DynaCool Physical Properties Measurement System (PPMS)

- General field/temperature platform:
  - Temperature: 1.8 – 400 K
  - Magnetic field: +/- 9 tesla (90 kOe)
  - 25mm diameter sample space
- Hosts wide variety of automated measurements...
- Electrical transport: magnetoresistance, Hall effect, I-V curves; external gating possible
  - Micro-ohm up to 5 giga-ohm
  - Automated sample rotation
- Thermal Transport:
  - Thermal conductivity
  - Seebeck & Nernst effects
- Magnetometry: DC magnetic moment using VSM
  - $10^{-6}$ emu up to 100 emu
- Custom probes, external electronics

Which research uses the PPMS?
- Magnetic materials
- Semiconductor transport / 2DEGs
- Phase transitions
- Photovoltaics
- Magnetocalorics
- Thermoelectrics
- Superconductivity

Other measurements can be added:
- Torque magnetometry
- Heat Capacity
- Dilatometry
- Fiber optic for photoconductivity
- Dielectric constant
- 20 GHz for FMR, NMR
- 50 mK Dilution Refrigerator
Gallery of PPMS data

ferromagnetic thin film sample, PPMS VSM

2 second average
RMS noise < 2 x 10^{-2} emu

Magnetic Field (Oe)
-200 -150 -100 -50 0 50 100 150 200
Moment (emu)
-1.5 x 10^{-6} -1.0 x 10^{-6} -5.0 x 10^{-7} 0 5.0 x 10^{-7} 1.0 x 10^{-6} 1.5 x 10^{-6}

2 K
10 K
20 K
30 K
40 K
50 K
75 K
100 K
200 K

B (T)

(a)

Using QD transport (ETO)

NYU 3nm Cu sample 6 Device 33

external lock-in

Hall Resistance (R_H) (ohms)
-0.301 -0.297 -0.294 -0.291 -0.288 -0.285 -0.282 -0.279 -0.276 -0.273
H_L (Oe)
-1000 -500 0 500 1000

Anomalous Hall Res. [Ω]
0.61 0.62 0.63 0.64 0.65 0.66 0.67 0.68 0.69 0.70
B_2 [mT]
-200 -100 0 100 200 300

Gd TTO vs T 0 to 1 tesla 2kOe steps

Sample Position (degrees)
0 50 100 150 200 250 300 350
Bridge 2 Resistance (Ohm)
-30 -20 -10 0 10 20 30

Sample Temp. (K)
270 280 290 300 310 320 330

Thermal Conductivity (W/mK)
7.8 7.9 8.0 8.1 8.2 8.3 8.4 8.5
Inside the PPMS DynaCool

Figure 1: The DynaCool Cryostat showing the components of the Cryostat Control System, Chamber Temperature Control System, and Magnetic Field Control System.