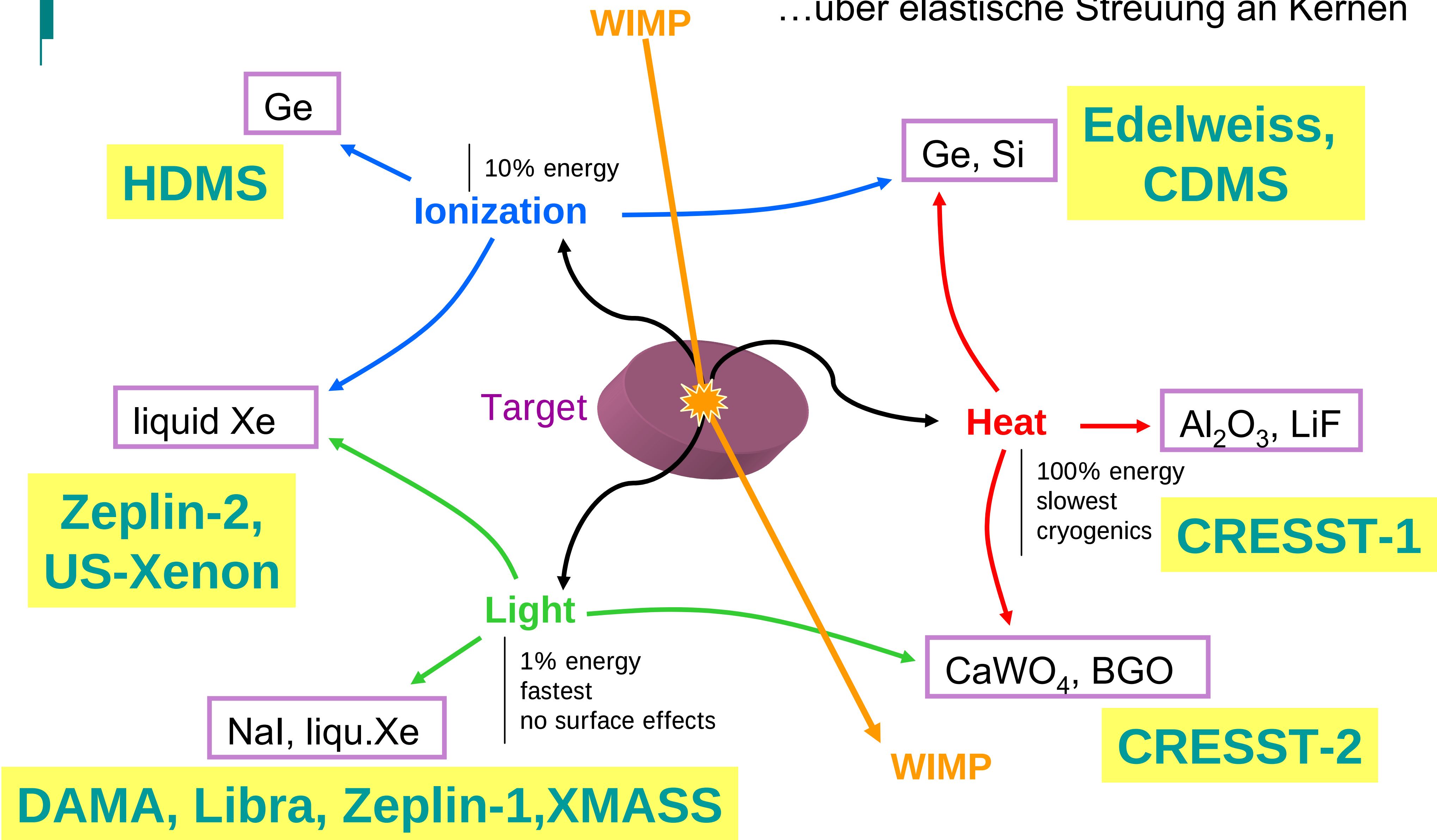
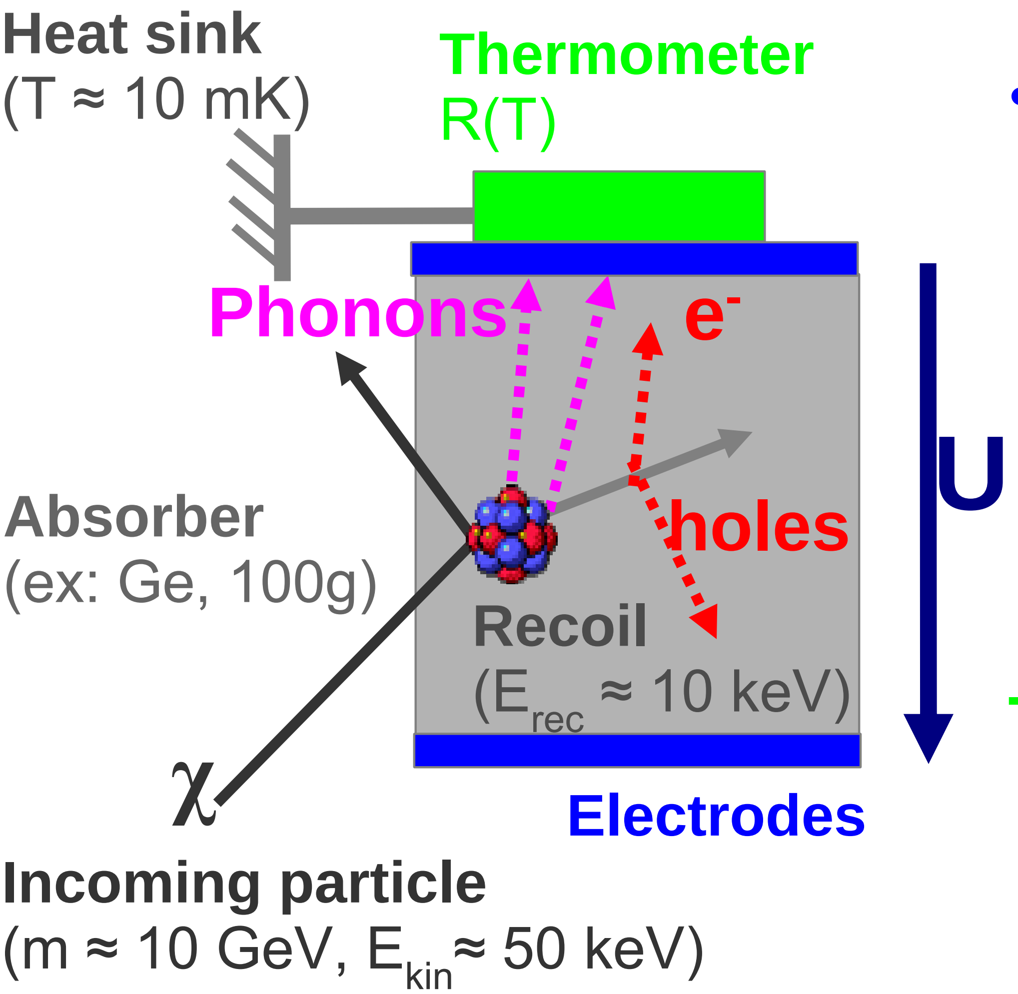
Direkte Suche nach Dark Matter …

…über elastische Streuung an Kernen



ionization – phonon detectors

(T. Shutt et al. PRL 69 3425 1992, L. Bergé et al. NPB 70 69 1999)



- Phonon signal:

  $\Delta T/T \approx 0.1\%$ over t≈ms

- Charge signal:

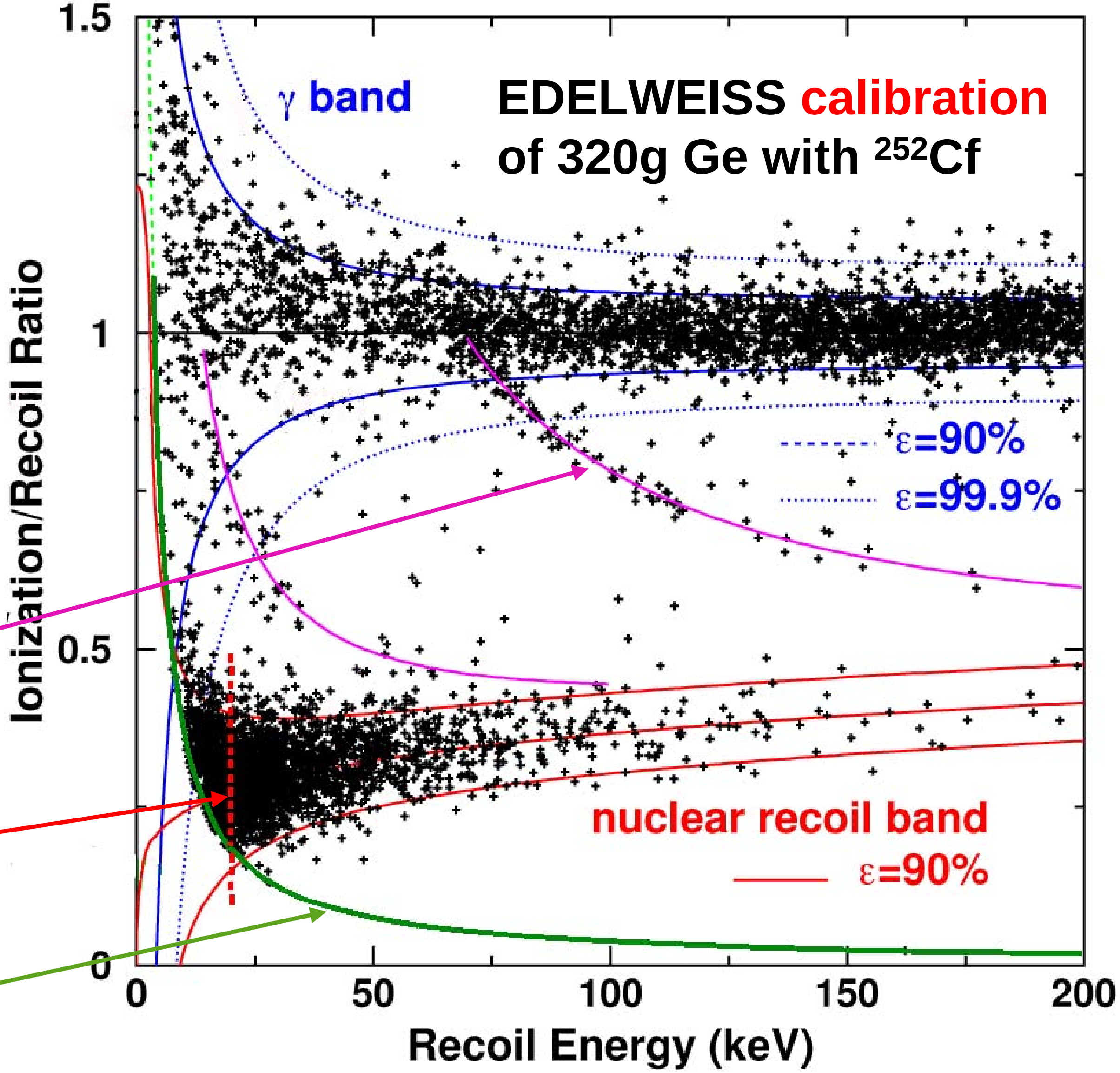
  ≈ 1000 pairs over t≈μs

  γs, βs ionize more than WIMPs, neutrons: quenching of nuclear recoils

→ Event by event background rejection

ionization – phonon signal plane

n/γ discrimination
> 99.9%
for E_r >15 keV

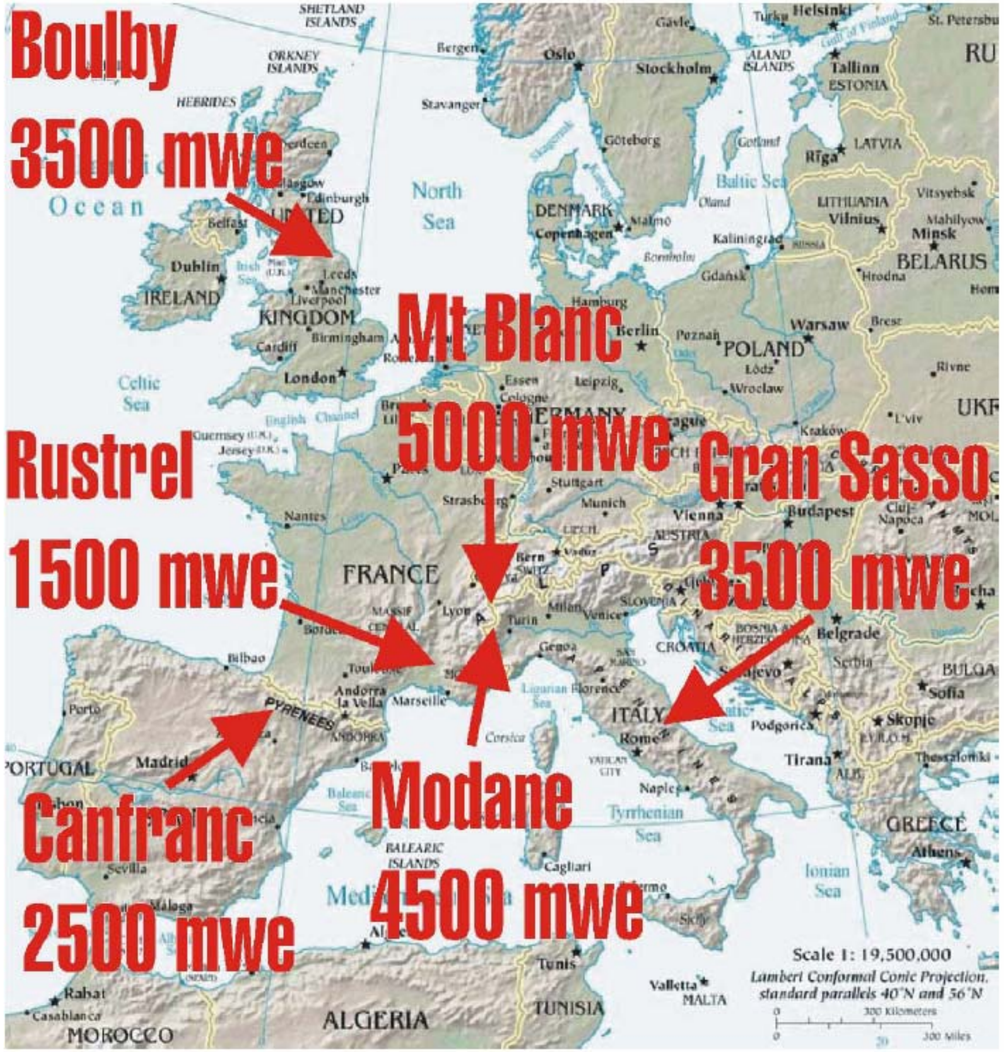


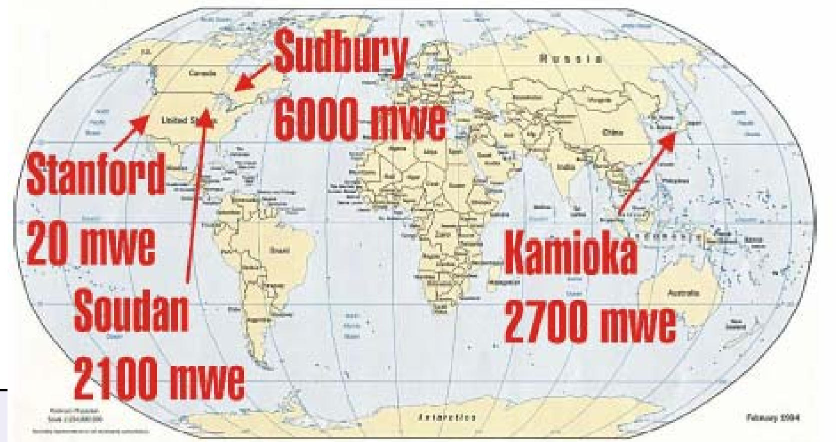
^{73}Ge(n,n'γ) 68.75keV

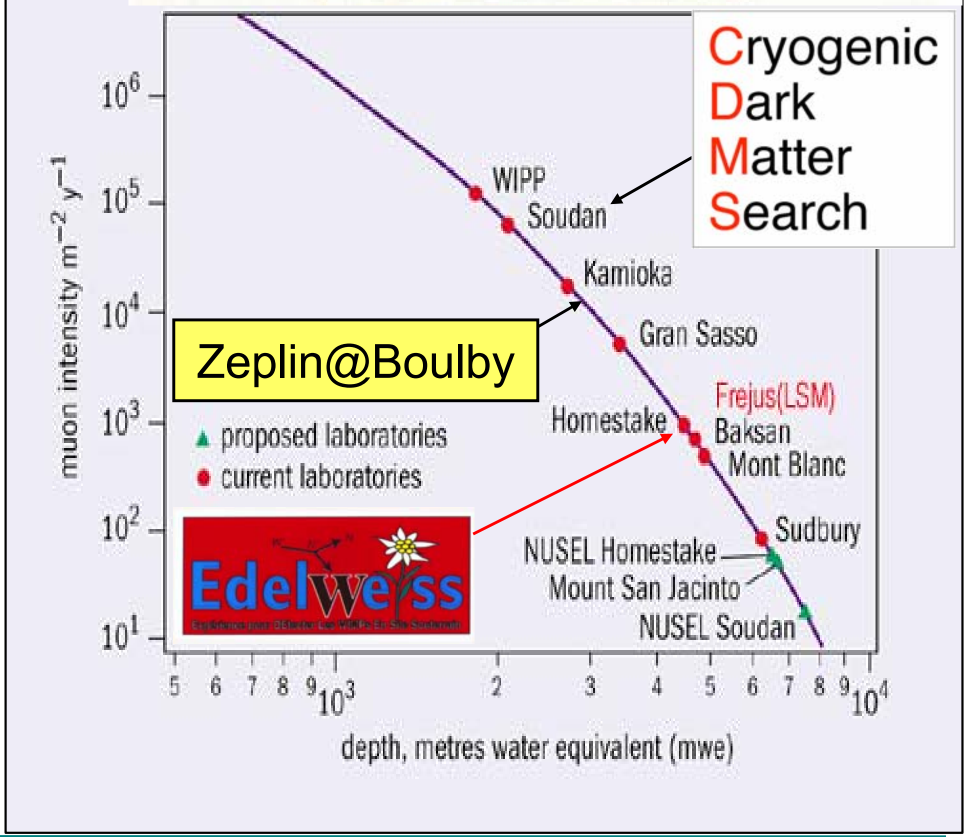
Recoil threshold
20 keV

Ionization threshold
3.7 keV

Underground Sites







the EDELWEISS collaboration

Expérience pour détecter les WIMPs en Site Souterrain

IAP Paris

IPN Lyon

CRTBT Grenoble

CSNSM Orsay

DAPNIA Saclay

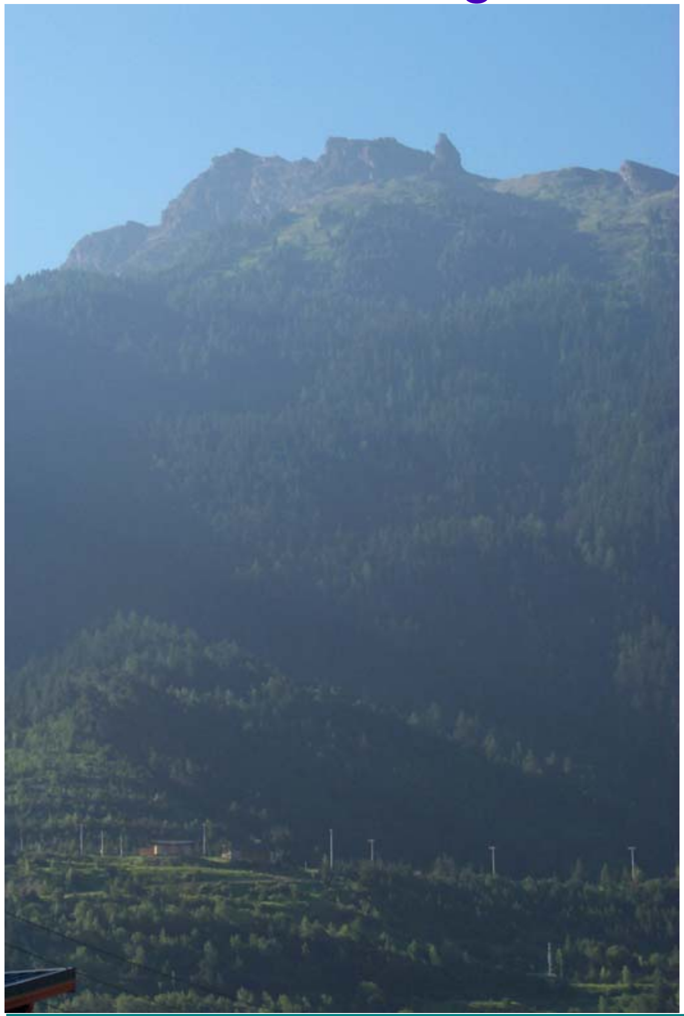
DRECAM Saclay

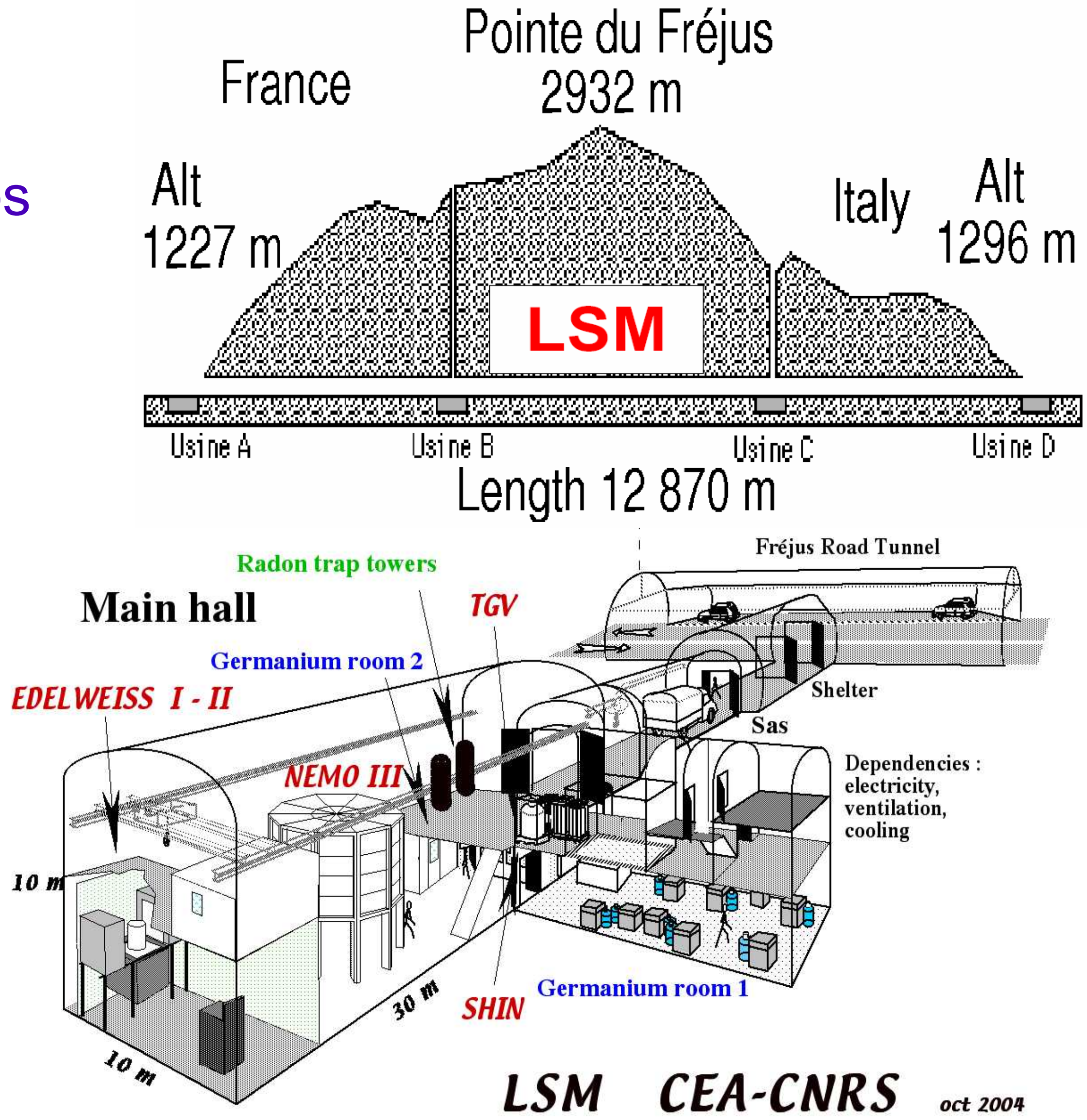
Forschungszentrum and Universität Karlsruhe

JINR Dubna

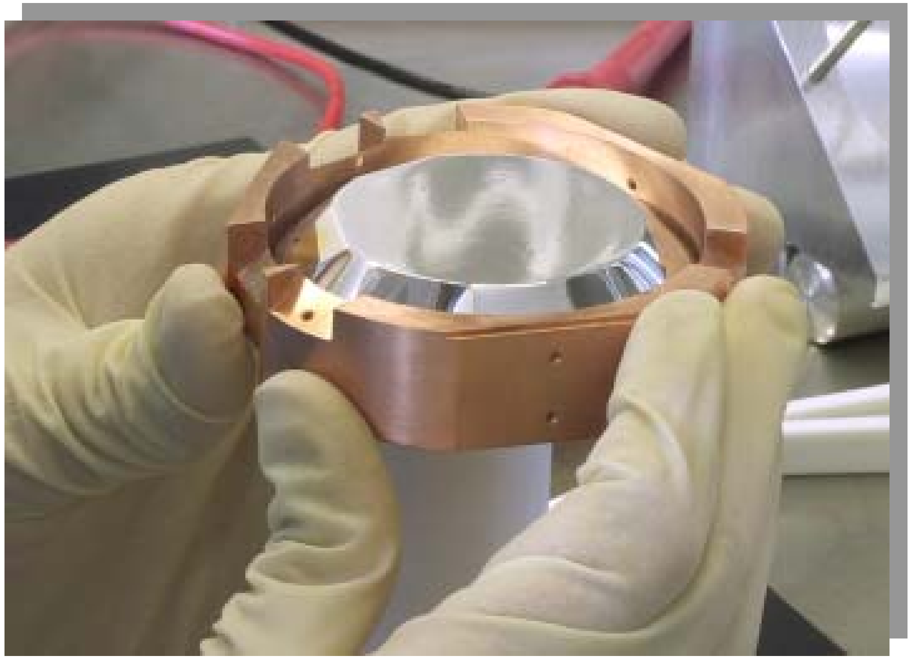
Laboratoire Souterrain de Modane

Part of a European (ILIAS) network of underground labs

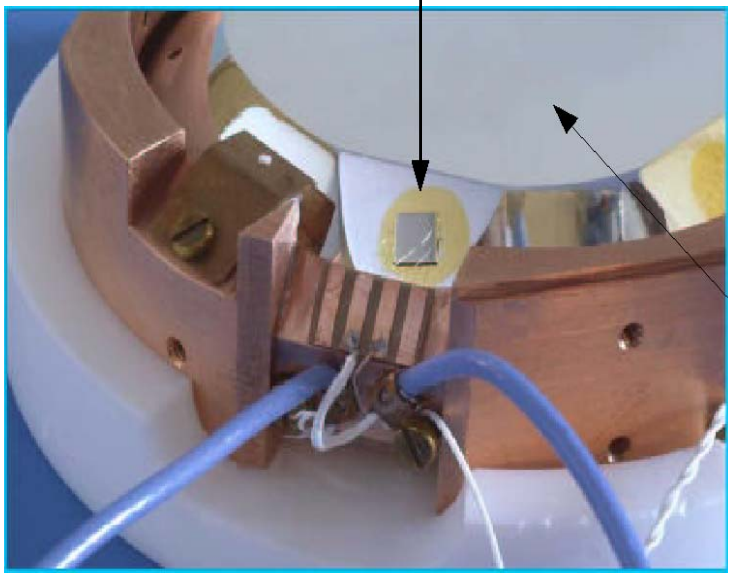




Edelweiss ionization-heat cryogenic detectors



- *heat and ionisation Ge detector*
- ***aluminium electrode (center + gard ring) + Ge amorphous layer***
- *NTD sensor on gard ring electrode*
- *Mass 320 g*



Resolutions	*@ 10 keV*	*@ 122 keV*
• *ionisation :*	*1.3 keV*	*2.2 keV*
• *heat :*	*1.0 keV*	*3.0 keV*

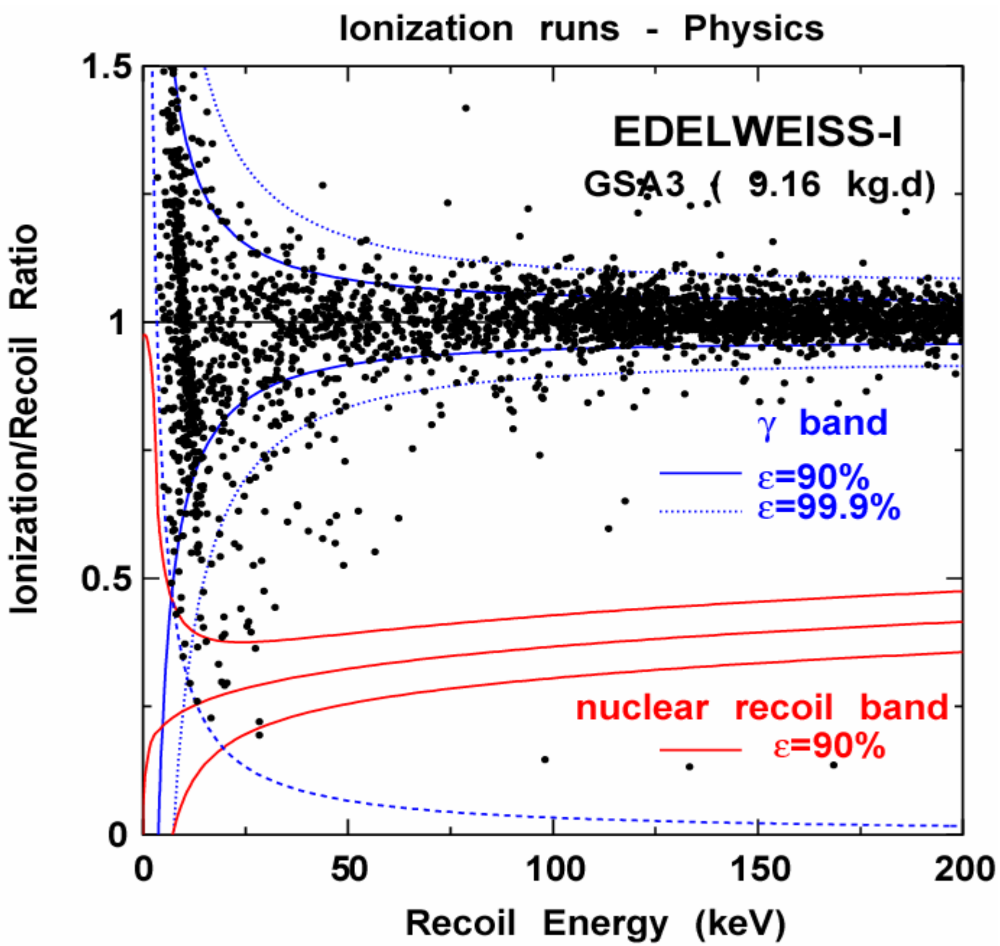
EDELWEISS-1 results

- 3x320 g Ge-NTD detectors
- Two trigger configurations (ionization, phonon)

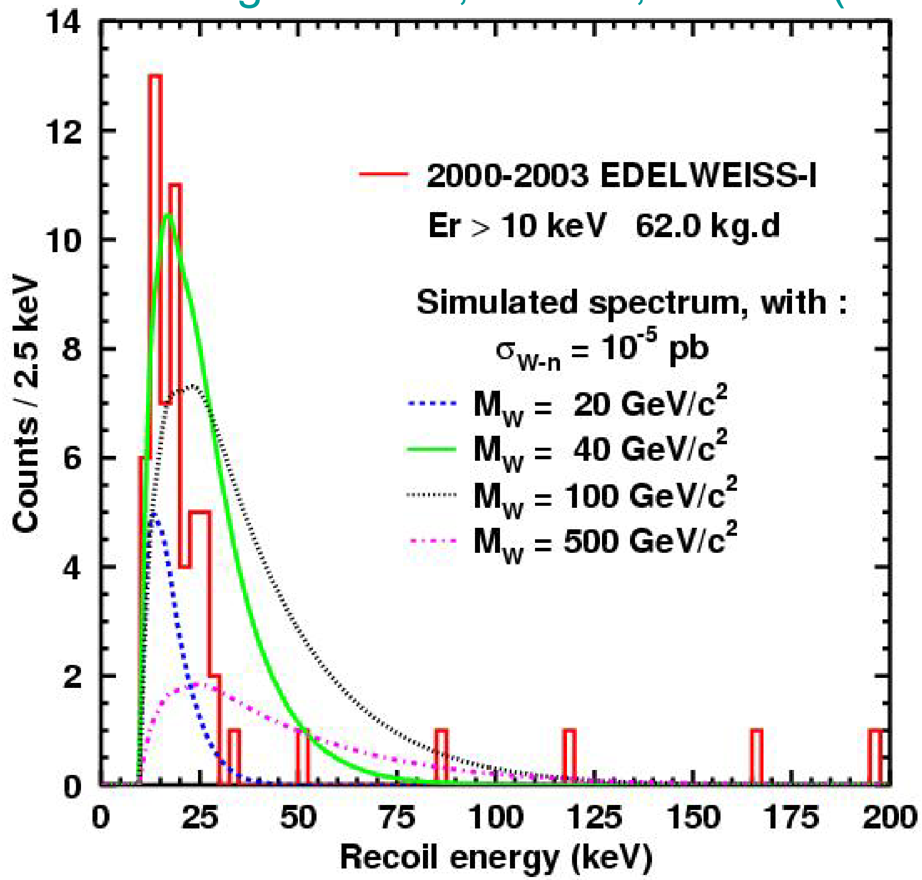
2000-2003:

62 kg.d fiducial exposure

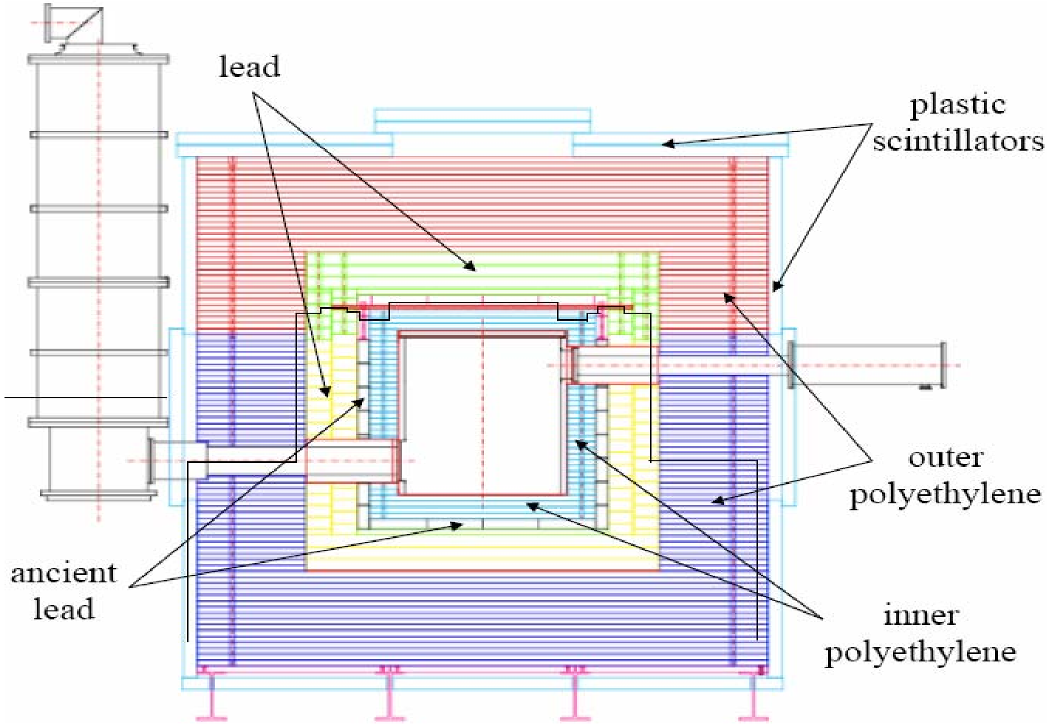
59 events, most at low E

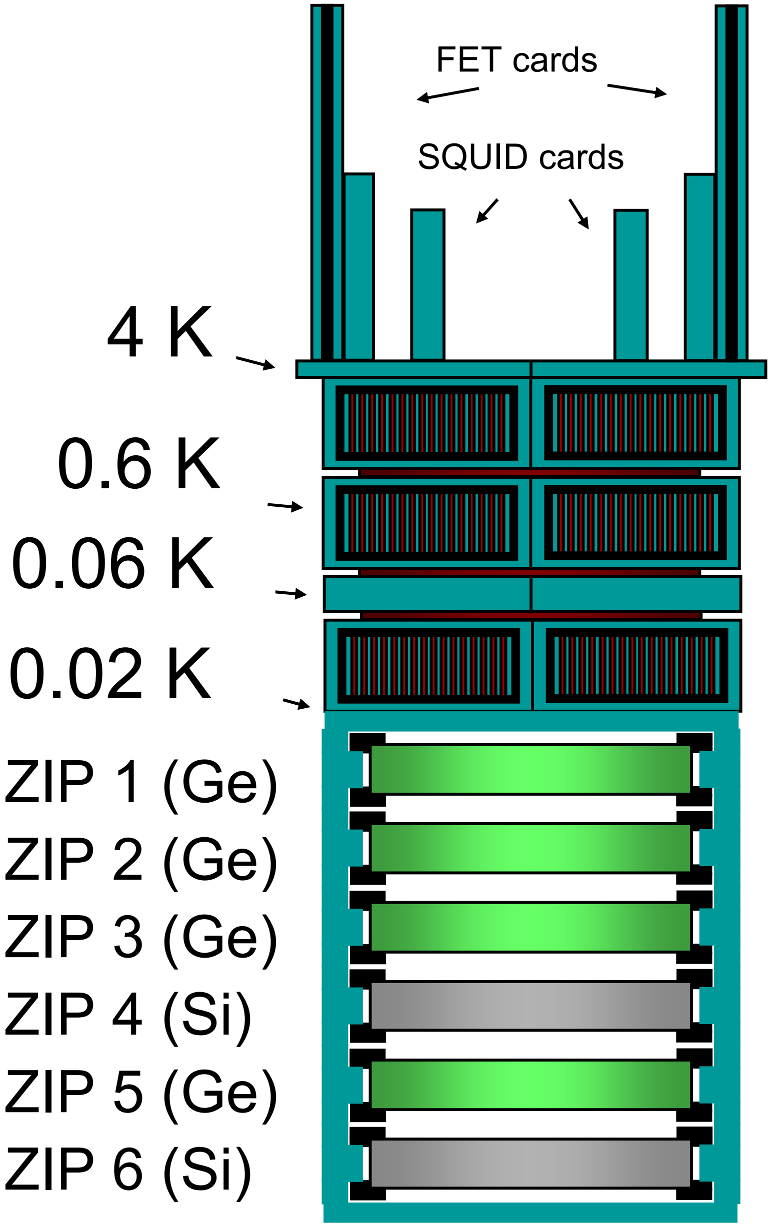


V. Sanglard et al., PRD**71**, 122002 (2005)



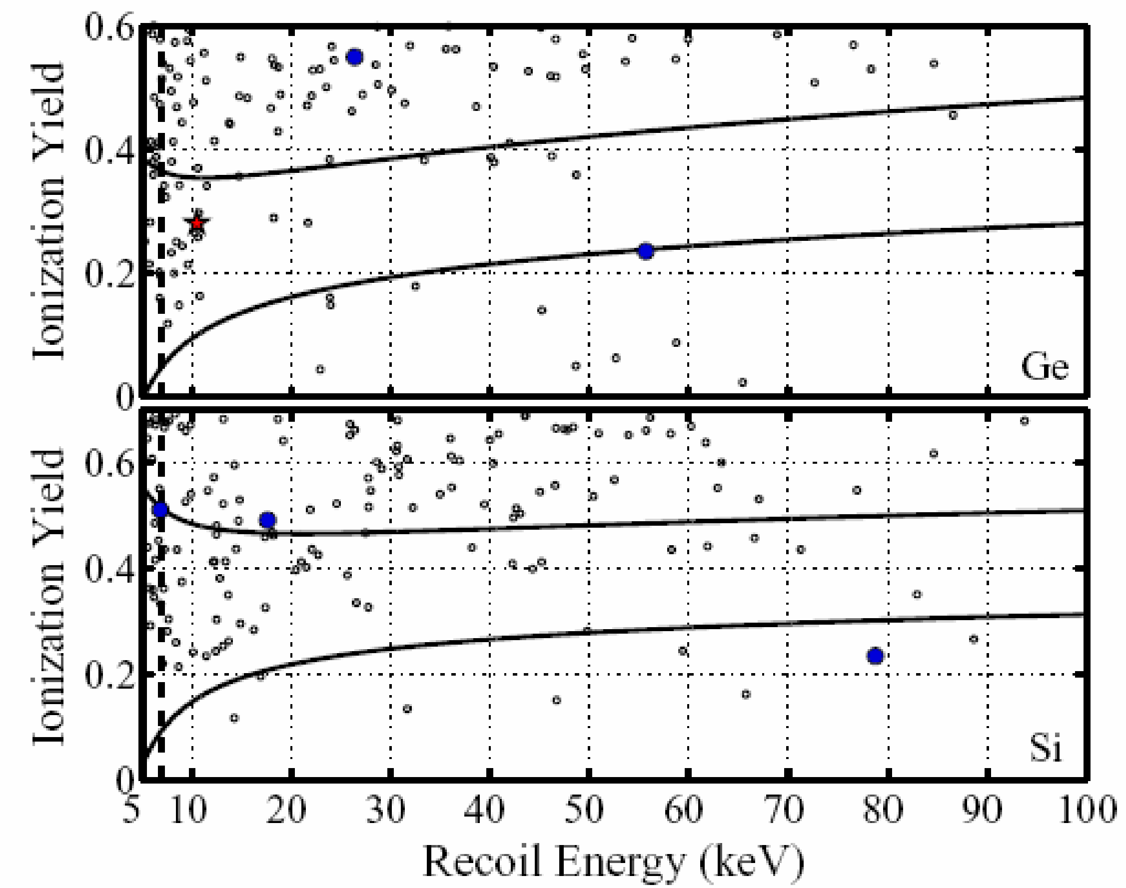
CDMS-2 experiment in Soudan





- Based in Soudan lab (2090 mwe)
- 4x250g Ge + 2x100g Si
- Net exposure: 19.4 kg.d (1 tower)
  astro-ph/0509259: 34 kg.d (2 towers)
- Detector = ZIP
  (sensitive to athermal phonon)
- Active μ veto + shielding (PE + Pb)

CDMS-2 results



data taking:
2 towers for 74.5 live days
(March 25 to August 8, 2005)
→ 34 kg.d of Ge
→ 12 kg.d of Si

before surface e⁻ cuts (○)

after surface e⁻ cuts (●)

1 „WIMP candidate“ (★)
in Ge at 10.5keV
no event in Si

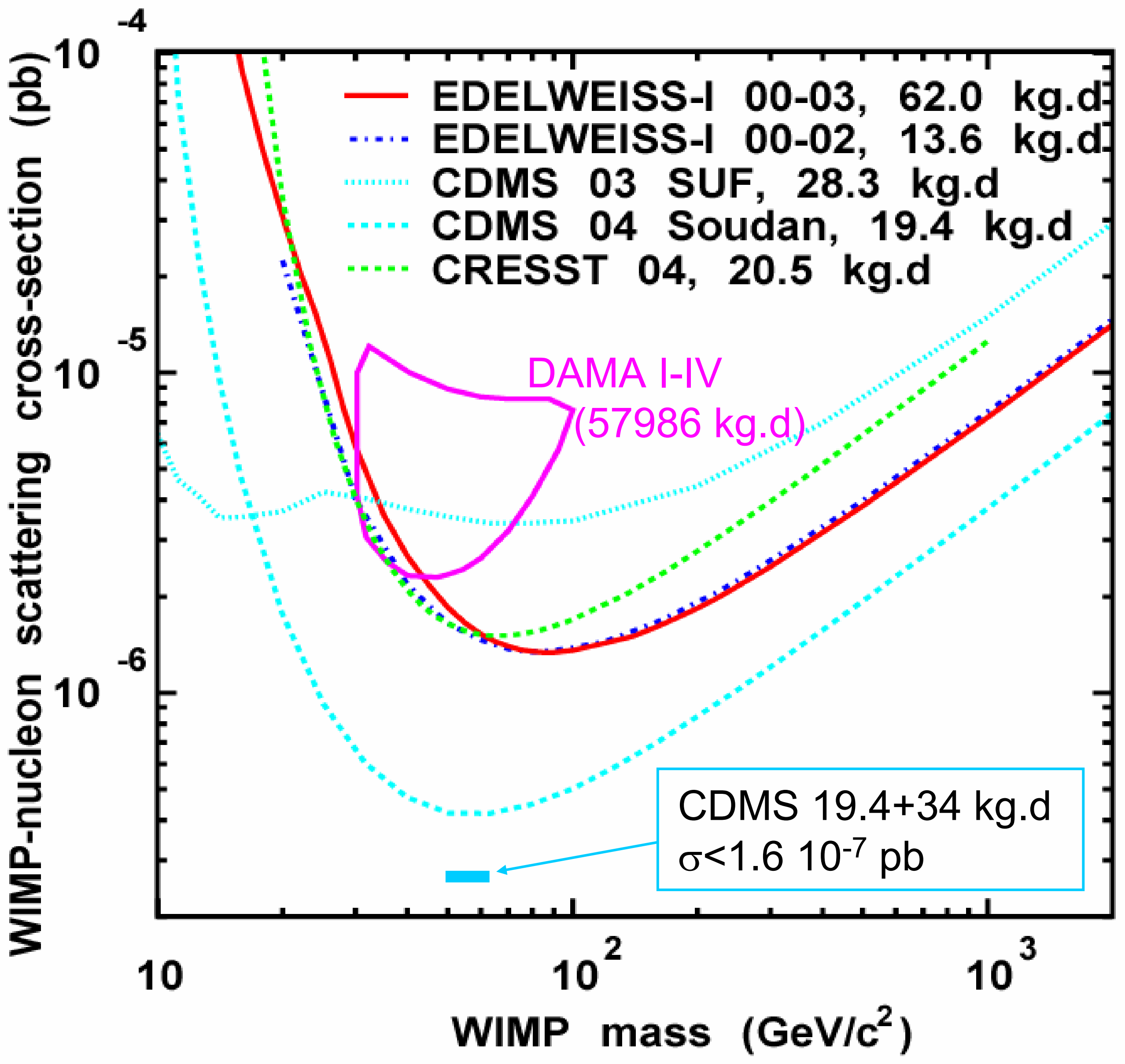
PRL93 (2004) 211301
astro-ph/0507190
astro-ph/0509259

CDMS-2 & EDELWEISS-1 limits

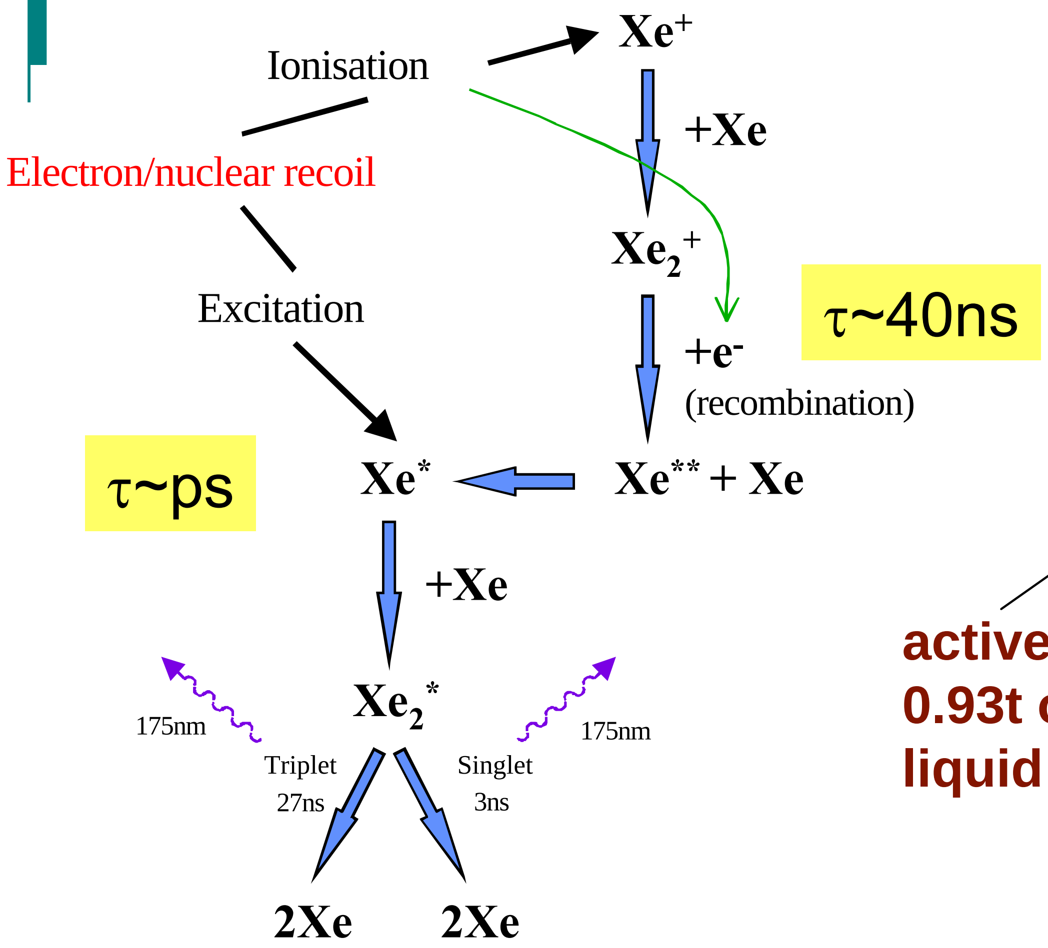
Unknown background:
Yellin method (CDMS´03)
to derive exclusion limit
without bg subtraction

62 kg.d limits consistent
with earlier publication
Phys.Lett. B**545** (2002) 43:
no events observed above
20/30 keV in first 11.7 kg.d

model:
coherent spin-independent
WIMP-nucleon scattering



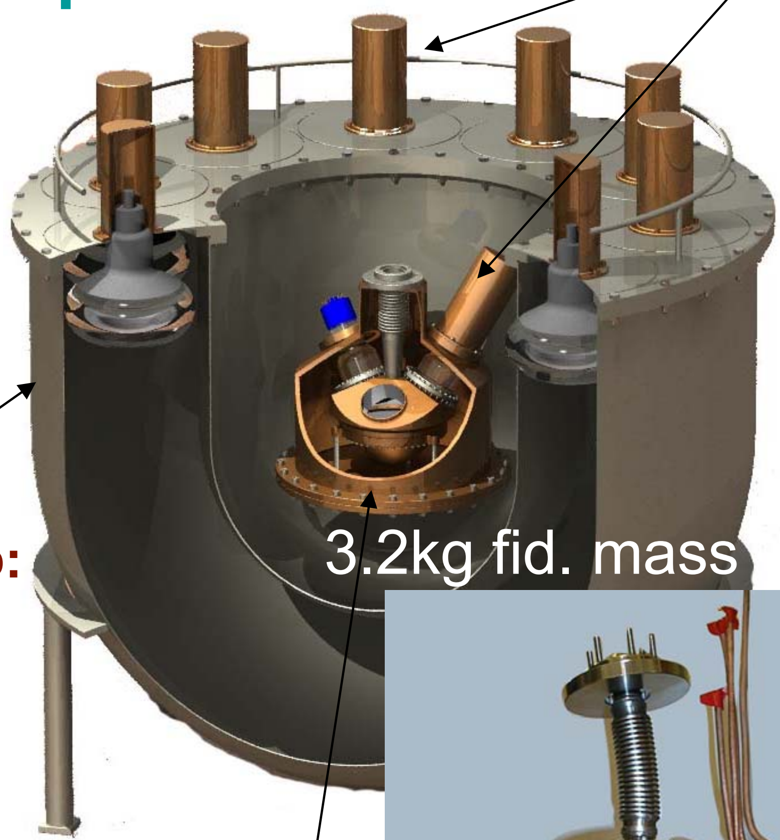
liquid Xenon as WIMP target



$(s/t)_{recoil} > (s/t)_{electron}$

→ nuclear recoil pulses faster than electron recoils → PSD !

Zeplin 1



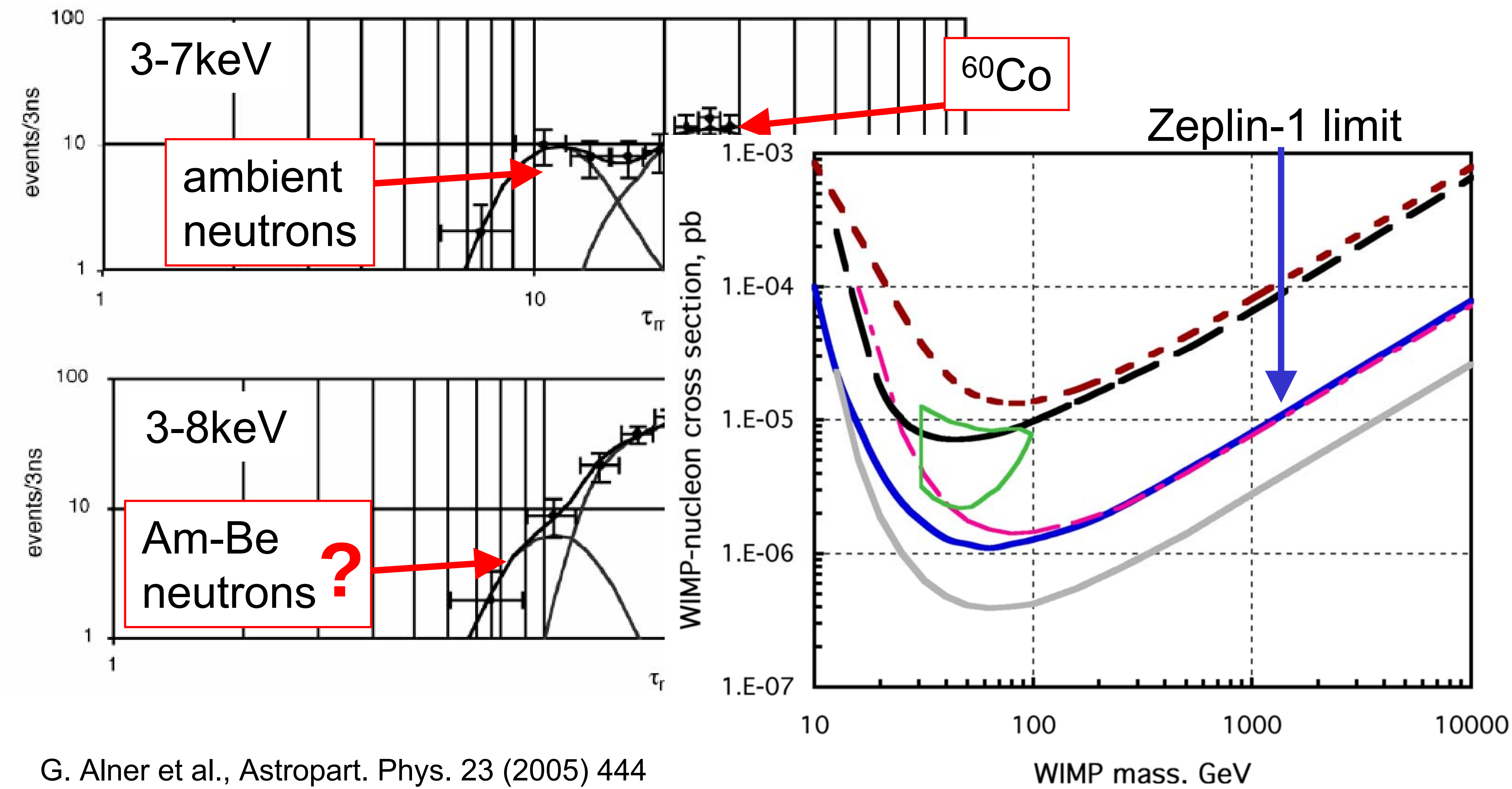
PMTs

active veto: 0.93t of liquid sc.

vacuum and target vessels (copper - low radioactivity)

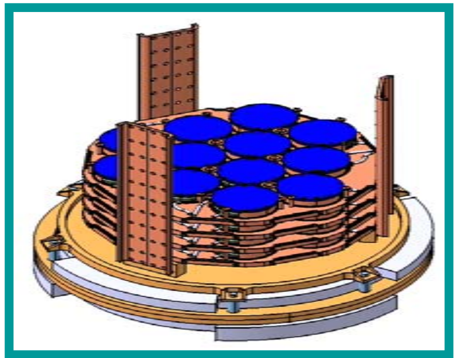
Zeplin-1 data

neutron calibration

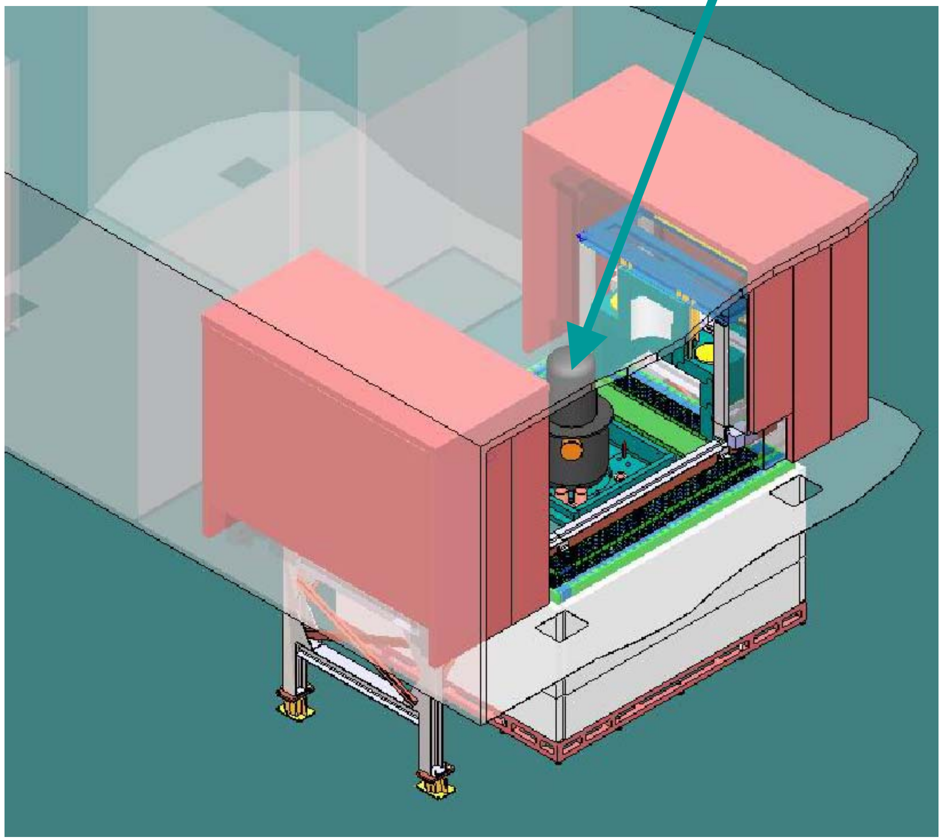


G. Alner et al., Astropart. Phys. 23 (2005) 444

the near future: EDELWEISS-2



- completely new experimental configuration:
- new 100 liter cryostat
- EW-2 first phase: **21×320 g Ge-NTD detectors** and
  7×400 g Ge detectors with NbSi thin film
- EW-2 second phase: up to 110 crystals
- new shielding concept:
  20cm Pb + 50cm PE + active μ veto



time schedule:

- mounting started in 2005
- first cryogenic tests in Nov./Dec. 05
- first data taking in Jan. 06

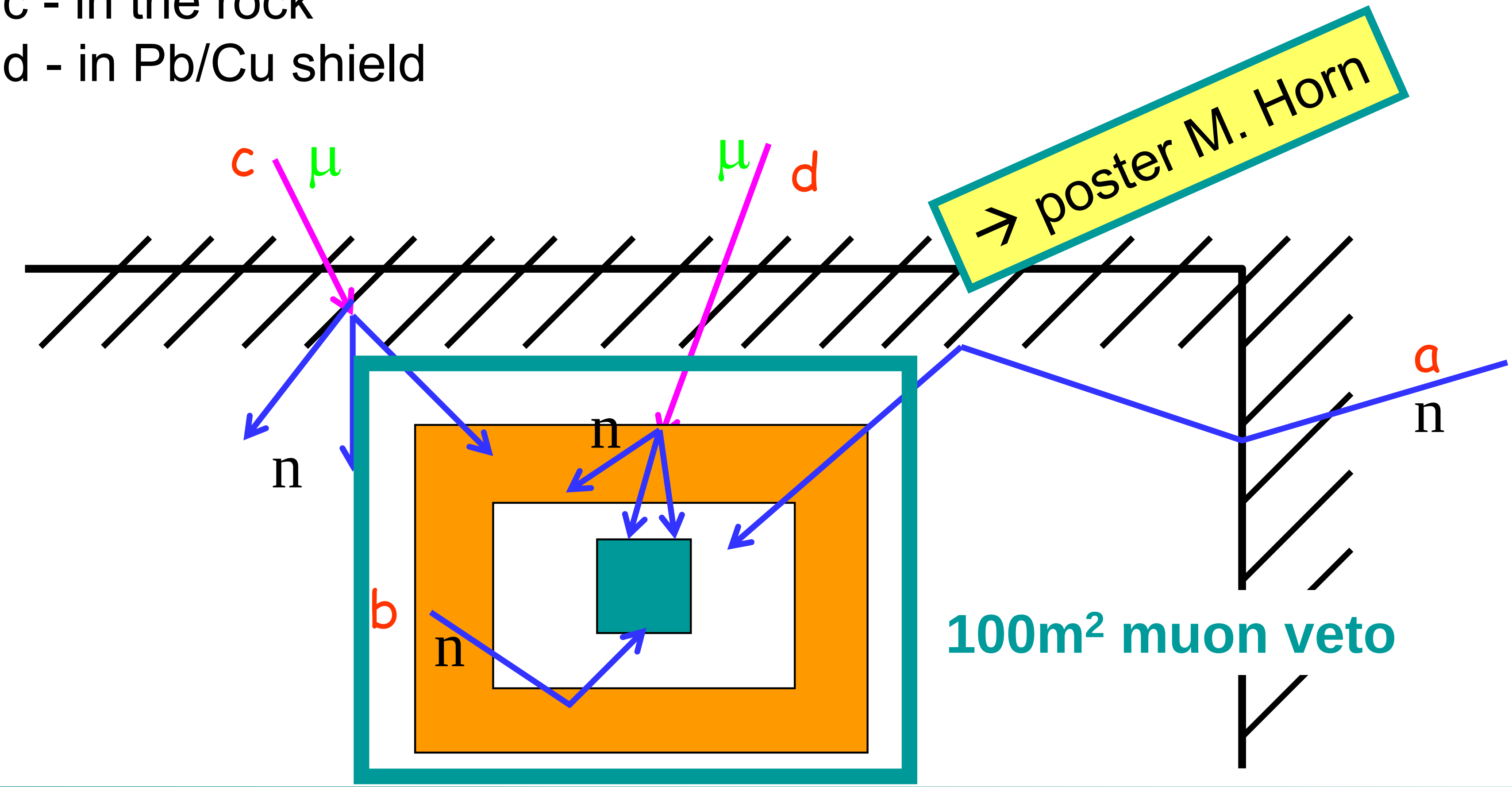
neutron background suppression by muon veto

Low energy neutrons induced by U/Th activities :

- a - in surrounding rock/concrete (fission and (α,n) reactions)
- b - in Pb/Cu Shield (fission reactions)

High energy neutrons induced by muons :

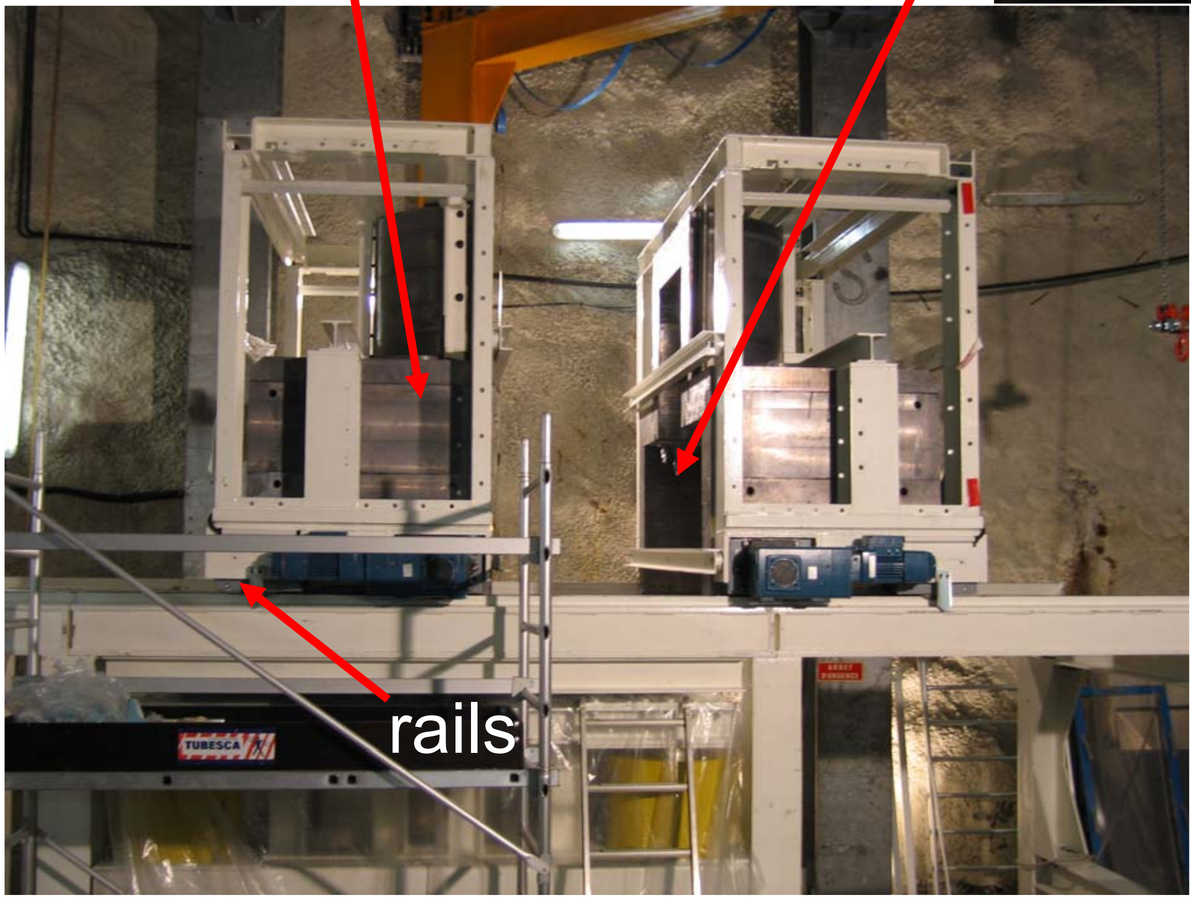
- c - in the rock
- d - in Pb/Cu shield



EDELWEISS-2 installation in LSM

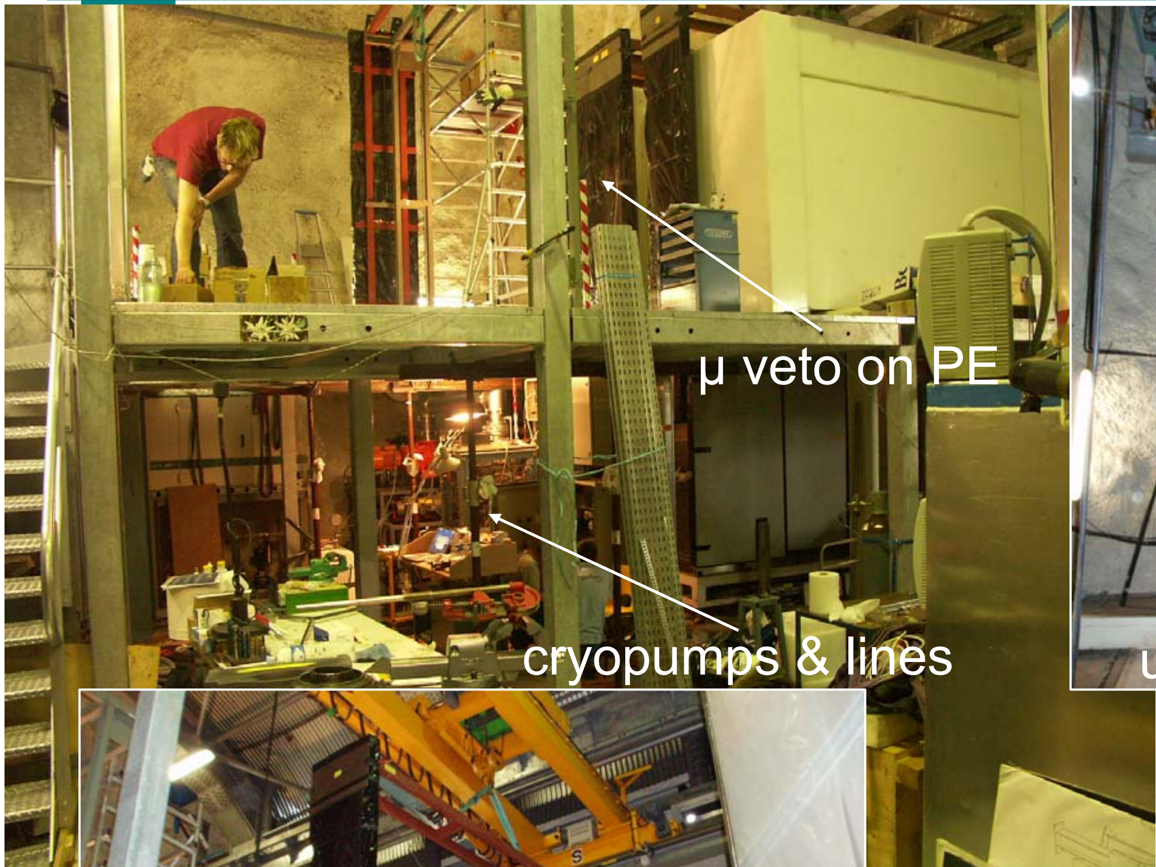
insert cryostat here

mobile 20 cm Pb γ shielding (30t, archaeological Pb lining)



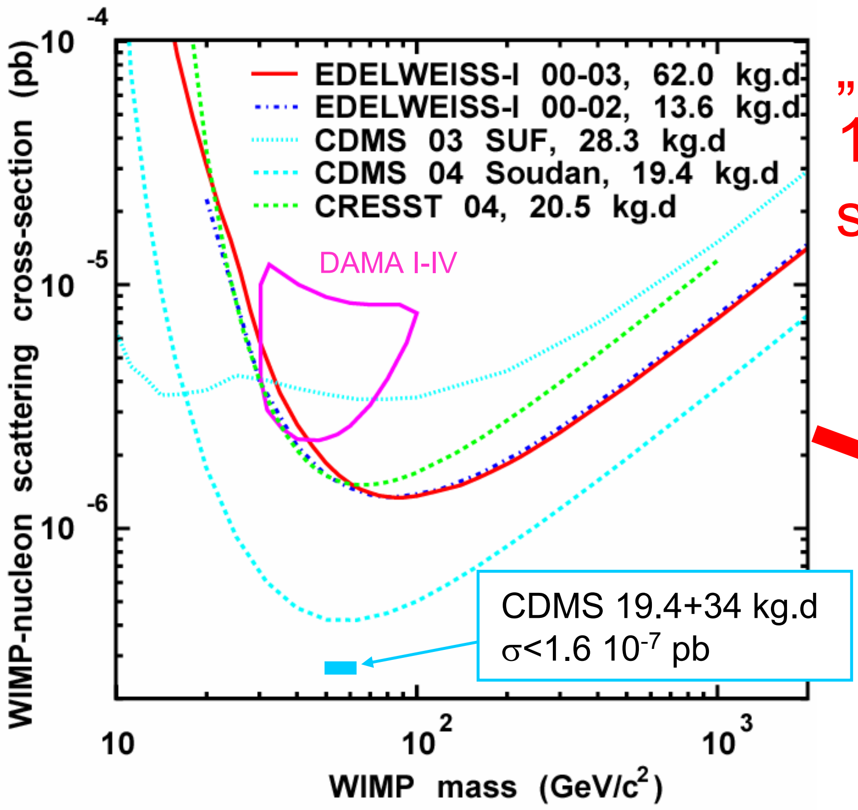
50 cm (30t) PE as neutron moderator

EDELWEISS-2 installation in LSM

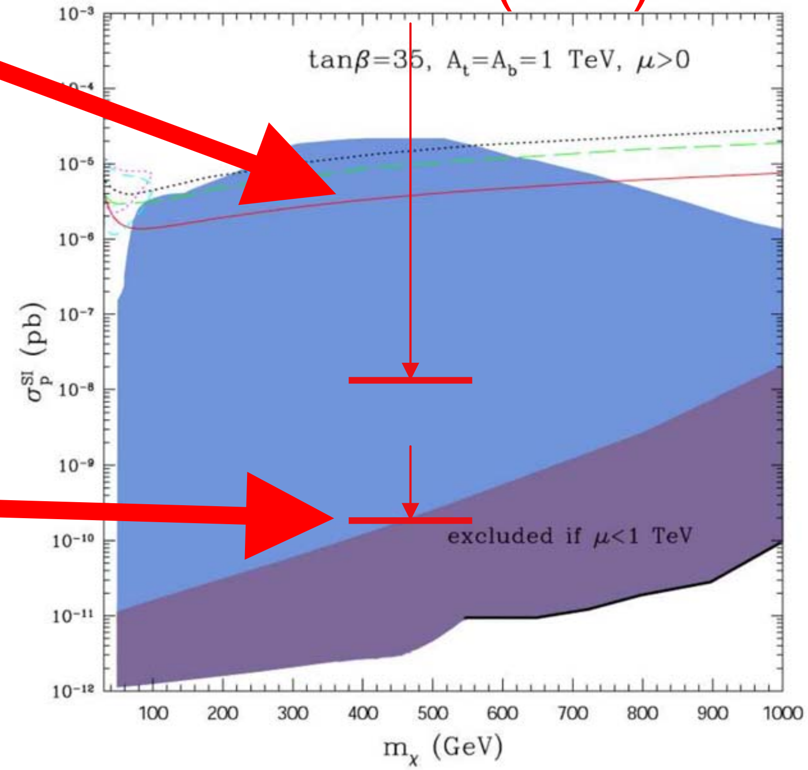


installation of the μ veto system

Conclusion and Outlook



„10kg-Phase":
100 times more statistics than EW-1
shielding against neutrons
=> from materials (Pb)
=> from rock (Pb+PE)
=> from DIS muons (veto)



„1t-Phase":
- VIDMAN
- ILIAS N3
- EURECA