LN_2-measurements at an AGATA-Triple-Cryostat

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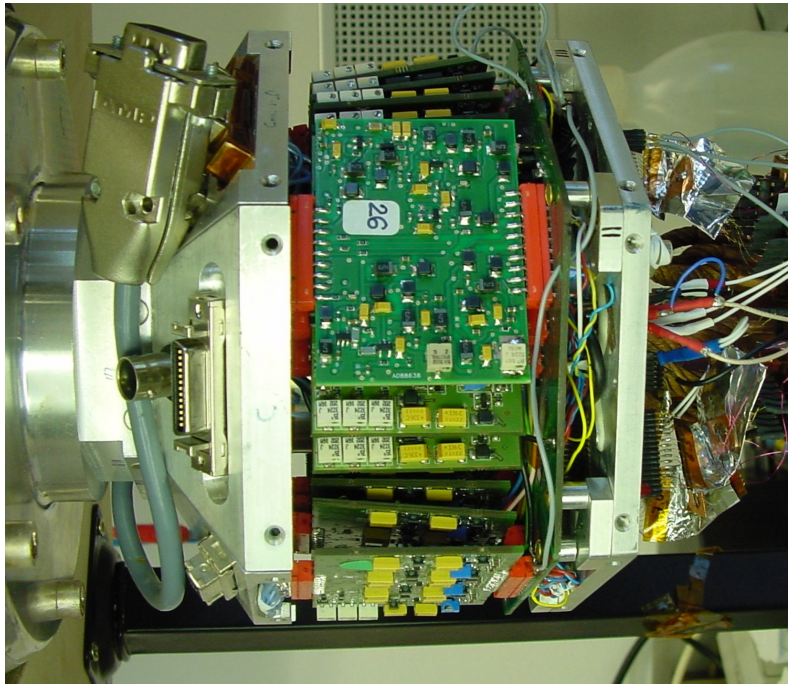
Abstract

1. Motivation
2. Temperature/LN_2-monitoring
3. Cooling in and warming up process
4. Position dependence
5. Summary and outlook

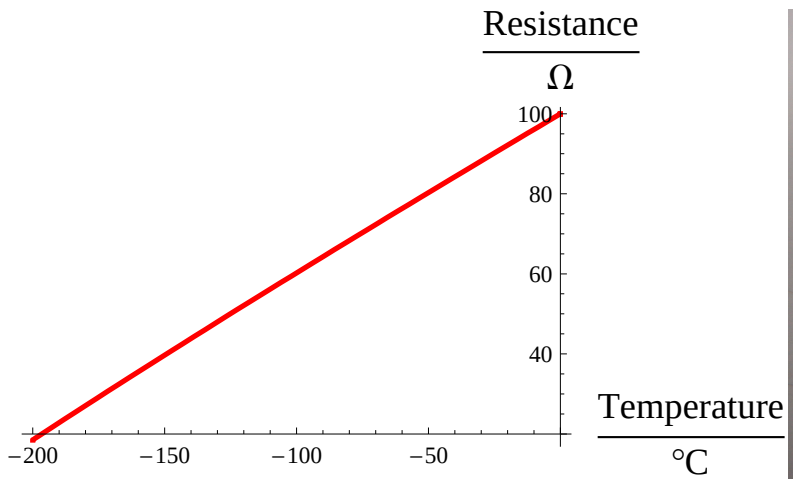
Motivation

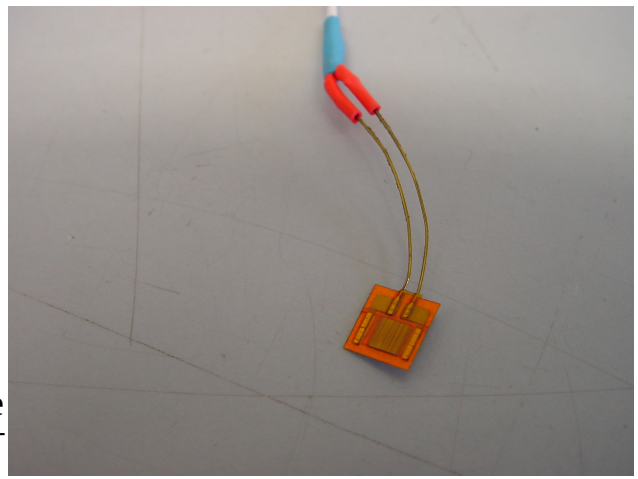


- When detector gets warm: HV-sparks can damage FETs and preamplifier
- Temperature-monitor via PT 100 is slow $\longrightarrow$ need an independent measurement of LN_2-level

Temperature-read-out

- Up to now: Via PT 100 sensor, which is fixed in the dewar or on the crystal itself.
- Principle: The PT-resistance $R(T)$ is measured with respect to the temperature



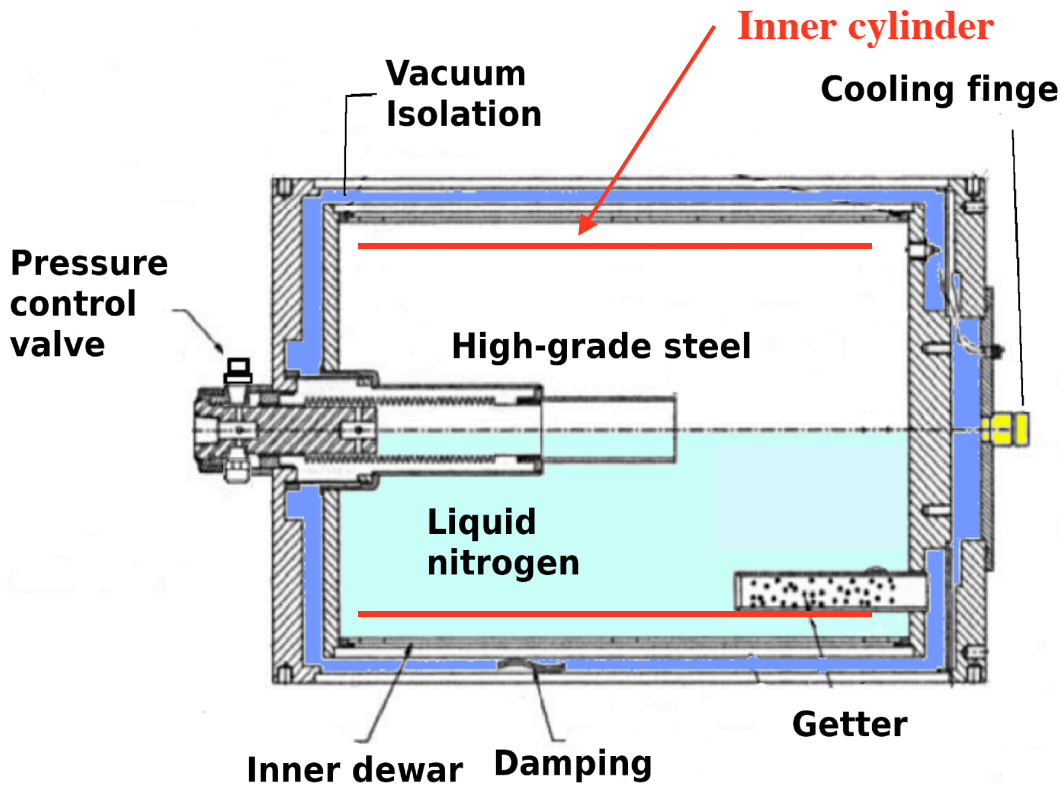


LN_2-read-out

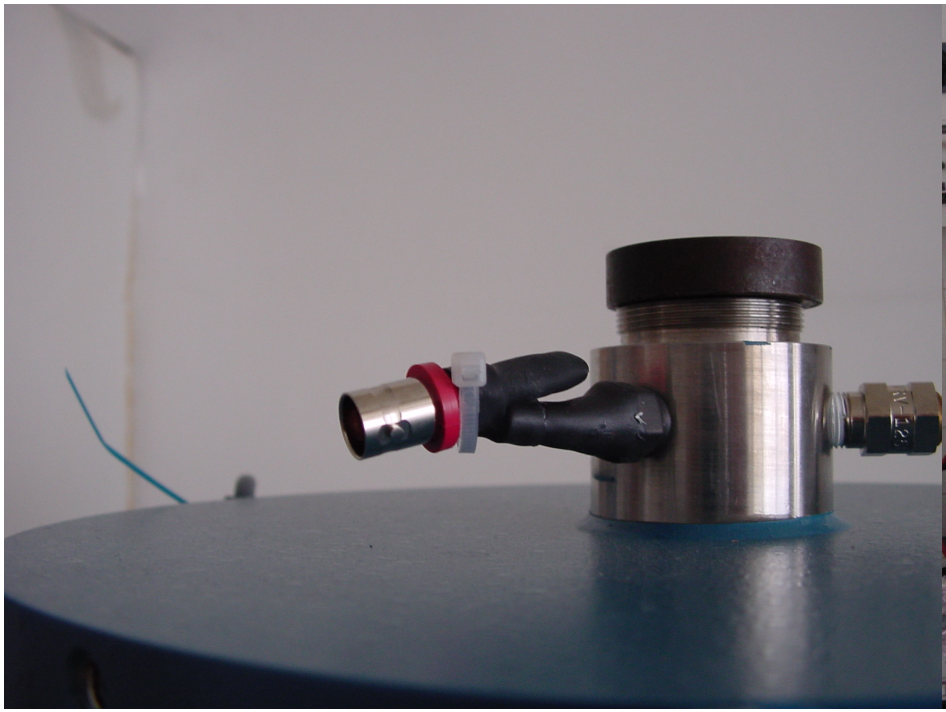
- A cylinder is mounted in the dewar. Use dependence of C from LN_2-level
- When dewar is in thermal equilibrium and horizontal position, LN_2-filling-level can be directly read out by C:

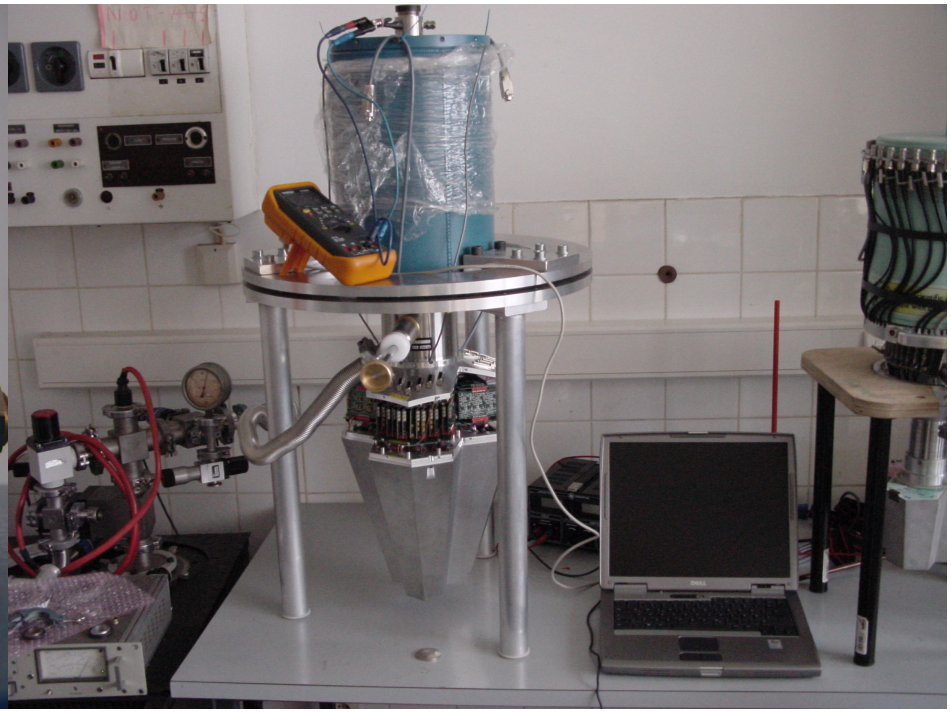
$$C = 2\pi\epsilon_0\epsilon_r \cdot \frac{h}{ln\left(\frac{r_2}{r_1}\right)}$$

- Two values are needed: C_{min}: no LN_2 inside dewar, but dewar is not warm. C_{max}: dewar is full



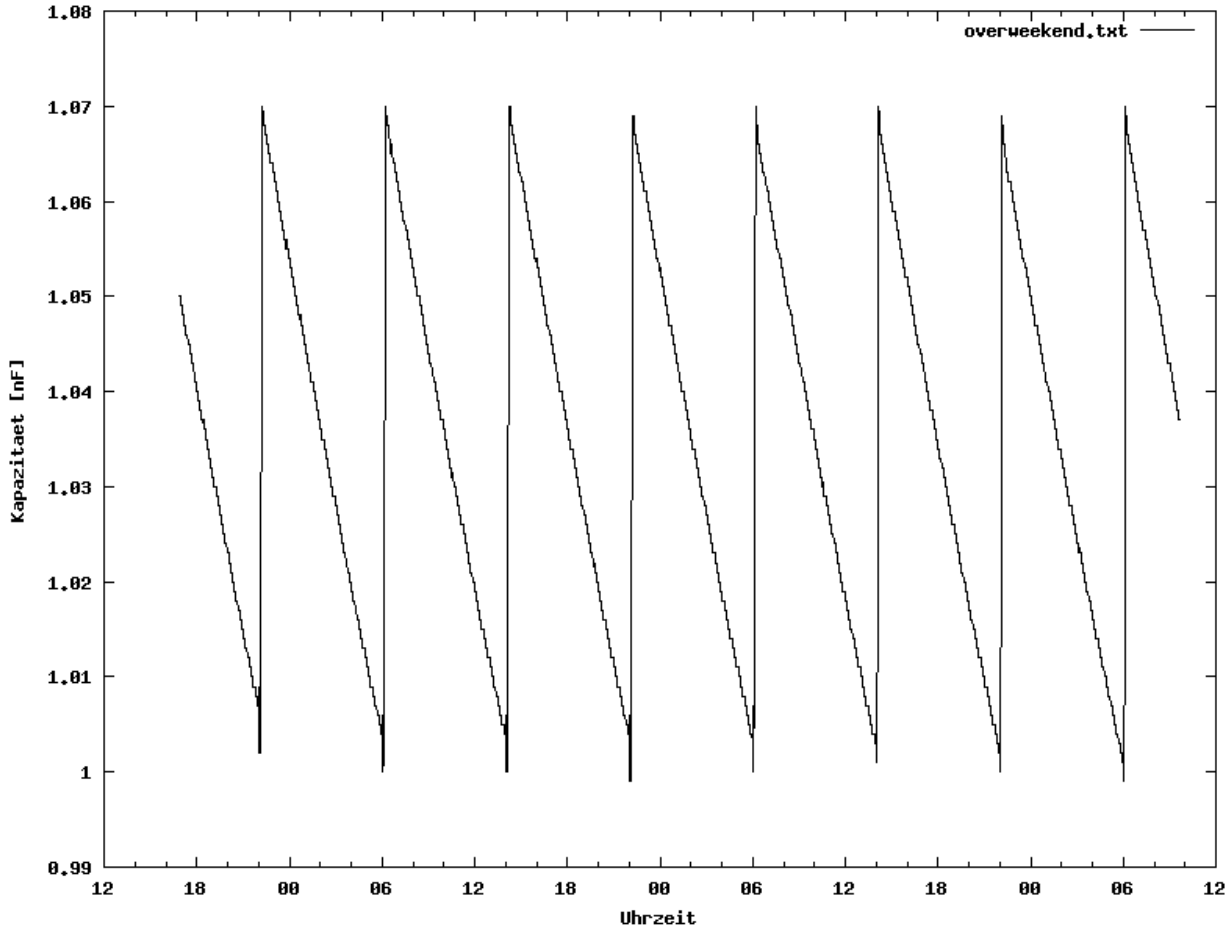
Measuring device





First measurements

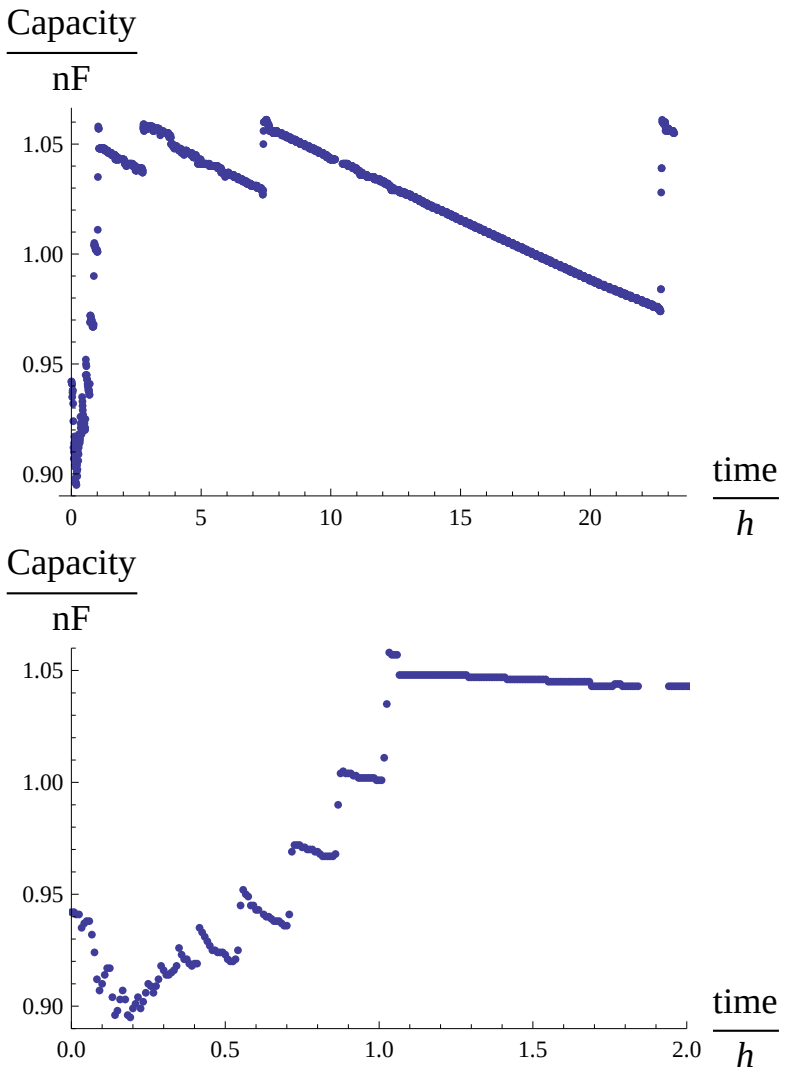
Capacity C was measured as a function of h during an over weekend filling cycle



Cooling in and warming up process @ AT-Cryostat

Cooling in

- When dewar is not in thermal equilibrium: $C = C(\epsilon_r(t), h) \rightarrow$ non-linear behaviour is expected
- In the first few minutes of the filling process, the capacity decreases
- At a certain point, the capacity increases with respect to the LN_2-filling -level



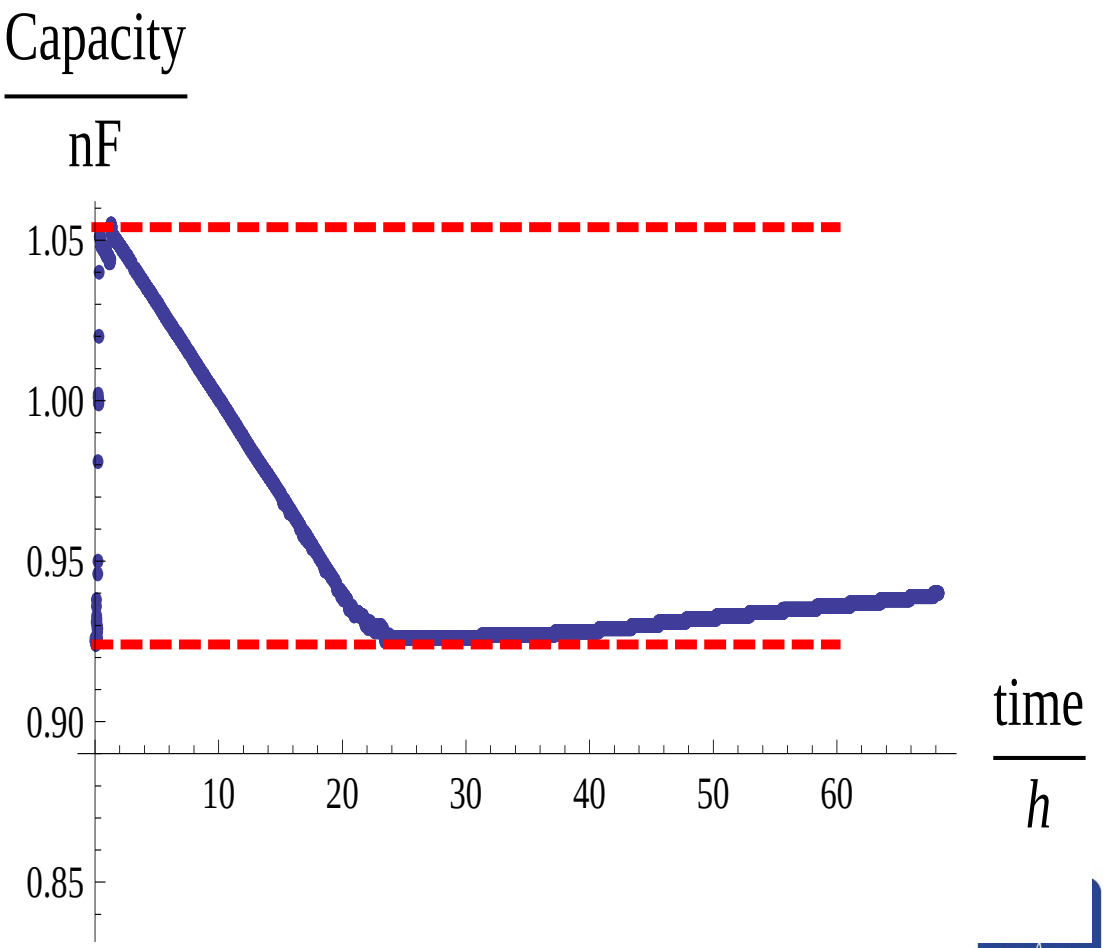
Cooling in and warming up process @ AT-Cryostat

Warming up

- Found two values for this cryostat: $C_{min} \approx 0.924nF$, $C_{max} \approx 1.054nF \Rightarrow$

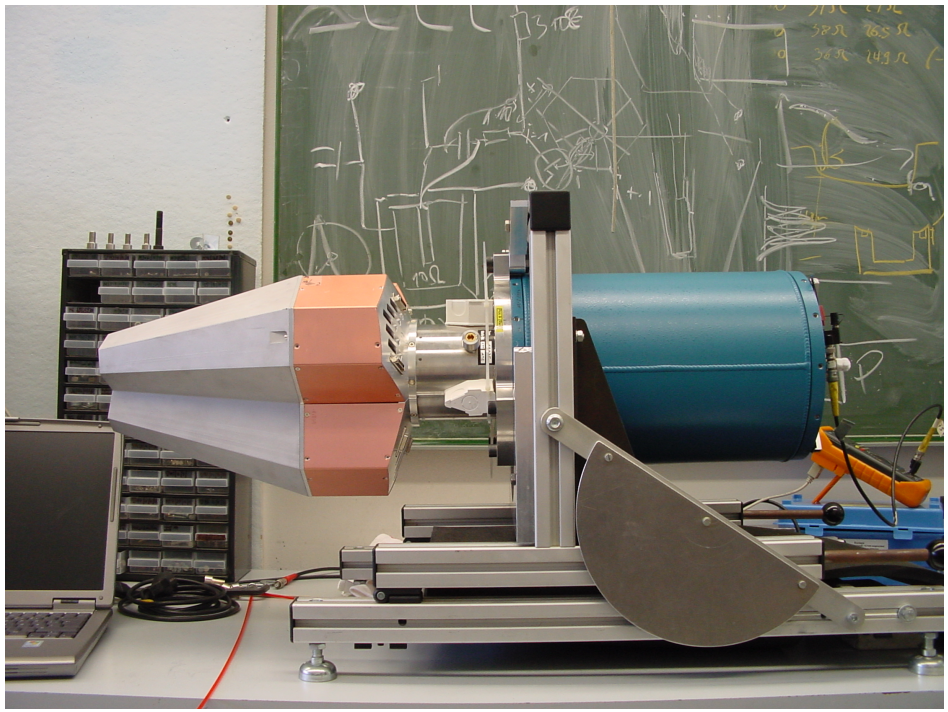
$$\frac{C_{max}}{C_{min}} \approx 12\%$$

- Without electronics and crystals, the LN_2-reservoir lasts about 20h
- After reaching C_{min}, the capacity increases with decreasing LN_2-filling-level (reverse to cooling in process)



Position dependence of the LN_2-read-out

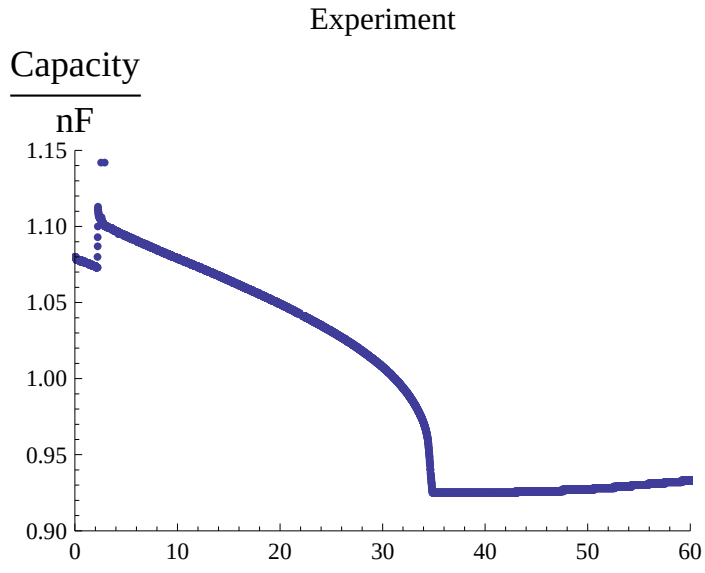
Horizontal angle

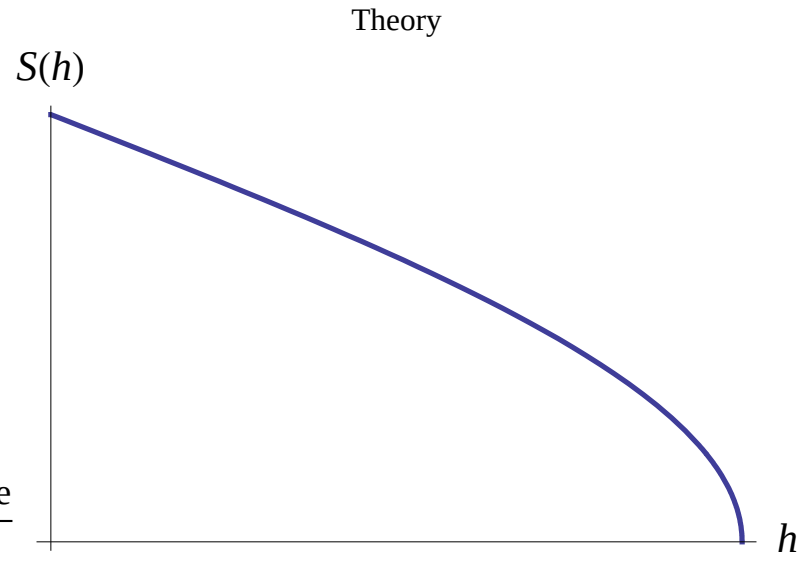


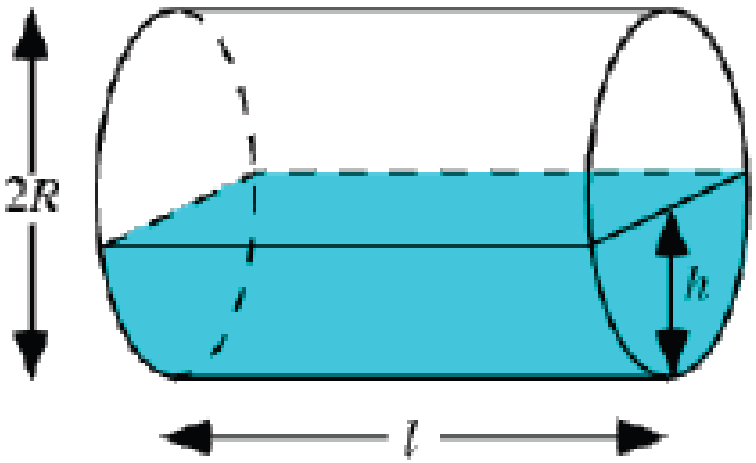
- Question: How depends C_{min} on horizontal inclination and rotations around detector axis?
- Answer: the cryostat has been turned into vertical position and rotated stepwise 120° around the detector axis
- C_{min}, C_{max} have been remeasured

Position dependence of the LN_2-read-out

Horizontal angle - First result and theory





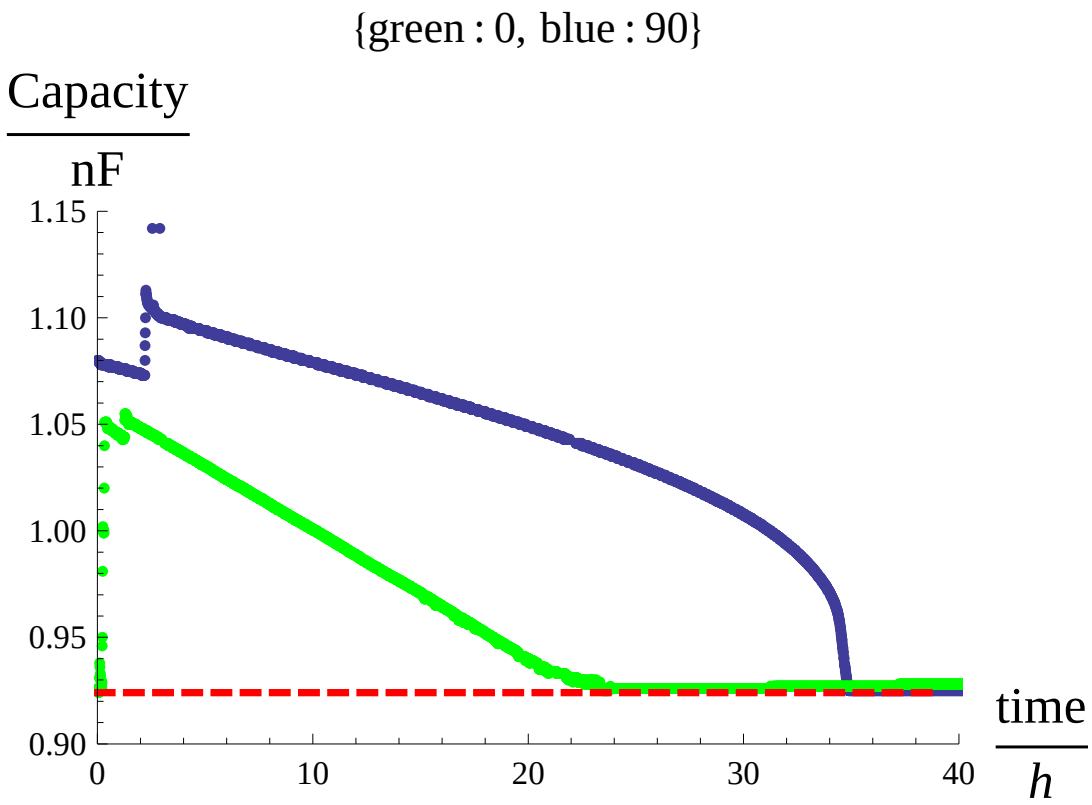


Surface of a liquid filled up to h in 90° turned cylinder (assume $C \sim S(h)$):

$$S(h) = 2 \cdot \arccos\left(1 - \frac{h}{R}\right) \cdot RL$$

Position dependence of the LN_2-read-out

Comparison 0° and 90°



Observation:

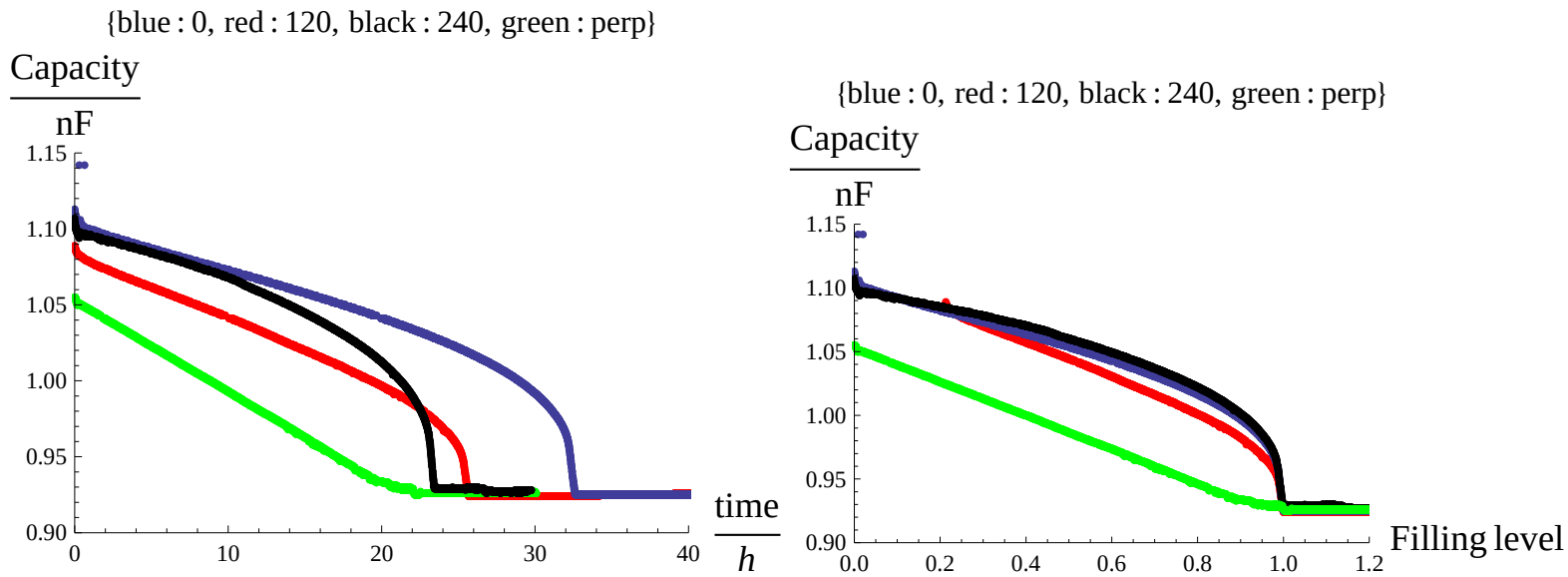
$$C_{min}(0°) \approx C_{min}(90°)$$

To check: Influence of rotation around detector-axis

Position dependence of the LN_2-read-out

Horizontal and axial angle

- Cryostat was rotated around own axis in 120° steps
- Cylinder is not perfectly symmetric: dependence of C on axial rotation



Summary and Outlook (I)

- The capacitive LN_2-read-out is working
- Cooling in and warming up process have been investigated
- For one cryostat, C_{min} is independent of horizontal or axial rotation $\rightarrow$ define a treshold for all positions in array
- Angles between two extrema (0° and 90°) have to be checked
- Repeat measurements with fully equiped and operating detector

Outlook (II)

- Optimize measuring device: up to now: capacity is measured with multimeter $\longrightarrow$ problem: sensitive on cabling, range, position
- Use: capacitive preamplifier: turn C into V $\longrightarrow$ no problems with cabeling, position, etc.

  Thank you!