale: 100-90% A; 90-80% B; 80-70% C; 70-60% D; <60% F

1) Rocket measurement techniques
    a. Instrumentation to measure neutral gas properties (week of Jan. 14)
        Lehmacher
    b. Instrumentation to measure plasma properties (week of Jan. 21)
        Lehmacher/Larsen
    c. Chemical release techniques (week of Jan. 28)
        Larsen
2) Radar techniques
    a. Incoherent scatter radar techniques (weeks of Feb. 4 and 11)

Larsen

b. Coherent scatter radar techniques (weeks of Feb. 18 and 25)
Lehmacher

3) Optical techniques

a. Imaging techniques (week of Mar. 4)
Meriwether

b. Fabry-Perot techniques (week of Mar. 11)
Meriwether

c. Lidar techniques (week of Mar. 25)
Meriwether

4) Satellite measurement techniques

a. Satellite remote measurements (weeks of Apr. 1 and 8)
Oberheide

b. Satellite in situ measurements (weeks of Apr. 15 and 22)
Oberheide