Water NMR Calibration

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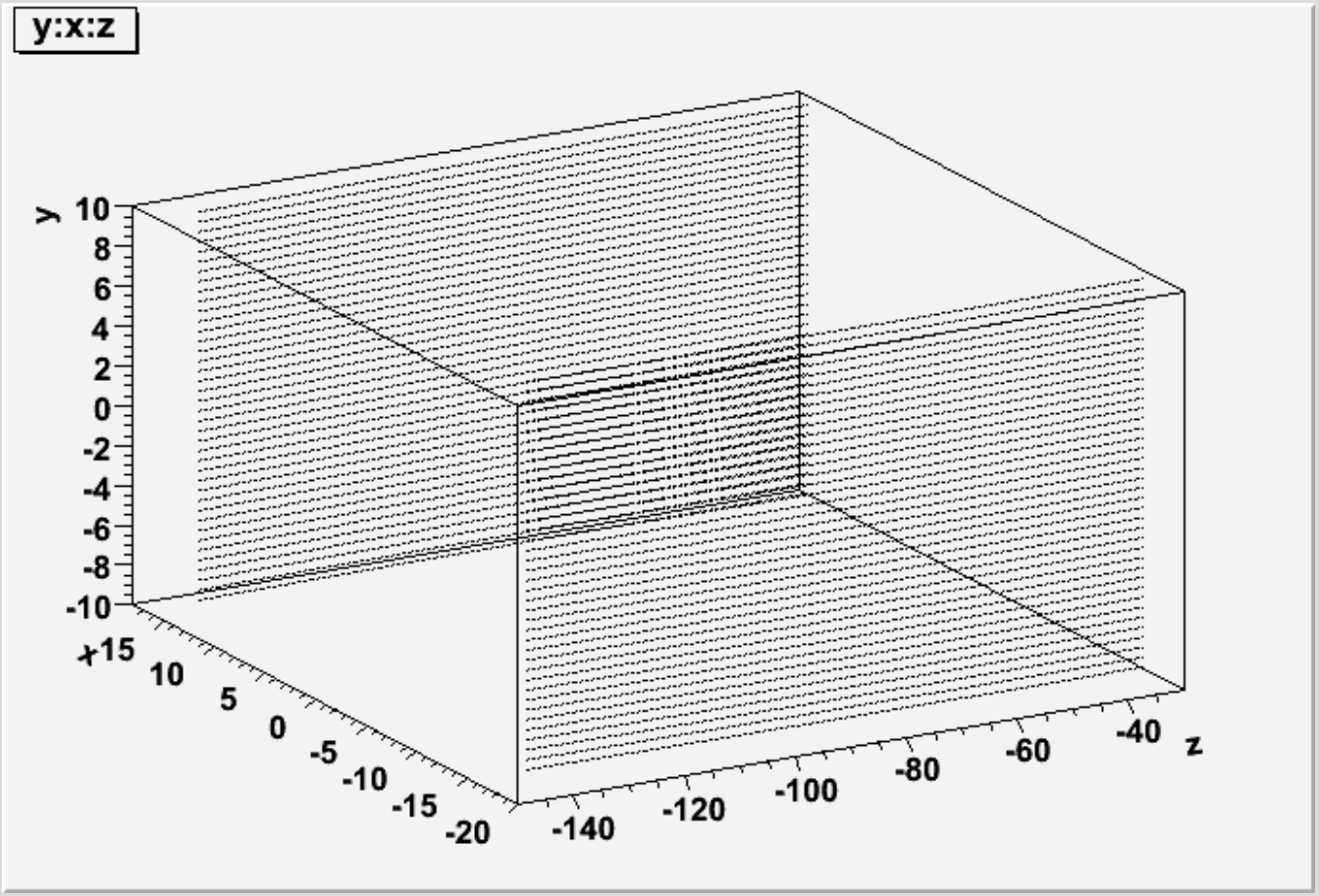
May 22, 2009

Outline

- Flux calcuation
- Water signal fitting
- To-do list

Flux I conventions



Now it is hall system

Flux II

Two methods to get flux

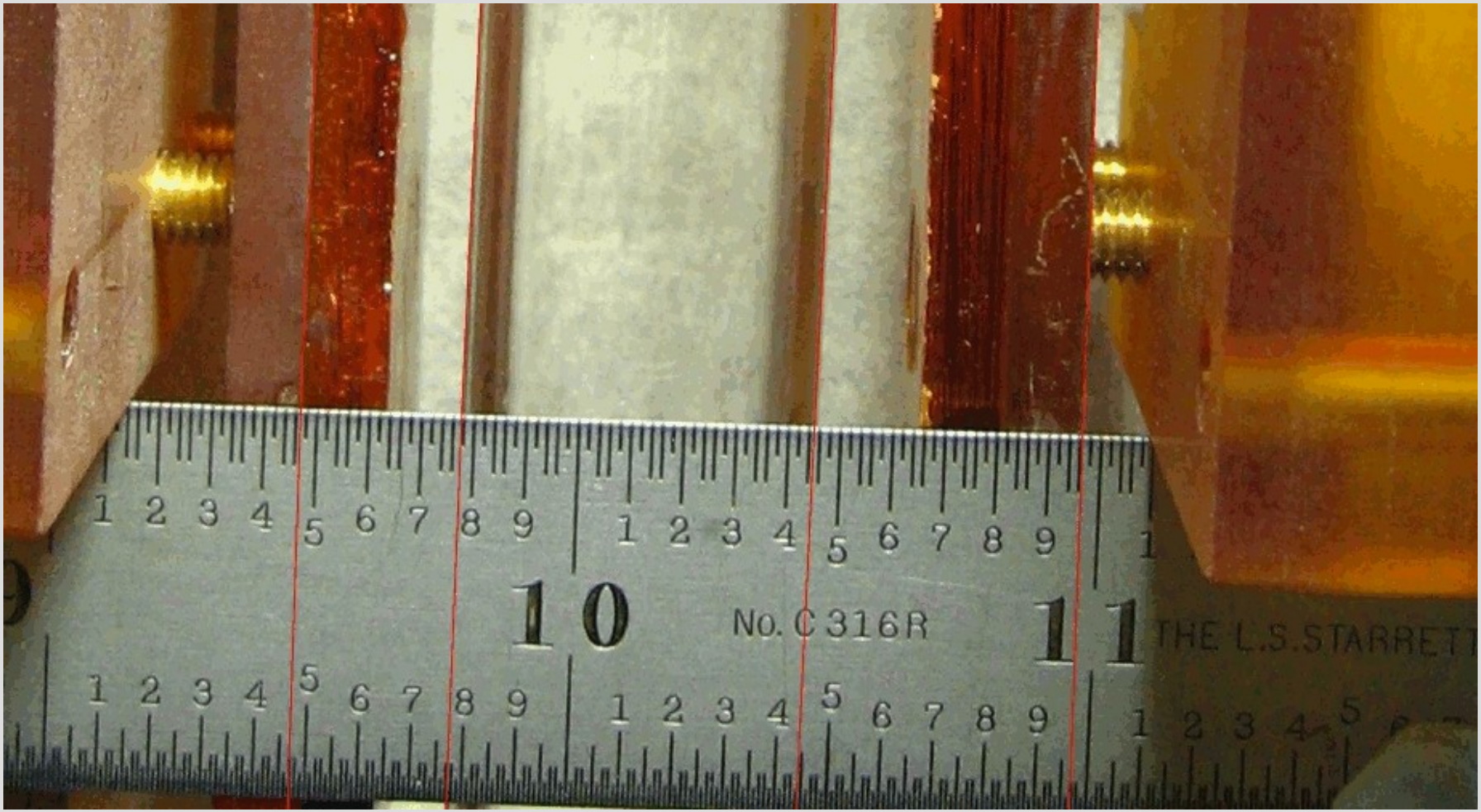
$$\vec{B} = \iiint_{cell} \nabla\left(\frac{\vec{m}\cdot\vec{r}}{r^3}\right)\cdot dv \qquad flux = \iint_{coil} \vec{B}\cdot d\vec{s}$$

$$\vec{A} = \iiint_{cell} \left(\frac{\vec{m}\times\vec{r}}{r^3}\right)\cdot dv \qquad flux = \oint_{coil} \vec{A}\cdot d\vec{l}$$

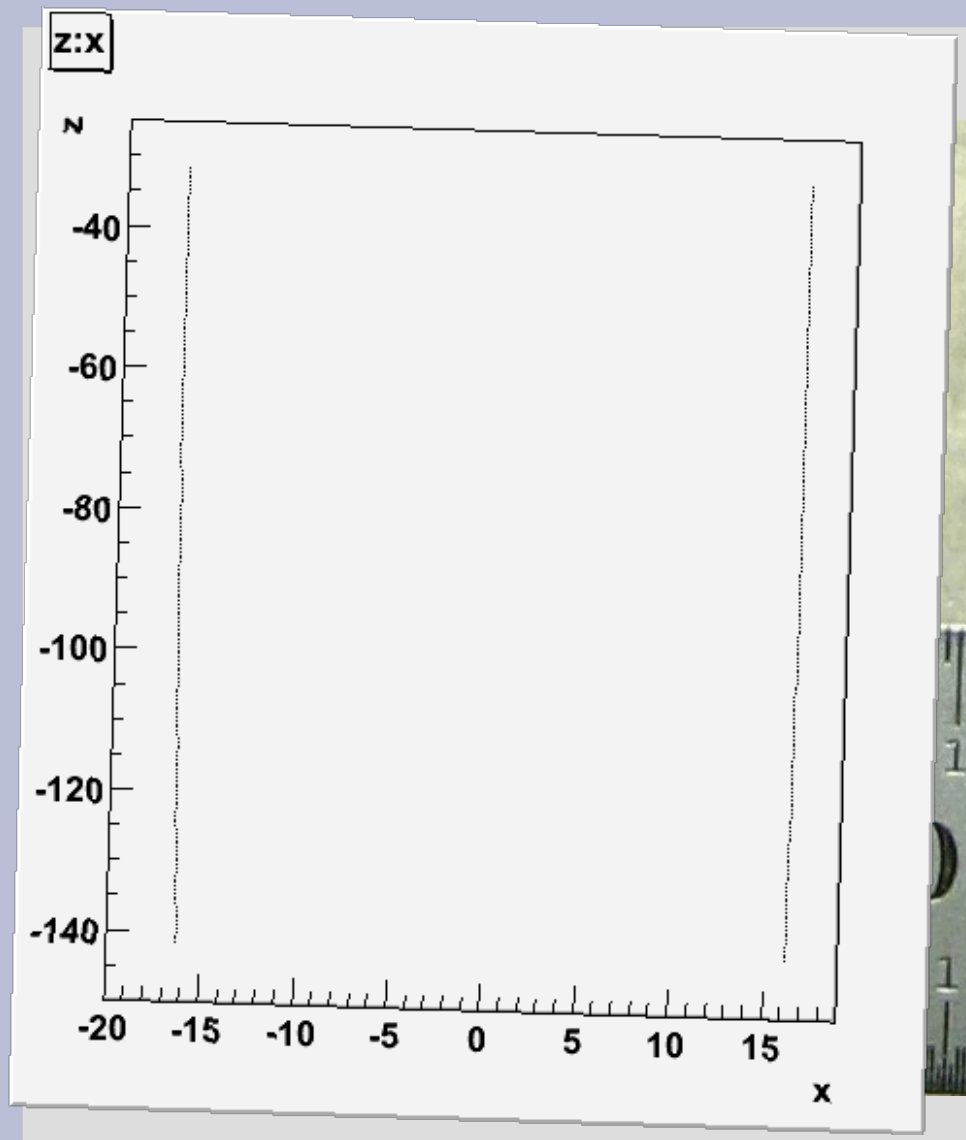
while $\vec{m} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$

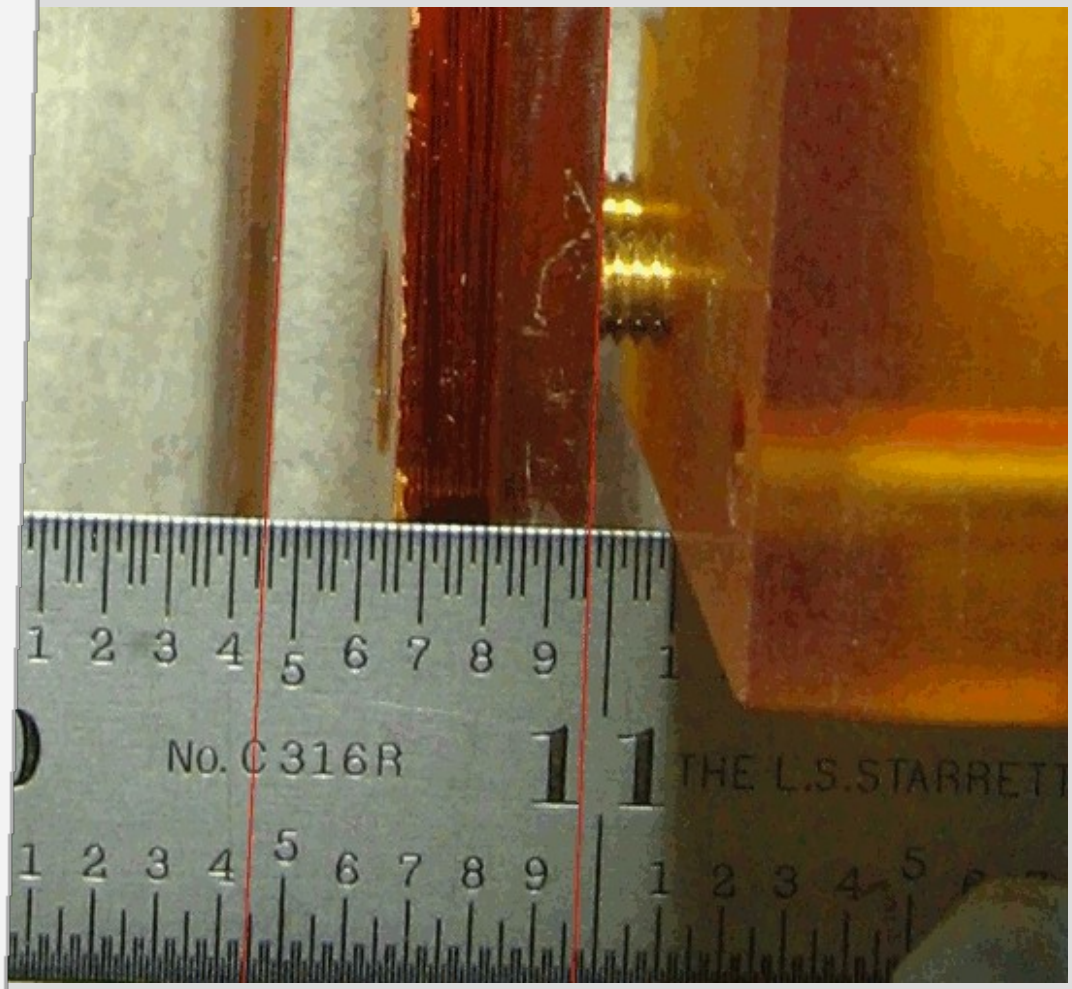
I did both.

Flux III Survey

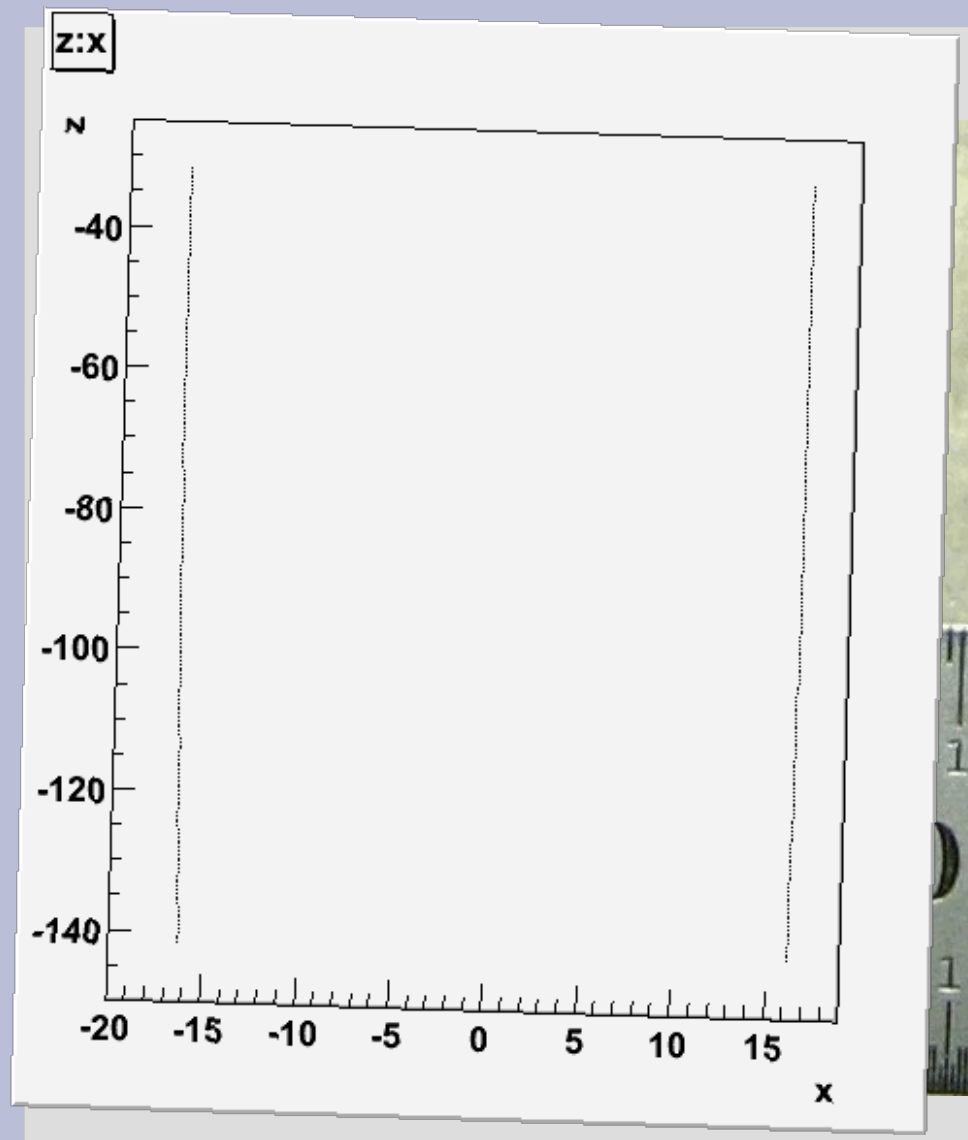


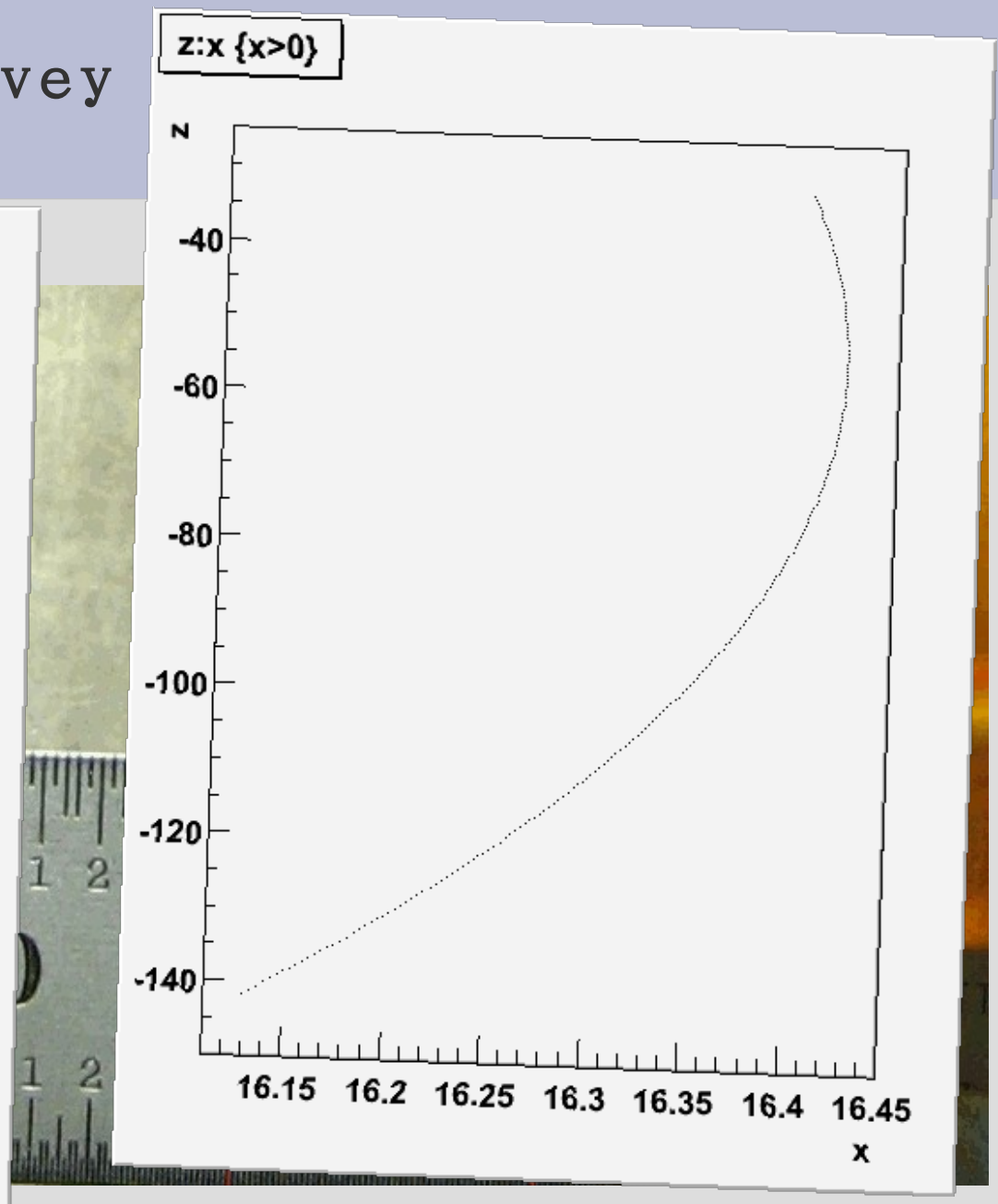
Flux III Survey





Flux III Survey





Flux IV Sensitivity test (summary)

Inside radii of target chamber

-1.0 mm:
A: L -2745.833 R 2764.819 5510.652(-19%)
B: L -2847.496 R 2777.610 5625.106(-19%)

-0.5mm
A: L -3093.097 R 3104.043 6197.140(-9%)
B: L -3196.079 R 3118.110 6314.189(-9%)

0 mm
A: L -3418.192 R 3421.649 6839.841
B: L -3522.387 R 3436.889 6959.276

+0.5mm
A: L -3844.346 R 3838.091 7682.437(12%)
B: L -3950.203 R 3854.941 7805.144(12%)

+1.0mm
A: L -4163.861 R 4150.011 8313.872(22%)
B: L -4270.867 R 4167.970 8438.837(21%)

Tuning angle in x axis

+2degree
A: L -3396.338 R 3399.993 6796.331(-0.6%)
B: L -3502.421 R 3415.093 6917.514(-0.6%)

-1degree
A: L -3412.502 R 3415.902 6828.404(-0.2%)
B: L -3517.717 R 3431.125 6948.842(-0.1%)

0 degree
A: L -3418.192 R 3421.649 6839.841
B: L -3522.387 R 3436.889 6959.276

+1degree
A: L -3413.375 R 3417.199 6830.574(-0.1%)
B: L -3516.326 R 3432.350 6948.676(-0.1%)

+2 degree
A: L -3398.085 R 3402.585 6800.670(-0.6%)
B: L -3499.645 R 3417.543 6917.187(-0.6%)

Flux V Some comments

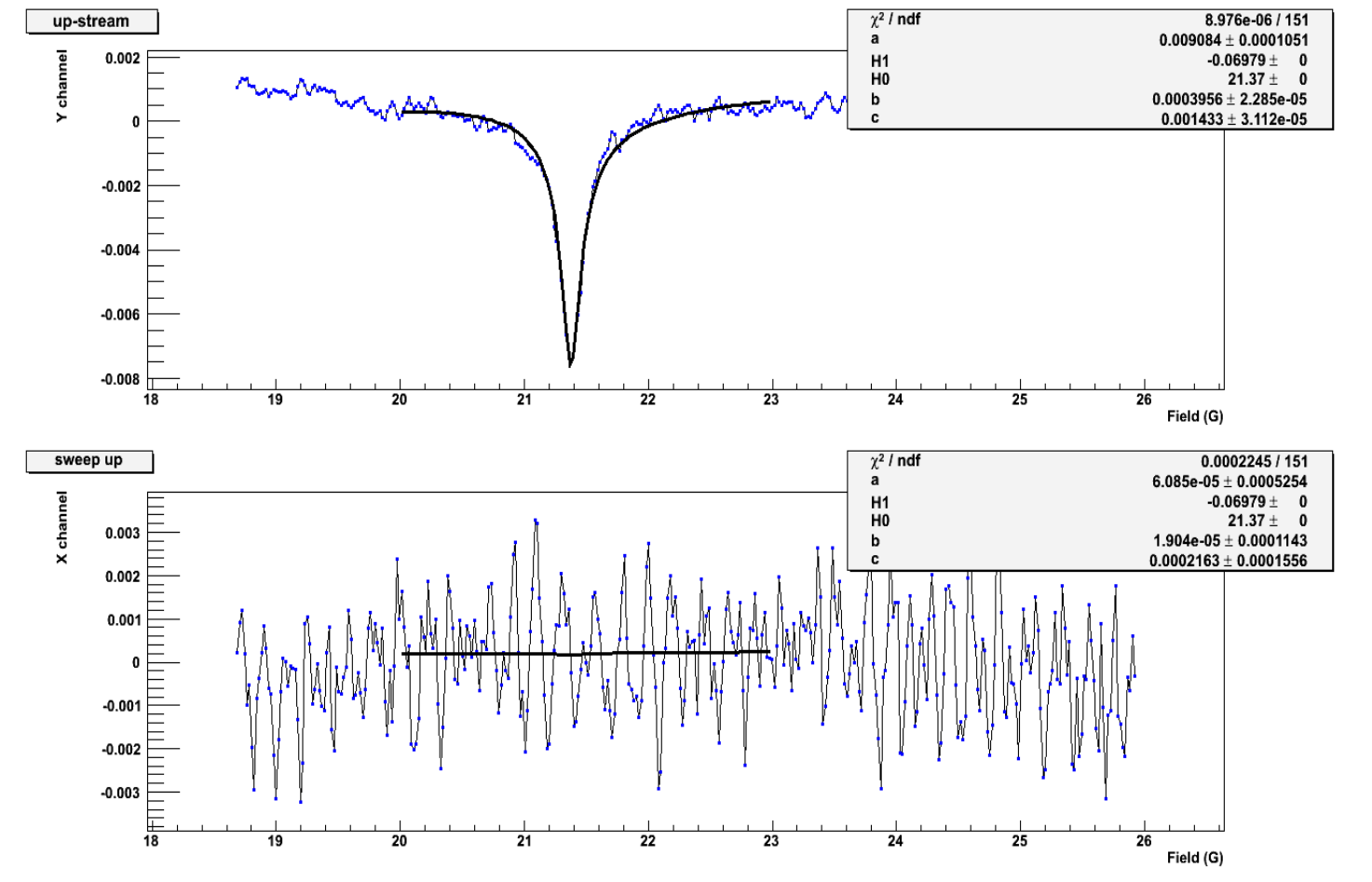
- Inside radii of target chamber were estimated by the volume and length.
- Outside radii were got from Al Tobias, who told that he would send me the results of dedicated measurement.
- Wall thickness of water cell is ~0.6 mm thinner that 3He cell, need to be measured maybe.
- Once the temperature in cell are ready, the distribution of 3He density in cell (especially in target chamber) can be taken into account in flux calculation.

Water calibration I

- Use Kevin Kramer's code, which was got from Aidan, also checked with the technical note, no modification.

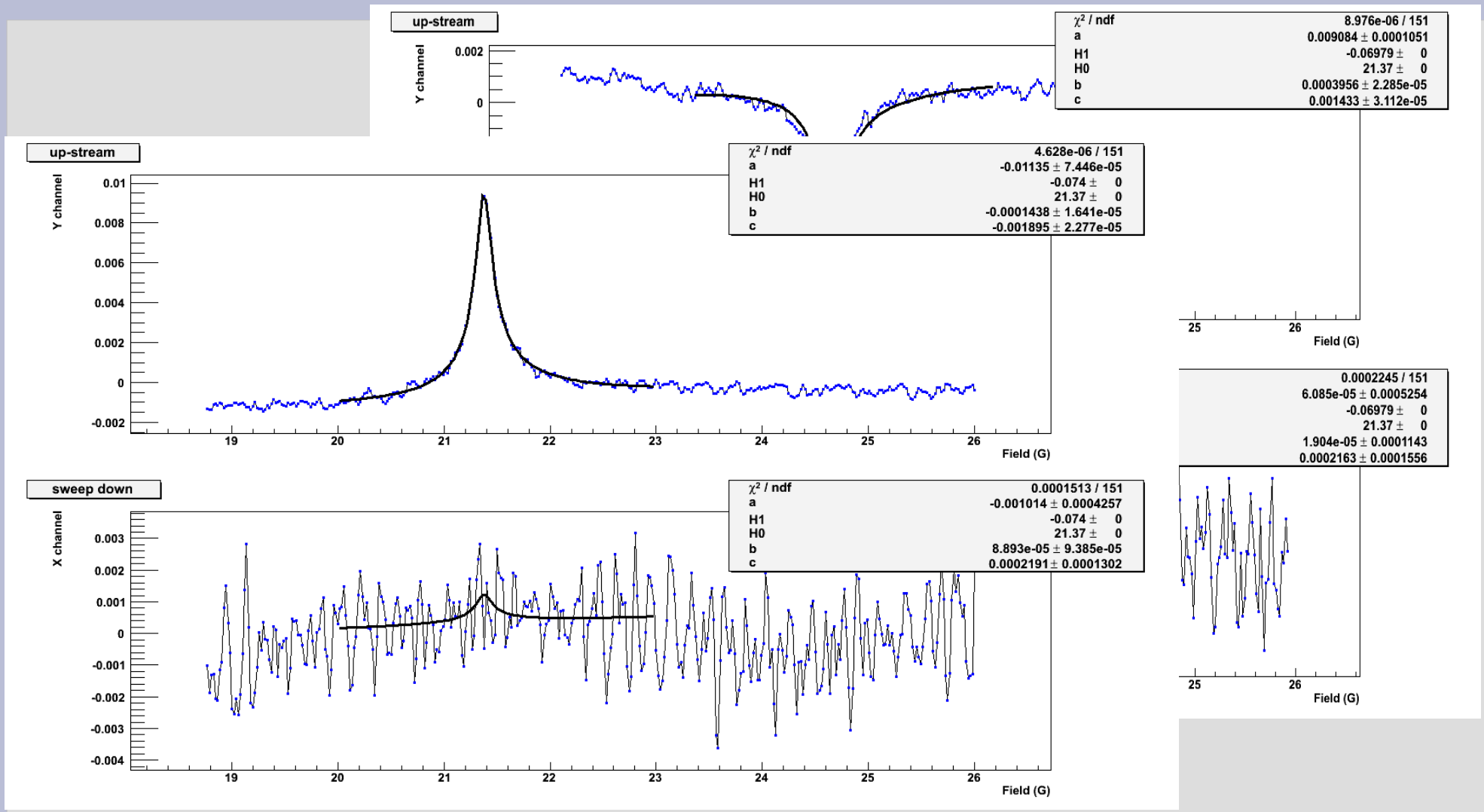
- We did 4 water calibrations. There are some little differences among them.

Water calibration II



B = 1.0393*(reading - 0.0391);

Water calibration II

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B =  1.0393*(reading + 0.0391);
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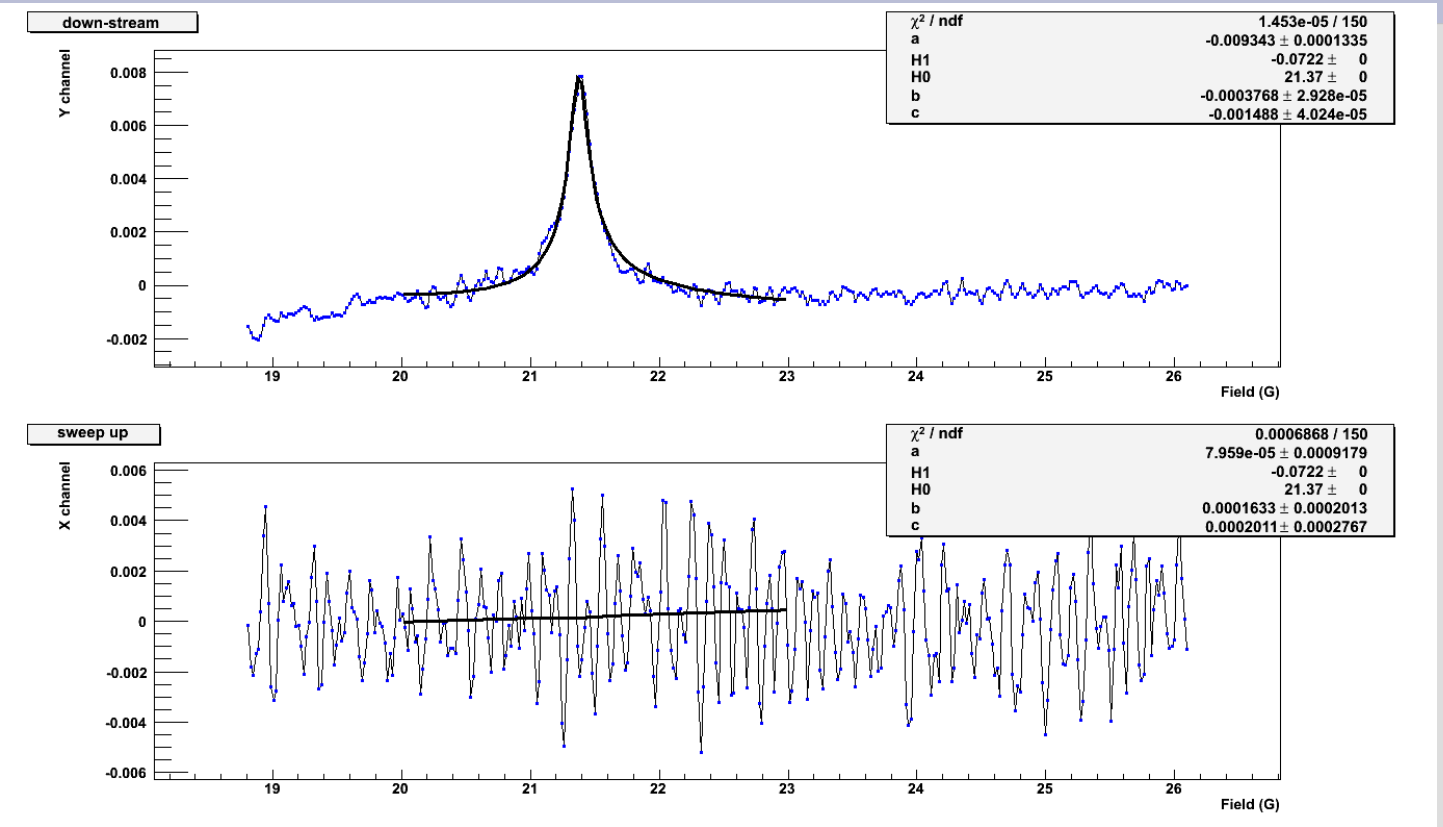
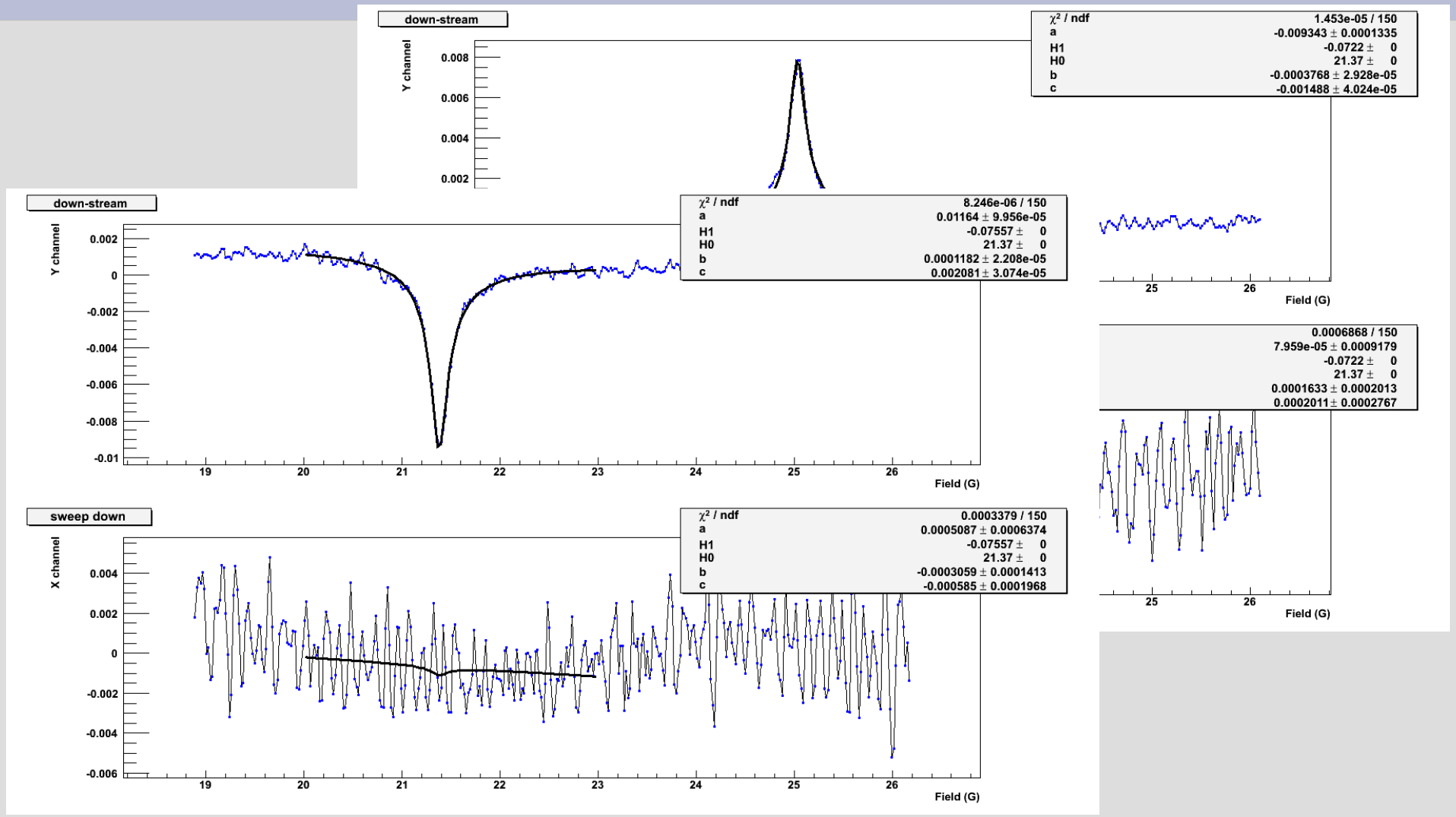
Water calibration III



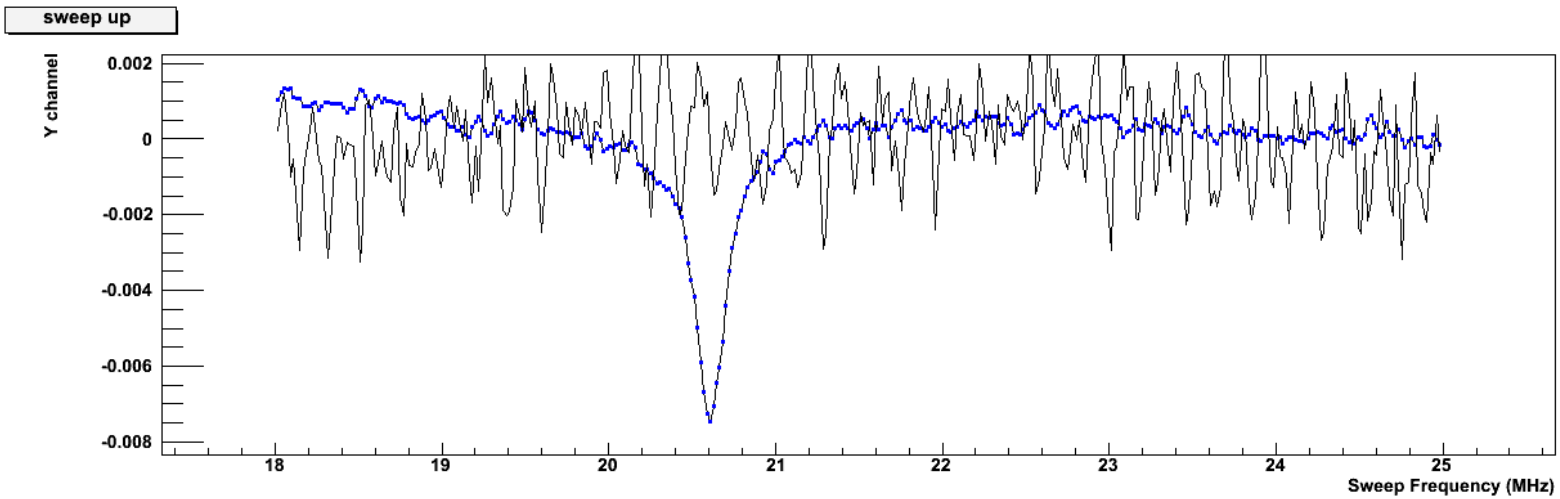
B = 1.0461 * (reading - 0.0366)

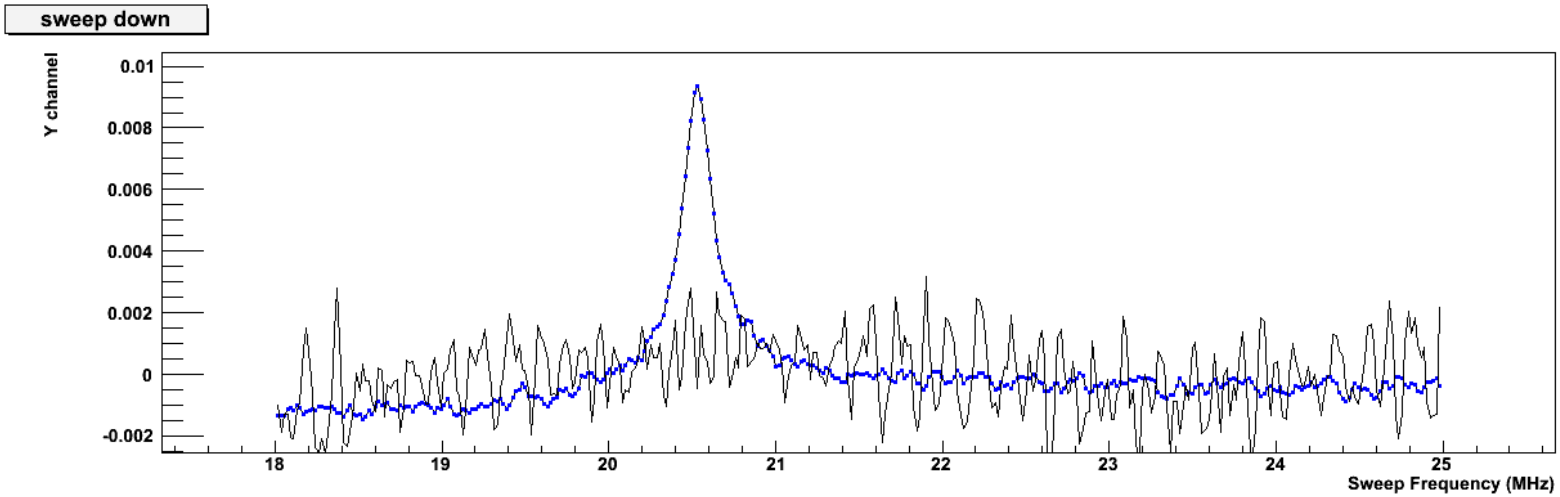
Water calibration III



B = 1.0461 * (reading + 0.0366)

Water calibration IV





Water calibration V

- The fitting works well.
- For sweep up signal, only tiny part (~0.7%) of signal are in the X channel, which can be ignored.
- For sweep down signal, there are up to 10% signals in the X channel. How to deal with them? Add them together will be too noisy.

To-do list (rough)

- Density!!!
- Temperature results.
- Wall thickness of the water cell.
- Compare with 3He signal (should not be too complicated to fit)
- How to combine different water calibration results together?
- Same thing need to be done for November and December.