CHEMISTRY 529 SYLLABUS
ULTRA HIGH MASS SPECTROMETRY

LECTURE: Fulmer Hall 1:10-2:00 PM Monday and Wednesday
INSTRUCTOR: Professor Peter Reilly
OFFICE: Fulmer 128 PHONE: 335-0042 Email: pete.reilly@wsu.edu
OFFICE HOURS: by appointment

GRADING: Base on oral presentations and class participation. Attendance is mandatory. Students will be assigned papers from the current literature to present, review and discuss in class. There are no formal examinations.

SUGGESTED PREREQUISITES: 1. Undergraduate physical chemistry and/or
2. Undergraduate physics
3. Chem 514
4. Graduate standing

NOTE: This is an advanced course. It is not a prerequisite for the analytical qualifying exams. Mass spectrometry topics covered on the qualifying exams can be found in Harris.

SYNOPSIS:
This is an advanced graduate level class. The material presented represents the next frontier in mass spectrometry—the ultra high mass range. Ultra high mass spectrometry is the mass analysis of analytes with molecular masses generally much greater than 20 kDa. This is an area of science that is currently rapidly advancing. Because of recent advances in instrumentation, the rate of growth in this area is expected to increase exponentially. The procedures and methods for analyzing large molecules will be changing rapidly. This course will have to evolve with the changes in the field. It is the goal of this course to prepare you for these changes.

The recent advances in this area are based on new methods for handling ions. This course thoroughly covers the fundamentals of ion handling in the ultra high mass range. You will learn how to sample ions with molecular masses ranging into the 10^9 Da range and well beyond from the atmosphere into vacuum and trap them. You will then learn to isolate ions with specific value of m/z and then move them into a mass analyzer and analyze them. You will learn how to use time-of-flight and digital ion trap analyzers for ultra high mass analysis and what to expect from each analyzer. Strategies for differentiating and quantifying biomolecules and complexes by determining cross sections, retention time and mass will be explored.

The literature relating to the analysis of intact proteins, protein complexes, RNA, DNA and viruses will be covered. Students will present, discuss and review assigned papers. We will discuss how the state of the art will change with the advent of the new technology.

All required reading will be sent as pdf files through email at least a week before being covered in class.
Schedule
Topics: Ion formation, controlling charge, moving into vacuum, slowing them down, moving them in vacuum and trapping massive ions.
Required reading:

Ion slowing and trapping and mass analysis


1-18  MLK Holiday

Controlling the Charge:
1-20a  S. Cristoni, L.R. Bernardi, I. Biunno, F. Guidugli, Analysis of protein ions in the range 3000–12000 Th under partial (no discharge) atmospheric pressure chemical ionization conditions using ion trap mass spectrometry, Rapid Communications in Mass Spectrometry, 16 (2002) 1153-1159.


Topics: Duty Cycle Waveform Manipulation of Ions and Isolation.
Required reading:


2-3 and 2-8  Fun with stability diagrams programs. You will download Excel Spreadsheet programs to directly observe the effects of changing the duty cycle. You will learn to perform ion isolation and MS/MS. Bring a laptop to class.

Ultra High Mass Detectors


2-15  Presidents Day Holiday


Ultra-High Mass Analyzers:

2-22  TOF—limits: Resolution, Mass Accuracy, Mass Limit, Detectors

2-24  Traps: ICR, Orbitrap and DITs—limits: Resolution, Mass Accuracy, Mass Limit, Detectors

Cross section measurement, IMS, MS/MS

Required reading:


3-14 to 3-18  Spring Break

Chromatography and MS of intact proteins.

Required reading:


Analysis of Protein Complexes


Week 13-14: Analysis of RNA and DNA


Analysis of Viruses


5-2 to 5-6  Final Exam week

The precise schedule and reading material are subject to change at the discretion of the instructor.

University required disclaimers:

ACCOMMODATIONS: Students with Disabilities: Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center (Washington Building 217; 509-335-3417) to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center.

ACADEMIC INTEGRITY: Cheating or plagiarism in any form will not be tolerated by University policy. Given the current grading system for this course is based on presentation and in class discussion, it is not really possible in any case.