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Thermal conductivity for MoRuB

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One of the approaches to the problem of thermal noise in gravitational interferometers, is the replacement of piano wire mirror suspension fibers with amorphous (glassy) metal flex joints. My project deals with doing measures of thermal conductivity on a sample of amorphous (glassy) metal, MoRuB, over the temperature range of 2K to 400K.

For these measures I use the longitudinal heat flow method.

The sample is fixed between a thermal bath, know as the cold-foot, and a heater. Two thermometers have to be fixed on the sample.

The cold foot is set to a temperature at which the measure is to be taken.

Heat is applied to one end of the sample by running current through the heater, in other words we apply to the sample a known power produced by the heater.

After the system reaches steady-state conditions, the temperatures (T(hot) and T(cold)) of the attached thermometers are recorded and their difference, ΔT, is calculated.

If the length between the thermometers, l, is known as well as the cross-sectional area, *A,* of the sample, then the thermal conductivity can be calculated from the empirically established relation.

$$k = \left(\frac{l}{A}\right)\frac{P}{\Delta T}$$

To increase the rate at which data are taken, instead of waiting for a steady-state for every measurement with a fixed temperature at the cold foot, the temperature at the cold foot is chosen to vary continuously at a steady rate while the power generated at the heater is produced in short pulses.

During the heat pulse, the temperatures at the two thermometers on the sample begin to approach their steady state values, but because the heaters turned off so quickly, fail to ever do so.

It is possible to take the difference between the two temperatures and fit the data to predict the temperature difference at the steady-state.

This technique was used by Michael Hall to measure thermal conductivity of sapphire fibers.

In fact another way to approach the problem of thermal noise in interferometers is doing cryogenic suspension with sapphire fibers.

During first weeks I worked with Michael to learn about the method to do this kind of measure.

For sapphire fibers the two thermometers were located in the middle of the sample and epoxy was used to attach each device to the fiber through highly conductive copper leads.

The geometry of the sample of MoRuB and its dimensions are very different from the ones of the sapphire fiber and so I thought to other ways to mount the sample.

In order to find the best way I'm testing some possible geometries with samples of Metglass.

For the first test, to fix the thermometers and the heater, I used copper leads attached on the sample with epoxy.

Now I'm doing other tests using copper tape to make thermal contact between copper leads and sample.

In this case I solder copper leads on the copper tape without using epoxy.

I'm studying the results of these tests