CRESST

Cryogenic **R**are **E**vent **S**earch with **S**uperconducting **T**hermometers

Max-Planck-Institut für Physik

University of Oxford

Technische Universität München

Laboratori Nazionali del Gran Sasso

Universität Tübingen

CRESST II

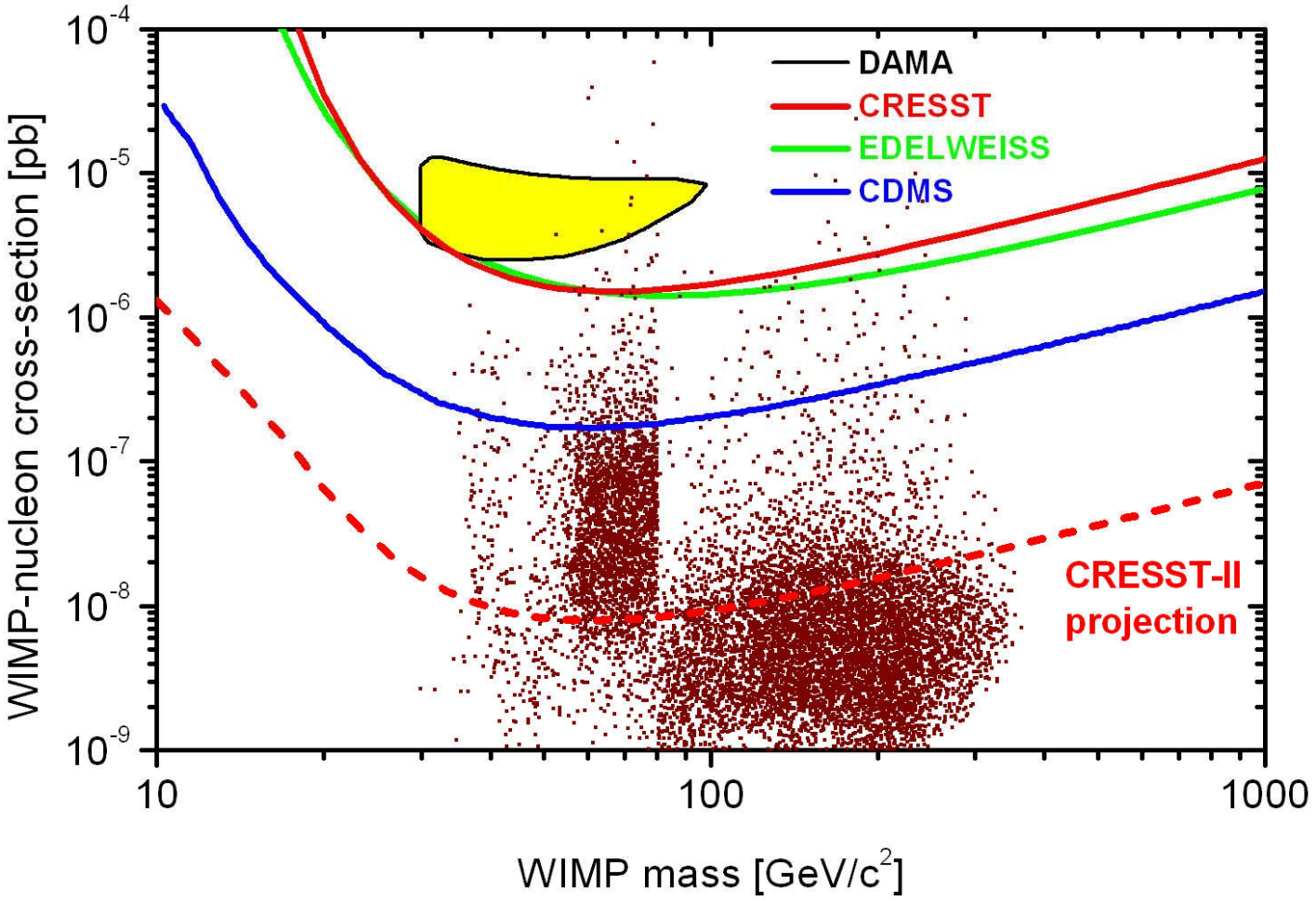
Features:

- mass : 10 kg $CaWO_4$
- threshold lower than 15 keV (recoils)
- excellent background discrimination
- **identification of recoil nucleus**
  (unique an important for
  positive identification of a WIMP signal)

Goal:

Sensitivity better than 10^{-8}pb

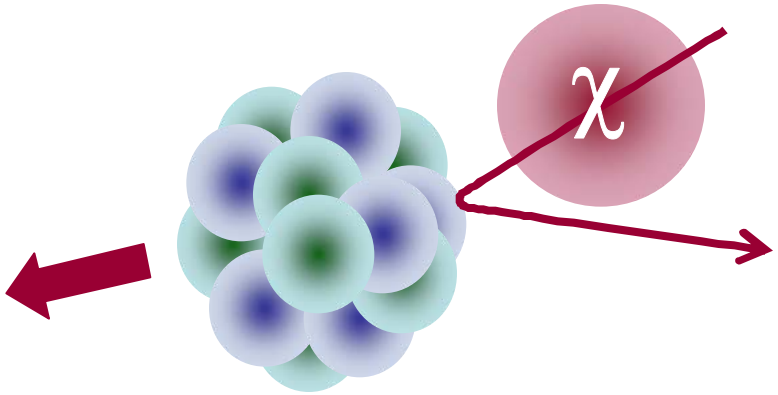
Expected Sensitivity

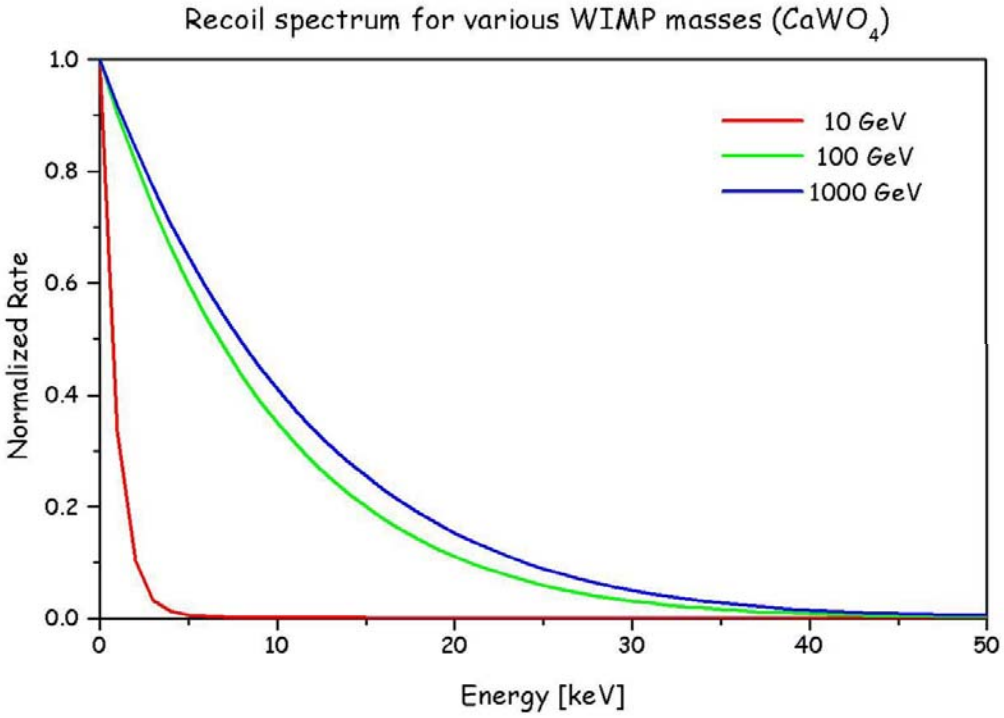


Direct WIMP detection

✓ Low energy transfer (< 40 keV)

Low energy threshold





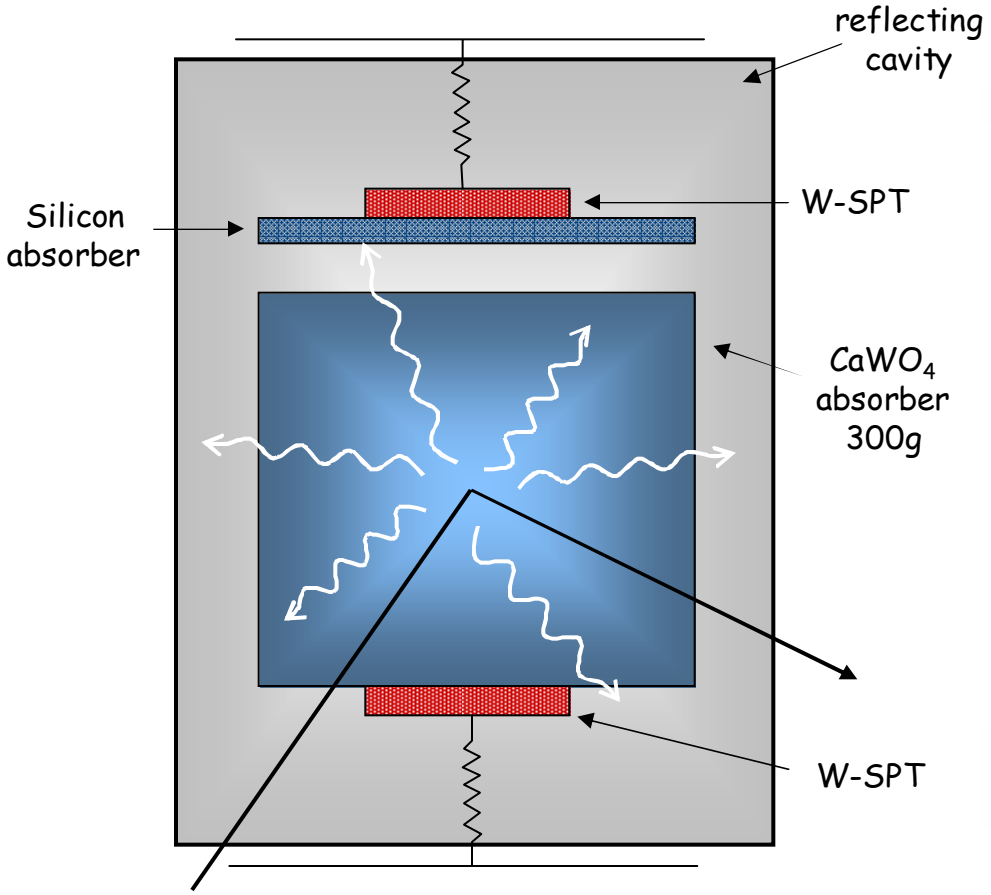
WIMP-nucleus scattering

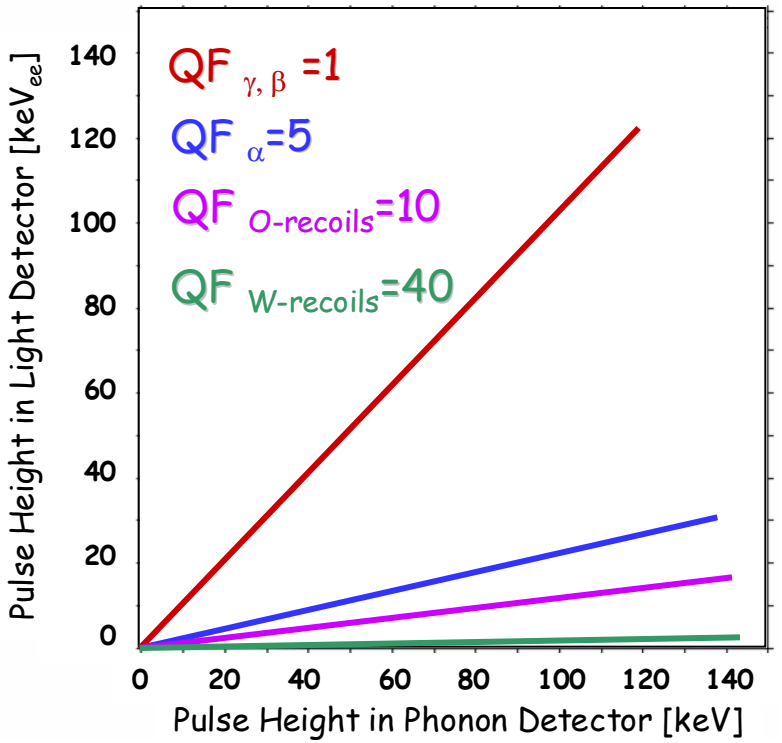
detectors for
rimination

kg in 3 years
hold

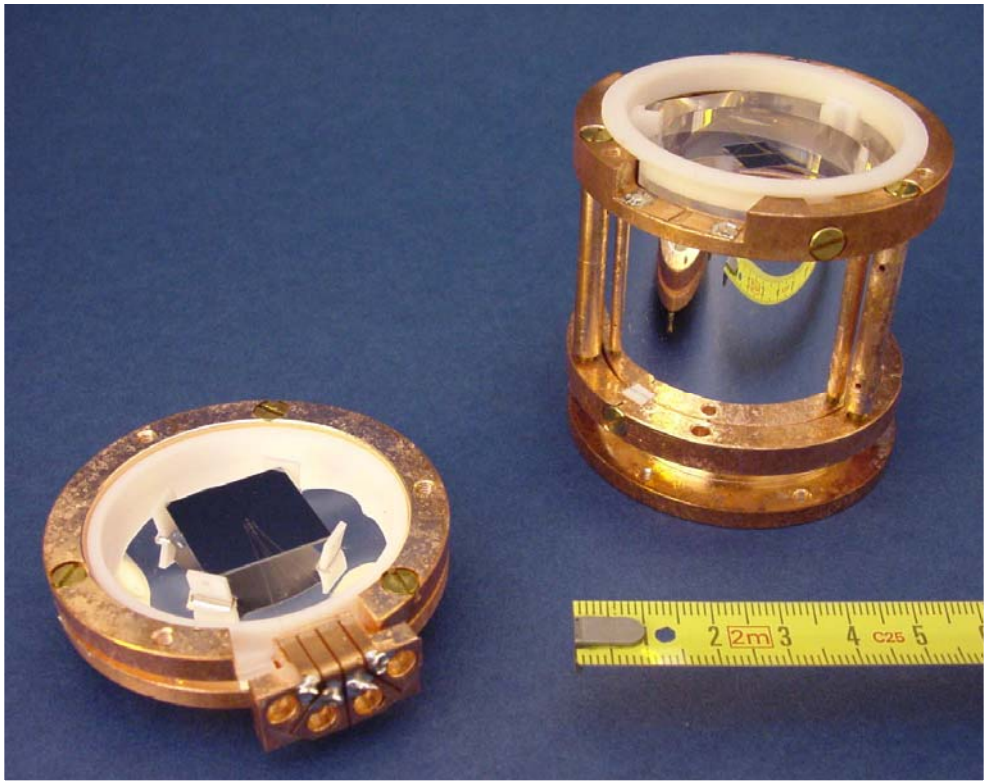
CRESST detector module – background discimination

Simultaneous measurement of phonons and scintillation light to discriminate nuclear recoil signals from radioactive background





300 g detector module



Operating temperature ~10 mK

33 modules in CRESST II

phonon channel:

- 300g $CaWO_4$
- Ø = 40mm, h = 40mm
- W-SPT 4 x 6 mm^2

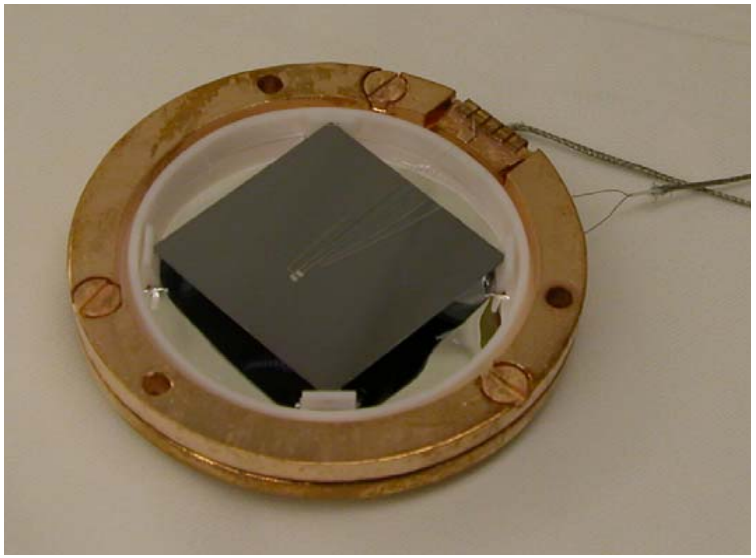
light channel:

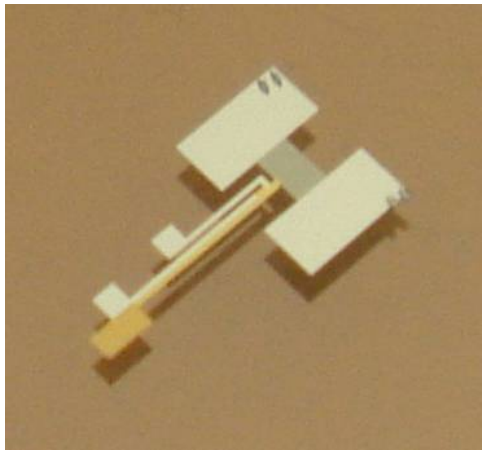
- Si 30 x 30 x 0.4 mm^3
- W-SPT with Al phonon collector

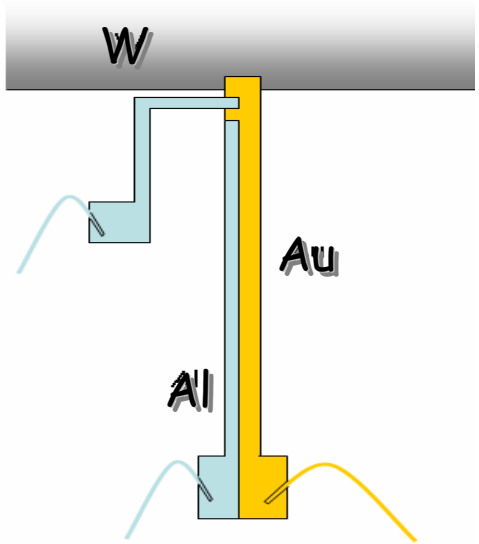
reflector:

- polymeric foil, teflon

Light Detector







Al-phonon collectors
separate heater / thermal link

Si wafer (30 x 30 mm^2) read out by W-SPT

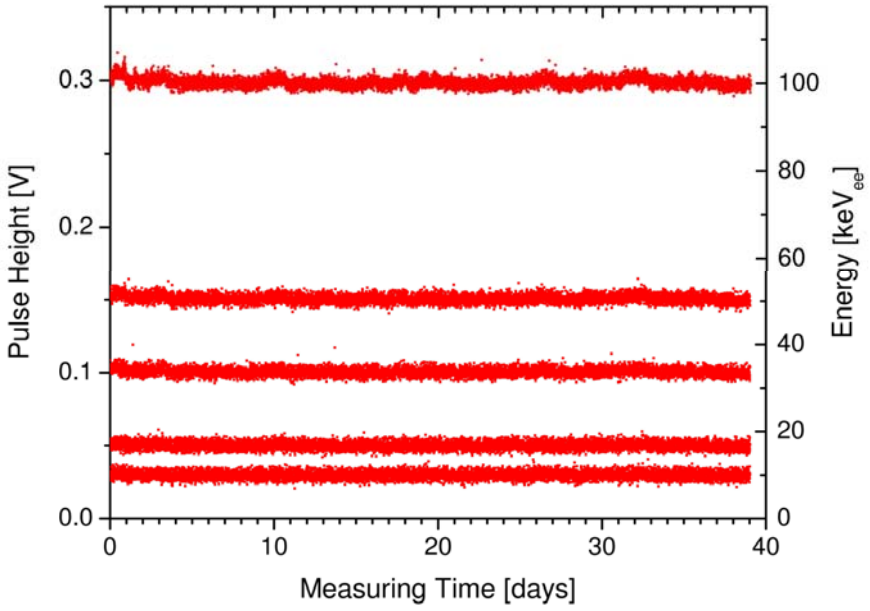
Effective threshold: $E_{thresh,ee}$ ~ 2 keV (few photons)

10 to 20 eV absolute

Run with two prototype detector modules

Stability of detectors:

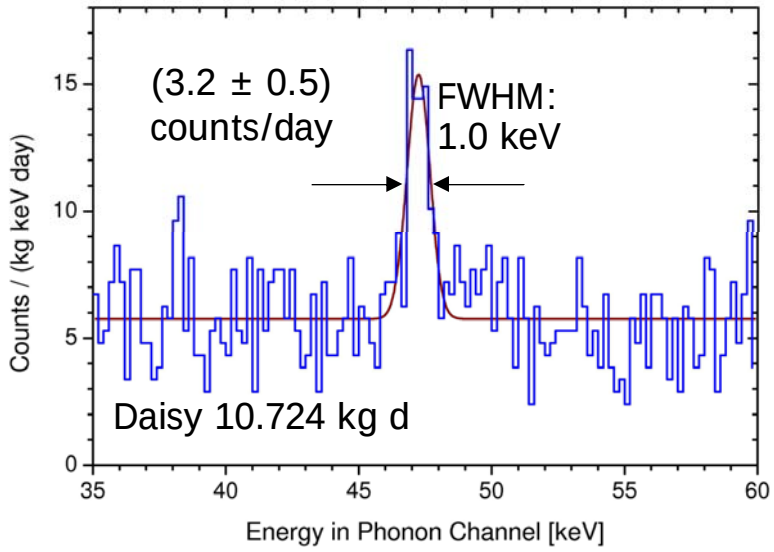
Very constant sensor response over a period of two months



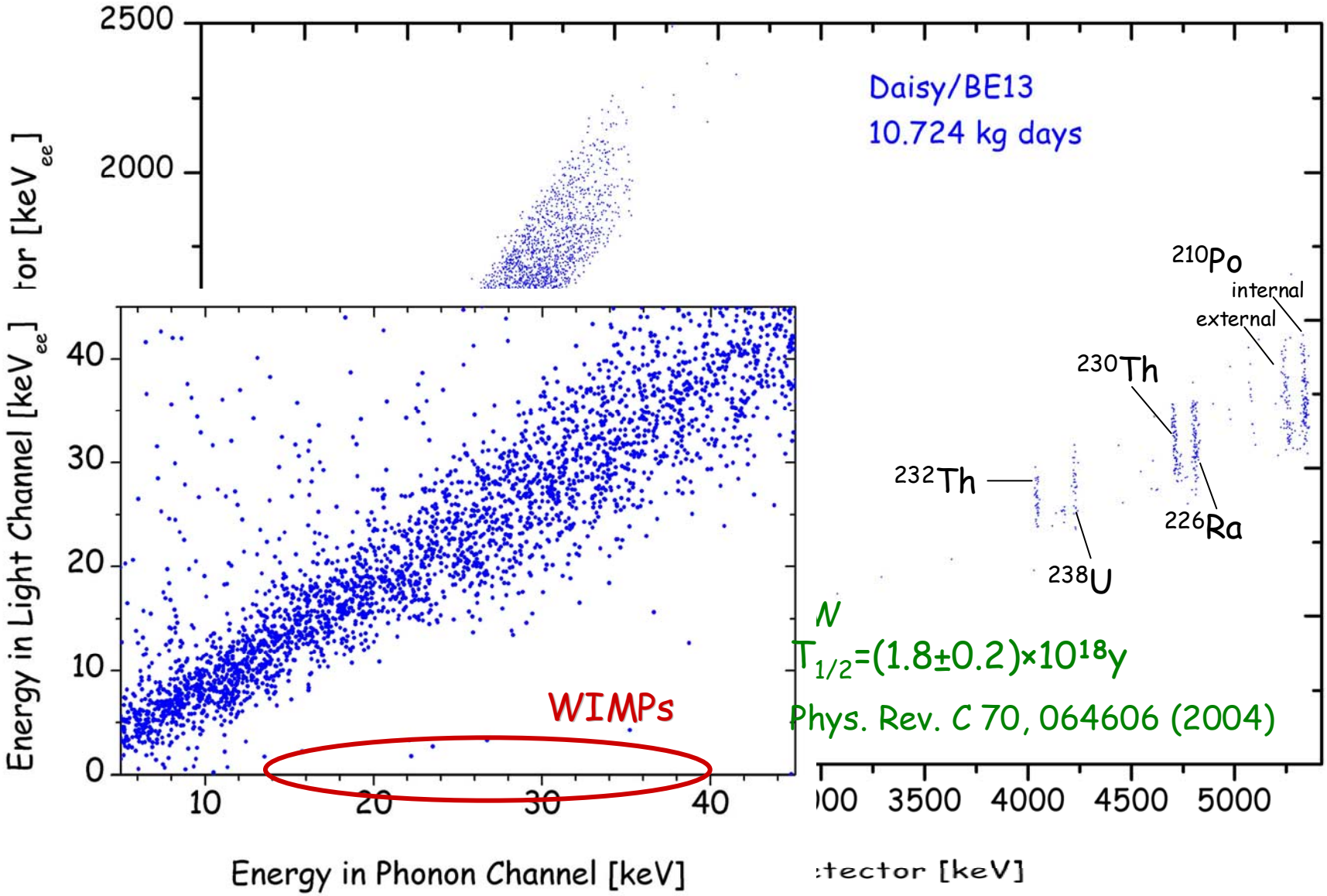
Energy resolution of phonon detector:

γ : 1 keV @ 46.5 keV:

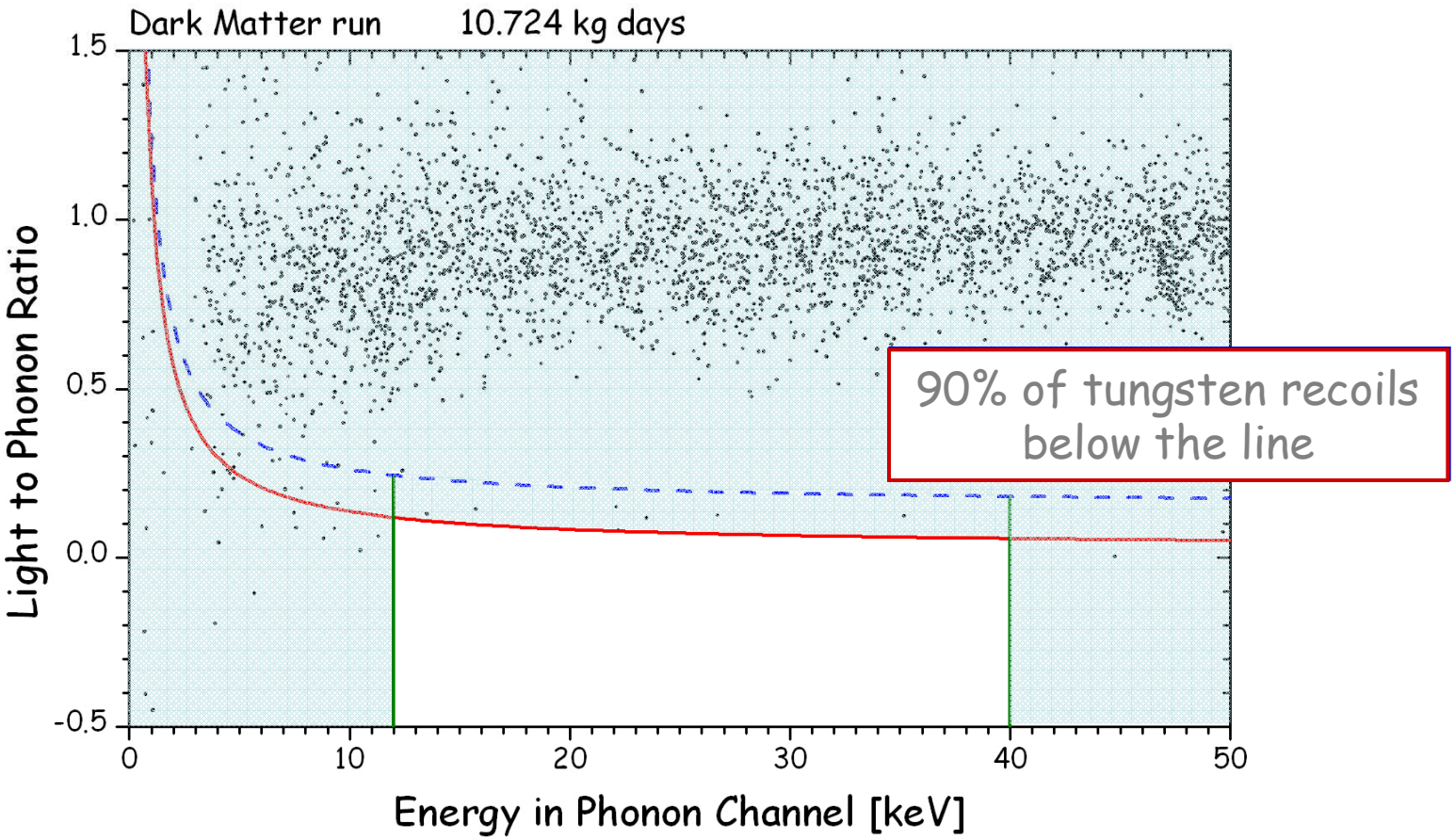
α : 8 keV @ 2.3 MeV



CRESST detector module – background discrimination

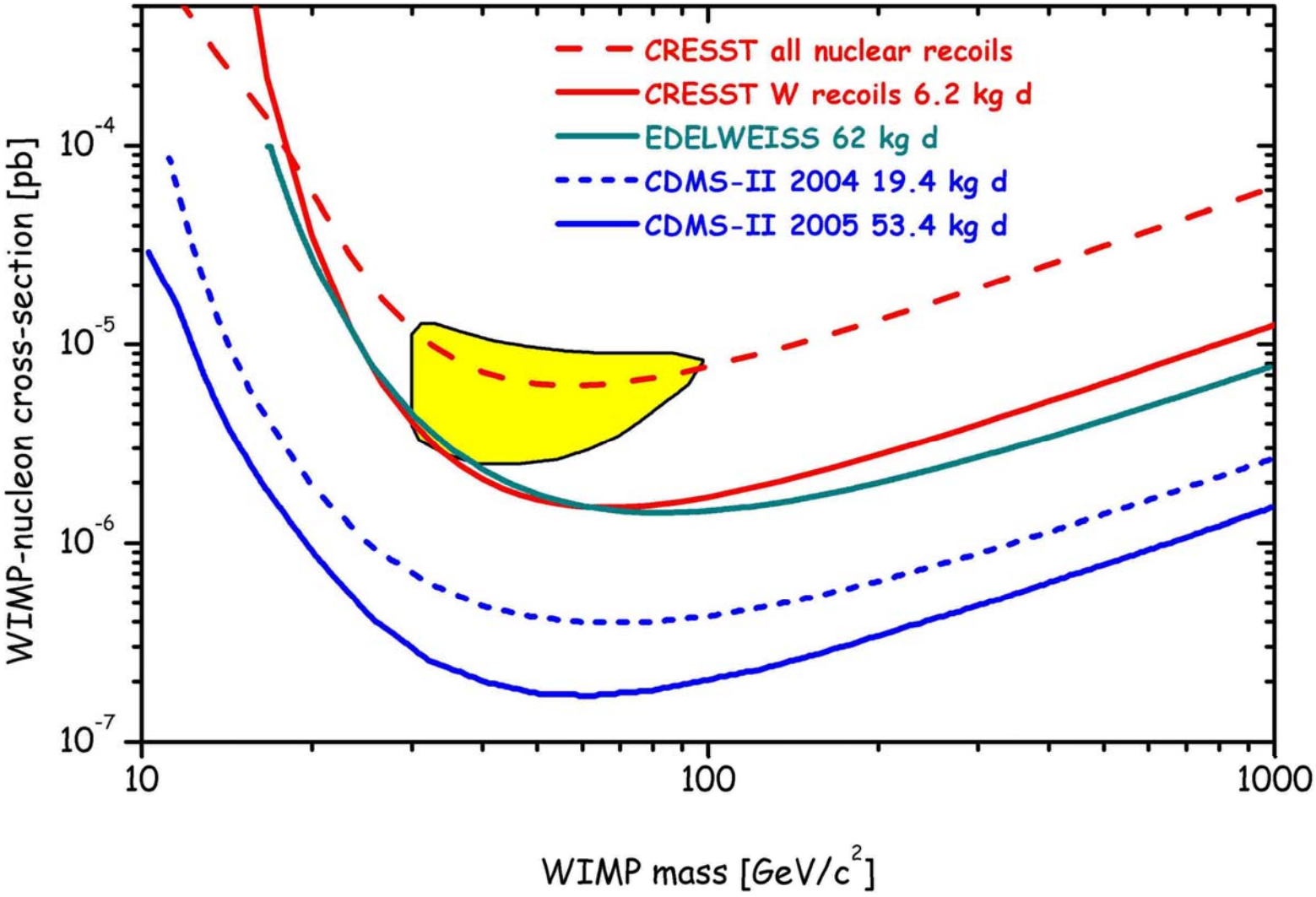


Acceptance regions



Exclusion limits

Astropart. Phys. 23 (2005)



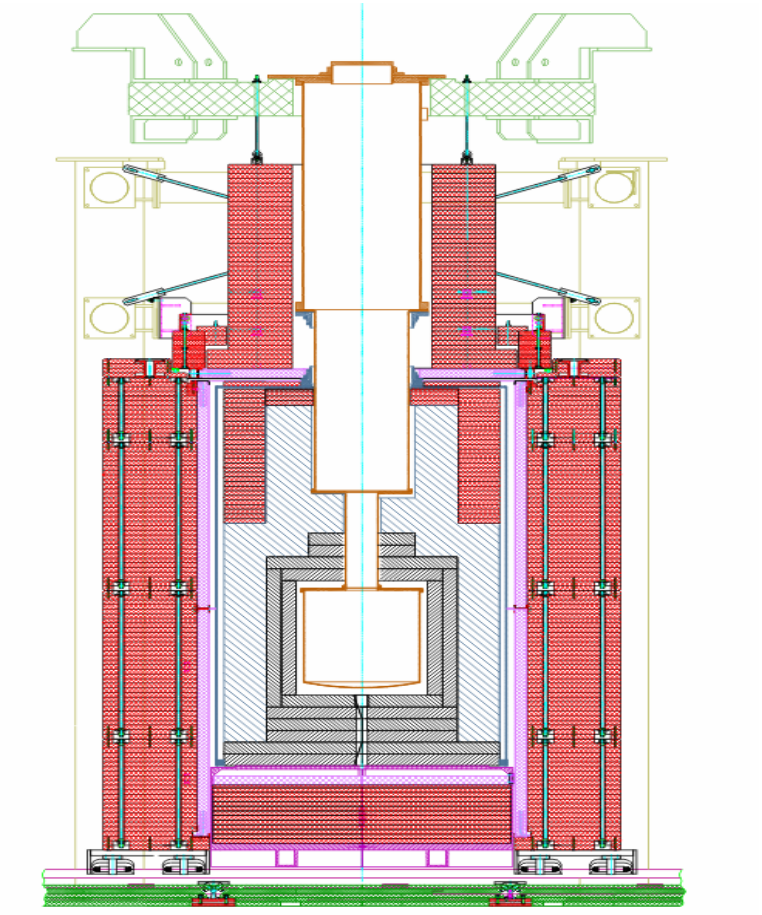
Upgrade

- n-shield (50cm PE) (MPI, wagons Oxford, PE paid by TUM)
- 66 channel SQUID readout (University of Oxford)
- new DAQ for detectors +muon veto + slow control, hardware + software (MPI)
- muon-veto (design MPI, paid by TUM, HV- TUM, DAQ MPI, glasfiber signal transmission MPI, characterization and installation Tübingen)
- Detector bias electronics (Oxford)
- Wiring until mixing chamber (Oxford)
- Low background wiring below mixing chamber (MPI)
- Detector modules (MPI)
- Detector support structure (MPI)
- Source lift (TUM)

Upgrade

- remove cryostat
- lift shielding
- exchange wagons
- mount PE-shielding
- Mount radon-box
- Mount muonveto
- install SQUIDs and wiring
- reinstall cryostat
- DAQ+electronics
- Wiring of coldbox and detector support
- Detectors

shielded cryostat



PE neutron moderator

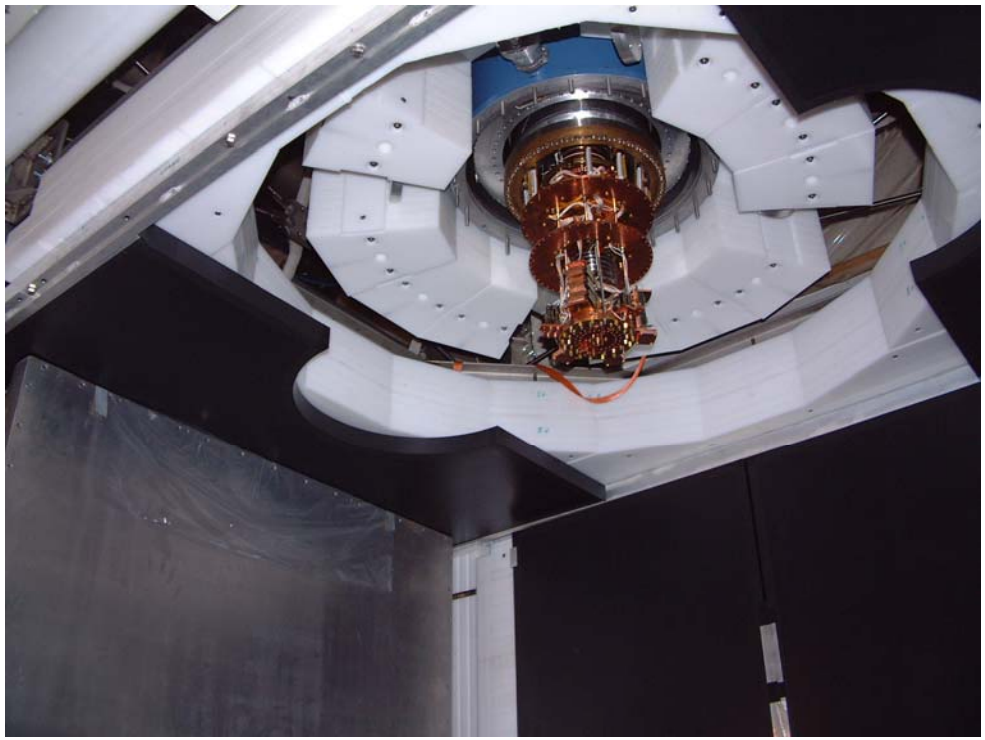
plastic scintill. μ-veto

Dismounting of Cryostat

Exchange shielding support waggons

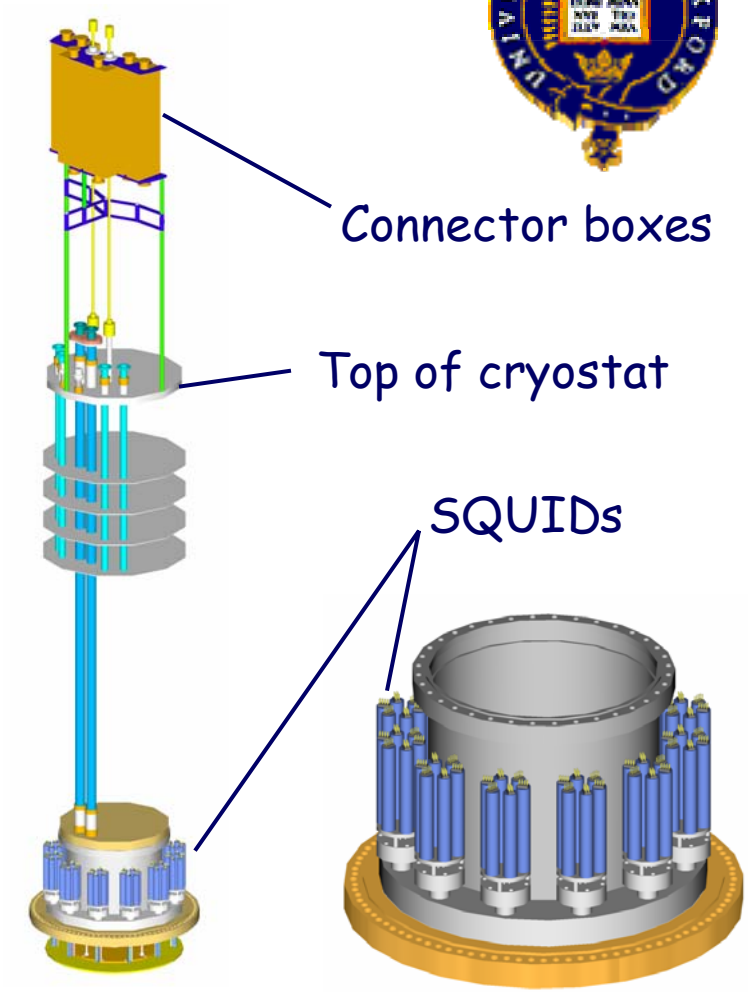
lifting the shielding (17tons)

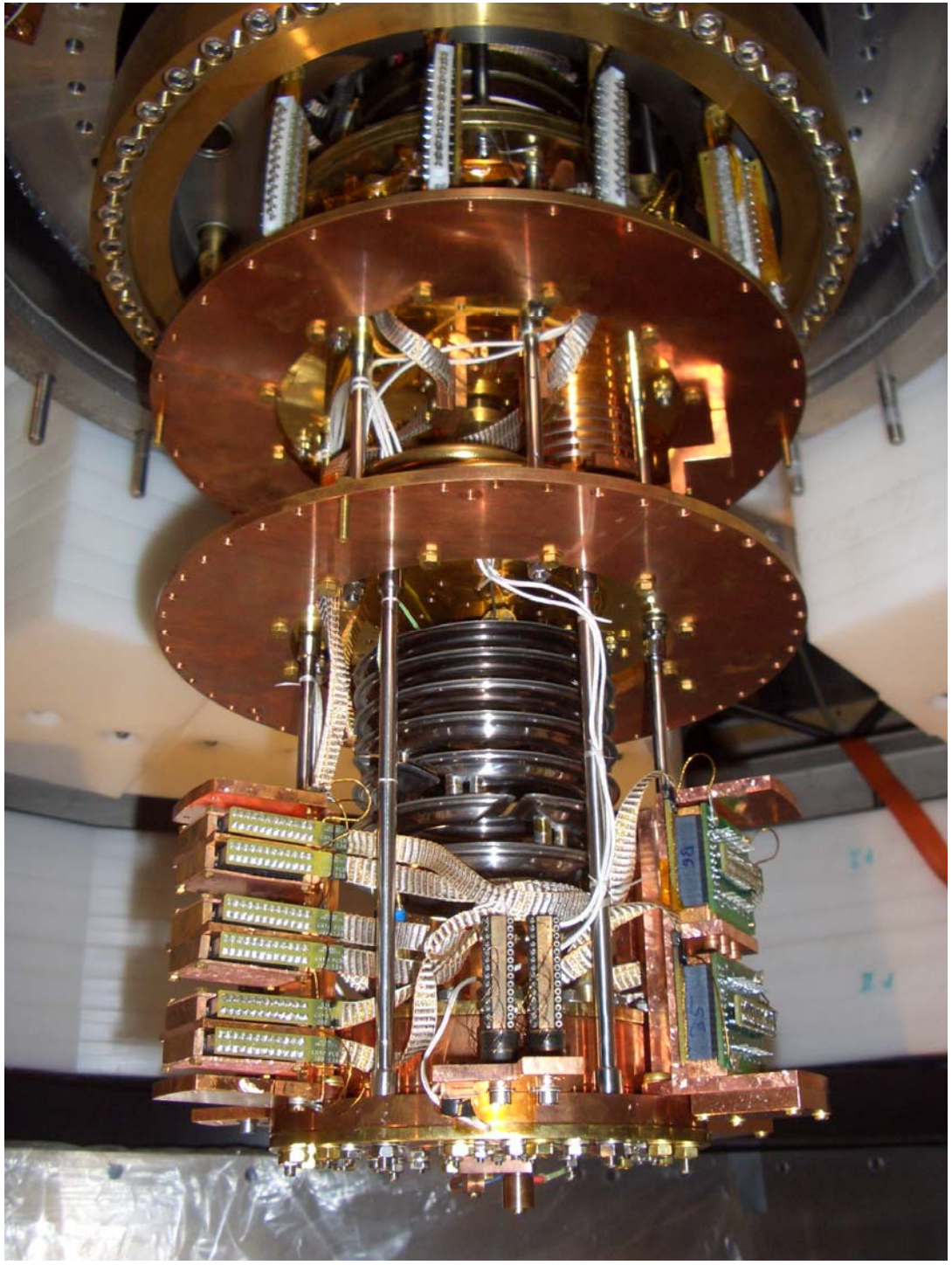
PE- shielding and muon veto



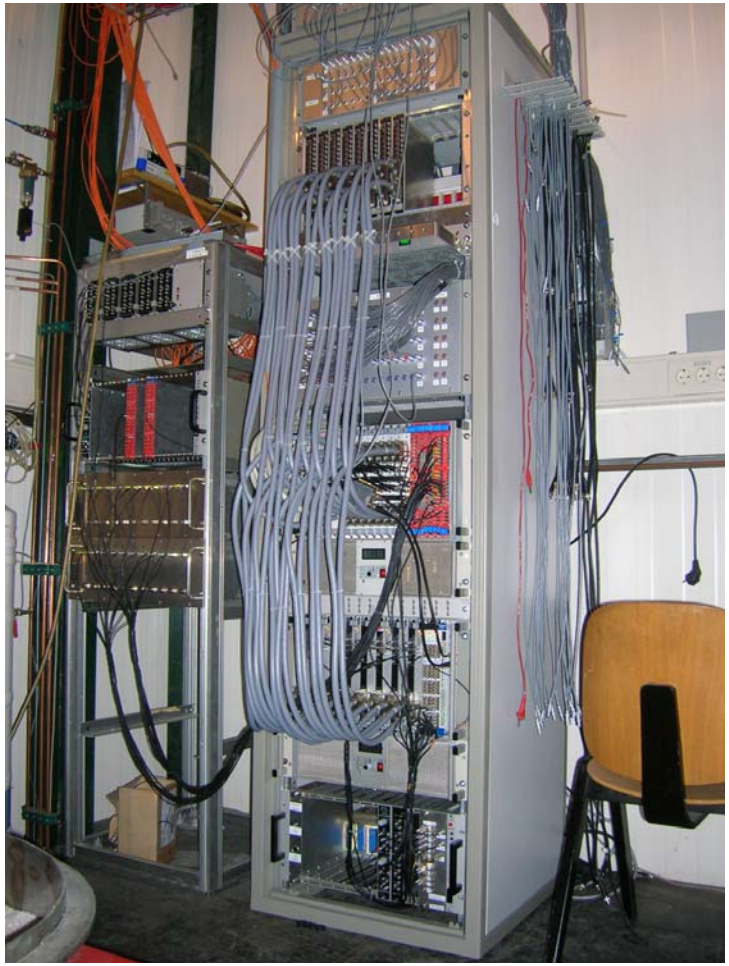
50 cm PE – shielding (12 tons)
Plastic scintillator muon veto

✓ Installation of 66 SQUID channels



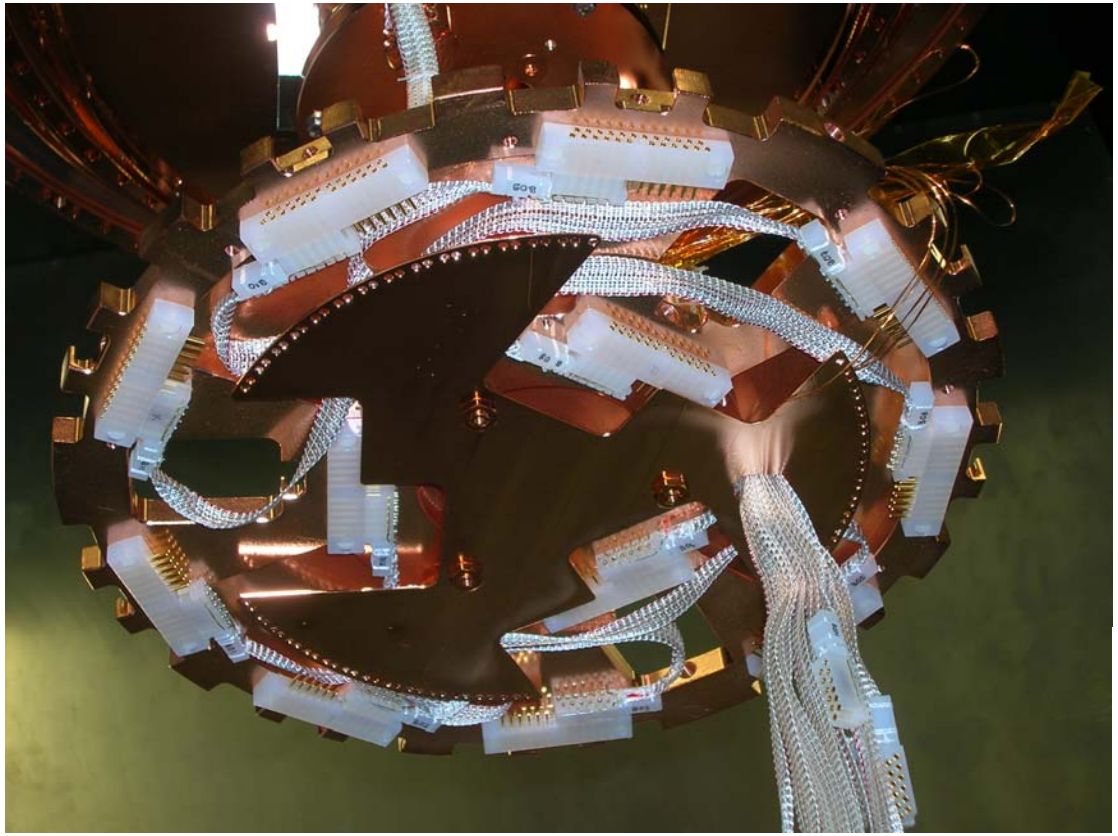


New DAQ



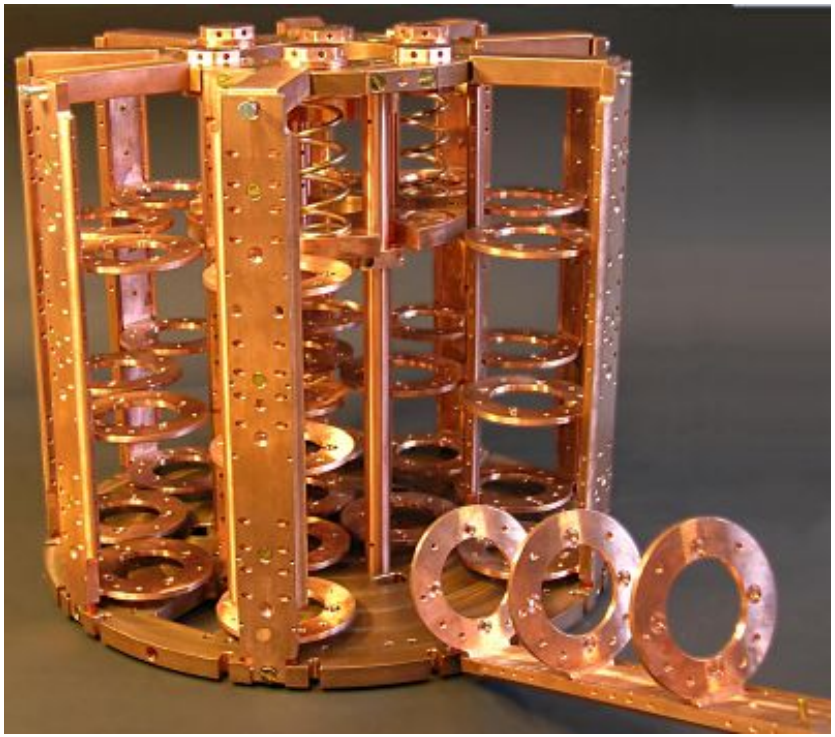
new wiring for 66 channels

- 576 wires into Helium bath
- 432 wires to mixing chamber (7mK)
-288 wires from mixing chamber to detectors



Low background
connectors and solder

Detector support structure



special low background, low heat leak copper
low background CuSn2 springs

Status

- 9 detector modules build in

- cryostat running

- commissioning run stated

status

- Heat leak in copper (50 pW /g)
- Electrical disturbances (Power must be below 10^{-15}W)
  modification of groundig and bias electronics
- wiring problem at inner towers

- Phonon channels are already ok

CRESST is running again