

Closed-cycle cryostats for Kelvin and milliKelvin temperatures

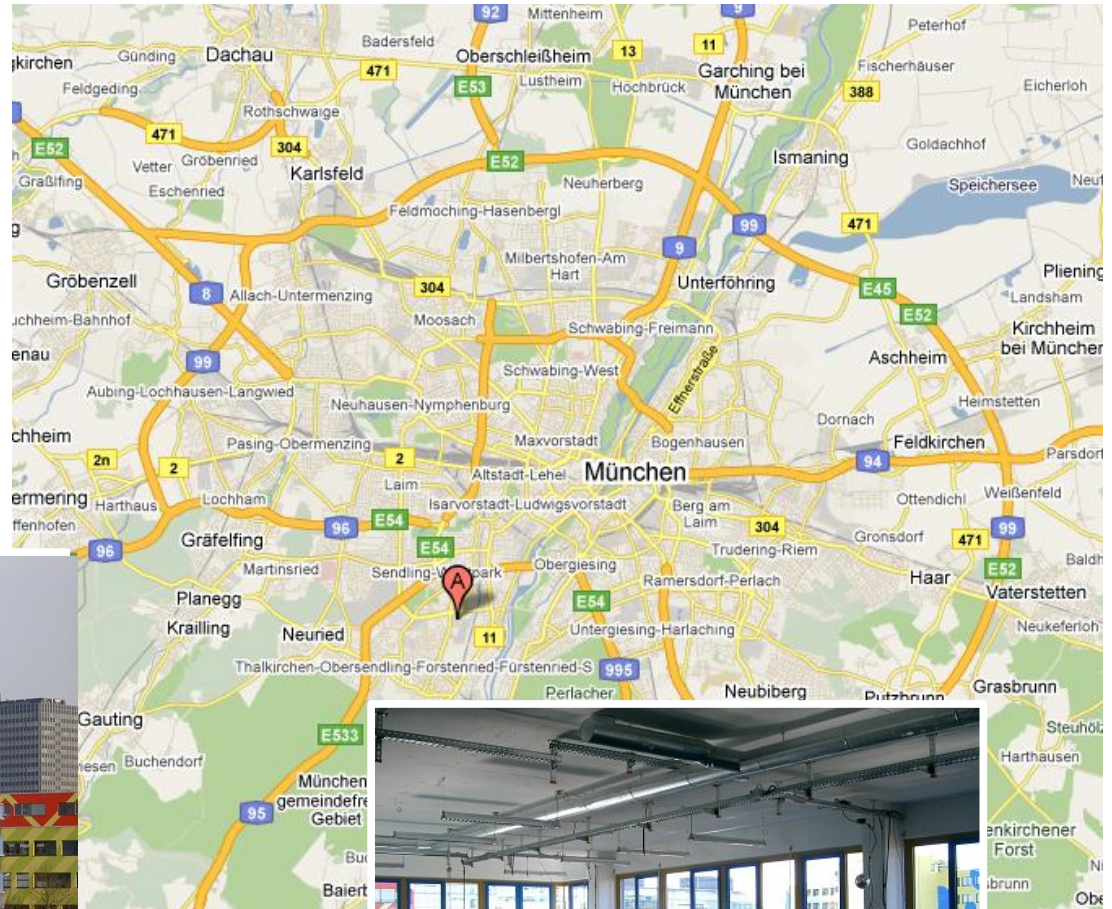
Doreen Wernicke

Entropy GmbH

Entropy GmbH

- Cryostat manufacture
- 'Dry' Cryogenics
- Based in Munich

Entropy GmbH



Entropy - What we do

- Cryostats based on 2-stage pulse-tube coolers



4K/10K Cryostat



$^3\text{He}/^4\text{He}$
Sorption Cooler
(300mK)

**Adiabatic
Demagnetization
Refrigerator**
(<100mK)



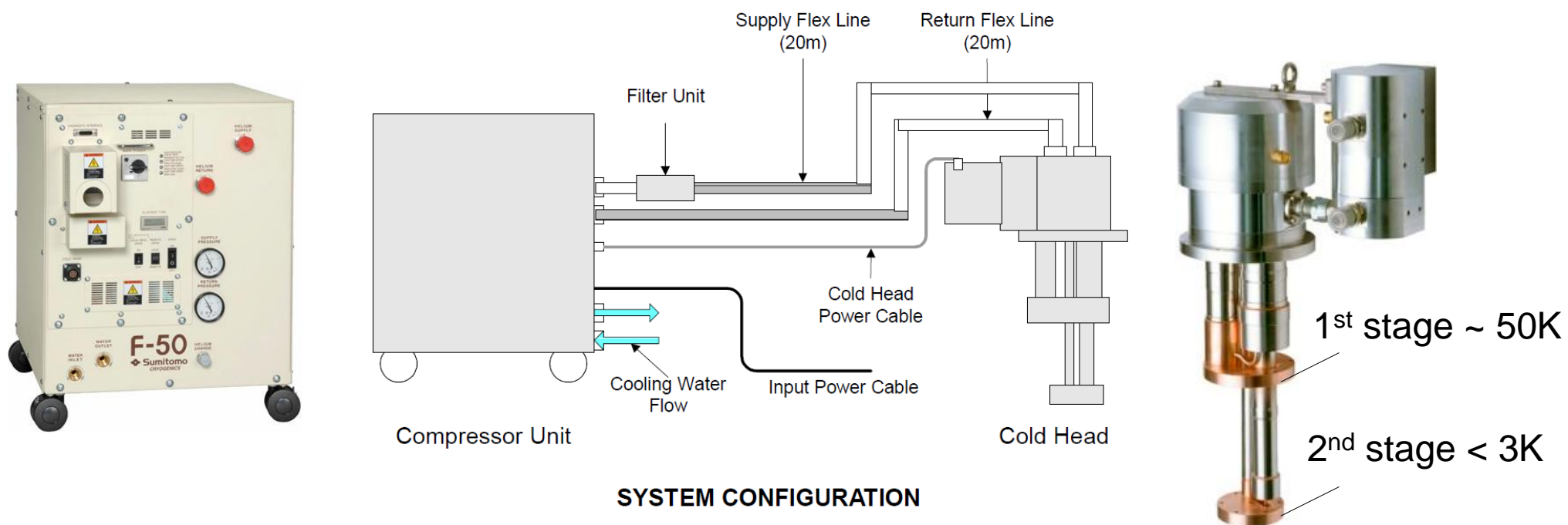
Joule-Thomson
(< 0.9K)

Dilution Refrigerator
(< 20mK)



Pulse-tube cooler

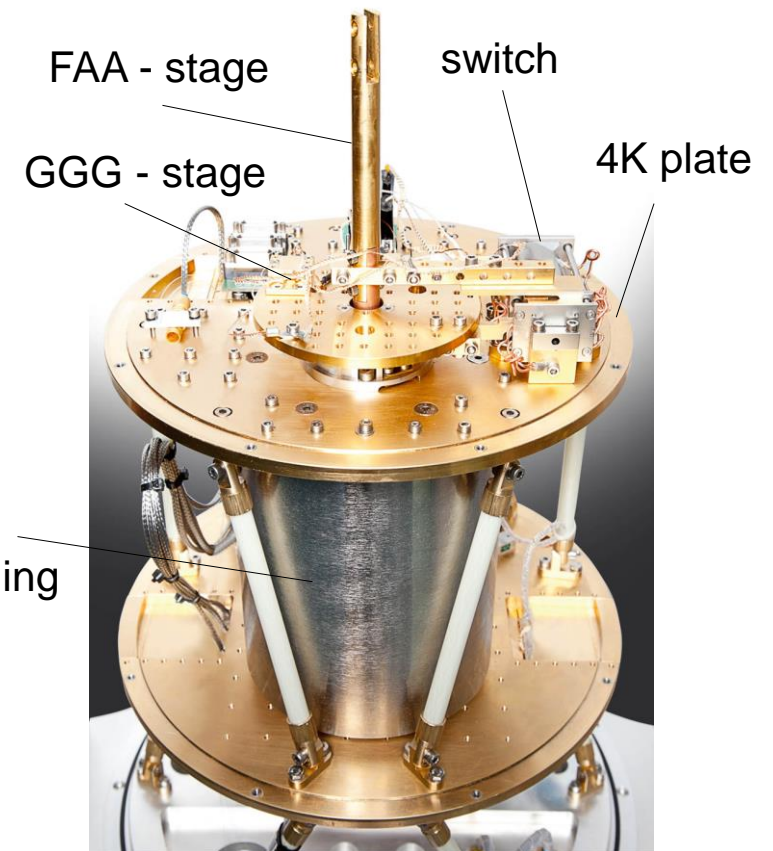
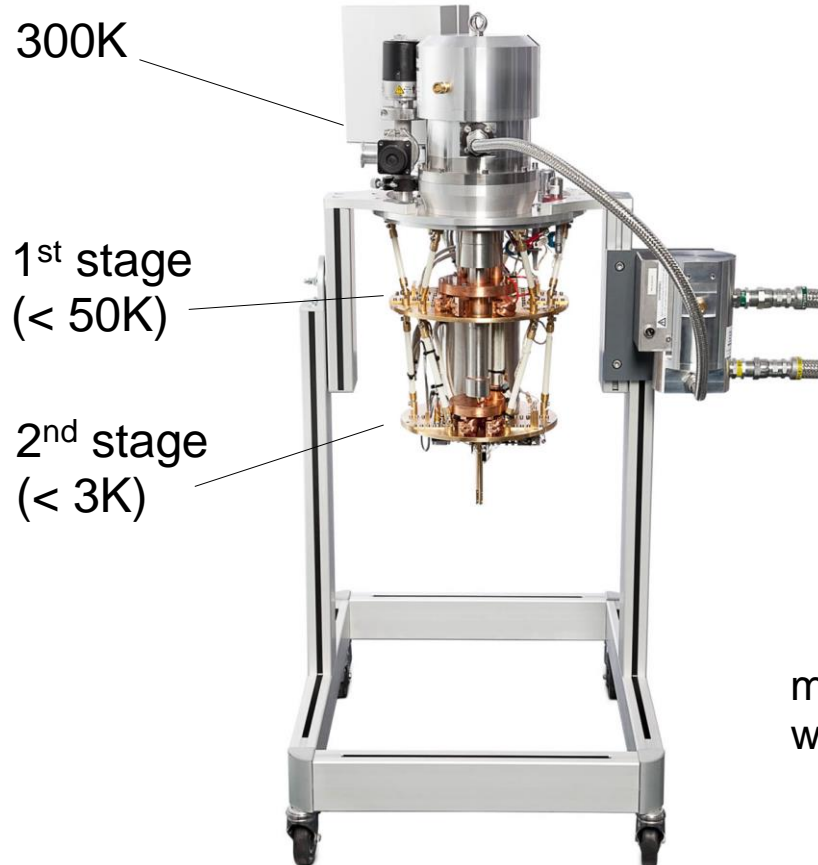
- Sumitomo (SHI) Cryogenics



<u>Power consumption (steady)</u>	<u>Cooling power @ 4.2K</u>
6.5 / 7.5kW (50/60Hz)	0.5 / 0.4*W
7.2 / 8.5kW (50/60Hz)	1.0 / 0.9*W

* remote valve

ADR - Cryostat



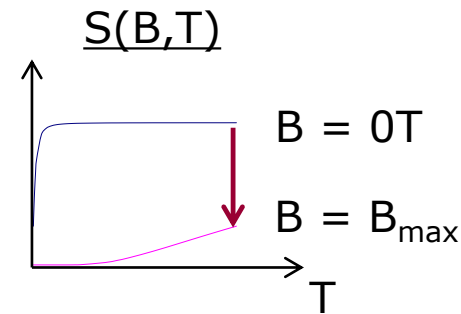
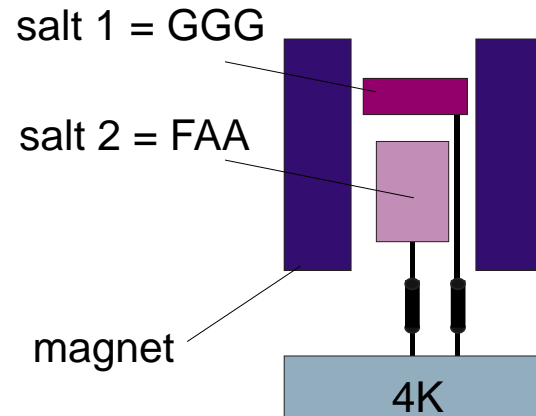
Paramagnetic salt:

- FAA = Ferric ammonium alum
- GGG = Gadolinium Gallium Garnet

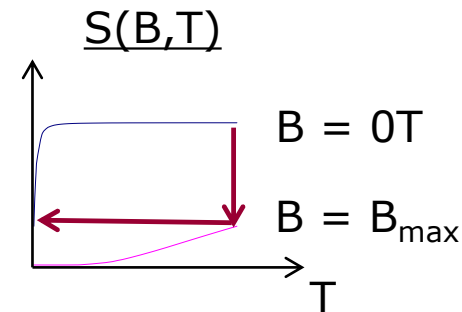
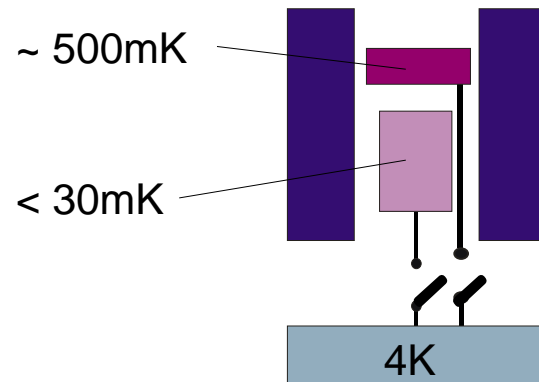
double-stage salt pill

Adiabatic Demagnetization Refrigerator (ADR)

Isothermal magnetization



Adiabatic demagnetization

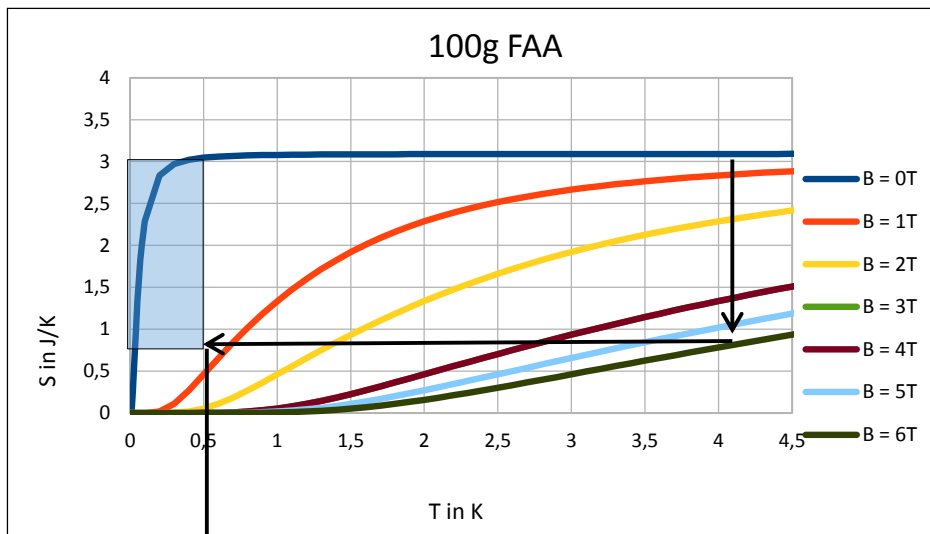


ADR - Holdtime

ADR cycle:

$$Q = T^*[S(0,T) - S(B_{\text{end}},T)]$$

$$t = Q/P$$



T Regulation

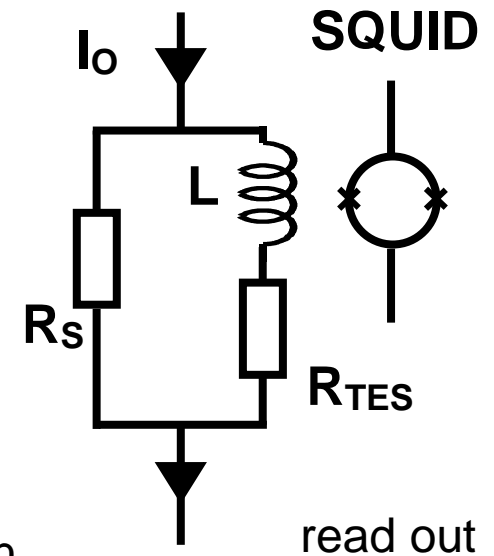
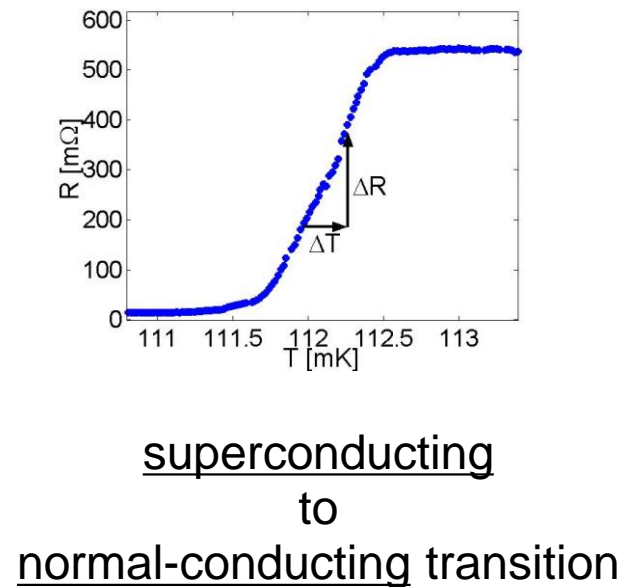
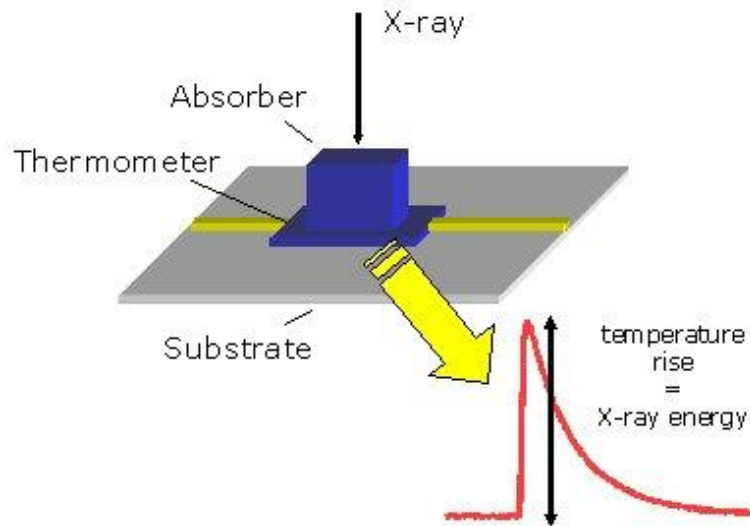
T [mK]	Q _{FAA} [mJ]	Holdtime [h]
50	10	5
100	100	50
300	660	300

holdtime calculation done with

0.5μW base load
+ 0.05μW load (10 x Manganin wires)

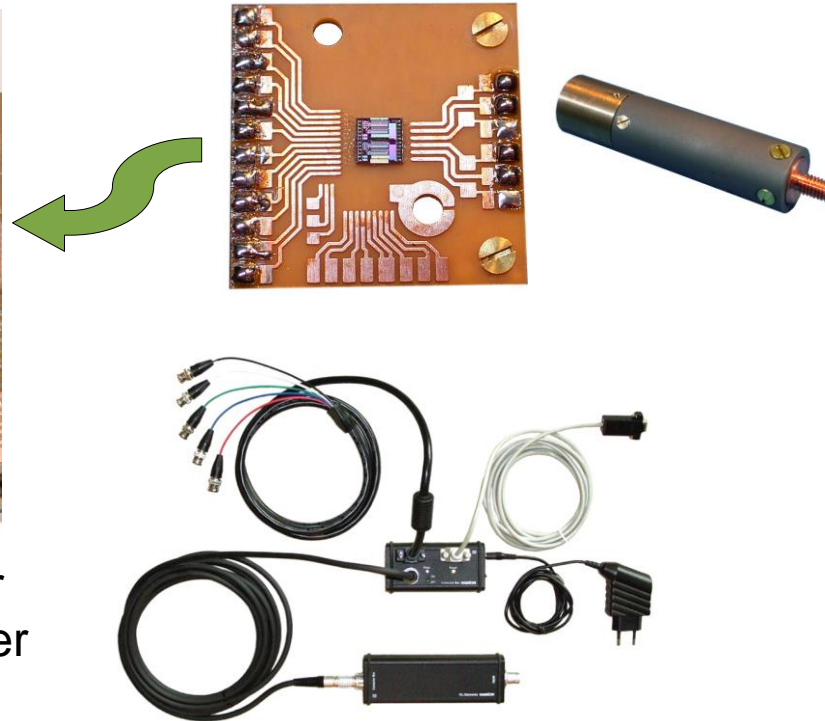
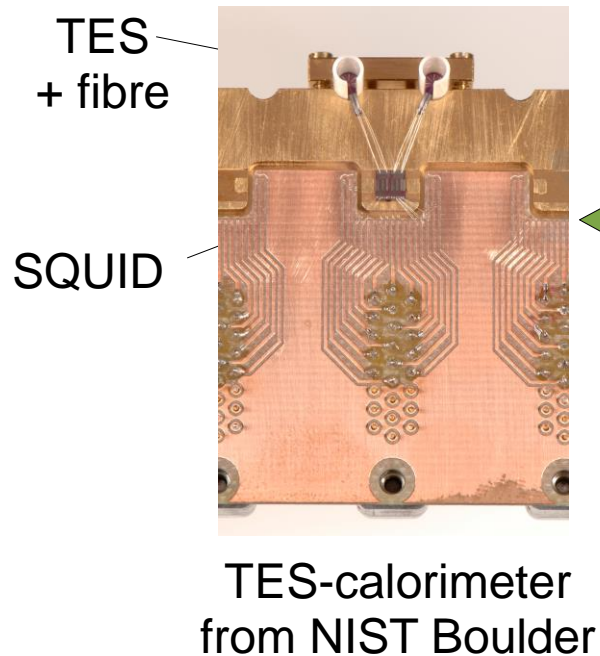
ADR - Application

Cooling of TES (transition edge sensors)



- X-ray detection in material science / astronomy
- Single-Photon detection for quantum optics and communication

ADR for Single Photon Detection



Experimental setup:

Dr. Jörn Beyer

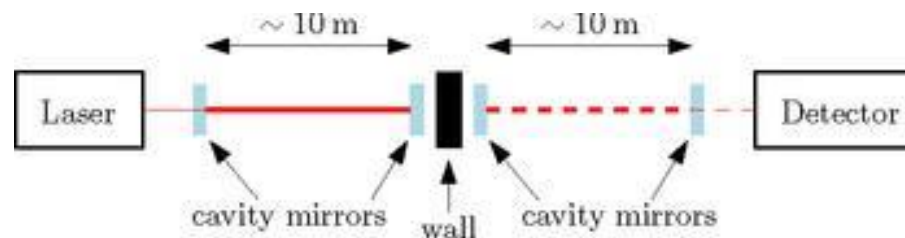
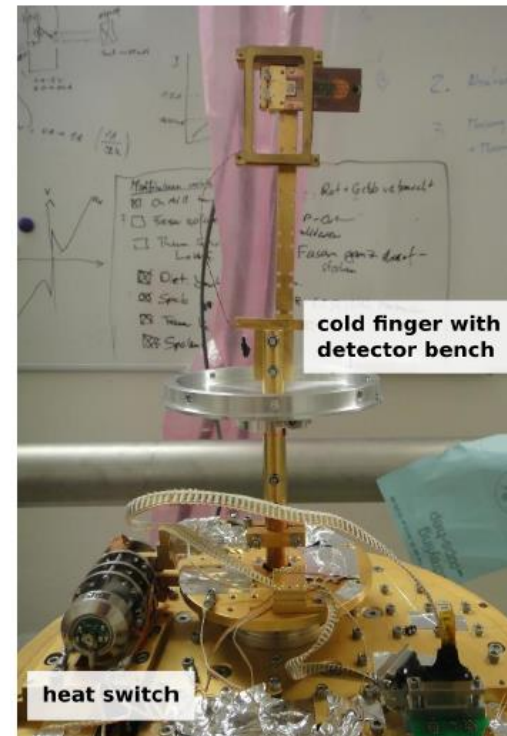
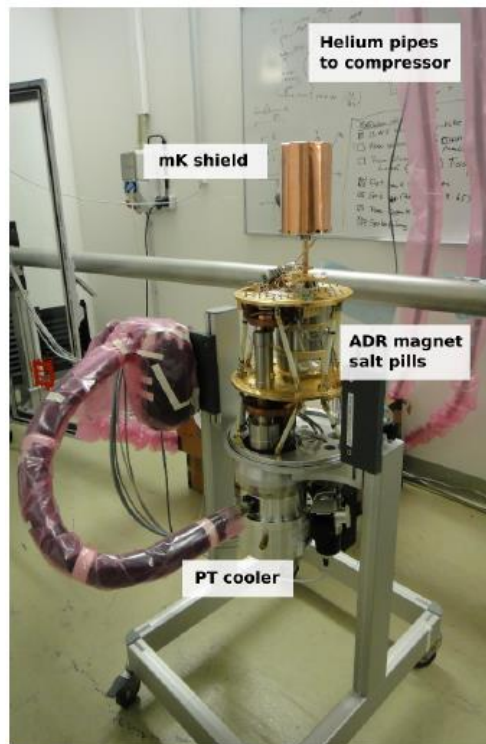
PTB Berlin
AG Kryosensoren

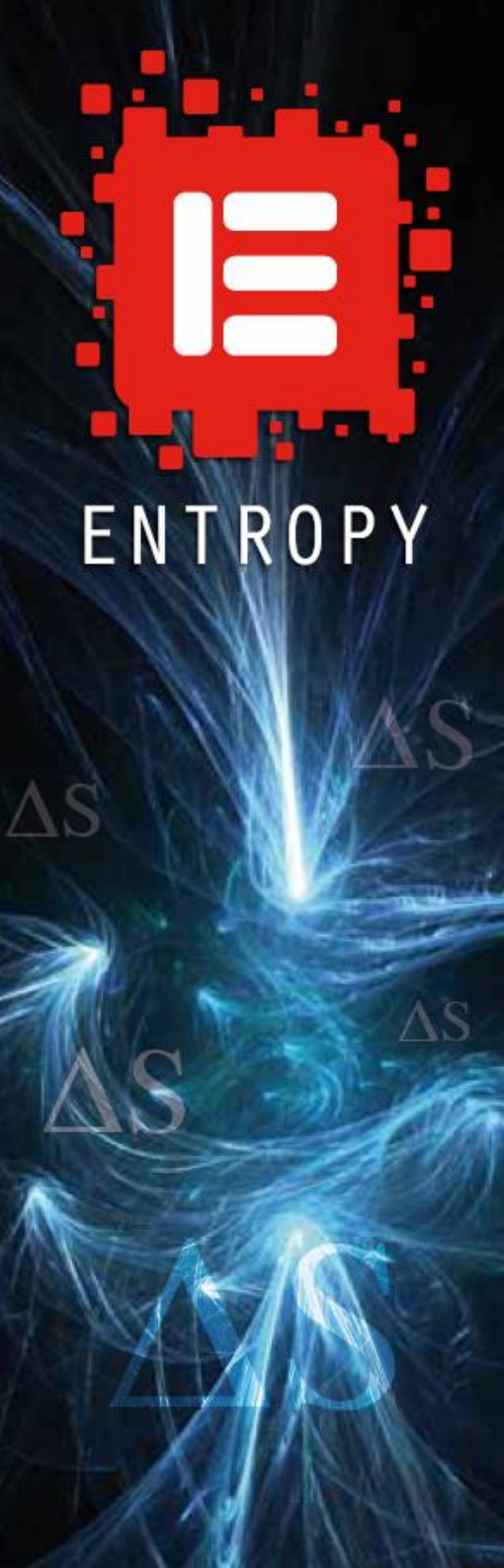
~~MAGNICON~~

physical research and instrumentation

ALPS – II at DESY Hamburg

Noemie Bastion, Jan Dreyling-Eschweiler, Dieter Horns,
Friederike Januschek und Axel Lindner for the ALPS-II collaboration





Thank you!

www.world-of-cryogenics.com