

# **Syllabus for Physics 250 (special topic): Advanced spectroscopies of modern quantum materials**

**Location:** Physics 525

**Time:** Monday/Wednesday 2:40-4PM

**Lecturers:** Eduardo H. da Silva Neto (219) and Inna Vishik (239)

**Office hours:** Monday 10-11AM (Vishik) and Tuesday 2-3PM (da Silva Neto) or by appointment

**Assignments:** 8 homeworks, all weighted equally. Homeworks will consist of a small number of problems and/or one or more papers to read and summarize. The summary should give an overview of the paper(s) and its conclusions, state the motivation, state the significance, and answer any additional questions about the paper in the homework. Homework will be assigned on Wednesday and due the following Wednesday in class.

## **Homework late policy:**

- Can drop one assignment
- For subsequent late assignments, can submit within 48 hrs with 50% reduction

## **Course outline:**

- **Introduction to scanning tunneling microscopy / spectroscopy (STM)**
- **Introduction to angle-resolved photoemission spectroscopy (ARPES)**
- **Charge density wave (CDW) systems**
  - **STM studies**
  - **ARPES studies**
  - **Introduction to resonant (inelastic) x-ray scattering (R(I)XS) and how it is used to study CDW systems**
  - **Introduction to time domain techniques and how they are used to observe collective modes of CDW**
- **Superconductivity**
  - **General introduction**
  - **Cuprate high-temperature superconductors**
  - **Iron-based high temperature superconductors**
  - **ARPES, RIXS, and STM studies**
- **Topological insulators**

- General introduction
  - ARPES and time domain studies
- Other Dirac materials
- Heavy fermions
- Outlook
  - Developments in experimental technology
  - The future of quantum materials, science and technology

**Homework **due** dates (tentative)**

**HW1:** Oct 5

**HW2:** Oct 12

**HW3:** Oct 19

**HW4:** Oct 26

**HW5:** Nov 2

**HW6:** Nov 9

**HW7:** Nov 16

**HW8:** Nov 30