High T_c superconductors

Some suggested background reading:
A review text on high T_c superconductors, e.g.:
K. Fossheim, A. Sudbo, *Superconductivity: Physics and Applications*
F.J. Owens, C.P. Poole Jr., *The New Superconductors*
There are many other review books available, as well as some early papers in the PHYS 431 website.

Backgound:
What is meant by a "type II superconductor"?
What is the distinction between H_{C1} and H_{C2}?
What is the connection between critical current and critical field?
What is the Bean critical state model of type II superconductors?

Experiments:

1. Meissner effect determination of Tc
This will take the first lab period and is intended to warm you up for the rest of the lab). Work through the Colorado superconductor labscript to get an idea of how the resistivity apparatus works.

2. SQUID magnetometer measurements
In this experiment you will use the superconducting quantum interference device (SQUID) in the department of chemistry. This will allow you to take some very precise measurements of the magnetic properties of a high temperature superconductor:

-magnetization versus applied field H. This will allow you to see the very unusual hysteresis properties of a type II superconductor.

-magnetization versus temperature for various magnetic fields. This will allow you to measure the critical temperature at field, and extrapolate to zero field for later comparison with resistivity measurements.

3. Measurements of the resistivity versus temperature using a four point probe sample of the same material used in experiments 1 and 2. You will also repeat these measurements at zero field and at the highest available fields (0.2T or so)

Notes:

Part 2: SQUID magnetometer

Hysteresis:

Cool sample at zero field to roughly 80K. Scan field from 0-1T, back to zero, then to -1T, then back to zero. Note: use very small steps for the magnetic field near H=0, e.g. 5Oe (5G) or even less. Steps of 50 Oe are fine for fields above 100Oe.

Temperature dependence of magnetization at various fields:

Scan from 120K down to 50K for YBCO. The effect of field is quite small. Try fields of up to 5T for a clear unambiguous result

Part 3: Resistivity

Use labview to acquire V23 vs temperature using the prepackaged four point probe sample. The effect of field is very small, therefore, use the largest and smallest fields to look for an effect. Make sure to repeat your measurements at least twice for each set of conditions in order to check reproducibility.