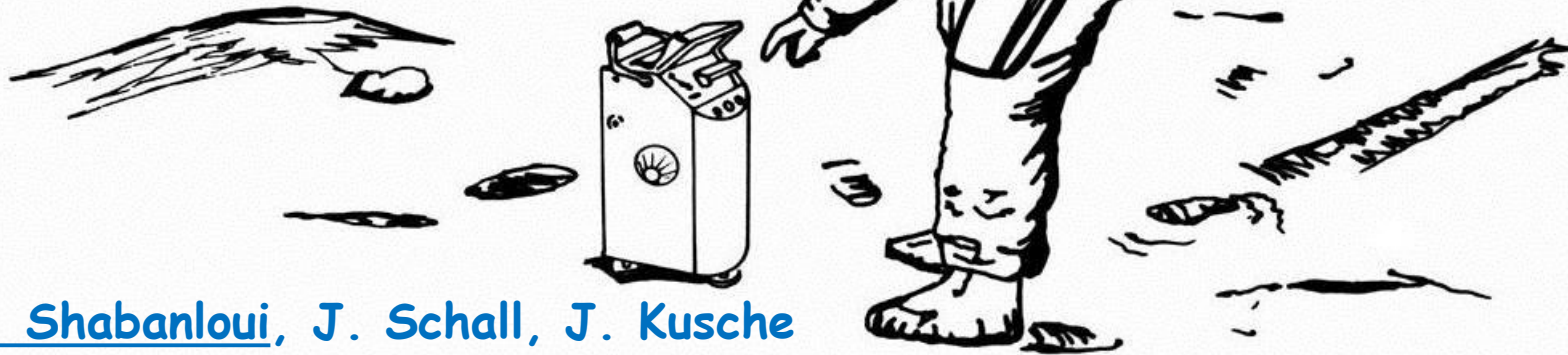


Experiment with the Bonn Scintrex CG-5



A. Shabanloui, J. Schall, J. Kusche
Luxembourg
2th Oct. 2013

- Introduction to CG-5 (Autograv Scintrex)
- Atmospheric Effects
- Data Corrections, Drift and Data Analysis
- Experiments (Bonn and Bad-Homburg)
- Tilt Experiments
- Summary and Outlook



CG-5 Autograv Scintrex

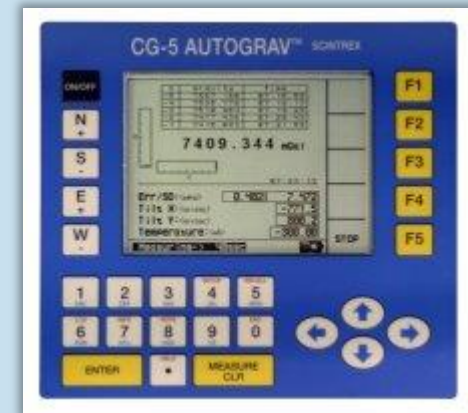
Sensor Type	Fused quartz using electrostatic nulling
Resolution(Reading)	1 Micro-Gal
Standard Deviation	5 Micro-Gal
Operating Range	8000 Milli-Gal
Drift	0.02 mGal/day
Tilt Compensation	±200 arcsec.
GPS receiver	Standard < 15m, CG-5 clock synchronisation
Key fob	30 m (line of sight)
Smart Battery (fan)	2 x 6.6 (Ah), Full day op.
Weight	8 kg. (portable)

AUTOgrav: All effective corrections have been **automatically** considered!

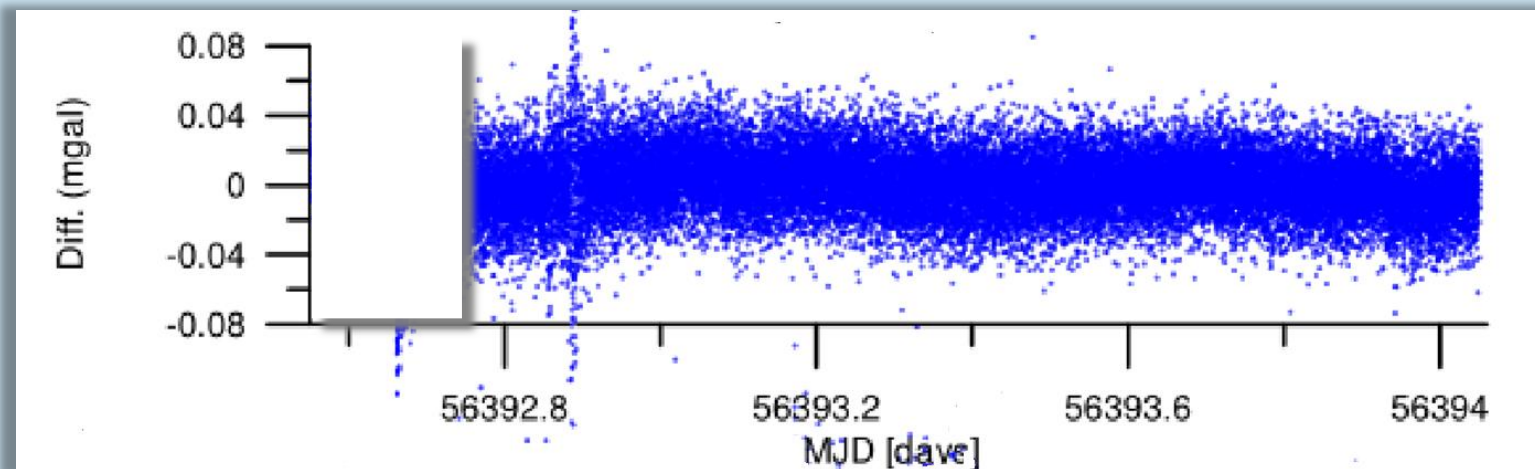
- Dis-advantages:

- Keyboard **sensitivity!** (2 sec. Pause!)

- Firmware **stability!** (hanging)



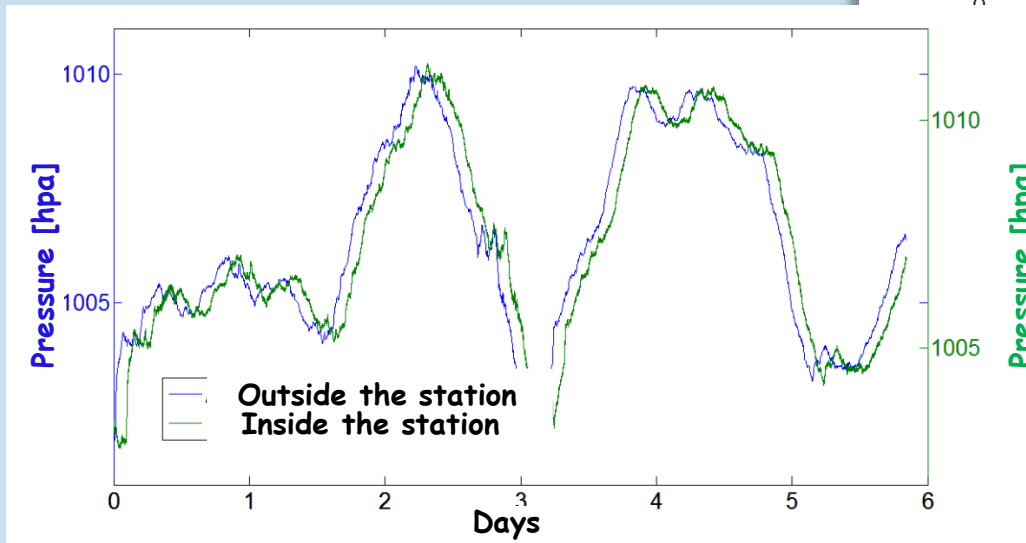
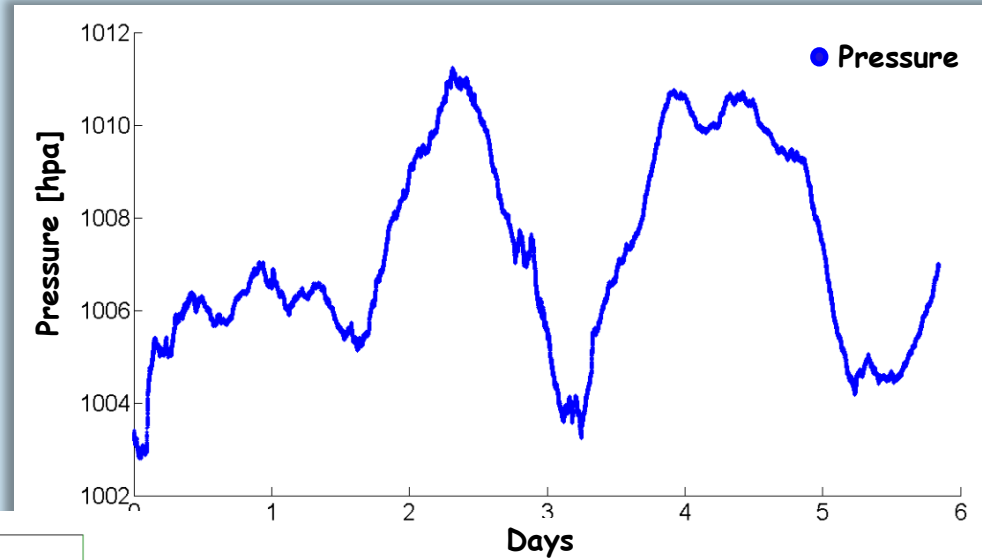
- Single observation [**1 Hz**] has an accuracy of around **80 Microgal!**



- Standard deviation (Time window of **60 sec** ~ **5 Micro-Gal**)

- Pressure

$$\Delta g_p = -0,3 \cdot \Delta p [\mu Gal]$$



✓ **Neglectable** (if pressure changes are less than 17 [hPa])

- Temperature

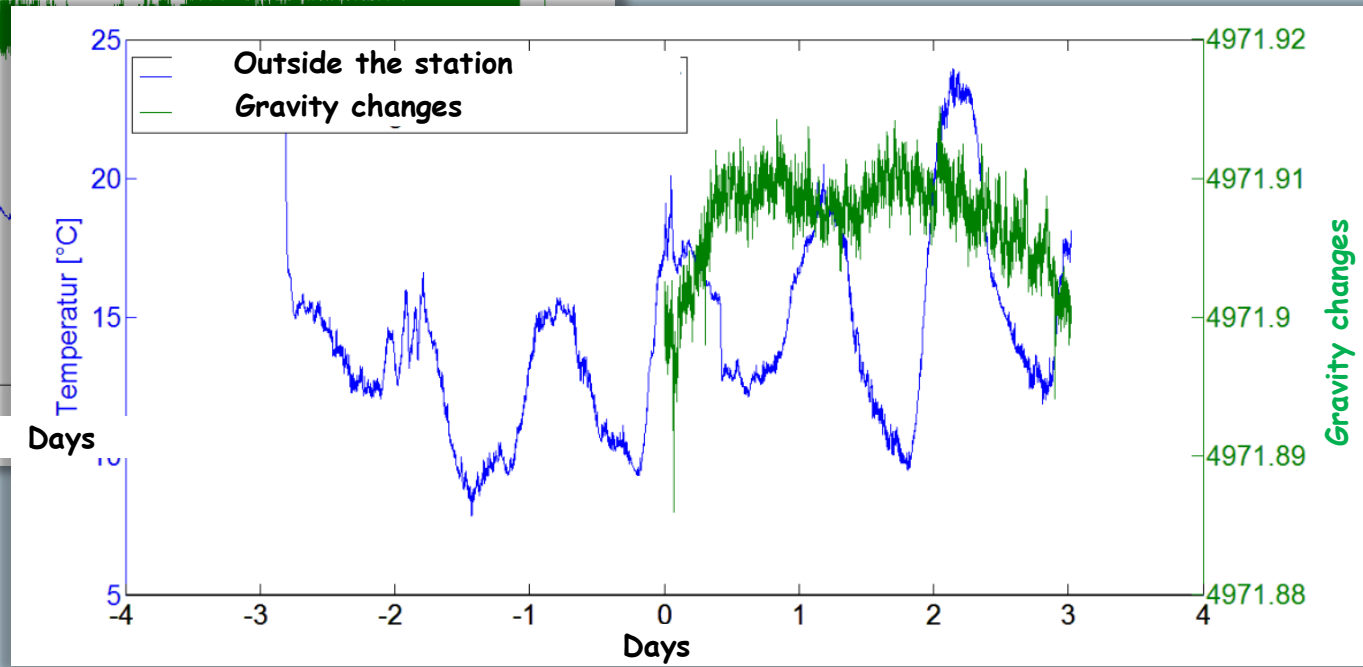
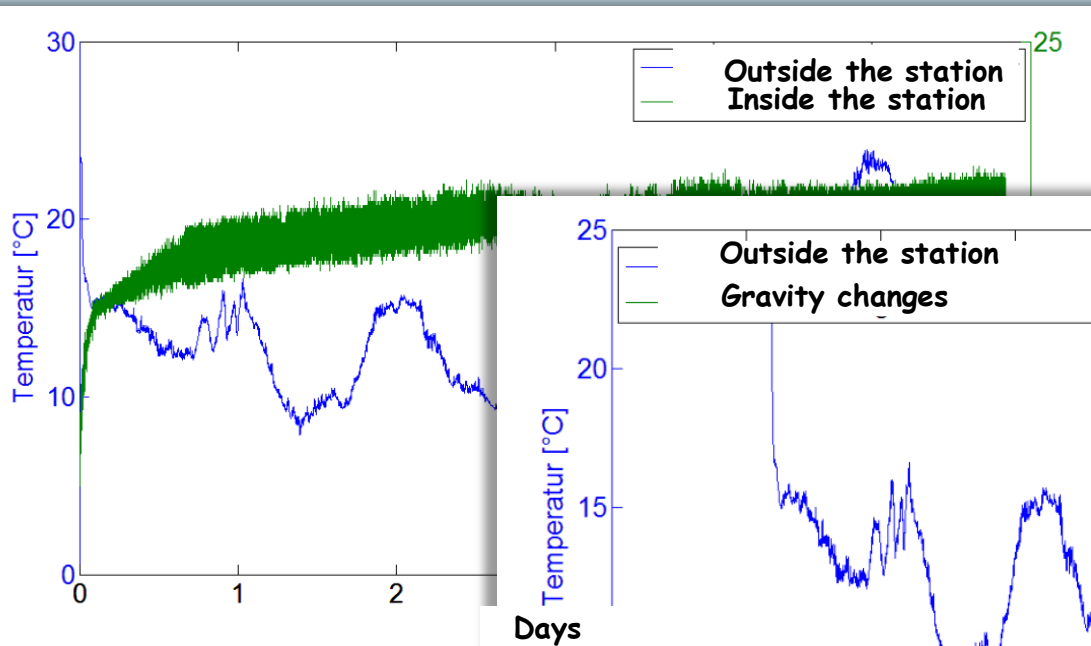
$$TEC = Tempco \cdot Temp$$



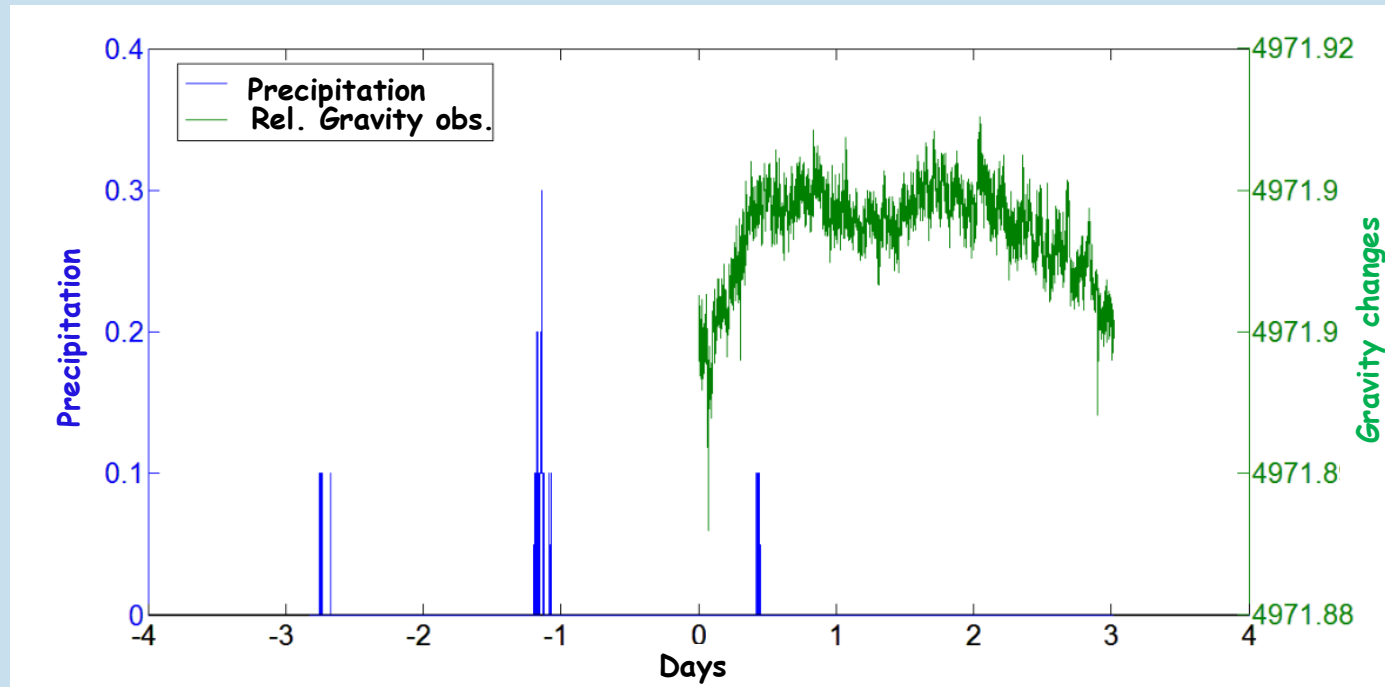
-0.122 mGal/mK



Measured in vaccum!



- Precipitation: changes in the **mass!**



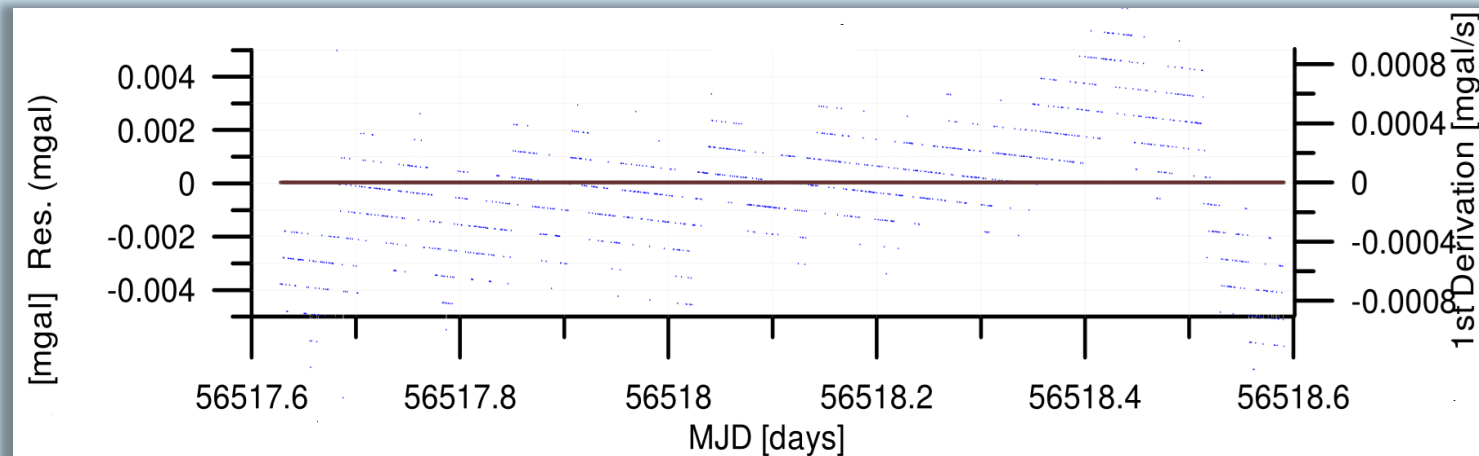
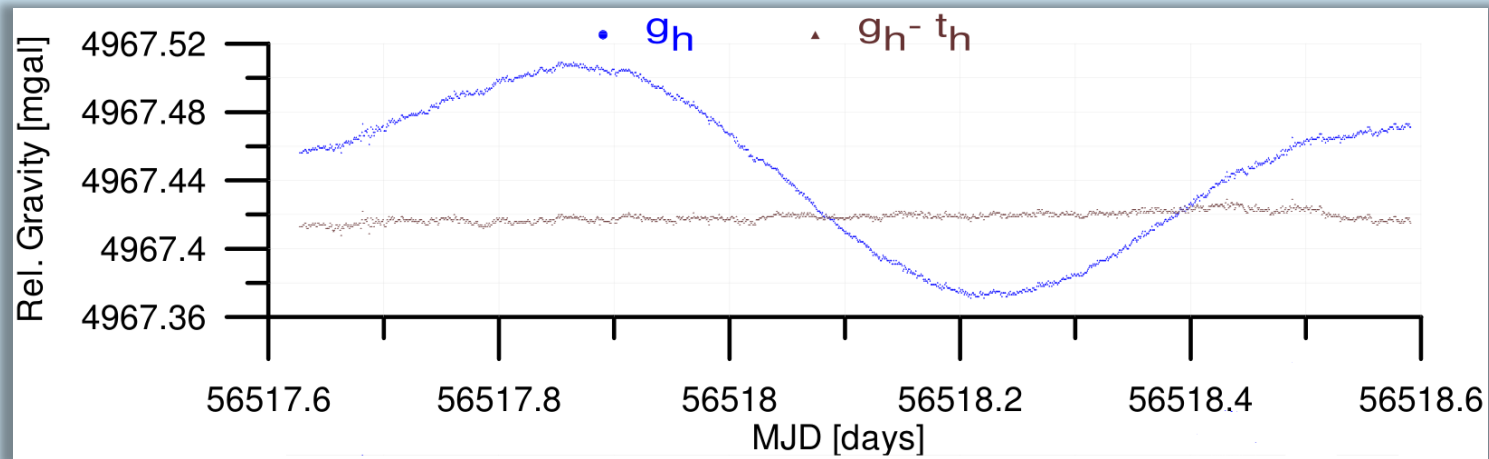
- Atmospheric effects can be **neglected** in the **normal** conditions!

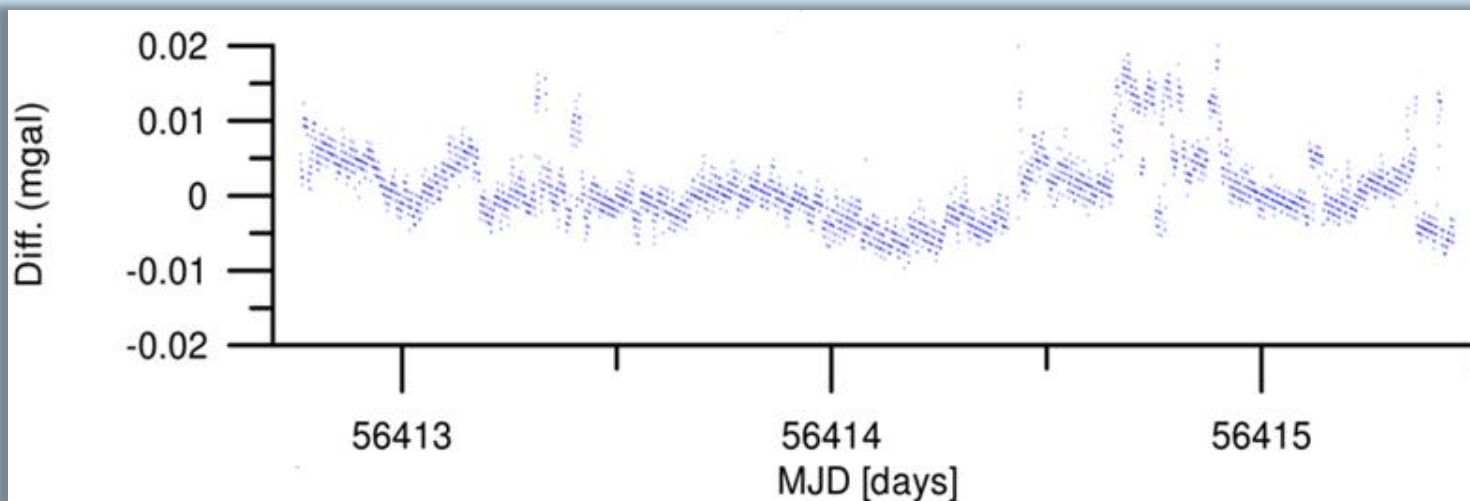
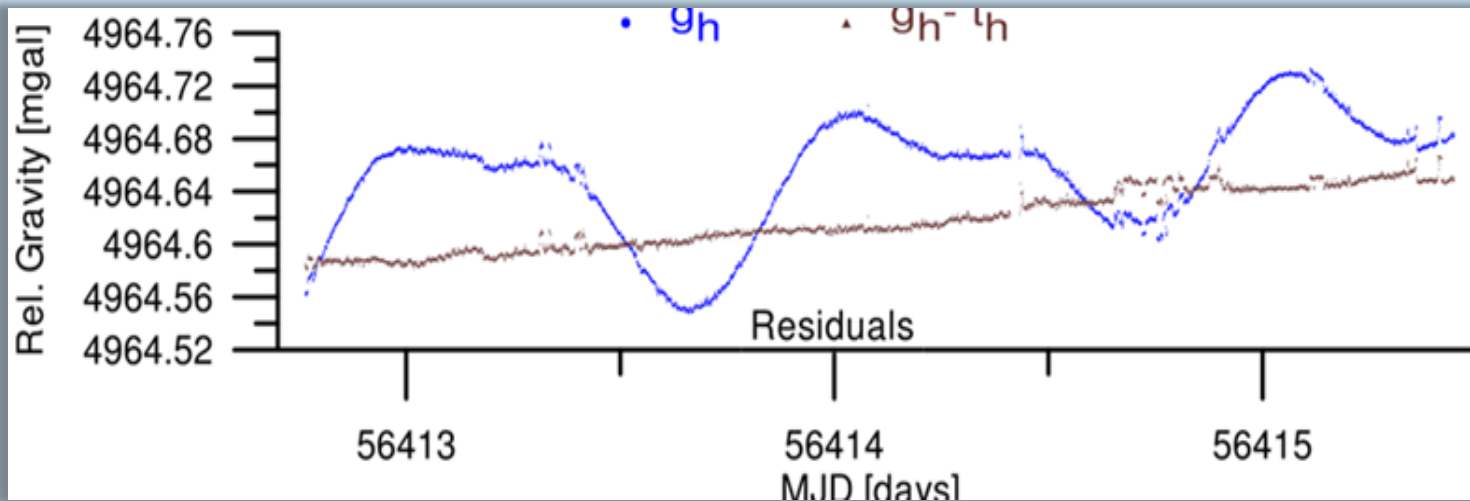
Corrections:

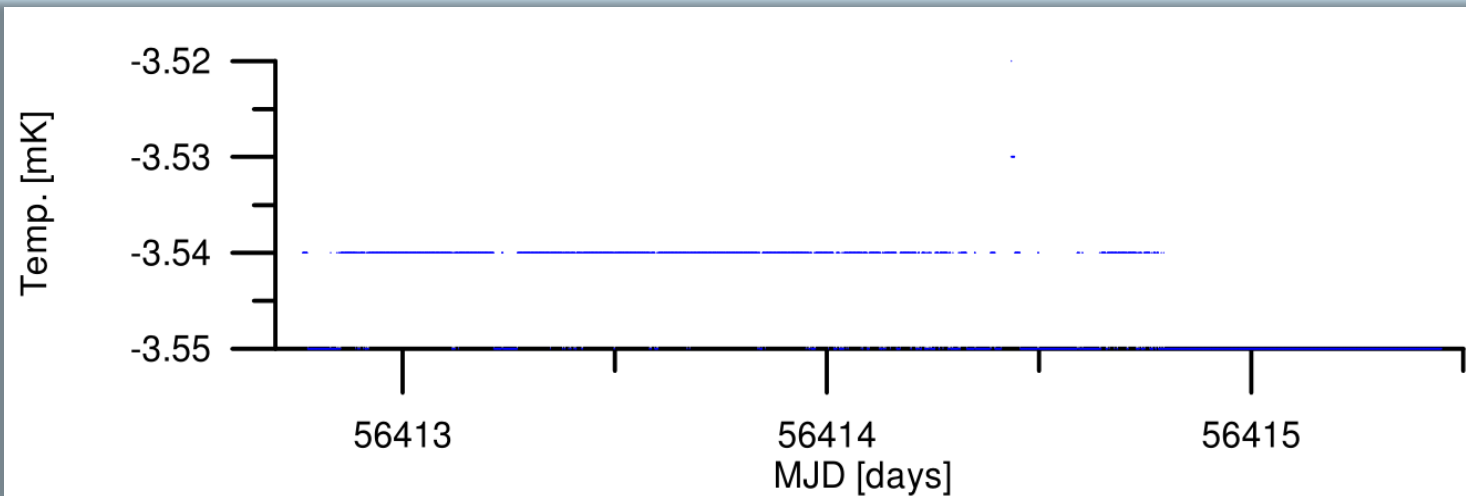
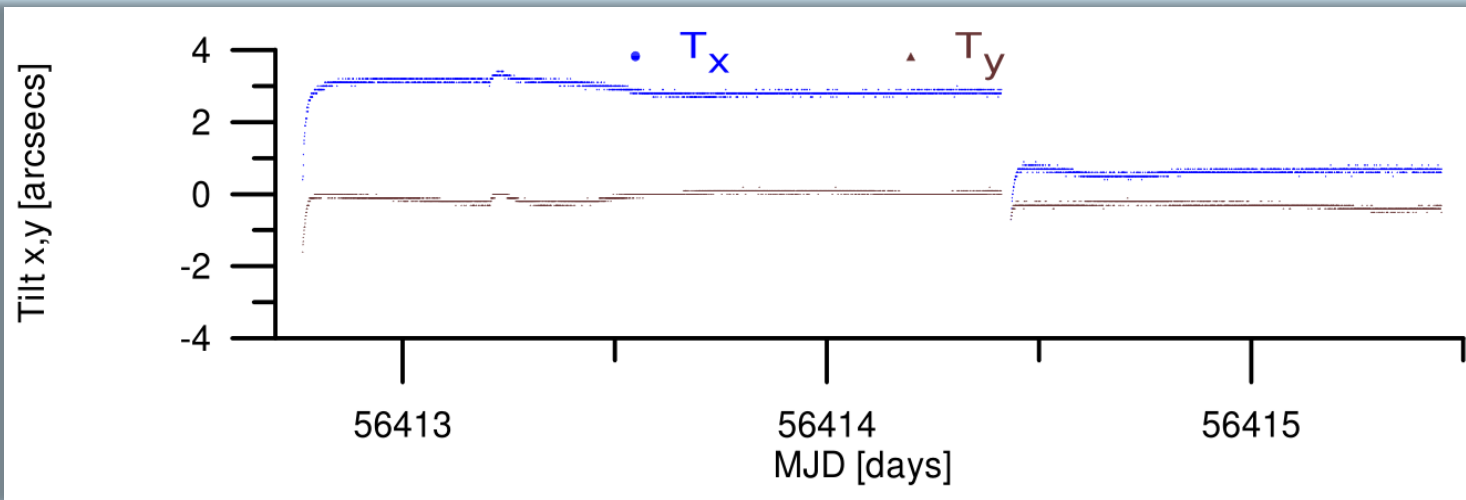
- Drift (**Manual** or Automatic)
 - ✓ **Automatically** corrected!
- Tide
 - ✓ Internal (Longman-Formula, **precision** problem!)
 - ✓ **External** (ETERNA precision less than **5** Microgal)
- Tilt (less than 200 arcsec.), recommended less than **± 10** arcsec.
 - ✓ **Automatically** corrected!
- Temperatur **changes** (Internal and External)
 - ✓ CG-5 is very sensitive to temperature change
 - ✓ Disply **heating** system
 - ✓ **Tilts** more than **200 arcsec.** cause strong **temp. changes**
- Filters
 - ✓ **Noisy** sample filter
 - ✓ **Seismic** noise filter

BLACK BOX!

- CG-5 has a drift of **0.02** [mGal/day] (ref. Scintrex Ltd.)

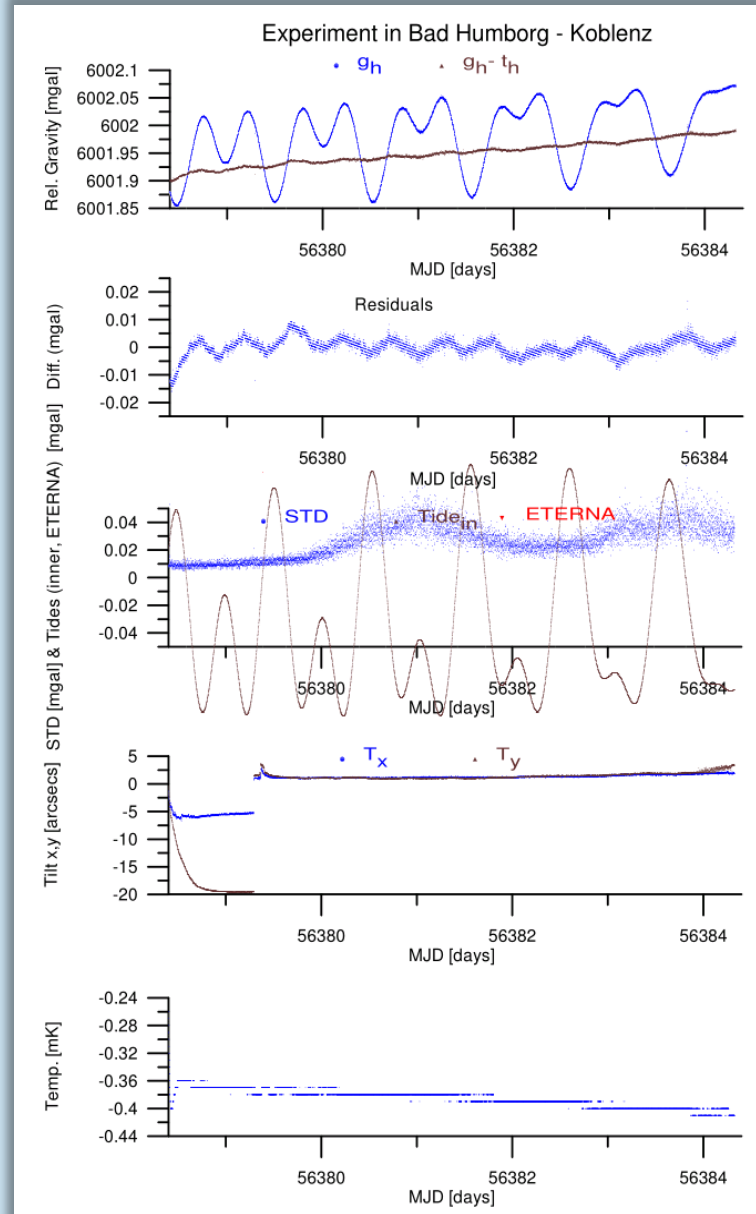
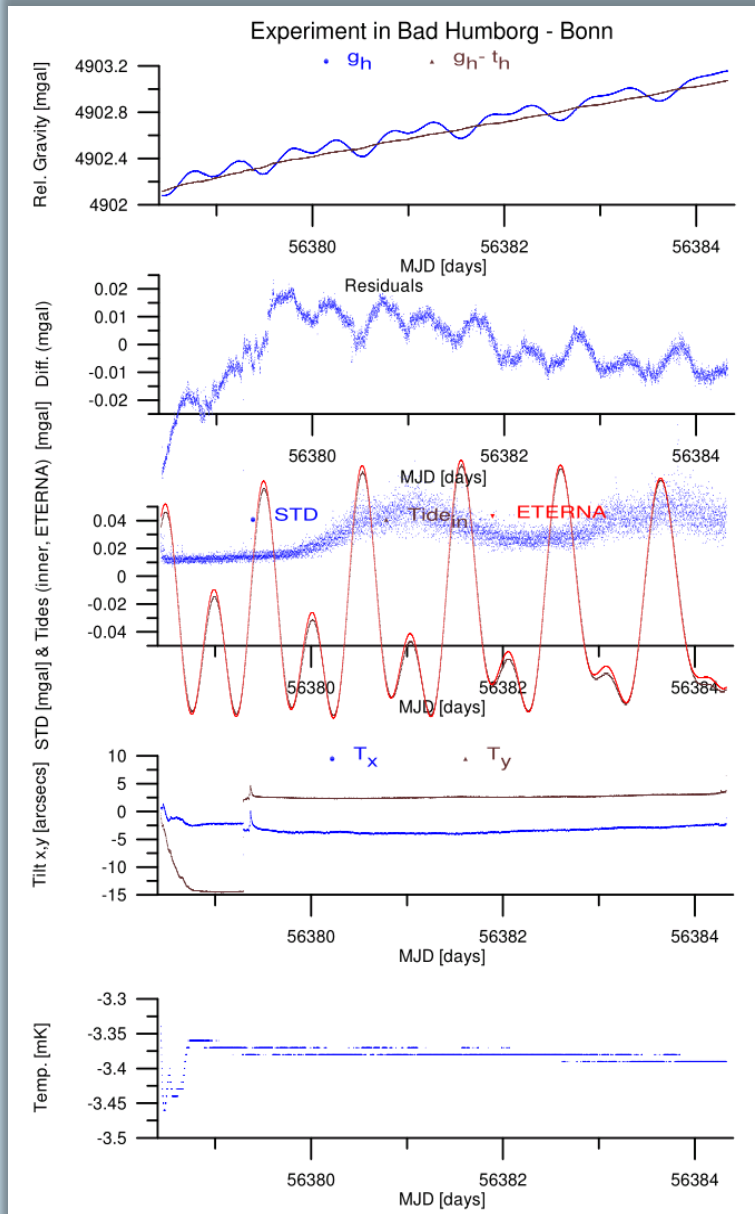


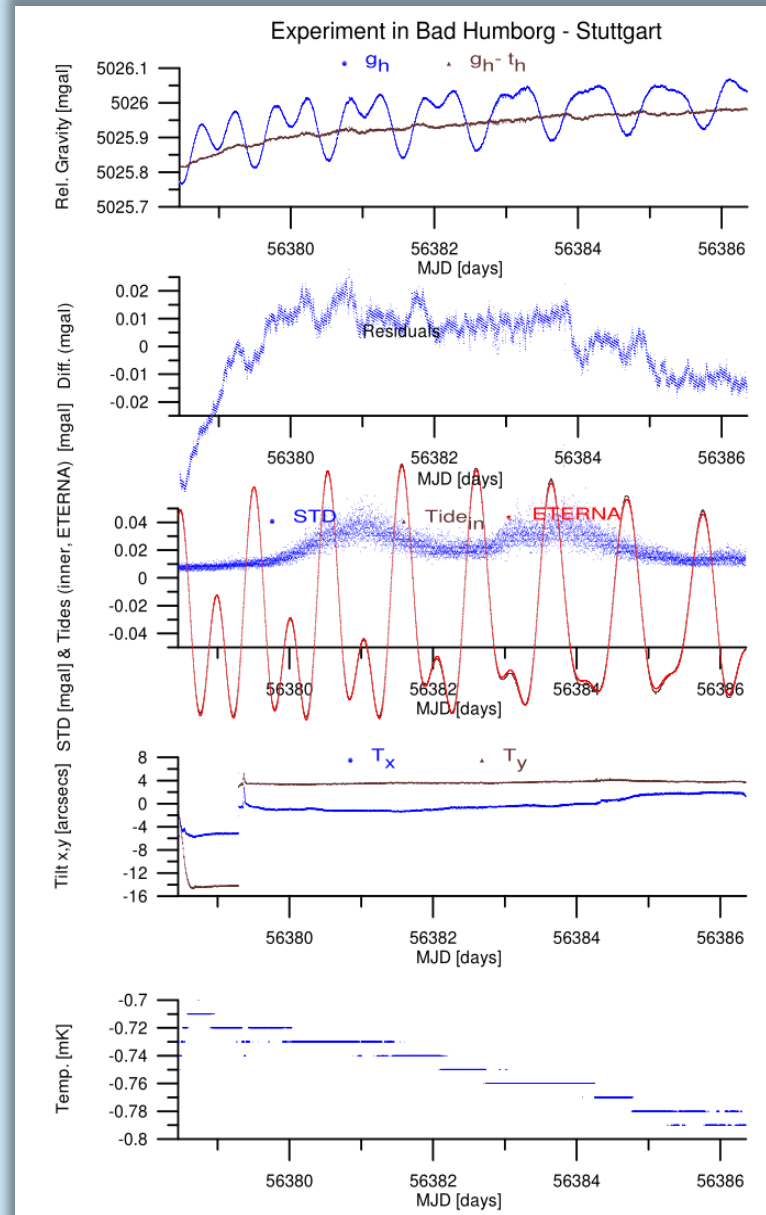
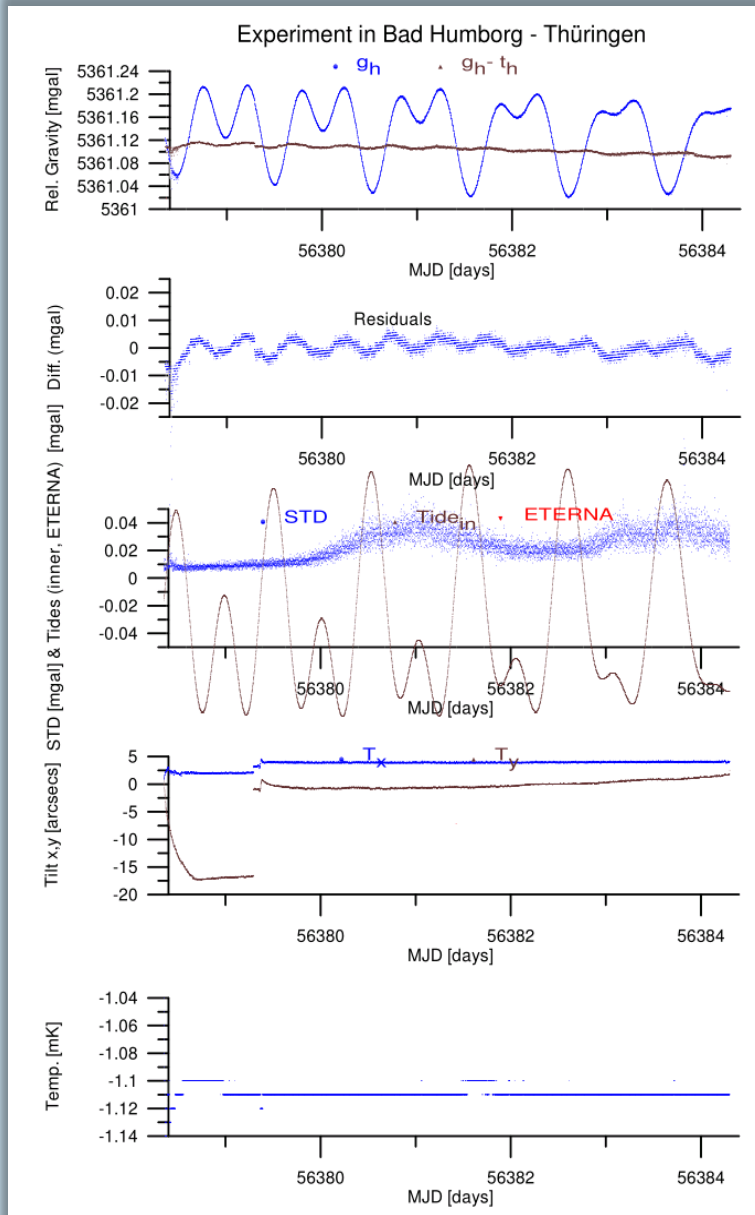


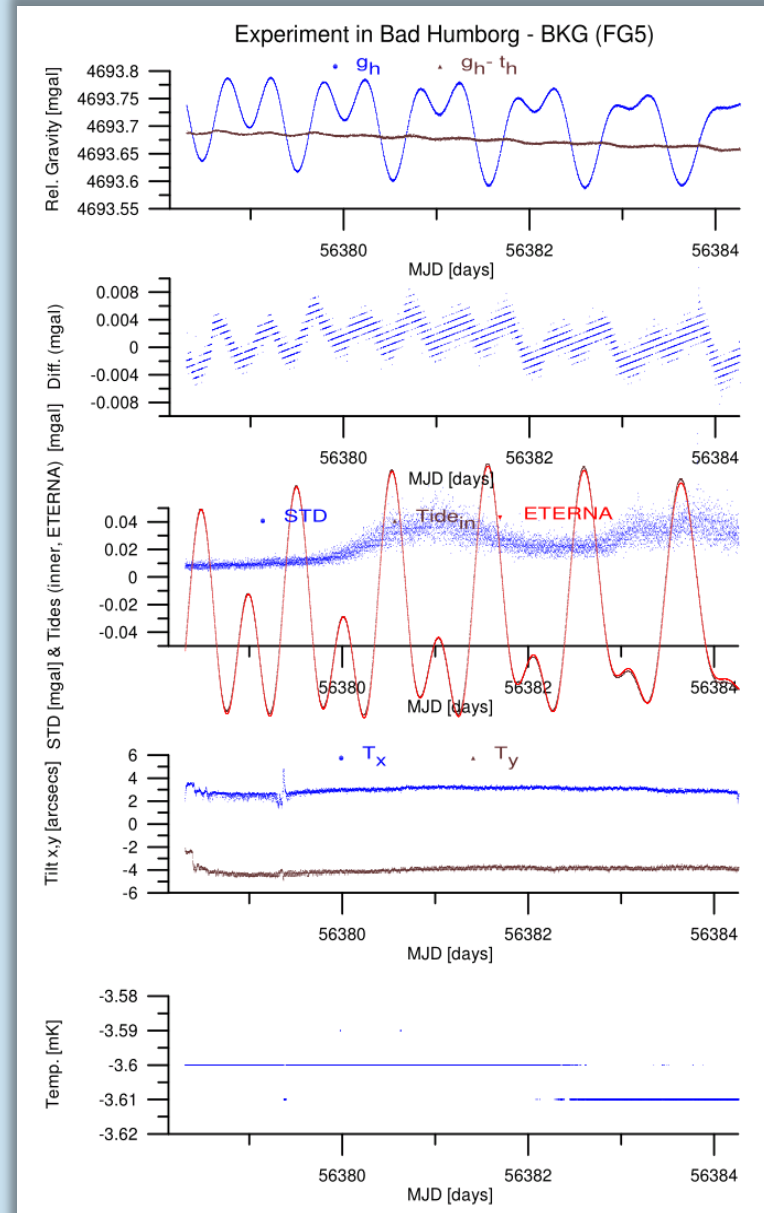
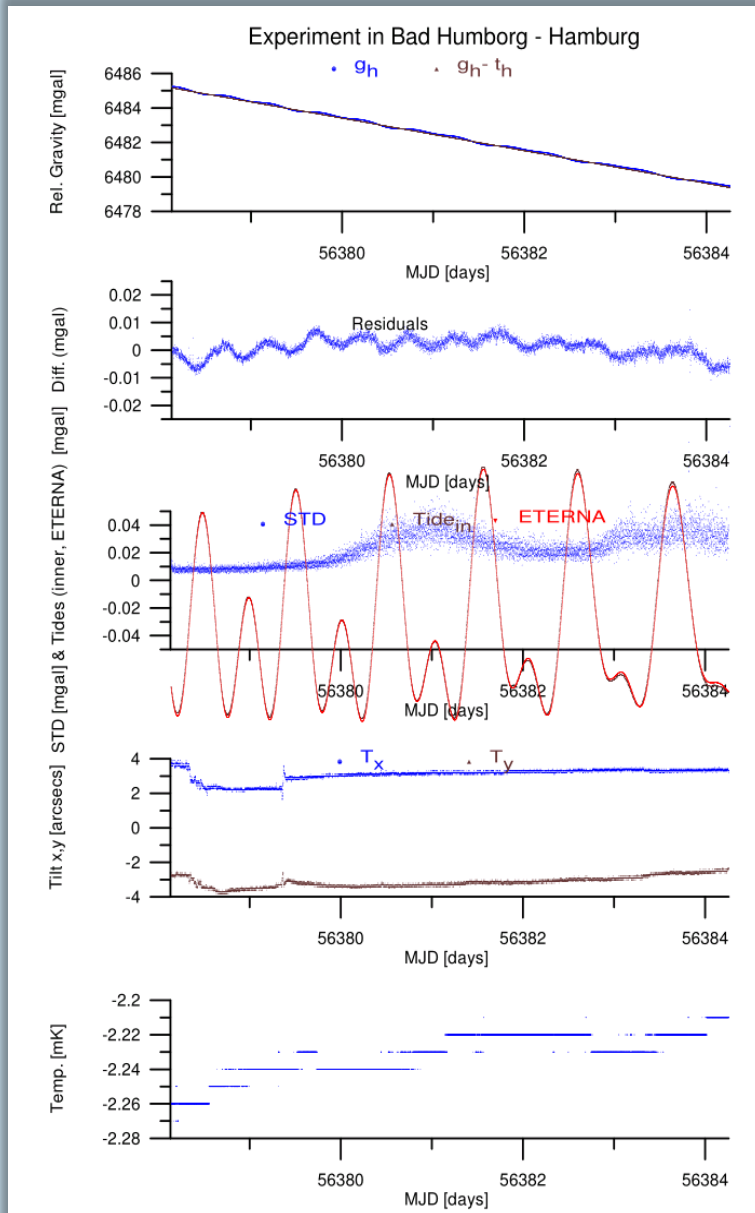










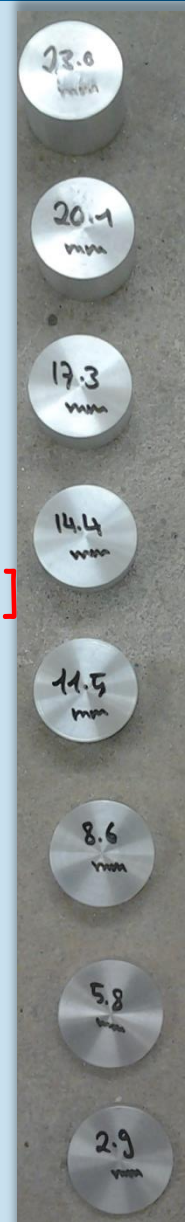




Piza, Italy



Disc Thicknesses [mm]



8 [○] ■

18

⋮

1 [○] ■

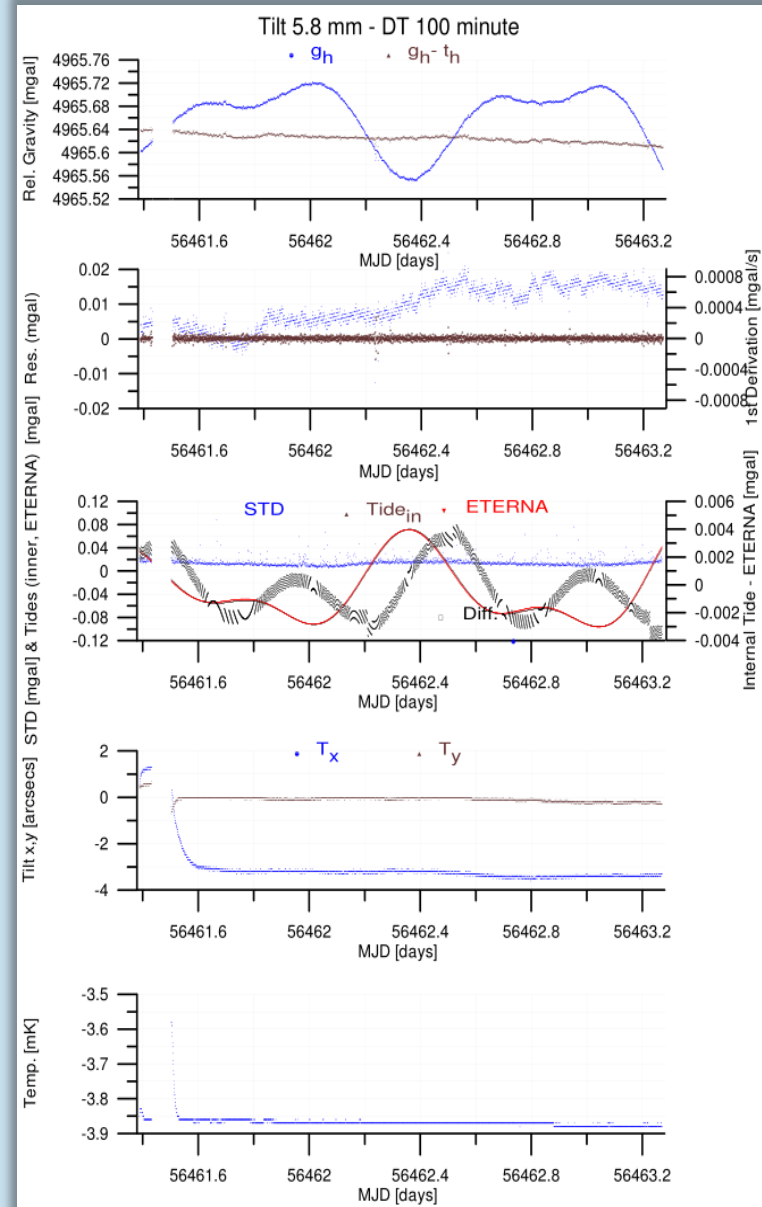
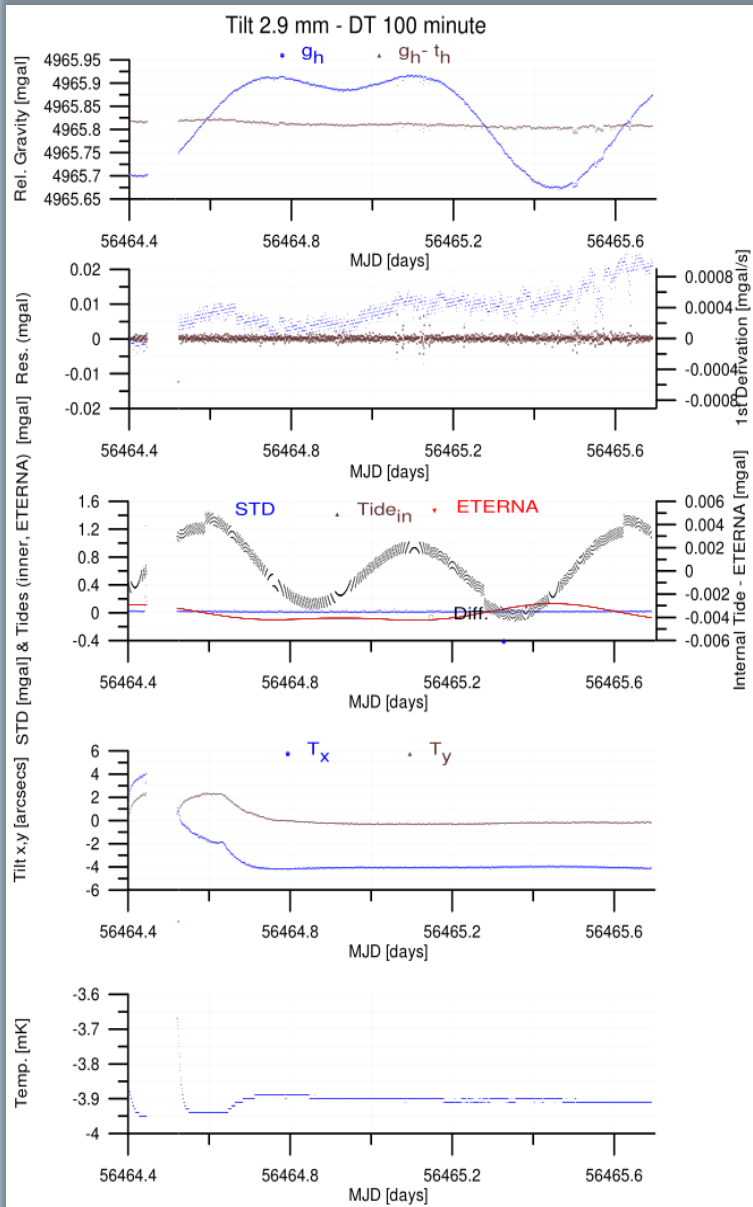


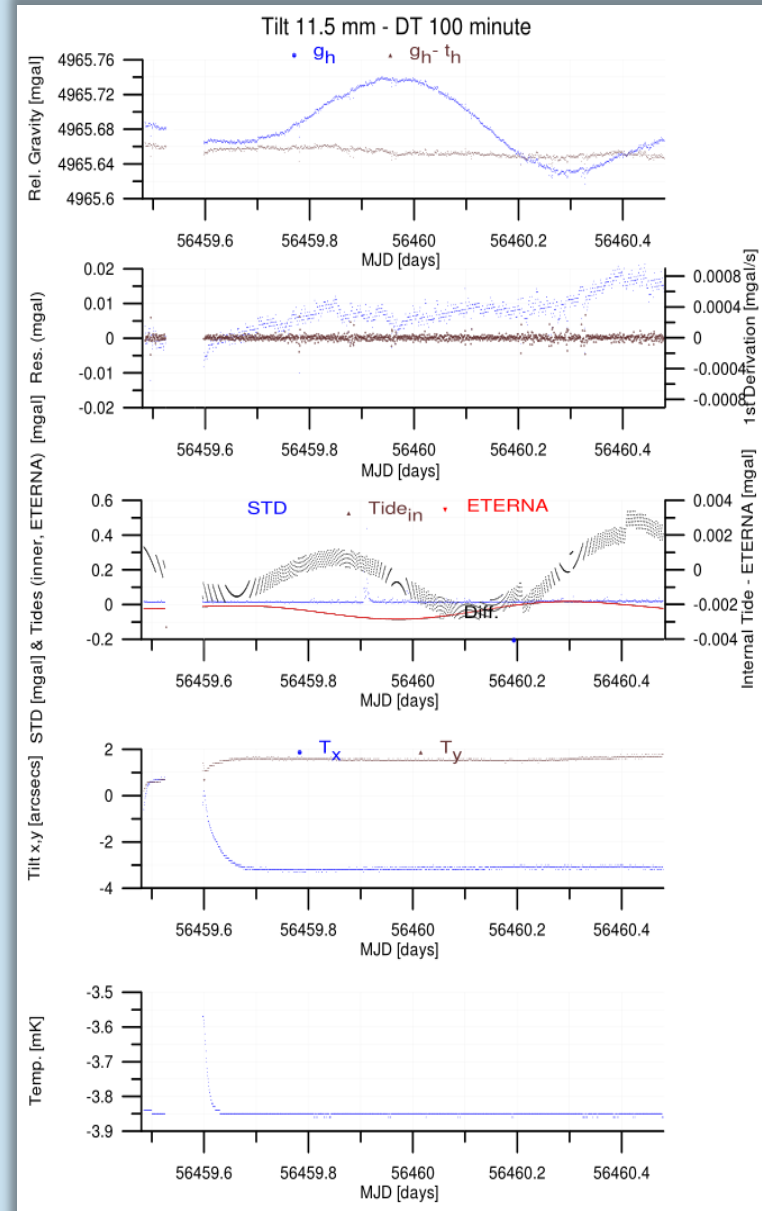
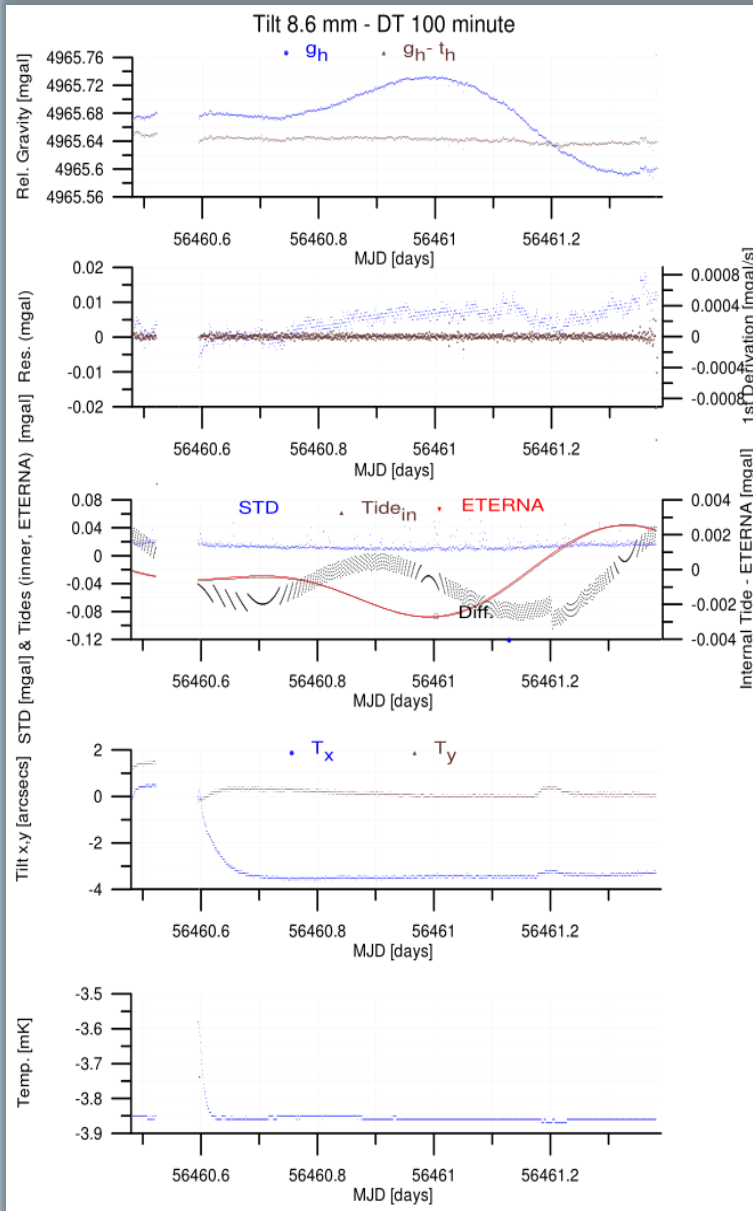
- 1) **Level** CG-5 & measure for **one** [h] 2) **Turn off** and **Tilt** it with the different tilt angles & waiting for **100** [min]

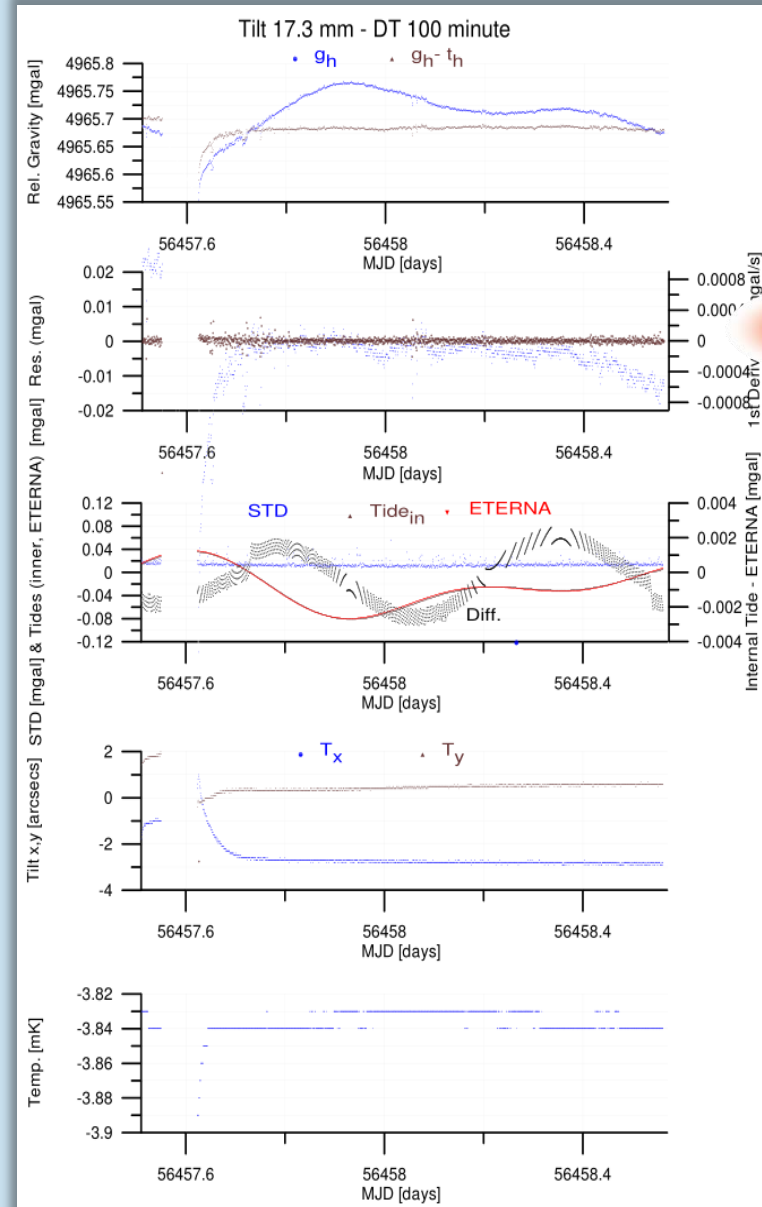
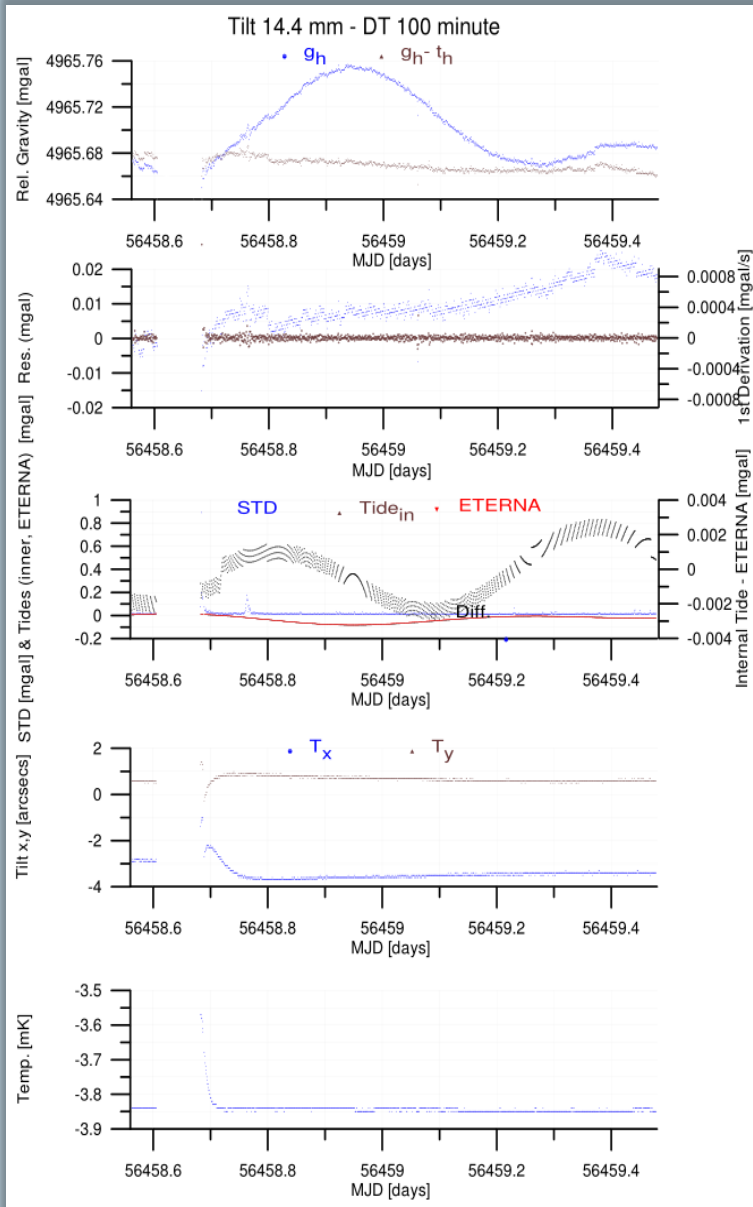
- 3) **Remove disc, turn on, level** it and take measurement for at least **24** [h]

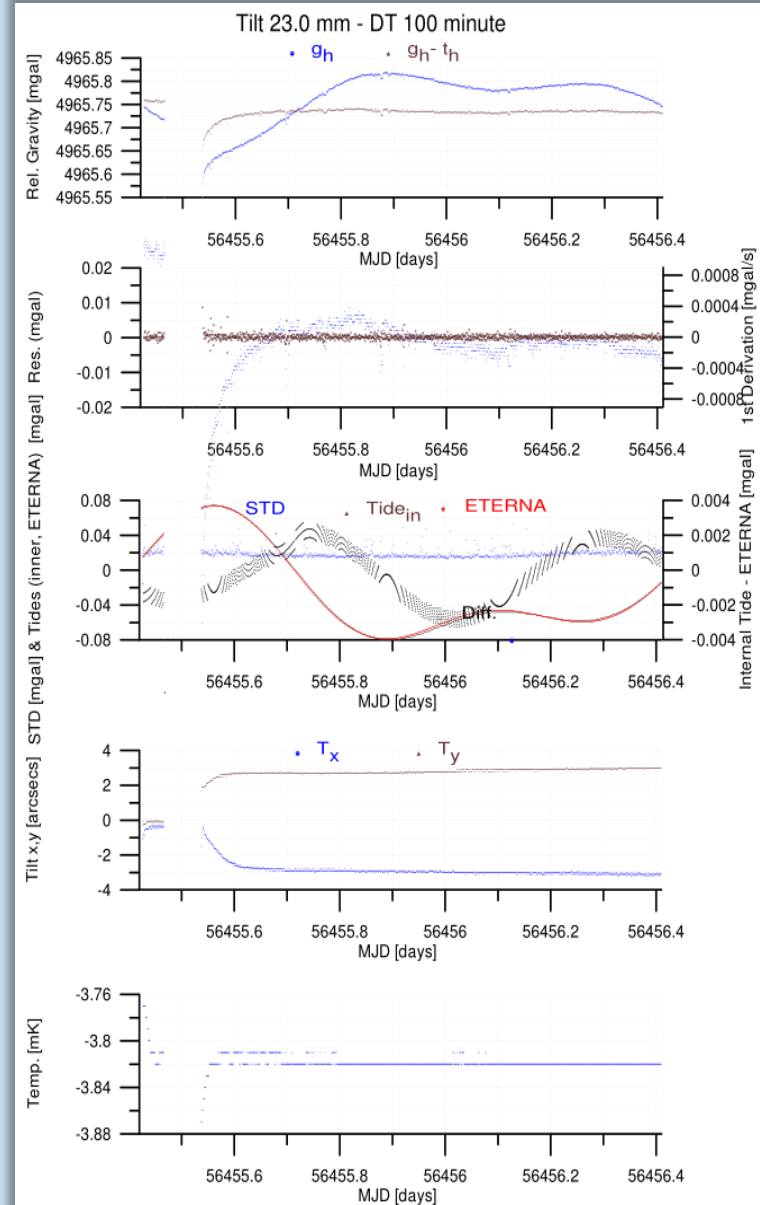
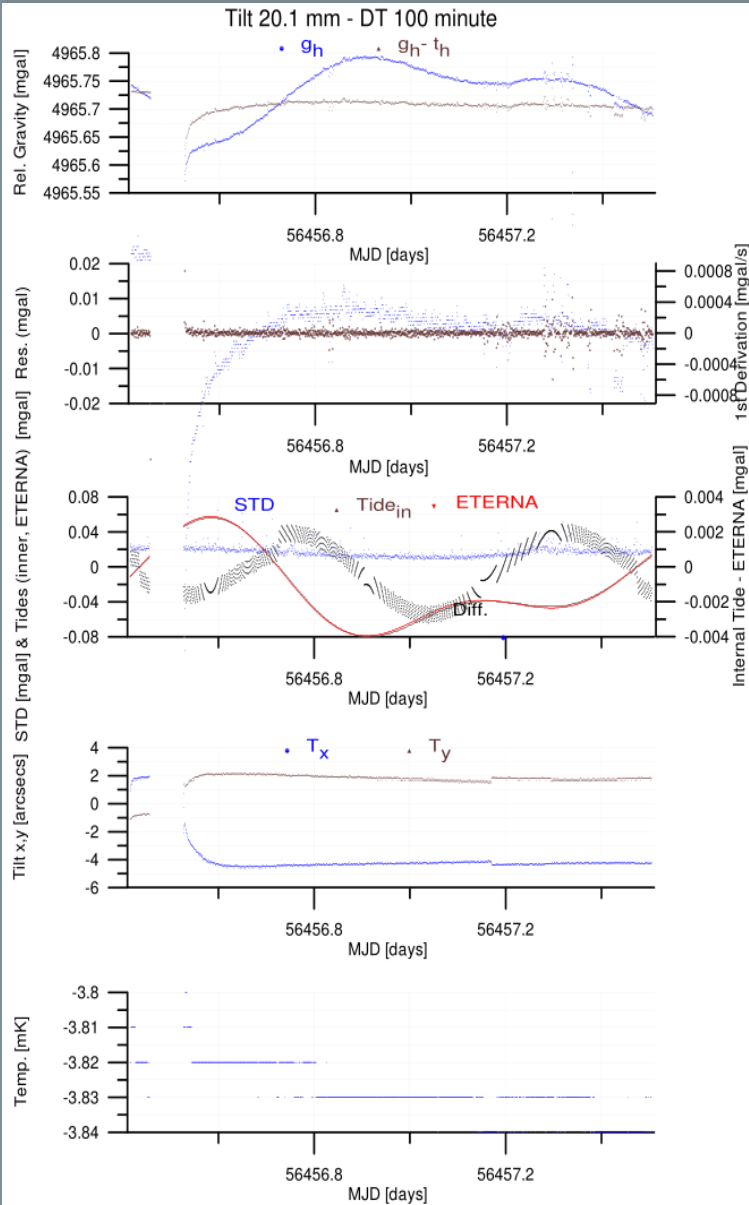


Finding the
critical angle









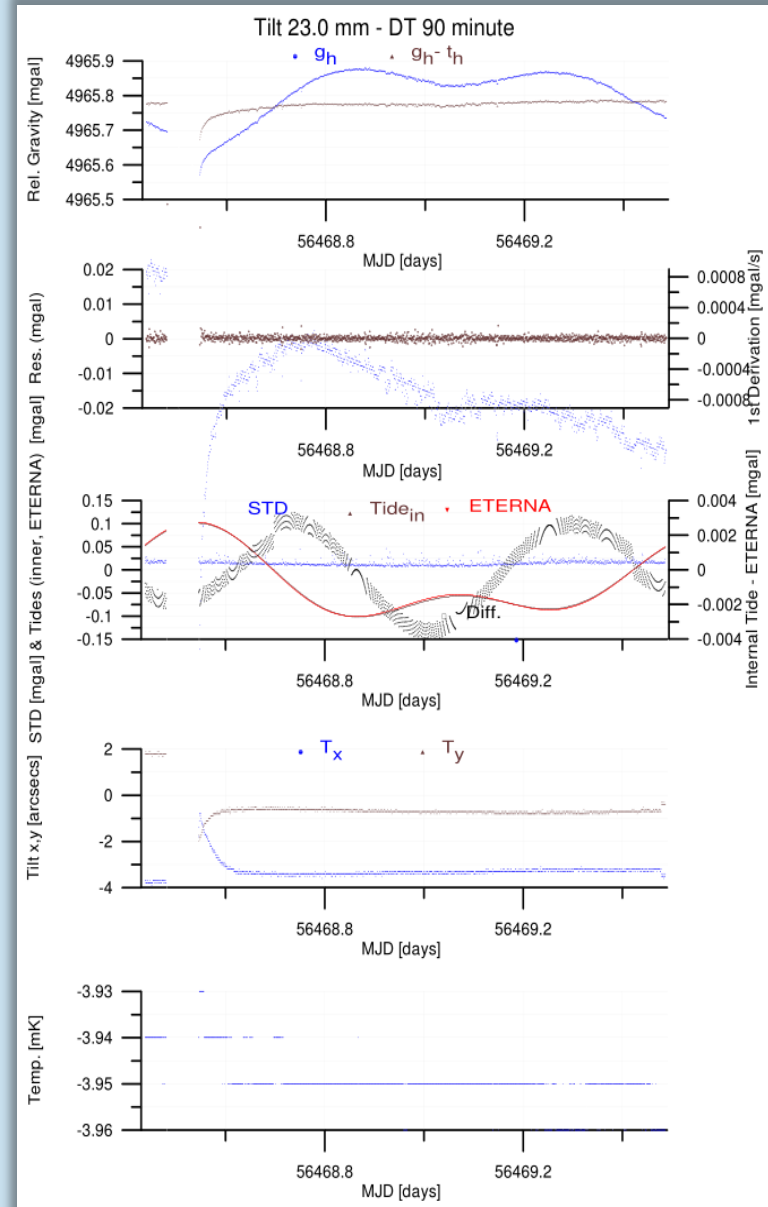
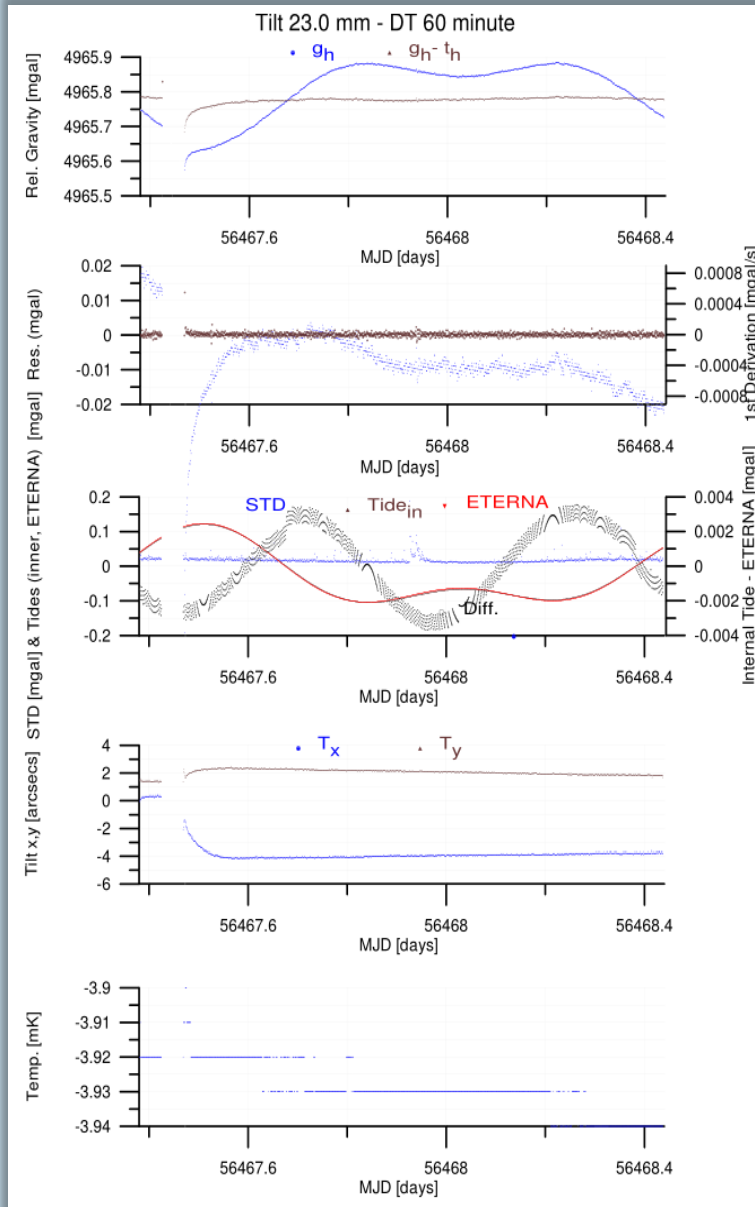


- 1) Level CG-5 & measure for one [h] 2) Turn off and Tilt it with the angle δ (Disc 23 [mm]) & waiting for 10, 30, 60, 90 [min]

3) Remove disc, turn on, level it and take measurement for at least 24 [h]



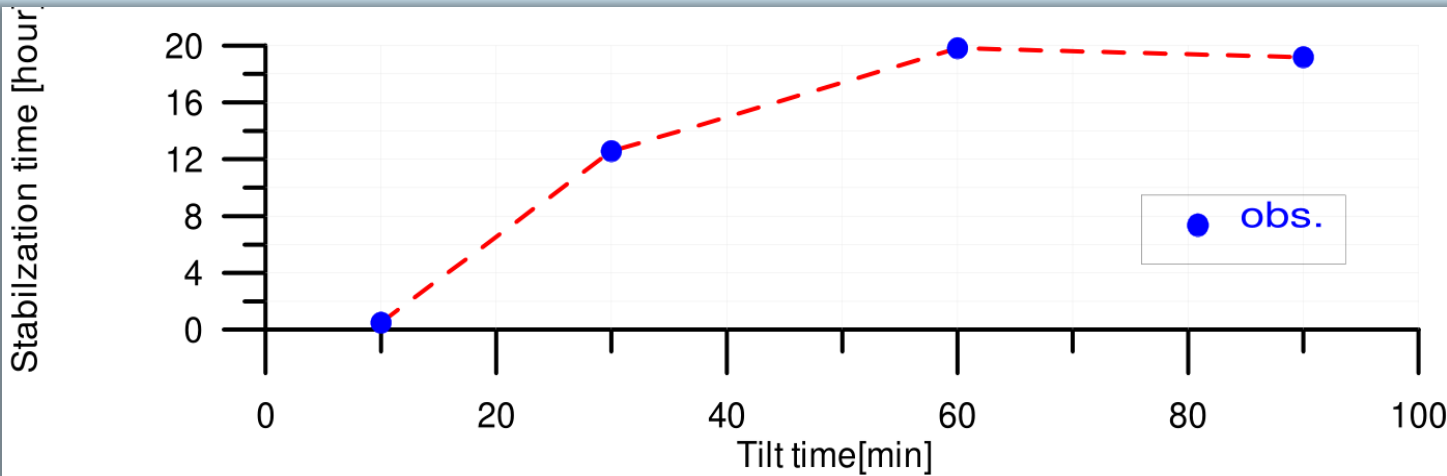
Finding the critical time



Functional relationship (tilt time & instrument stabilization)

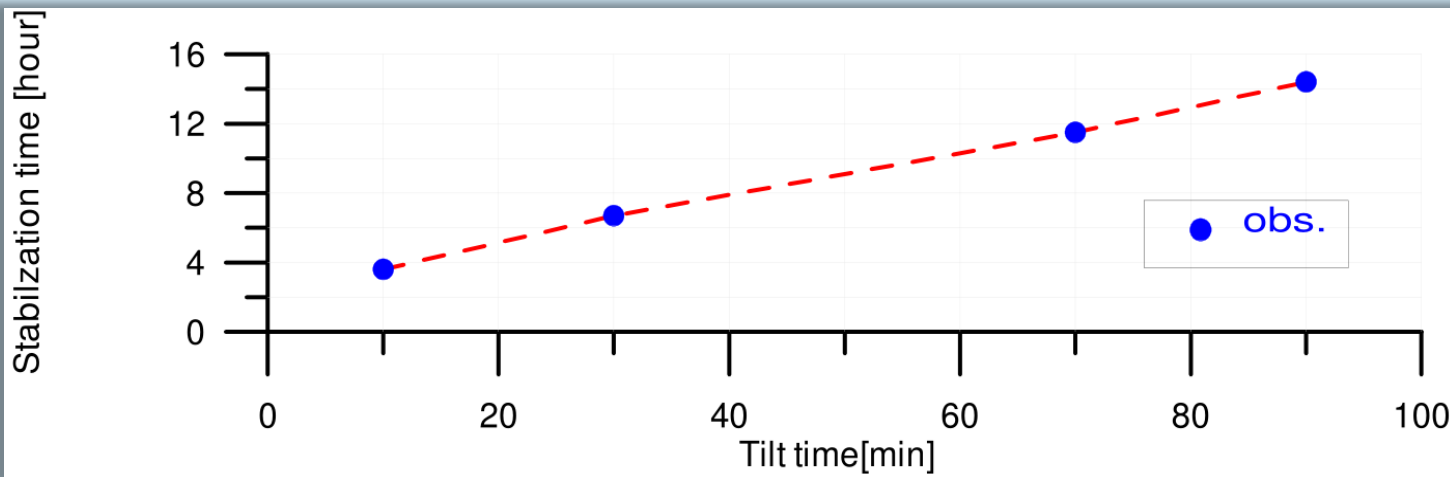


Tilt angle of 8 [°]	
Tilt time [min]	Offset[mGal] / Stab. Time [hour]
10	-55 / 0.5
30	-43 / 12.6
60	-85 / 19.82
90	-89 / 19.18

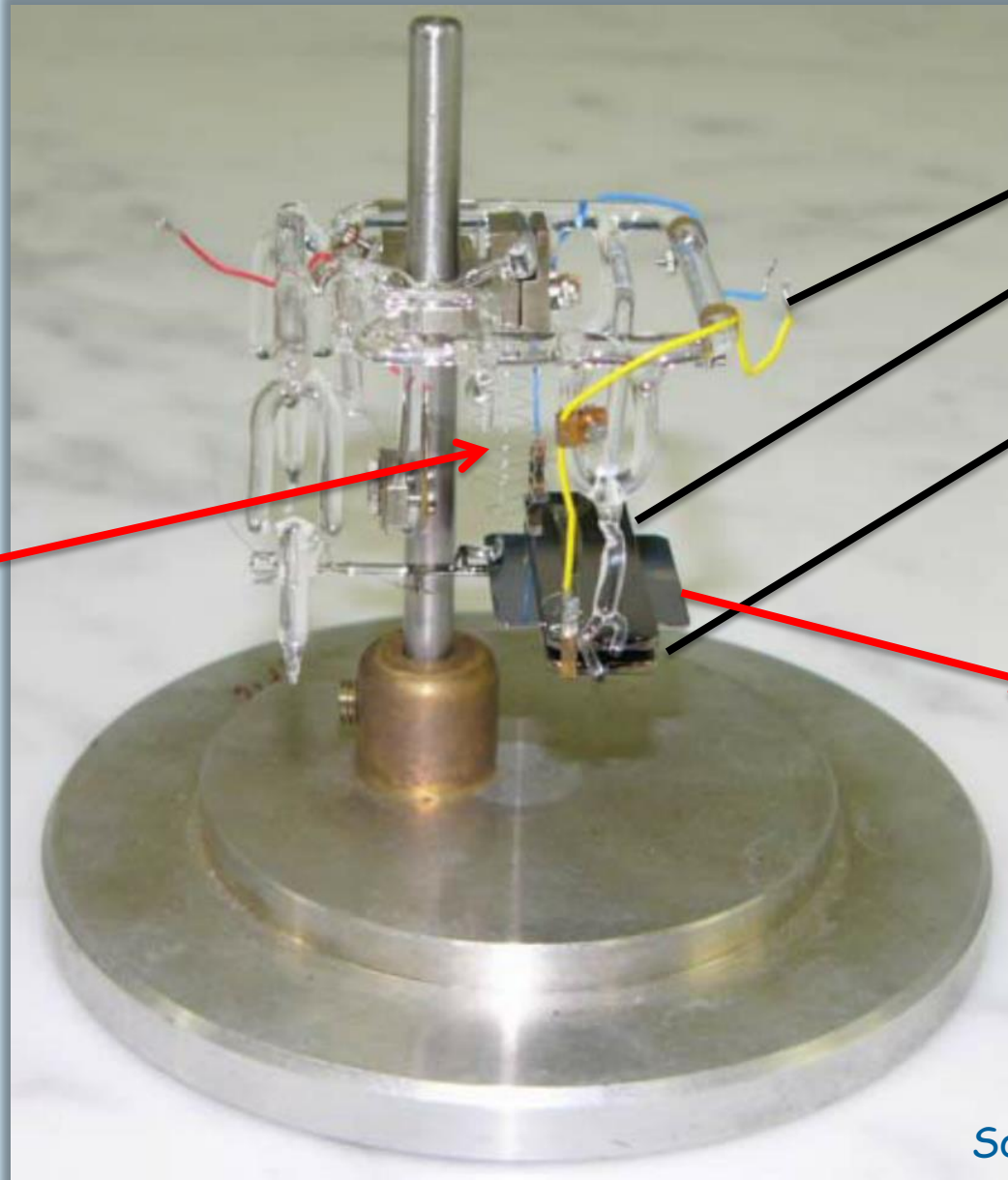


$$s(\Delta t) = 0.81 + 0.66\Delta t - 0.005\Delta t^2$$

Tilt angle of 8 [°]	
Tilt time [min]	Offset[mGal] / Stabilization time [h]
10	-40 / 3.6
30	-120 / 6.7
70	-150 / 11.5
90	-180 / 14.4



$$s(\Delta t) = 3.72 + 0.14\Delta t - 0.00008\Delta t^2$$



Quartz-Glass
spring

Electrostatic
nulling

Two plates

Test mass

-
-
-
-
-
-

- ✓ **Caution** in transport
- ✓ Check the „**USER Check Voltage**“ before starting to take measurement
 - ✓ If „**USER check Voltage**“ approaches zero, wait at least 14-20 [h]
- ✓ Use a **Gyroscope!**
- ✓ Other **ideas**



- ✓ Autograv is very sensitive instrument to the tilt!
- ✓ Critical angle and time, and stabilization function have been found for the Bonn CG-5.
- ✓ Causes for the tilt offset are not clear exactly!
- ✓ Shake effect is another important effect, but has not been investigated!

Thank you
for your attention!

