



Cryogen-free cryostat with sample changer for fast automatic data collection

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Motivation

Improvement of the sample exchange process:

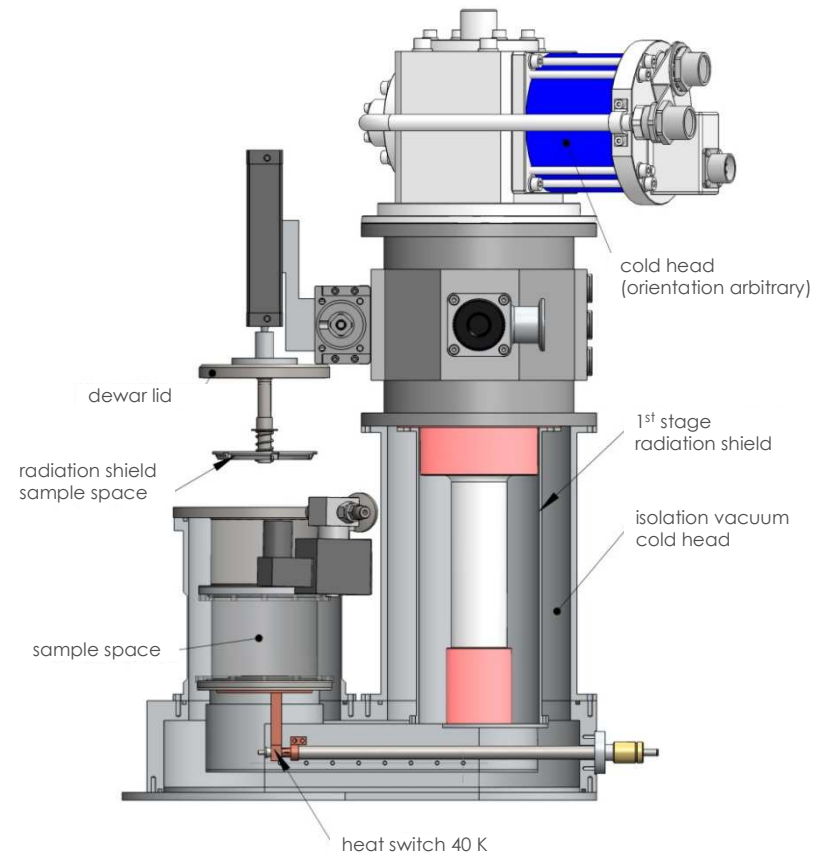
- ◆ Shorter exchange time
- ◆ Automatisation of the exchange process

➔ Two separate ideas:

- ◆ Precooled samples (ILL)
- ◆ Compact cryostat: Minimised cold mass (MLZ)

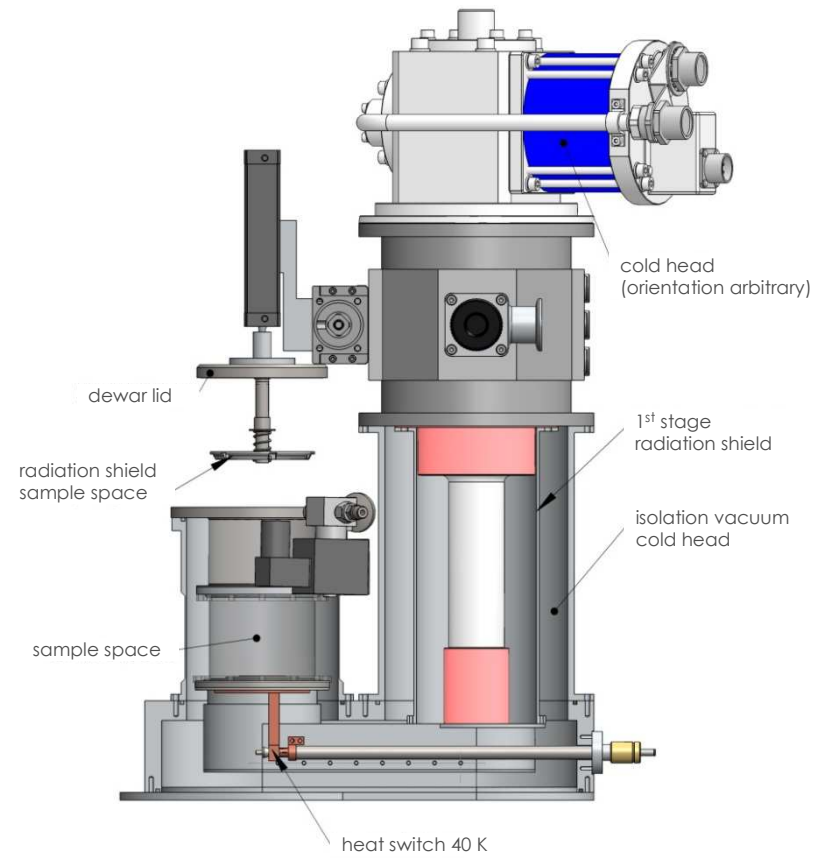
Last time

- ◆ Separate sample space vacuum and cold head isolation vacuum
- ◆ Minimised cold mass
- ◆ Remote controlled reload
- ◆ Standardised sample holder
- ◆ Sample in exchange gas via sample container





Last time





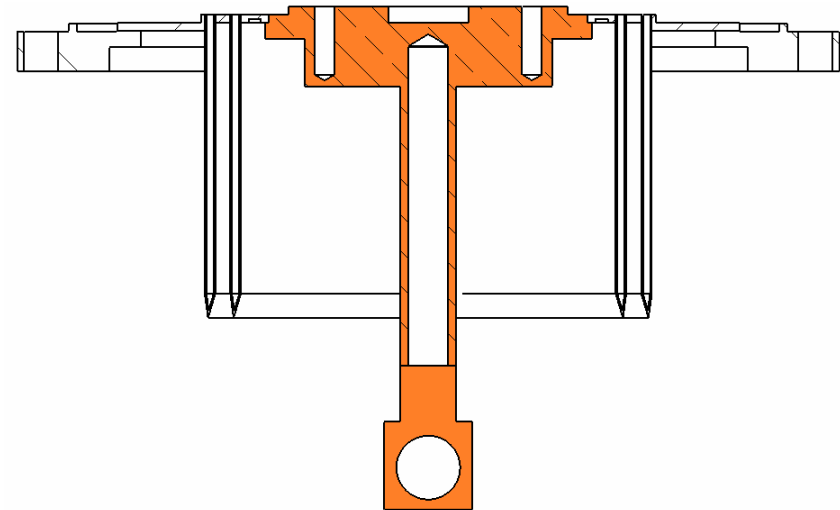
Last time

First sample holder



Length = 75 mm

New sample holder



Length = 150 mm

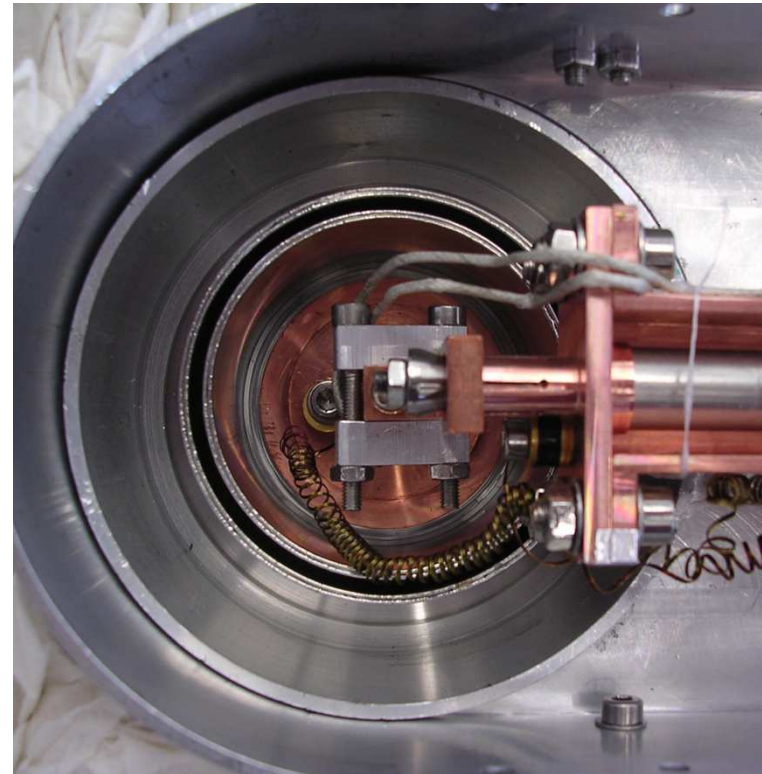
Now

First sample holder



Length = 75 mm

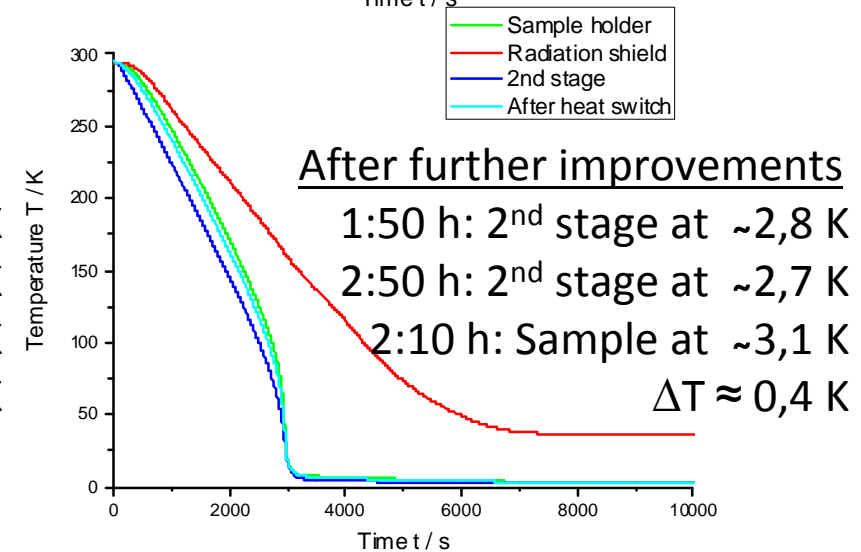
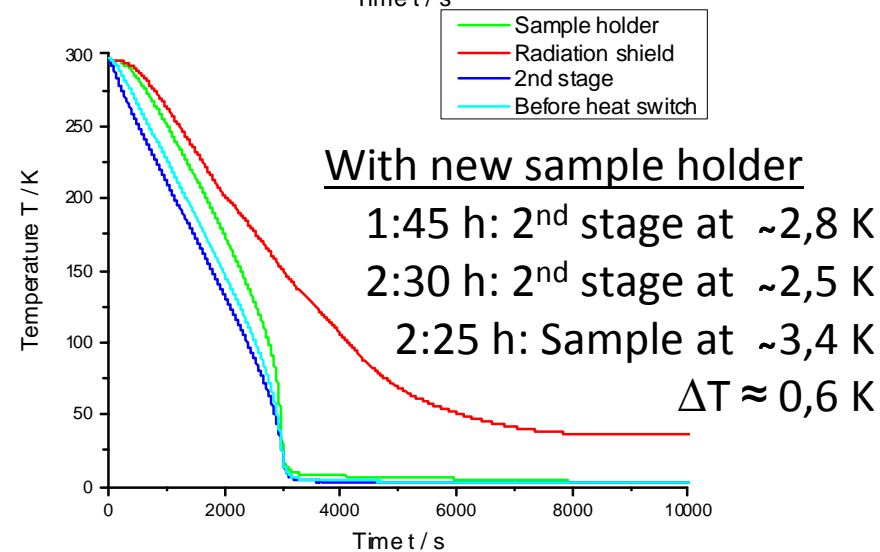
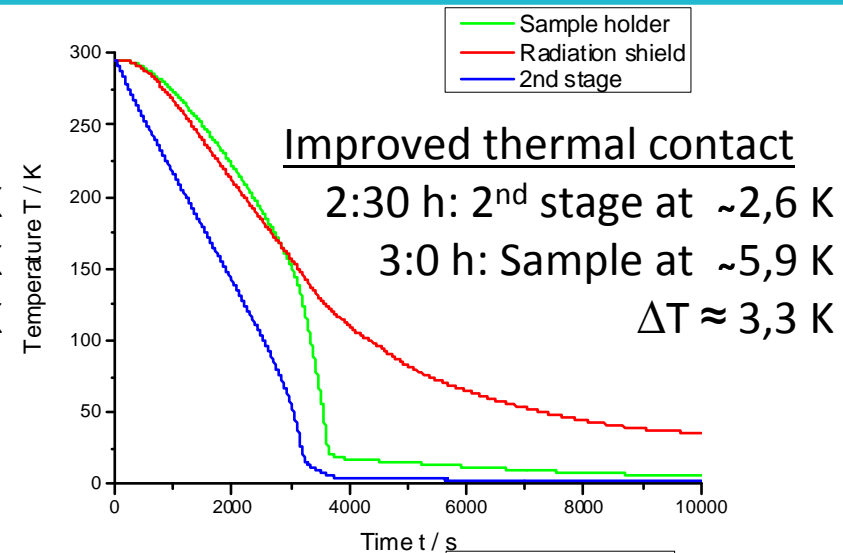
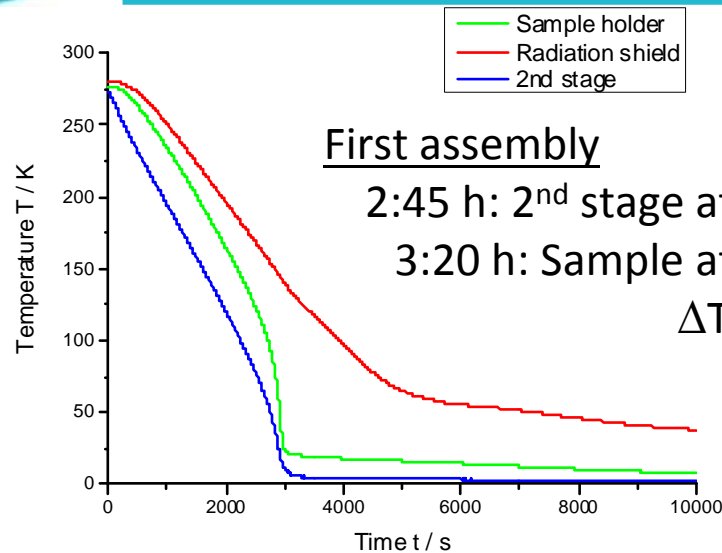
New sample holder



Length = 150 mm

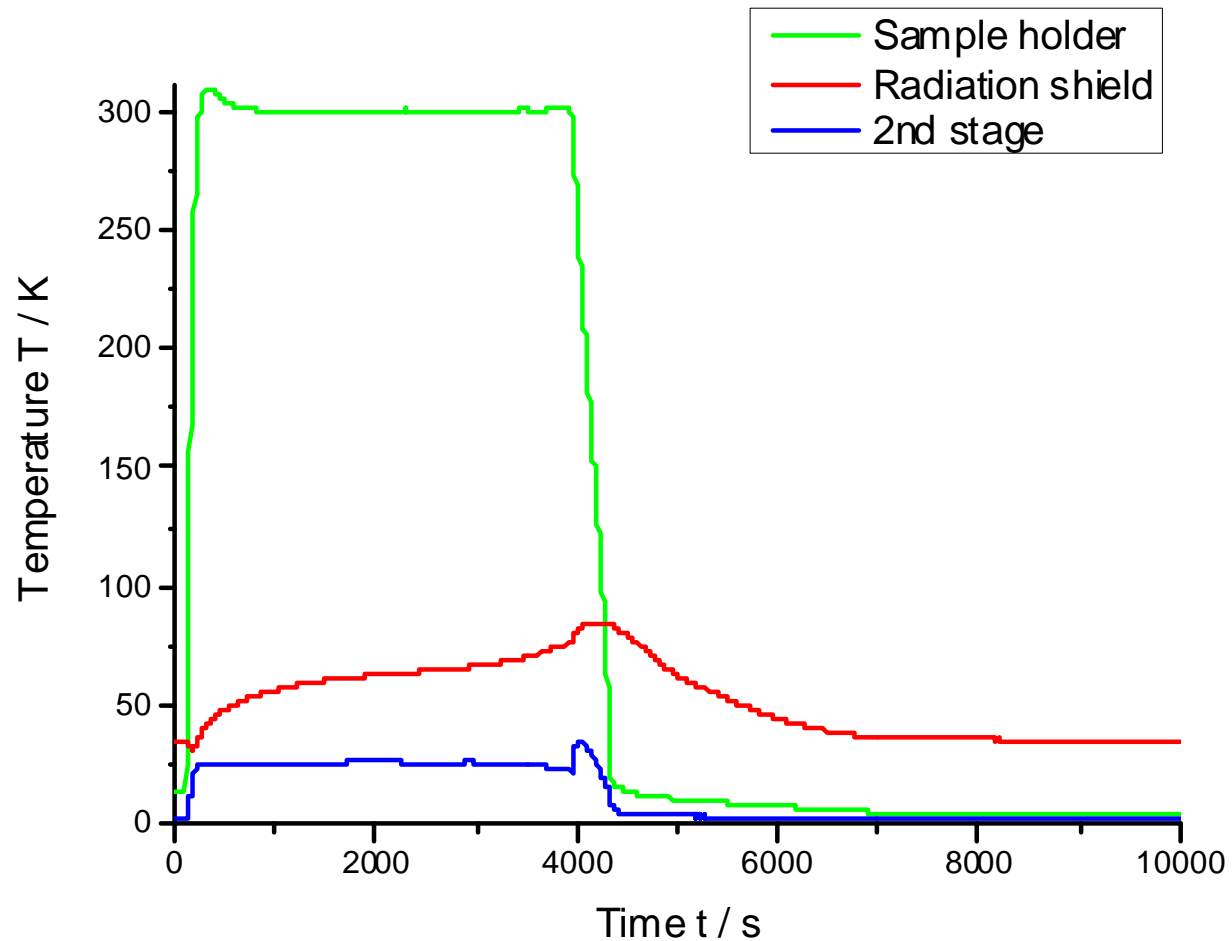


Cooling from room temperature



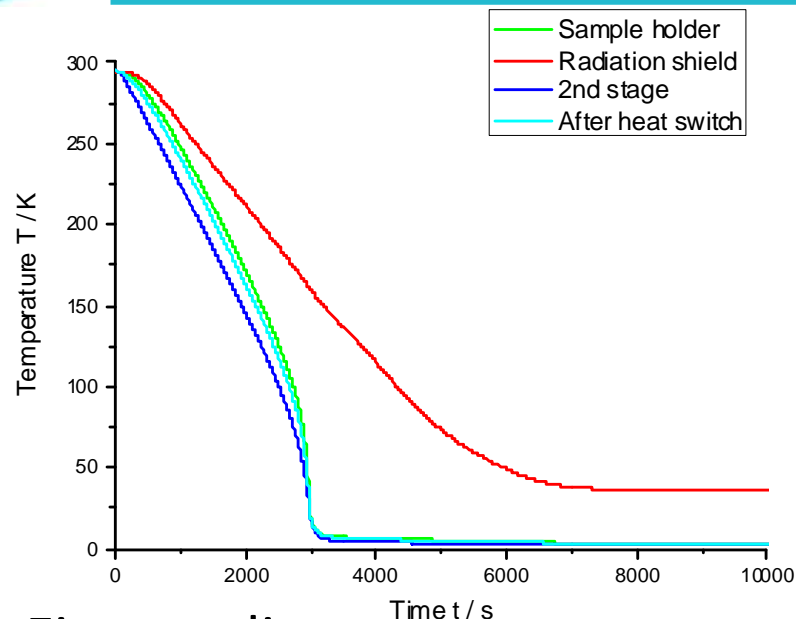


Simulated sample exchange





Simulated sample exchange



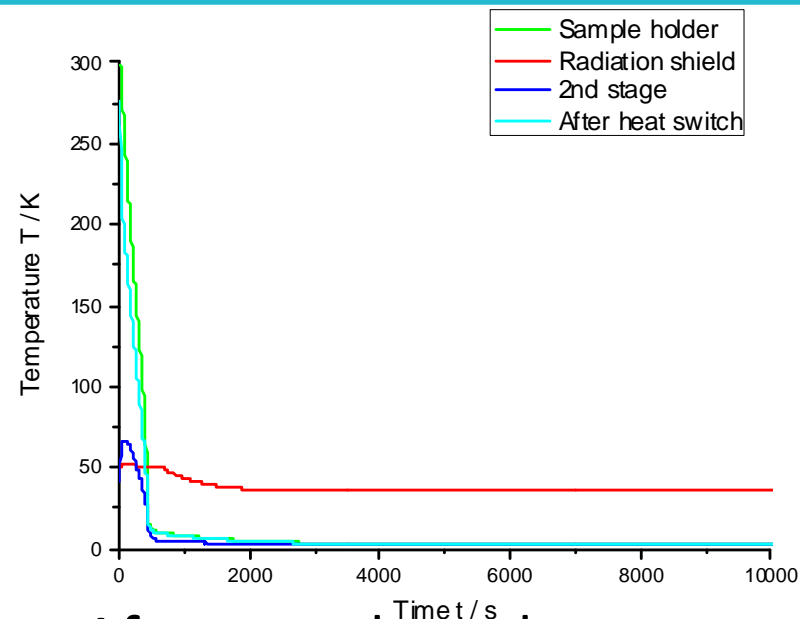
First cooling

1:50 h: 2nd stage at ~2,8 K

2:50 h: 2nd stage at ~2,7 K

2:10 h: Sample at ~3,1 K

$\Delta T \approx 0,4$ K



After sample exchange

0:40 h: 2nd stage at ~2,8 K

0:55 h: 2nd stage at ~2,7 K

0:50 h: Sample at ~3,4 K

$\Delta T \approx 0,6$ K

(0:10 h: sample at ~ 20 K)



Problems/Improvement ideas

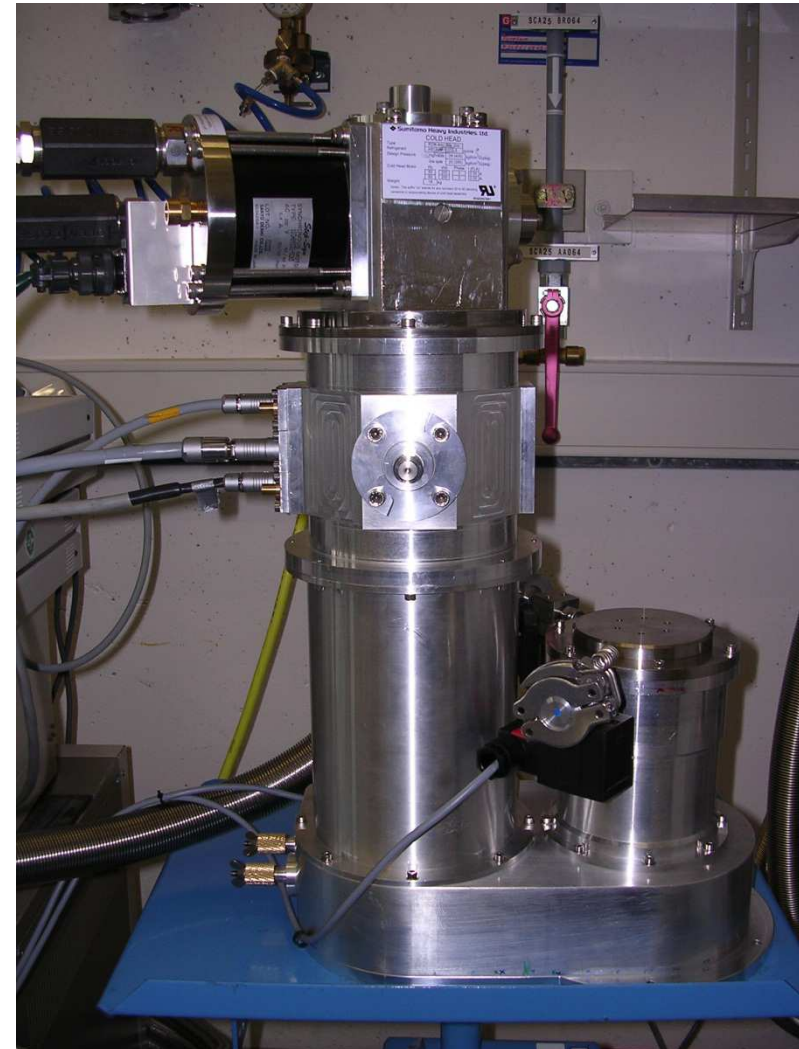
- ◆ Non-ideal cooling process
 - ◆ Better thermal decoupling
 - Thermal connection of the heater cable to 2nd stage
 - Reduction of heat input to sample tube
 - ◆ Improvement of the heat flow
 - Polishing of the cone (heat switch)
 - Gilding of the heat switch
- ◆ Temperature higher after sample exchange
 - ◆ Avoidance of water condensation (heater on radiation shield)





Further work

- ◆ Fine tuning the cooling process
- ◆ Optimisation of the sample exchange
- ◆ Automated sample exchange
 - ◆ Standardised sample cans
 - ◆ Robotic arm
 - ◆ Heat switch control



Thank you
for your attention



<https://en.wikipedia.org/wiki/File:Smiley.svg>