

## Aligning the Beamline for emiT

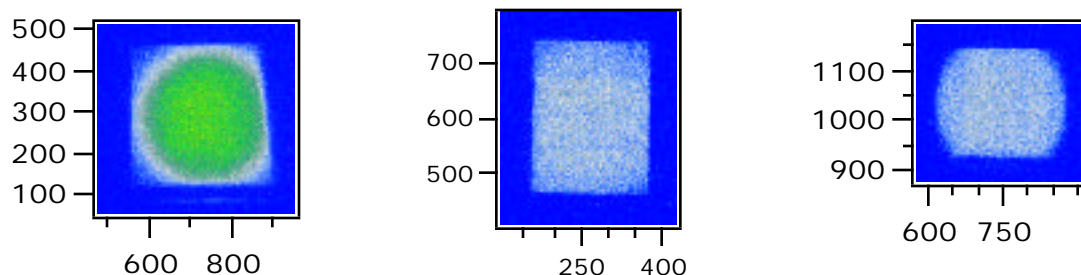
(First Cycle, spring 2002)

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1) Before building our beamline we spent some time (March 8-18) building the mezzanine floors to leave room for three beam-lines (white beam, 5 Å, and 9 Å) to share floor space.

2) Initial Supermirror (SM) rocking (March 22 -March 31)

Set up Polarizer SM (PSM) and theodolite and measure transmission versus angle of SM with respect to incident neutron beam line. The images from the left are of the full beam upstream of PSM (the cut at the right is due to the shape of the Cu foil used in the irradiation), downstream of the PSM without an aperture, and downstream of the PSM with 2" aperture.



A rock of the PSM indicated the maximum transmission at 23 arcminutes west of the incident neutron beamline. The rock was done using the Mama bear fission chamber (3" diameter that covers a large fraction of the beam area) attached to the downstream end of the PSM. A second rock was done that was in agreement with the first.

[Three fission chambers were used in these measurements. Papa, mama, and baby bear correspond to the relative efficiencies of the chambers high, medium, and low, respectively. Baby is a calibrated and has a 0.5" deposit diameter; papa and mama are uncalibrated and have a 3" deposit diameter.]

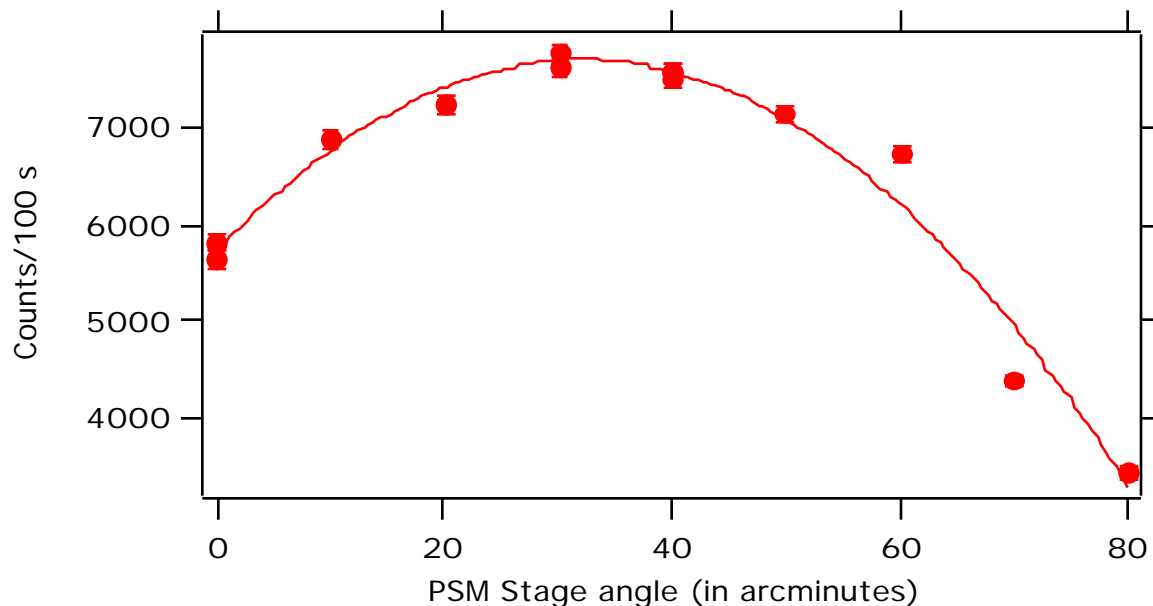
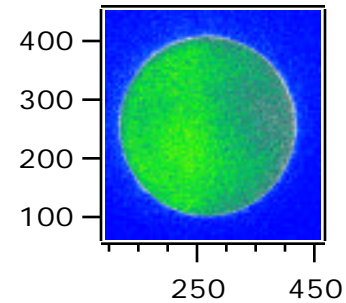
Because the SM is rotated around its center, with the consequent motion of its upstream face with respect to incident beam line, check for dependence on translation; yield looks flat versus translation on a +/-0.4 inches range. This is expected but reassuring.

3) Installed Guide Tube 1 (GT1) after PSM and measure transmission versus angle. Find best at 43 arc minutes west of PSM alignment. Total angle of GT1 with respect to incident neutron beam line = 66 arcminutes = 19 mrad.

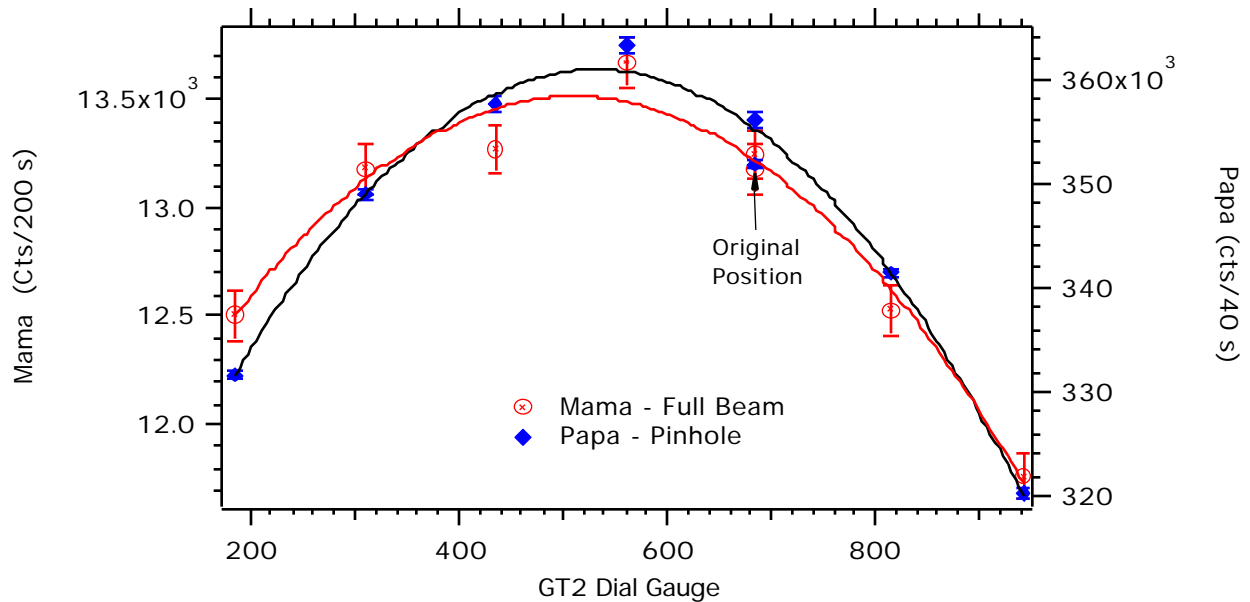
4) Second PSM and GT1 and GT2 alignment (April 1-April 15)

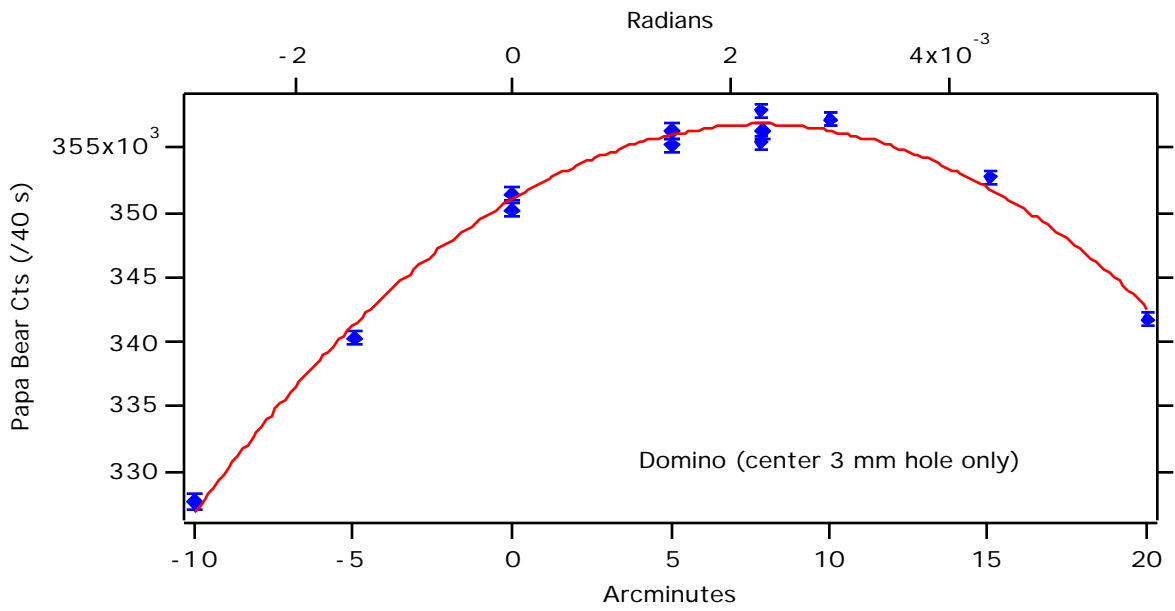
Set up second Guide Tube (GT2) and noticed asymmetric-looking scans of the beam at downstream end of the GT.

Rock GT2 and noticed maximum at different angle than GT1. Decide to rock GT1 again, but, concerns about potentially having to re-do everything at a later stage make us decide to start from the PSM again. Re-rock PSM with fission chamber now sitting about 2" from downstream end of PSM in a stand independent of PSM. We find that the best transmission is consistent with our previous measurements.

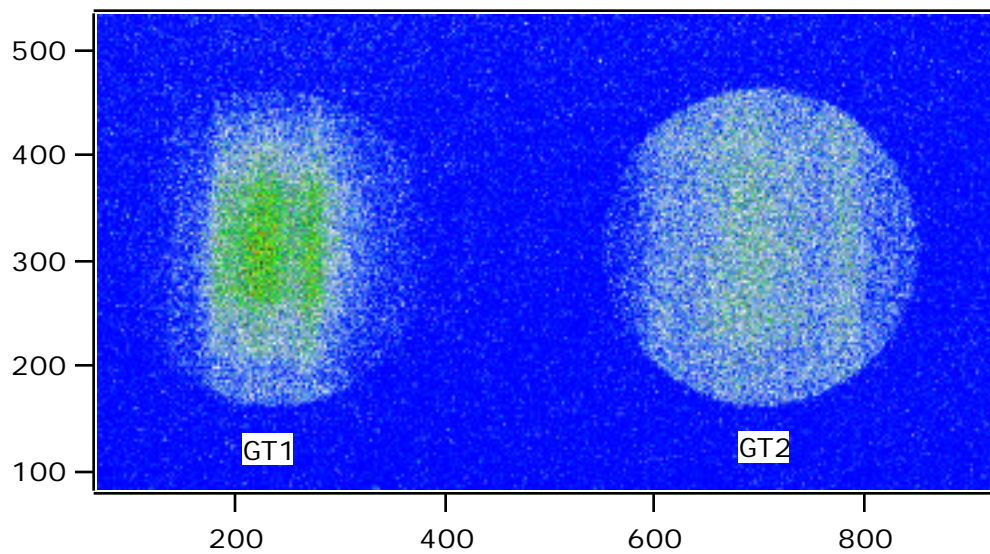


The amount of translation between the downstream face of the PSM and the detector should be only about  $7'' \times 9.3 \times 10^{-3} = 1.6$  mm. Without a very clear explanation on the difference between the two measurements (above and here), we decided not to change the PSM angle but to continue and rock GT1; then rocked GT2; then rocked GT1 and GT2 together. After all these exercises arrived at a best emiT beam line 7.8 arc minutes east of the previous; or a total angle between GT1&2 with respect to incident neutron beam line of 58.2 arc minutes -- 16.9 mrad.





Beam scans with Cu plates now look symmetric. Put new (and out with the old) markers on floor for emiT beam line. The images are with the 3 mm pinhole.



## 5) Flux and transmission

The total flux measured with the "baby bear" fission chamber upstream of the PSM is  $1.45 \times 10^9 \text{ cm}^{-2} \text{ s}^{-1}$ . Downstream of S4, the flux is  $1.8 \times 10^8 \text{ cm}^{-2} \text{ s}^{-1}$

### --Transmissions through beam components

SM	0.25
GT1	0.96 (this number was incorrect in previous report)
flipper	0.94
GT2(a)	0.91
GT3	0.96
S4	0.62

### --Alternative guides

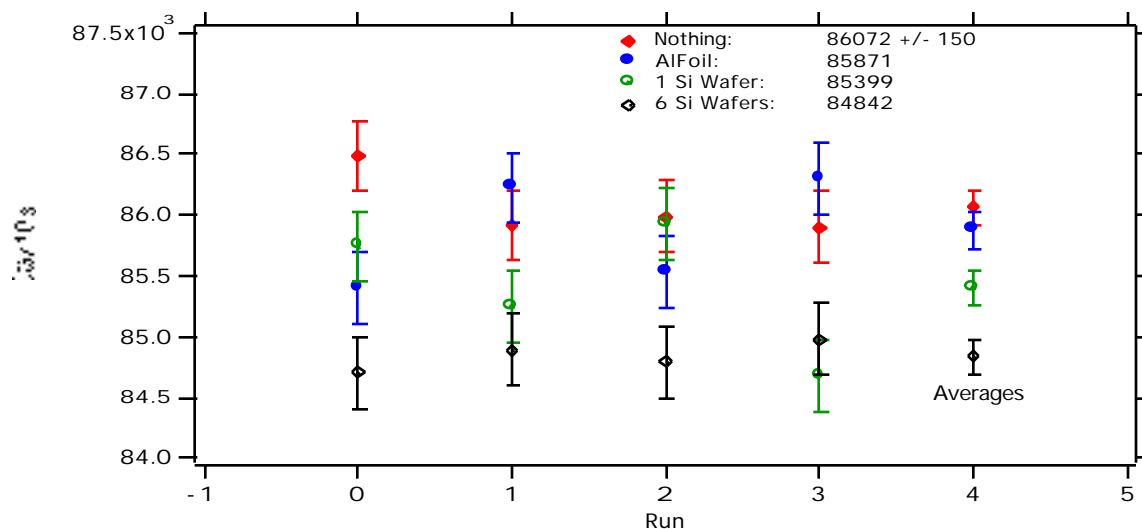
Replace GT2 by other existing Be-coated and uncoated guides and obtained the following:

GT2(b)	0.91
GT2(c)	0.90
bare quartz tube	0.83

### --Transmissions through window foils

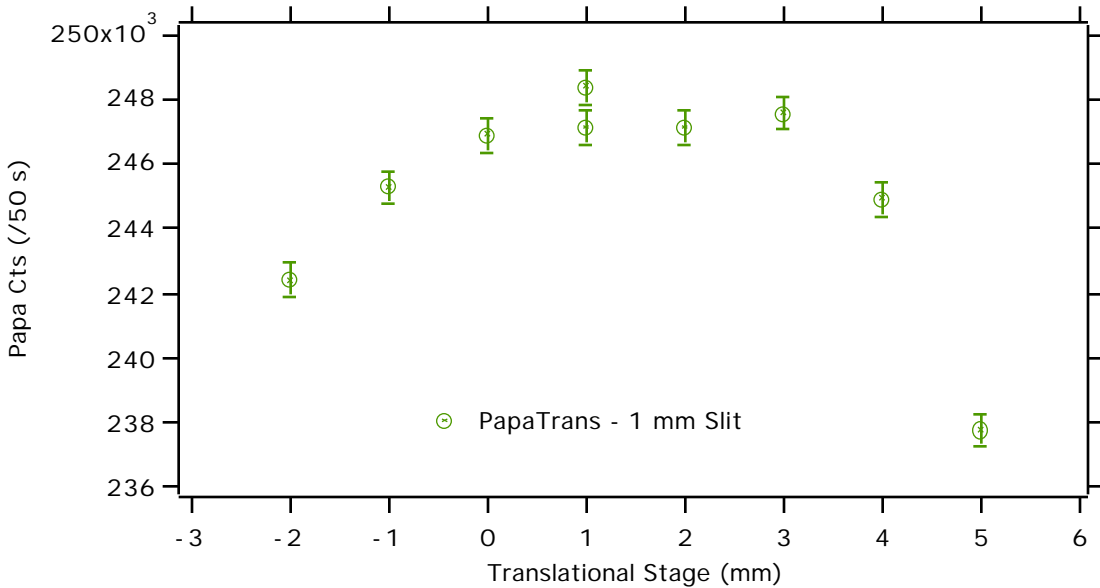
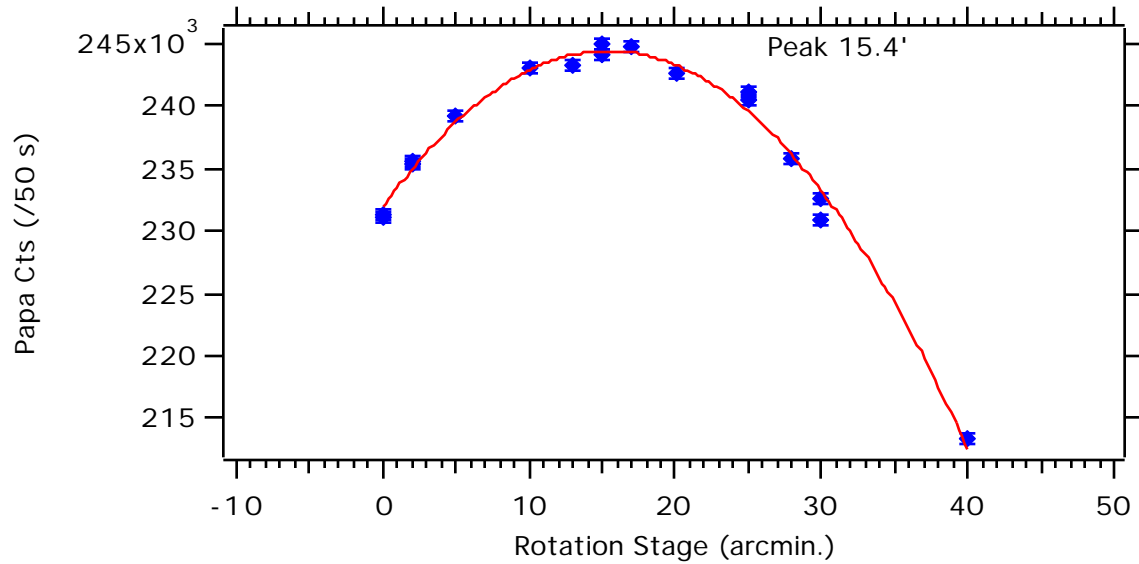
Added foils in between GT1 and GT2 and measured change in transmission downstream of GT2.

1 Al foil	0.997
1 Si wafer	0.992
6 Si wafers	0.986



## 6) Polarization

Set up Analyzing SM downstream of GT2. Align it to emiT beam line (defined above). Rock it with papa bear fission chamber and a 1 mm slit aperture upstream of the PSM. Find peak at 15.4 arc minutes west of emiT beam line. Measure transmission versus translation with respect to emiT beam line and found more sensitivity than for the PSM.



We took Cu pictures with both polarization states which can be used to get scans of polarization.

We measured the polarization product using a 1-mm horizontal slit aperture and the 2" aperture. In both cases we found a polarization product of 0.91 using a polarization flip efficiency of -0.95.

Aperture	Spin Transport	Pol. Product
1 mm slit	all on	0.907
1 mm slit	all on	0.907
1 mm slit	S2 off	0.613
1 mm slit	S2 = 5 V	0.908
1 mm slit	no perm. shim	0.843
1 mm slit	all on	0.908
2" circle	all on	0.905

## 7) Backgrounds

Comparison of backgrounds under different circumstances. Used a 3"x3" (10 mm thick) scintillator located approximately where the emiT beta detectors would be and measured rate above a low threshold (arbitrarily decided to be at 0.56 of the Compton edge of  $^{60}\text{Co}$ ).

- 1) GT1&GT2 no wall (iron wall with wax and lead shot, perpendicular to emiT beam line, shielding PSM and spin flipper)
- 2) GT1&GT2 with wall
- 3) GT1&GT2&GT3 with wall
- 4) GT1&GT2 & collimator system (except last section which is in Seattle) but incomplete lead shielding
- 5) GT1&GT2 & collimator system (except last section which is in Seattle) with lead shielding

