Electrically Cooled Ge-Detectors development

Status Report 2013

I. Kojouharov, GSI

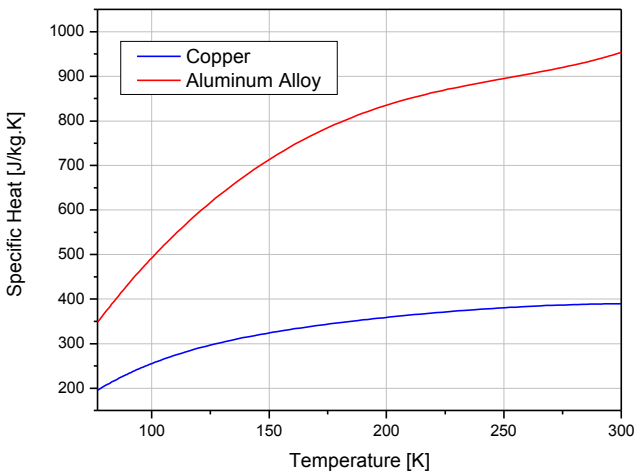
Electrically Cooled Ge-Detectors development

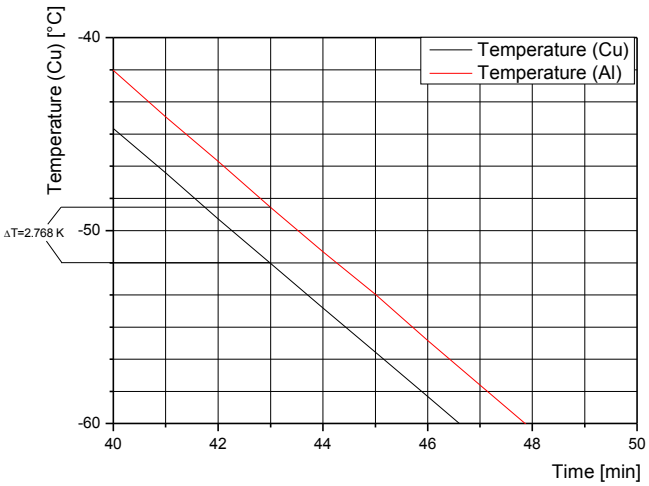
Status Report 2013

I. Kojouharov

Further studies of the thermal transfer and properties of the components and the full assembly of the single and the triple cryostat – experimental results.

Test of the thermal contact by differential temperature measurements. Two cooling stages are used – Cu and Al. The thermal contact produced by screwing with torque of 5.5 N.m (at the limit of the stability of the thread) resulted into 1900 W/sqm.



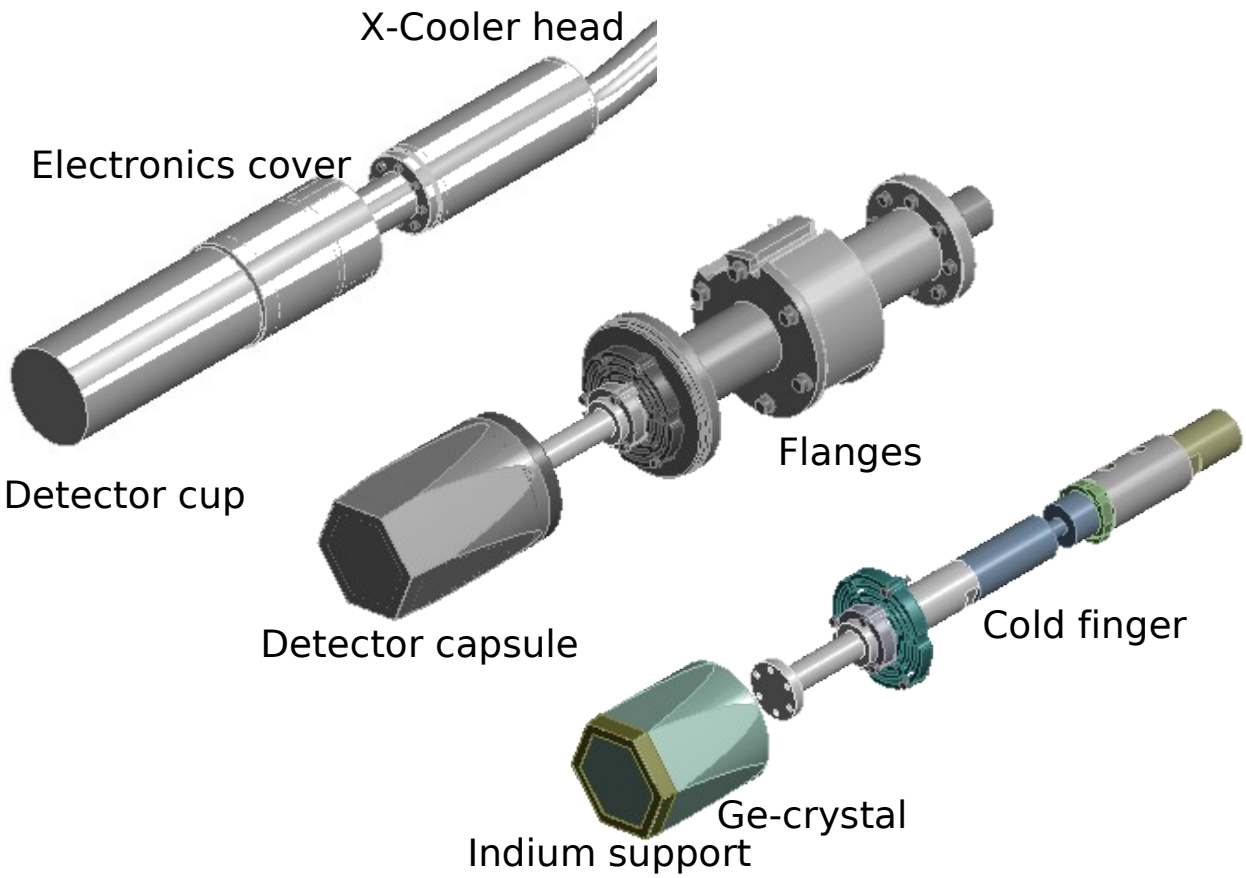


Electrically Cooled Ge-Detectors development

Status Report 2013

I. Kojouharov

Further studies of the thermal transfer and properties of the components and the full assembly of the single and the triple cryostat.

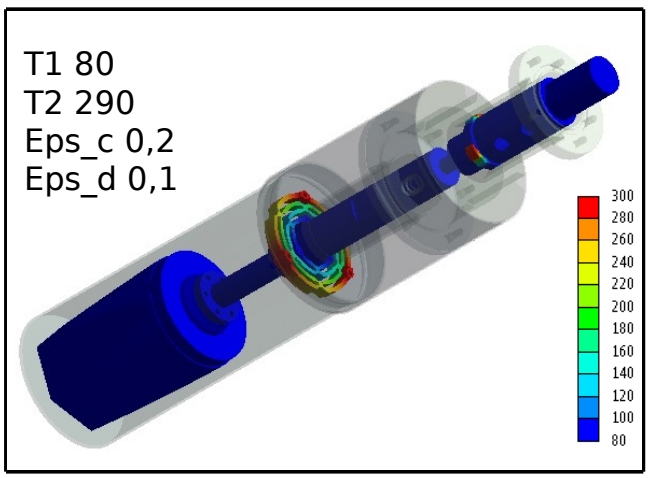


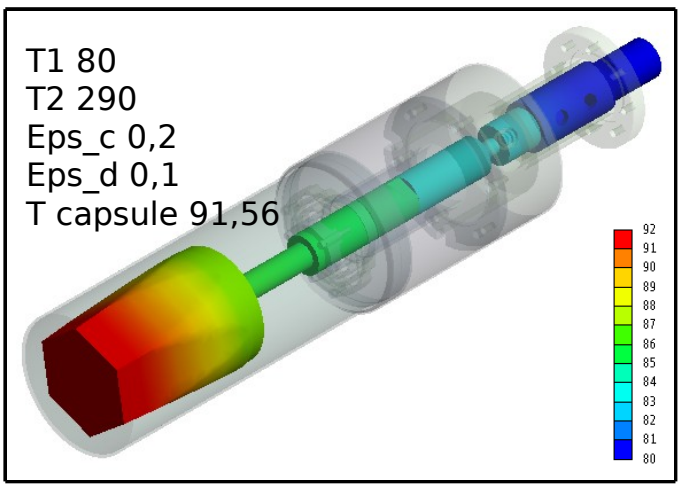
Electrically Cooled Ge-Detectors development

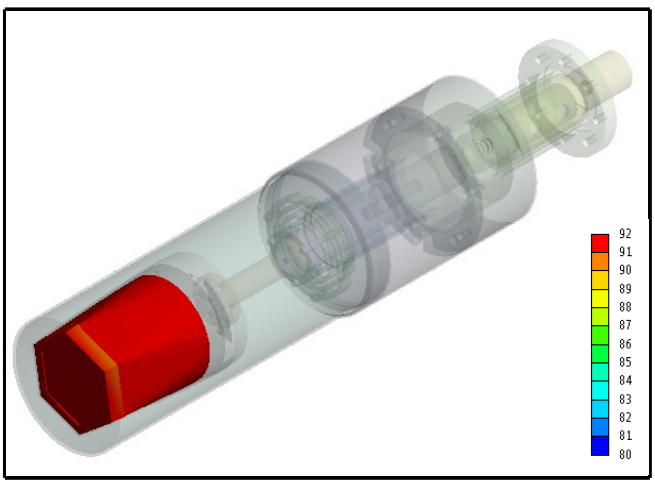
Status Report 2013

I. Kojouharov

Further studies of the thermal transfer and properties of the components and the full assembly of the single and the triple cryostat.







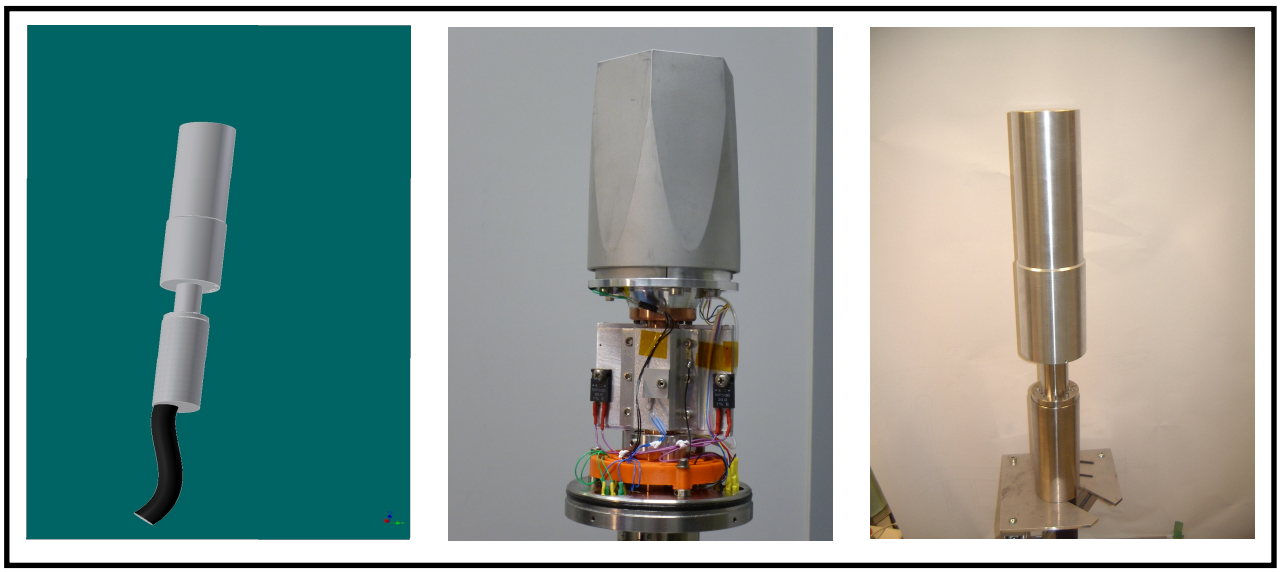
The operational temperature measured completely is within the predictions of the simulations!

Electrically Cooled Ge-Detectors development

Status Report 2013

I. Kojouharov

Status of the single cryostat



The Single Capsule Cryostat

The single capsule cryostat is assembled, tested and delivered. The operational temperature is measured to be -180 ºC. The spectroscopy test confirmed the excellent performance and 2.15 keV energy resolution (at1332 keV 60-Co line) of the capsule assembled. By LN2 cooling it showed the same energy resolution. This cryostat was used to verify the predictions for the operational temperature, the cooling power of the cooling engine, the cycling capability and the thermal timeout.

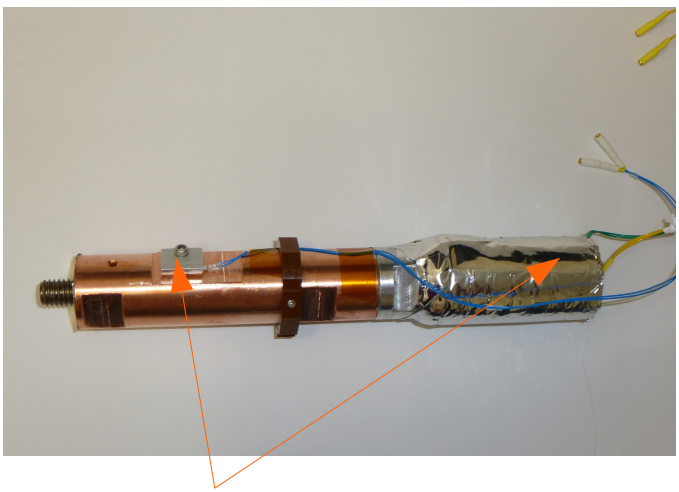
Electrically Cooled Ge-Detectors development

Status Report 2013

I. Kojouharov

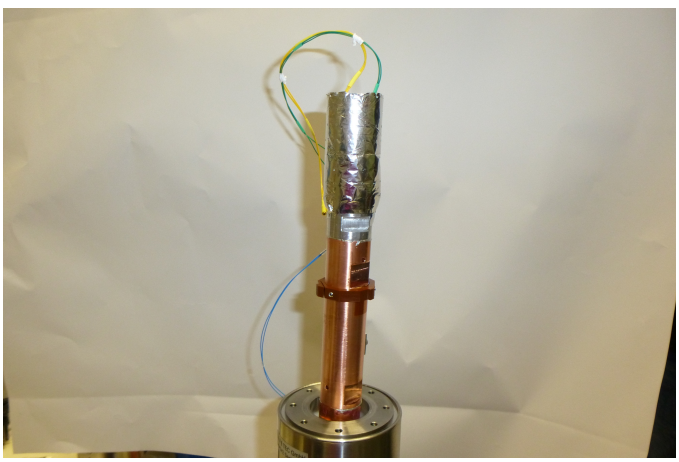
Further studies of the thermal transfer and properties of the components and the full assembly of the single and the triple cryostat - experimental results.

Test of the thermal power of the cooling engine and the thermal contact



Two Pt100

Assembled together with X-Cooler 2



Electrically Cooled Ge-Detectors development
Status Report 2013

I. Kojouharov

Further studies of the thermal transfer and properties of the components and the full assembly of the single and the triple cryostat – experimental results.

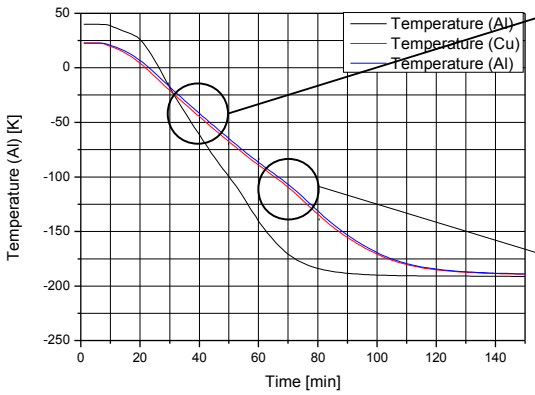
The test of the cooling power of the X-Cooler II resulted in 13 W! Still enough...

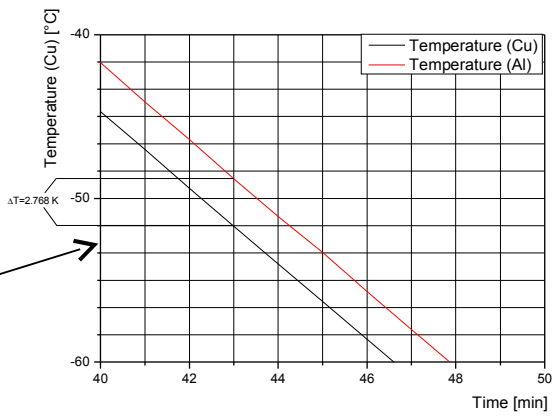
$$E_1 = P_0.\Delta t_1 = (C_x m_x + C_{Cu} m_{Cu} + C_{Al} m_{Al}).\ \Delta T_1$$

$$E_2 = P_0.\Delta t_2 = (C_x m_x + C_{Al} m_{Al}).\ \Delta T_2$$

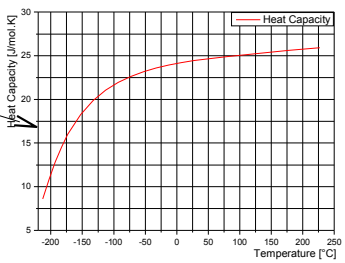
$$\Delta T_1 \approx \Delta T_2 \Rightarrow P_0 = 13\ W\ !$$

Cooling power test fixture





Contact thermal resistivity problem.



Cooper heat capacity

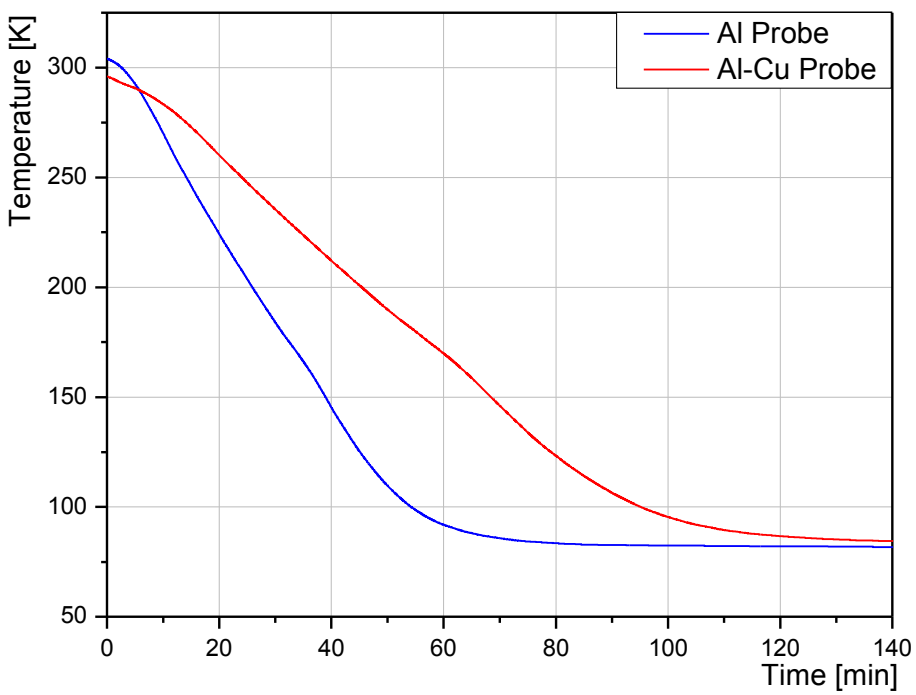
Electrically Cooled Ge-Detectors development

Status Report 2013

I. Kojouharov

Further studies of the thermal transfer and properties of the components and the full assembly of the single and the triple cryostat – experimental results.

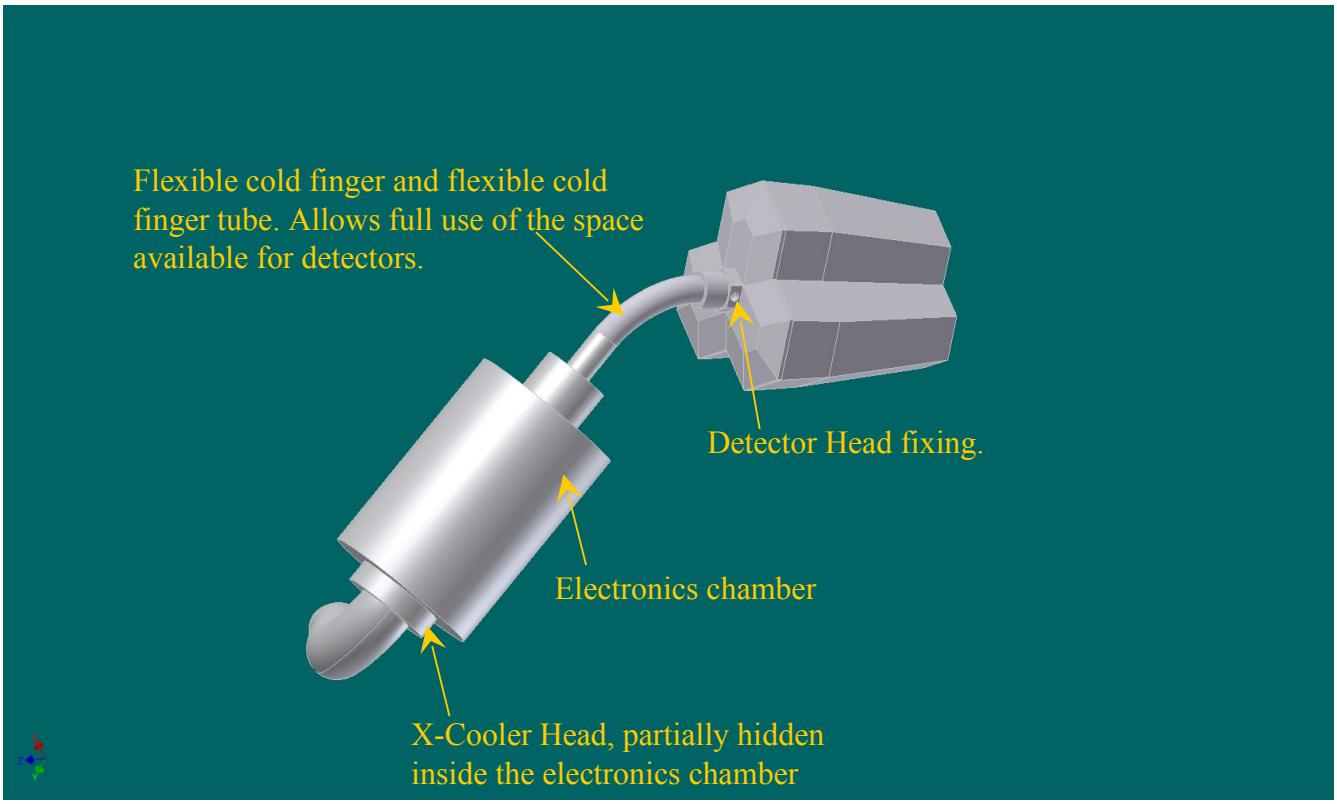
The cooling power has been experimented and the results are shown below. The method is based on the specific heat capacity of two different heat conductors. The estimation based on these results is 13 W, far enough for we need.



Electrically Cooled Ge-Detectors development

I. Kojouharov

Status of the development of the triple cryostat



The Triple Capsule cryostat design status:
-Full development and production is expected in 2014.◊

Electrically Cooled Ge-Detectors development

Status Report 2013

I. Kojouharov

Studies on the cryostat properties and the important components and assemblies – the impact on the design.

-The properties of single components and assemblies have been studied in order to assess their impact on the specific performance and the overall one of the cryostat. These studies points on the importance of:

- **Two stages vacuum supporting system. It is important for a complicated cryostat system with a common vacuum.**
- **The quality of the joints. The thermal energy is being transported through cold finger comprised of many sections and the joints are acting as thermal resistors. It has been concluded that joints with thermal conductivity less than 2000 W/sqm are not tolerable for this assembly.**
- **The quality of the cold finger. It is of paramount importance. The use of zirconium doped cooper may deliver good thermal conductivity at the same time having good mechanical stability, thus going beyond 2000 W/sqm.**
- **The quality of the cold flex bonding. This is a crucial point. The thermal contact has to be beyond 2000 W/sqm.**
- **The quality of the thermal bridges. Since they can be rather good optimized their impact on the overall eat transfer seems not too severe. However, the mechanical stability is questionable. A new type of holding structure (bipod, proposed for DESPEC planar detector) is to be used for heavy loaded sections.**
- **The radiative heat transfer. It is still too strong and a thermal shield may be needed. The overall performance strongly depends on the cooling power of the cooling engine and the quality of the cold finger.**