COMPASS Polarized Target:

Polarization measurement

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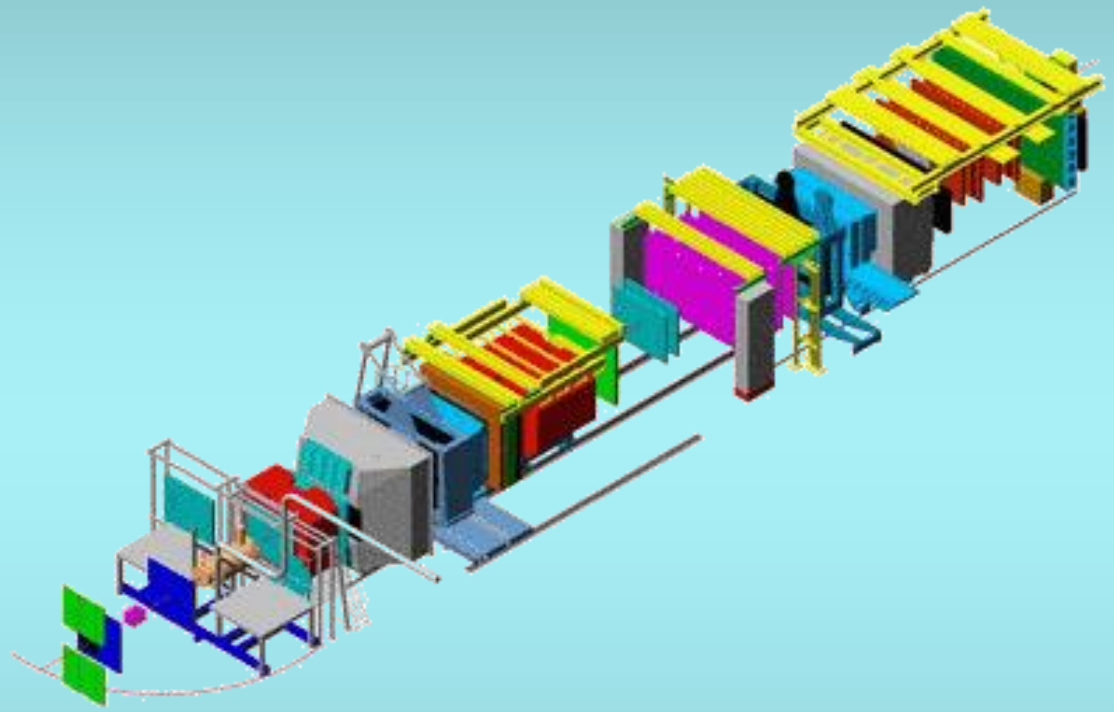
Outline

1) COMPASS experiment
2) Polarized target
3) Polarization measurement and results
4) Conclusion

COMPASS experiment

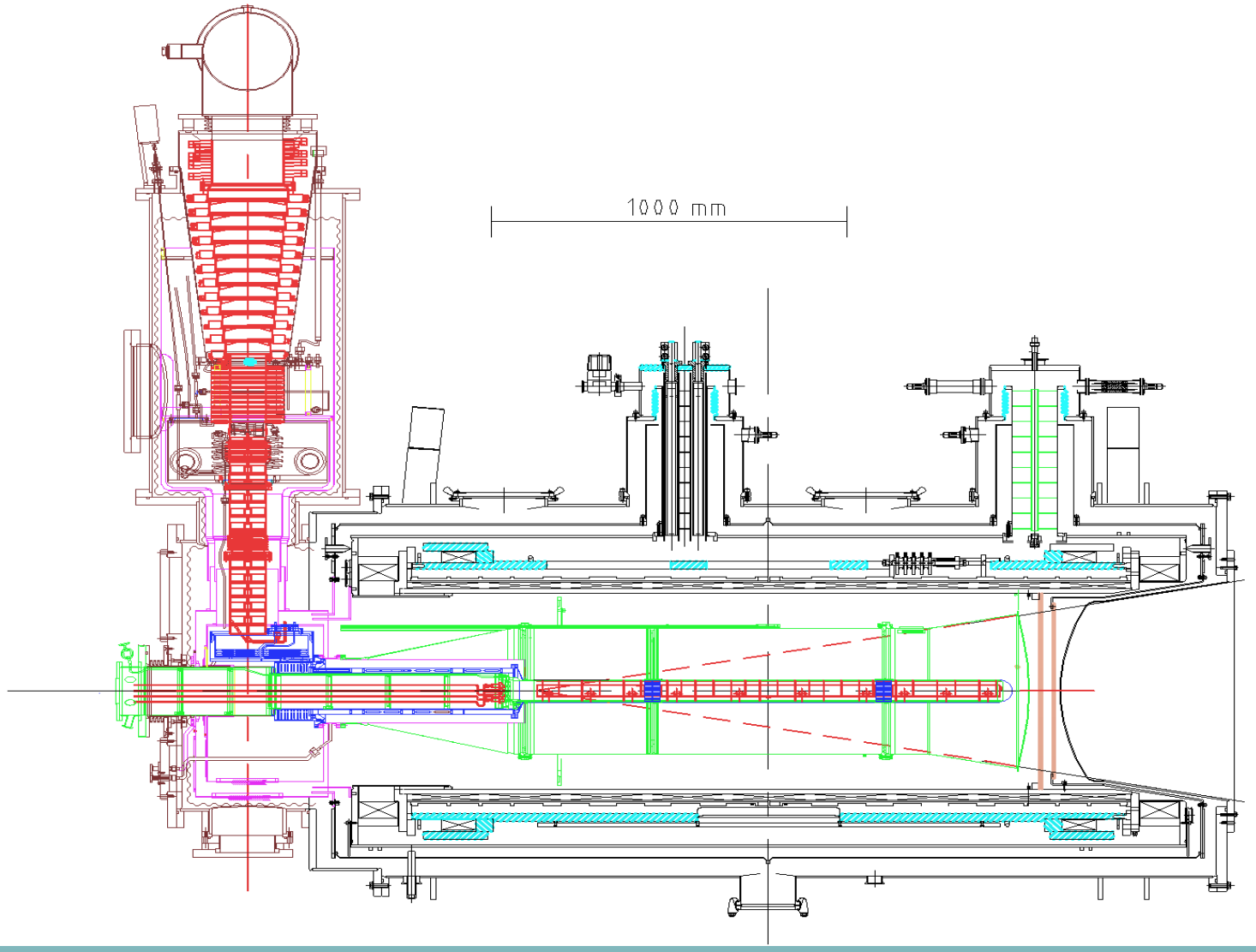


- Two-stage spectrometer+polarized target
- Secondary 160 GeV/c μ highly polarized beam from SPS
- Measurement of spin asymmetries

PT – basic facts

- Dilution refrigerator 5mW@75mK
- SC magnet 0.6T dipole/2.5T solenoid
- Homogenity of magnetic field $\sim 10^{-5}$T
- 10 NMR coils for polarization measurement
- 3 cells in configuration 3-4-3
- Solid NH_3 (or ^{6}LiD in past) in form of small balls
- LabView for data taking

Layout of the target




NMR PC
PlotArea.vi
STOP
SAVE DATA
CLEAR DATA
LOAD DATA
polarization
rel. time [h]
DELL

Polarization measurement

- Spin ½ ensemble - protons in NH_3 $P = \frac{n_+ - n_-}{n_+ + n_-}$
- Thermal equilibrium of lattice and nuclei =>P can be calculated $P_{TE} = \tanh\left(\frac{\hbar\gamma B_0}{2k_B T}\right)$
- P_{TE} – very small – P=0.25% for protons at 2.5 T and 1 K
- Can be measured by NMR => $P \sim S_{NMR}$

  =>idea of TE calibration

Measurement using NMR

- Actually measurement of susceptibility

$$P \propto \int \chi''(\omega) d\omega$$

- Inductance of coil with material

$$L(\omega) = L_0 \left[1 + \mu_0 \eta \chi(\omega)\right]$$

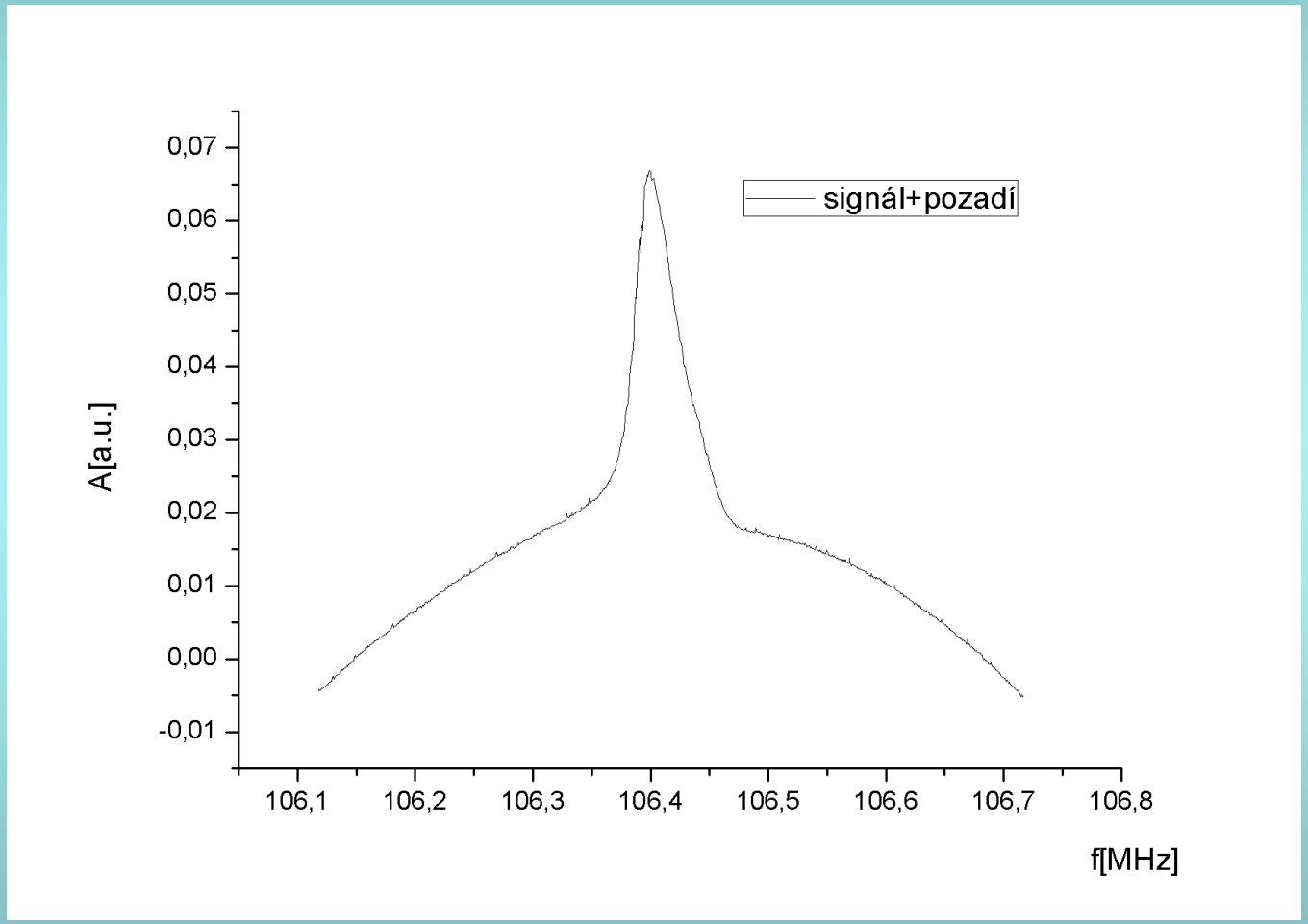
- Measured using Q-meter

$$V_{NMR}(\omega) \propto \chi''(\omega)$$

TE calibration

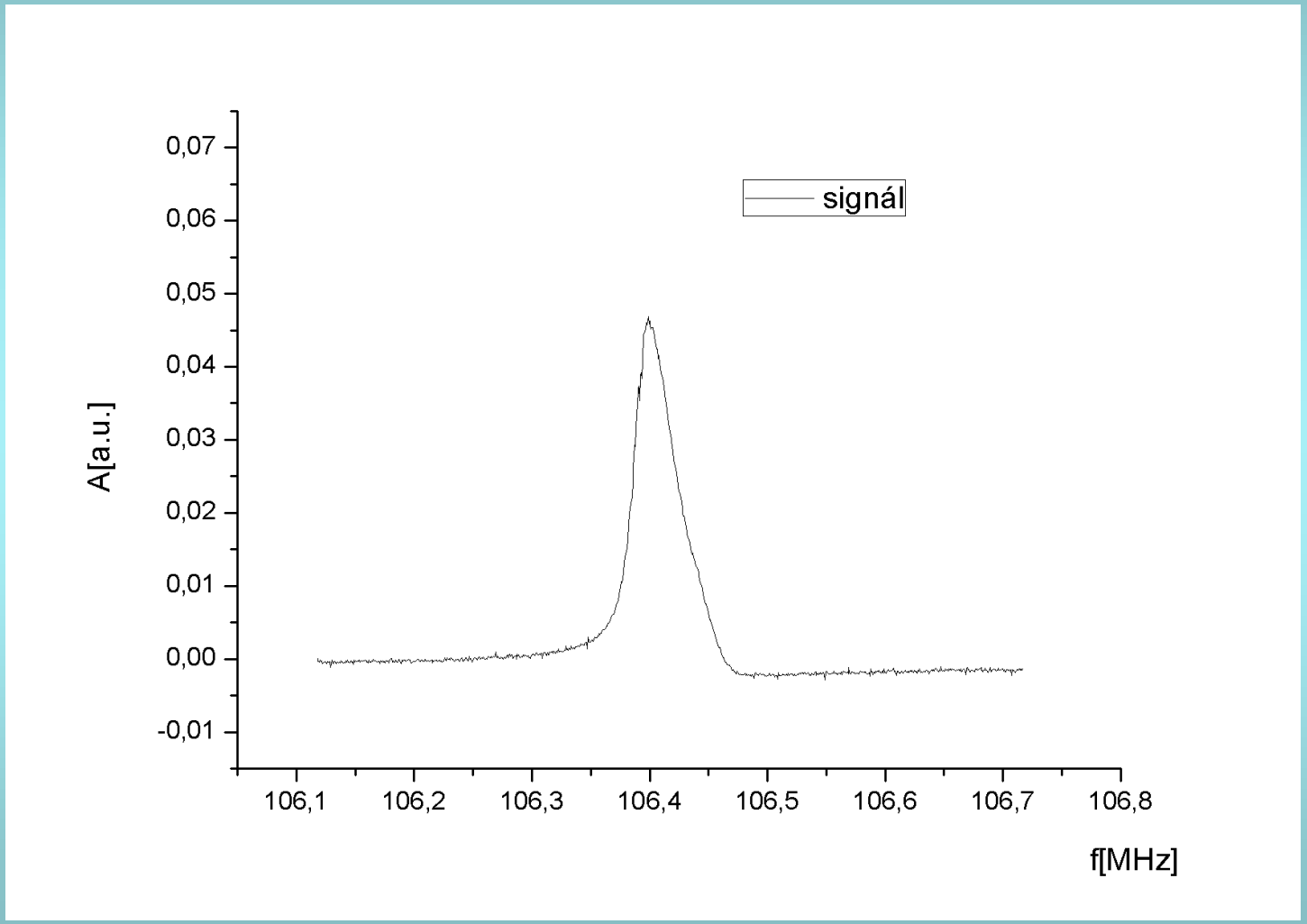
- NMR measurement in target with and without material
- Several different temperatures
- Before and after run
- Analysis is rather delicate (S_{TE} is small, parasitic signal from target material holder,..)

TE calibration

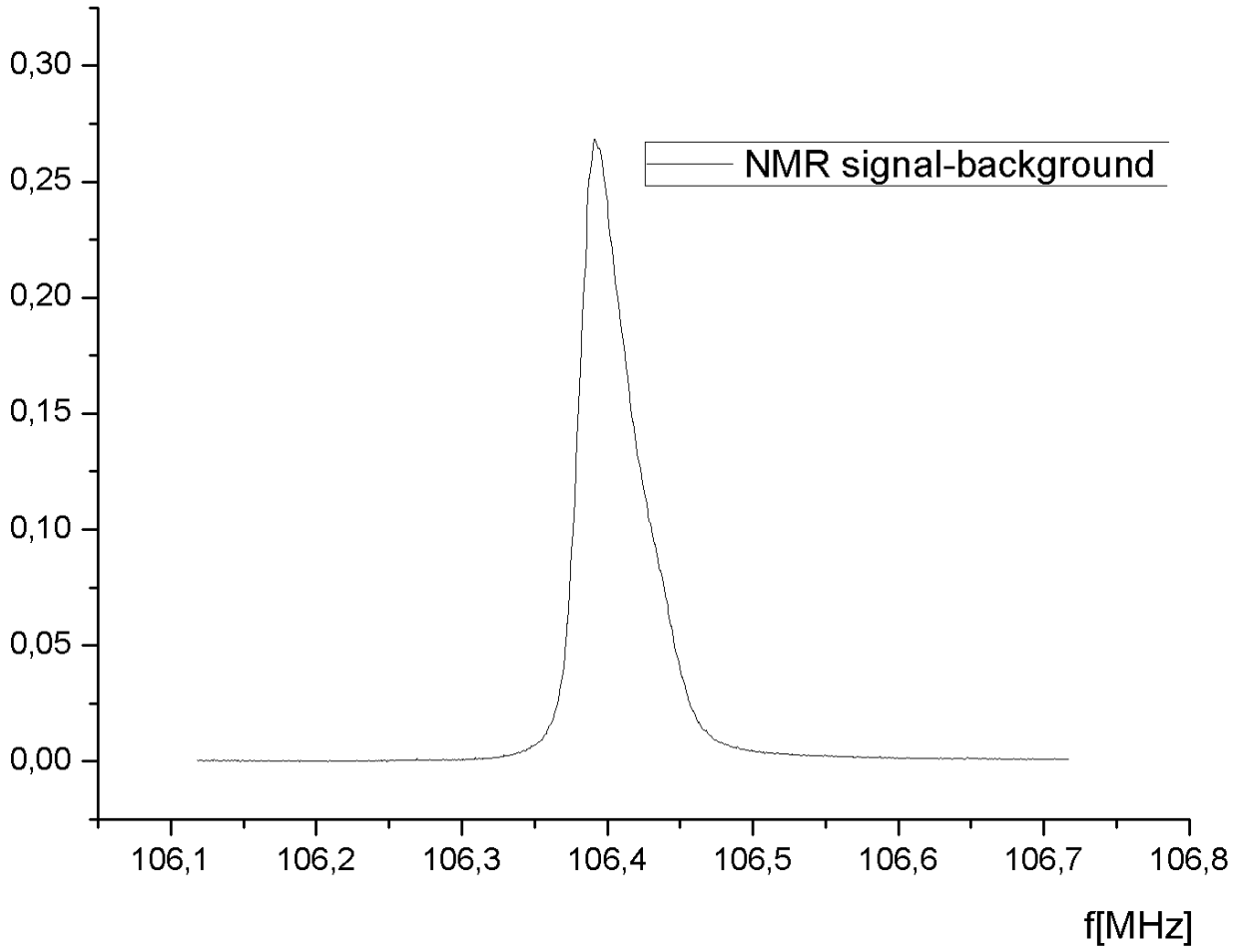


app 200x. amplified

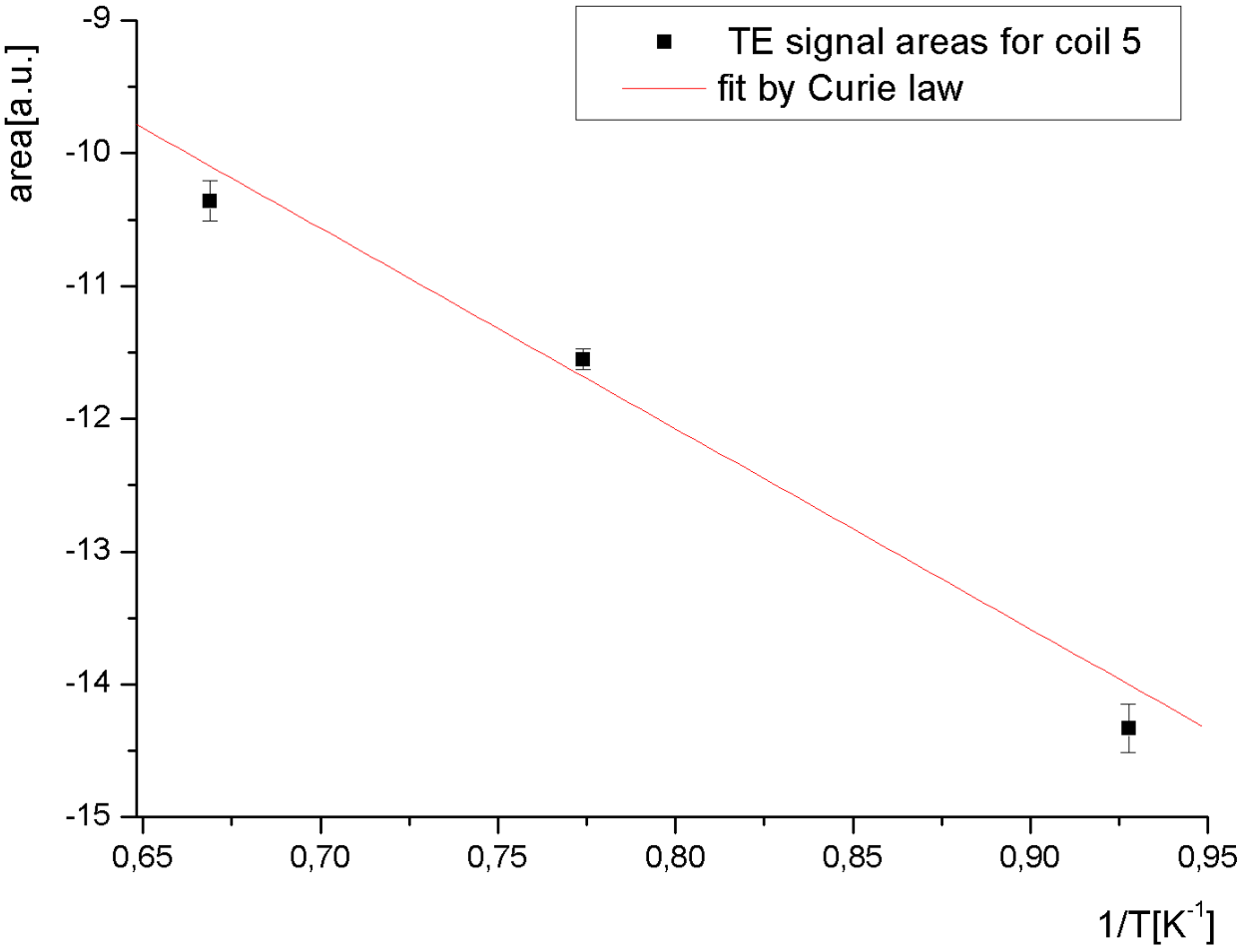
TE calibration



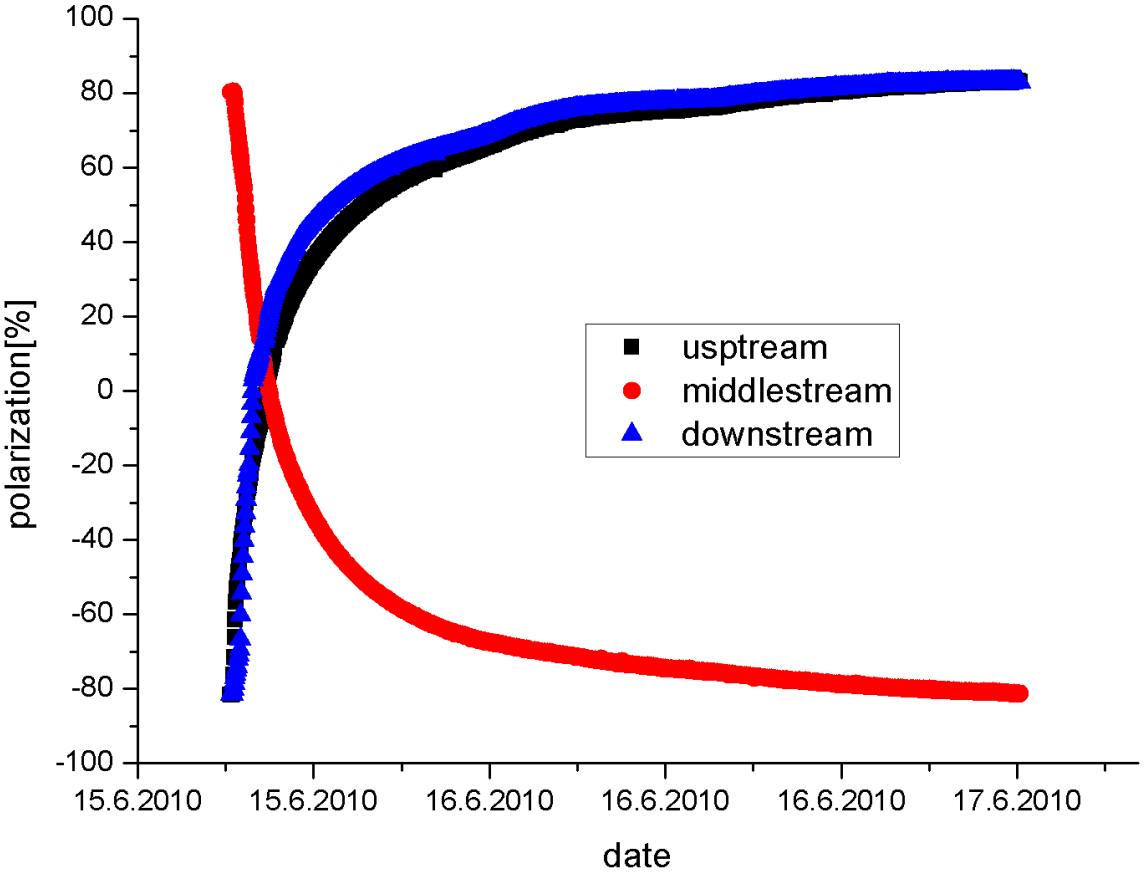
Enhanced signal



TE calibration



- Example of polarization buildup in 2010



Relaxation rates

- Relaxation of polarization very slow in 0.6T dipole (even slower in 2.5T solenoid)=>

  T_{up} $=(7{,}0\pm1{,}7).10^3$h

  T_{middle} $=(5{,}7\pm0{,}7).10^3$h

  T_{down} $=(5{,}7\pm1{,}2).10^3$h

- 2011 relaxation not determined

Few comments of systematics

- Temperature
- TE fitting
- Circuit nonlinearities
- Field polarity
- ….

Results on polarization

- Average polarization ~80% in 2010
- ~85% in 2011
- Statistical uncertainity ~2. 0%
- Systematic uncertainity ~3. 5%

Conclusion

- PT perfomed well during 2010 &2011
- It will be used for polarized DY after modifications

- I would like to thank whole COMPASS PT group and many other members of colaboration for their hospitality and help.

Thank you for your attention