Untergrundstudien für das Xenon1t-Projekt

Marijke Haffke

Universität Zürich

Gliederung

I. Einleitung
   - XENON
   - LVD

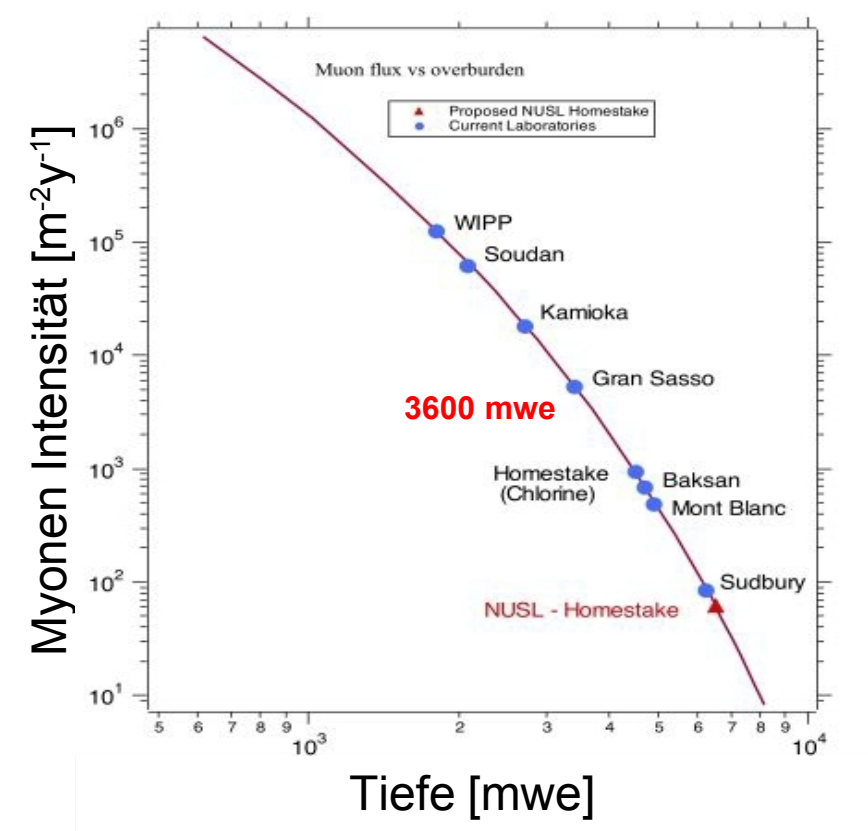
II. Gamma Messungen

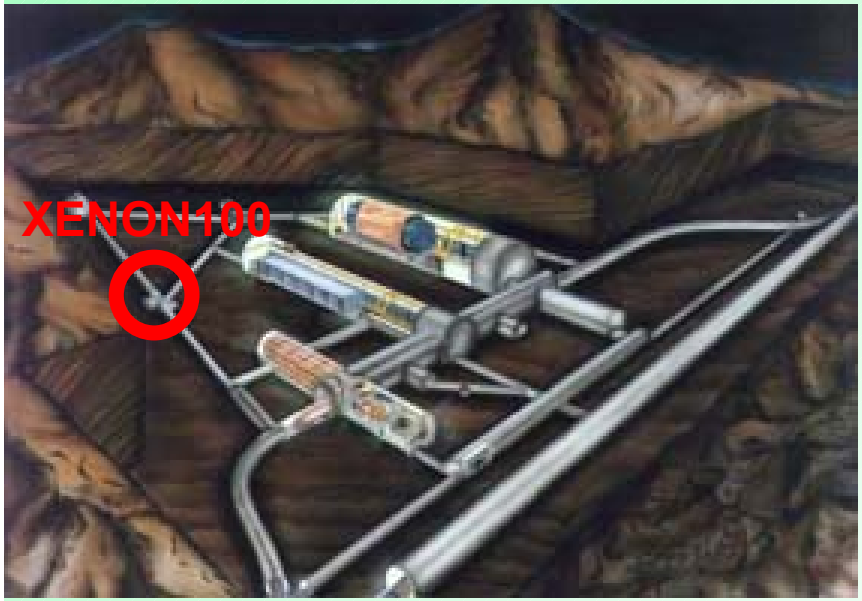
III. Untergrund Simulationen für Xenon1t

IV. Zusammenfassung

I. Einleitung
Xenon

- Dualphase Detektor mit flüssigem XENON
- Im Gran Sasso Untergrund Labor, Italien

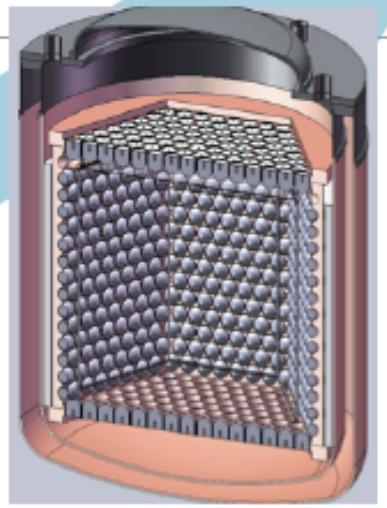




The XENON Program

???

XENON1t

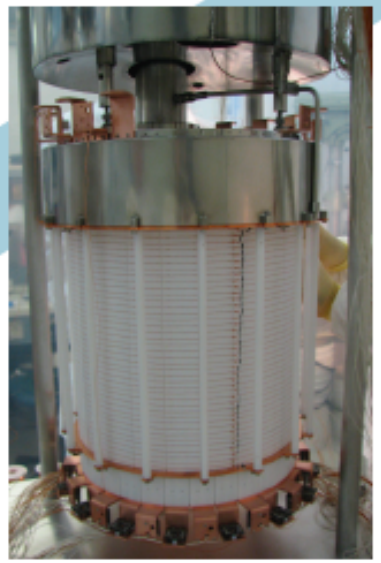


2009-2013
studies in progress

Columbia Zurich Coimbra

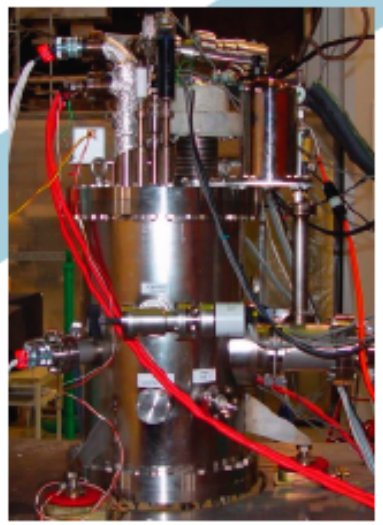
Rice LNGS UCLA

XENON100



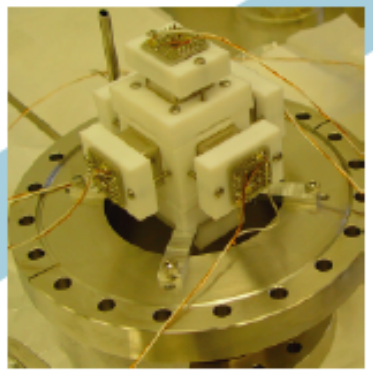
in commissioning

XENON10



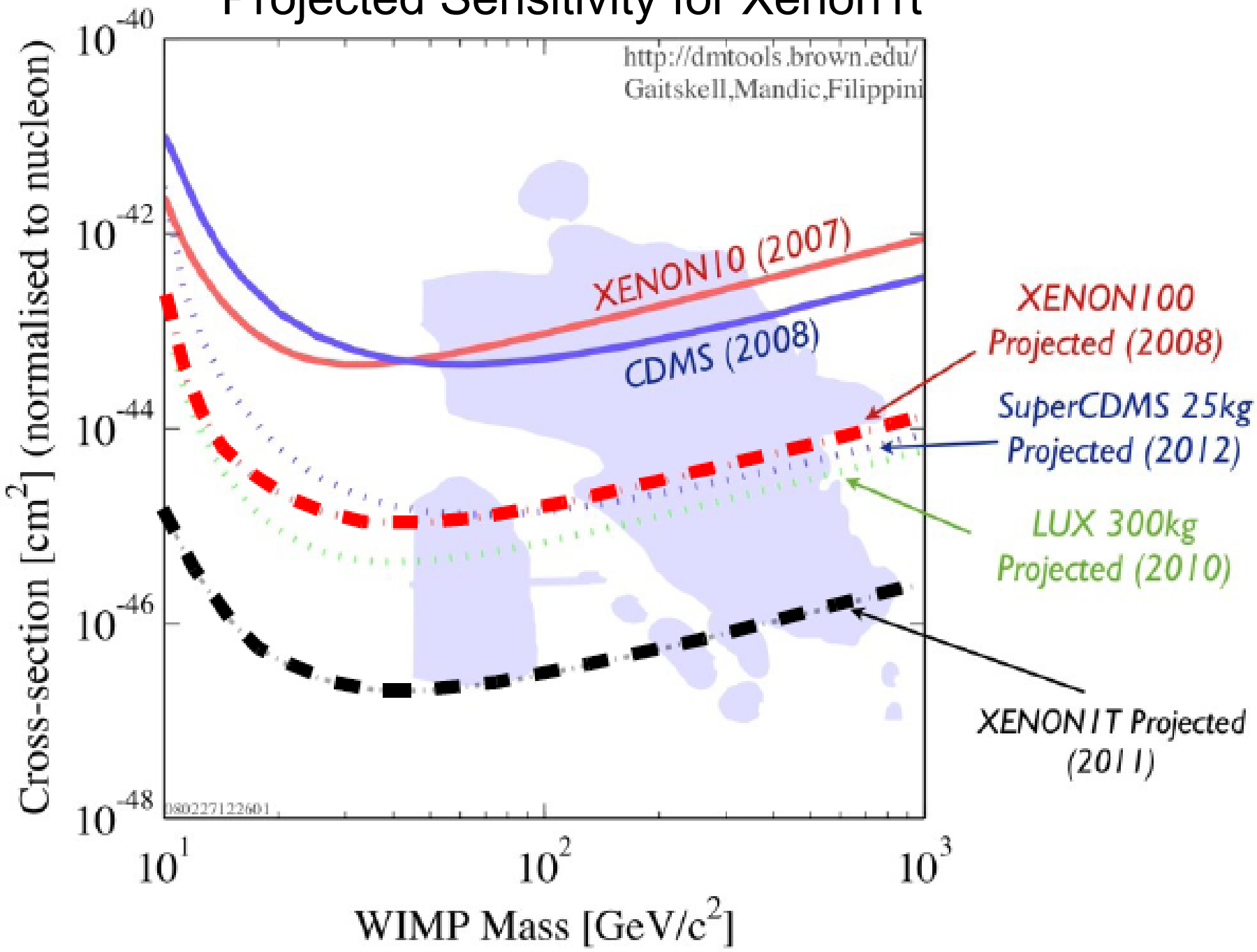
2006-2007

XENON R&D



ongoing

Projected Sensitivity for Xenon1t



I. Einleitung
Xenon1t

- Sensitive Masse: 1t
- Gesamtmasse flüssiges Xenon: 3t

- Ziele

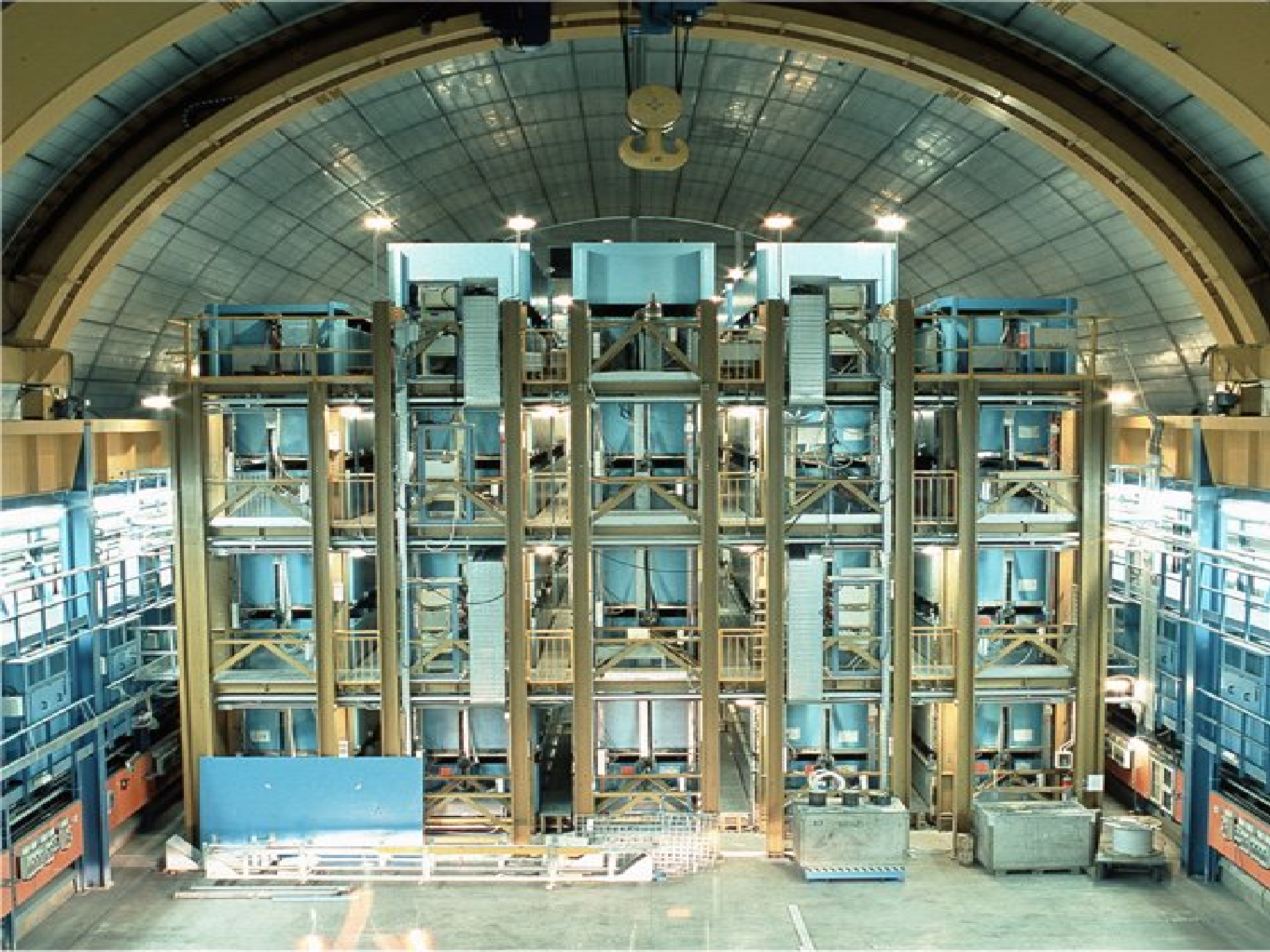
Experiment	XENON10	XENON100	XENON1t
effektive Masse [kg]	5	50	1000
Gamma-Untergrund [events/kg/keV/Tag]	1	10^{-2}	$< 10^{-4}$
Neutron Untergrund [pro Jahr]	< 1	< 1	< 0.5
WIMP-Sensitivität bei 100 GeV [cm^2]	$0.9{\cdot}10^{-43}$	$2{\cdot}10^{-45}$	$3{\cdot}10^{-47}$

Mögliche Positionierung:

- Im Large Volume Detektor (LVD) im Gran Sasso Labor

I. Einleitung
LVD

- Large Volume Detector
- Halle A im Gran Sasso Labor
- Ziele: Detektion von Supernova-Neutrinos
- 49 m lang
  13 m hoch
  12 m breit



Gliederung

I. Einleitung
- XENON
- LVD

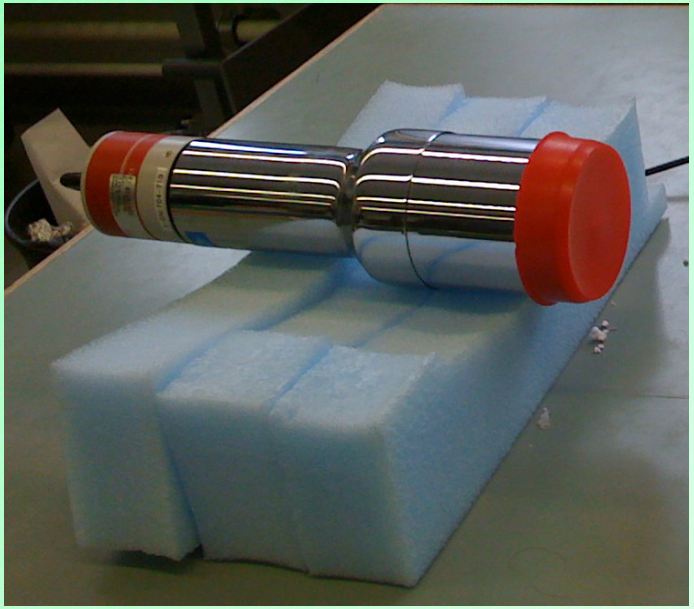
II. Gamma Messungen
- Gammaflüsse
- Aktivität LVD

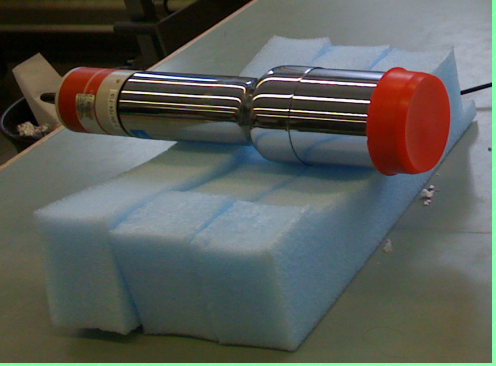
III. Untergrund Simulationen für Xenon1t

IV. Zusammenfassung

I. Gamma Messungen
Flüsse

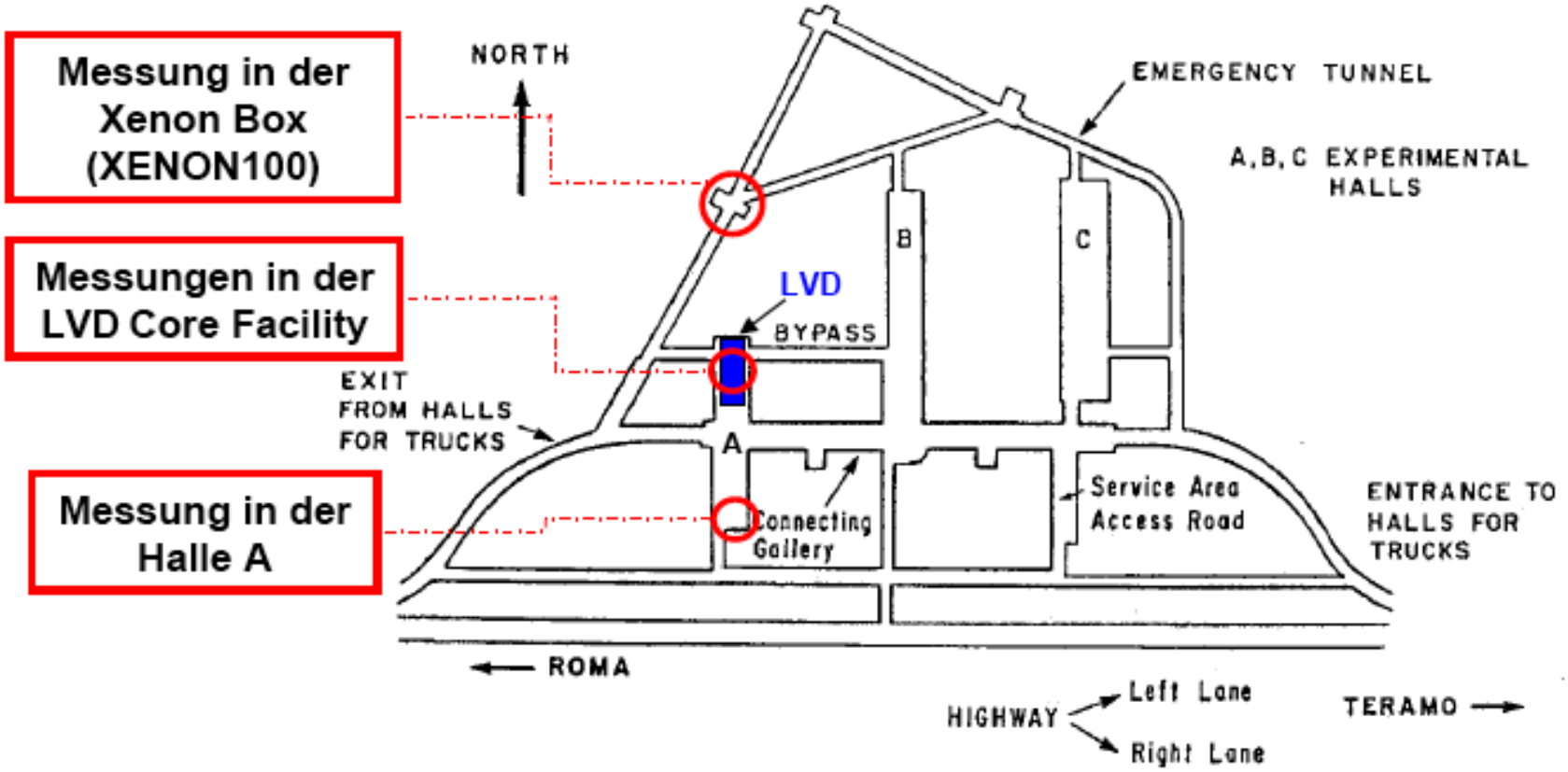
- Messungen des Gammaflusses mit NaI-Detektor

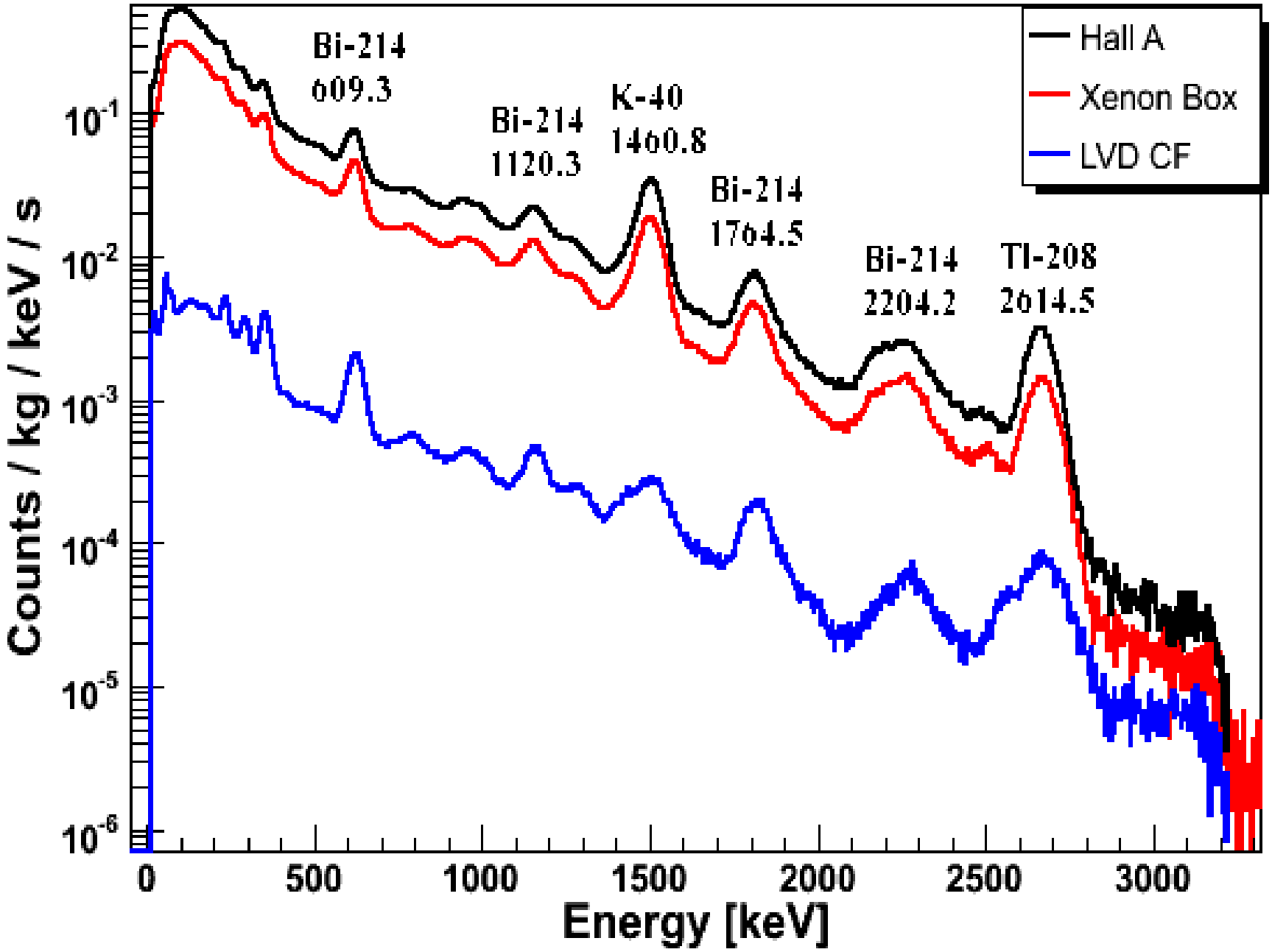


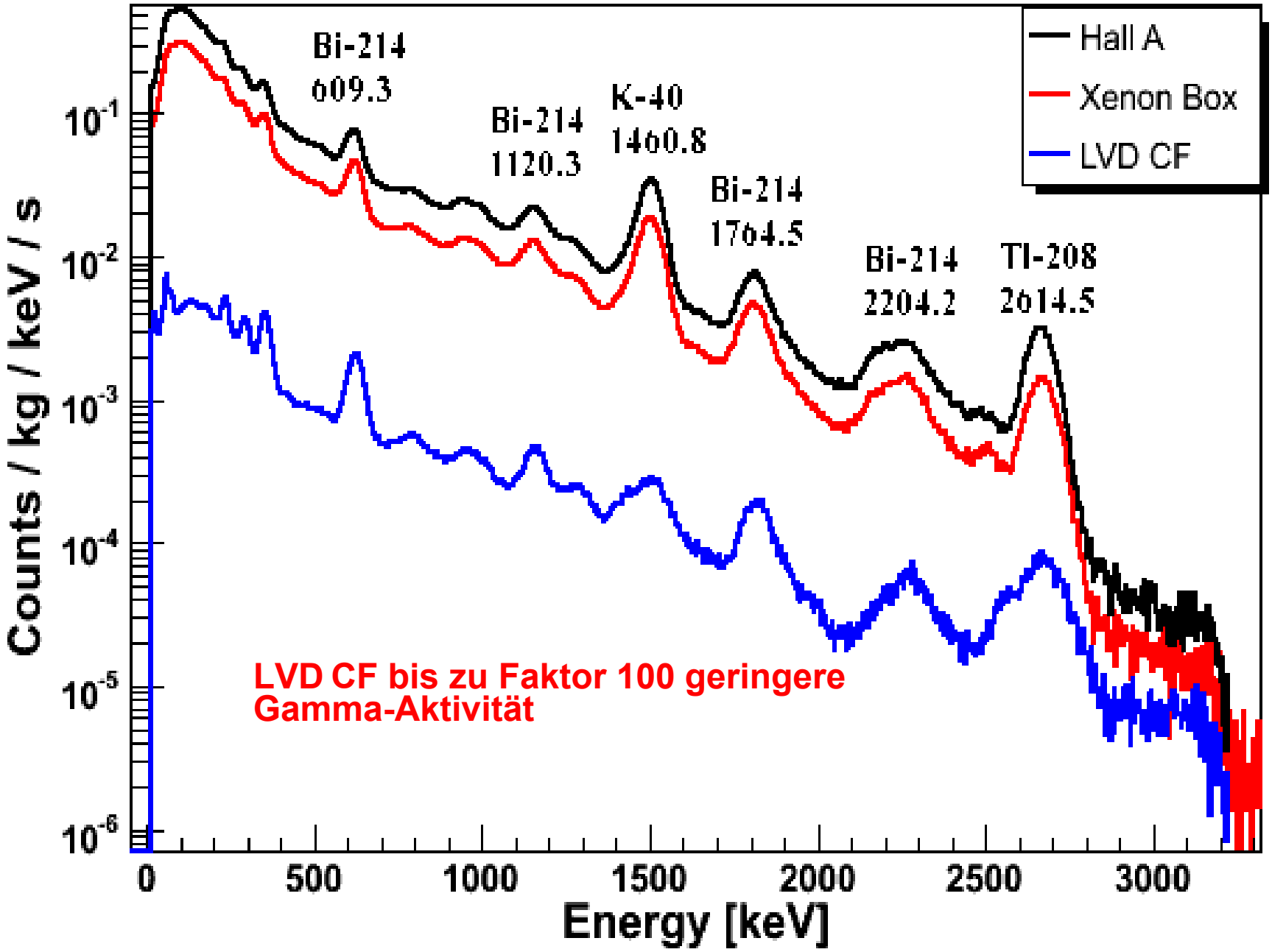


I. Gamma Messungen
Flüsse

- Messungen des Gammaflusses mit NaI



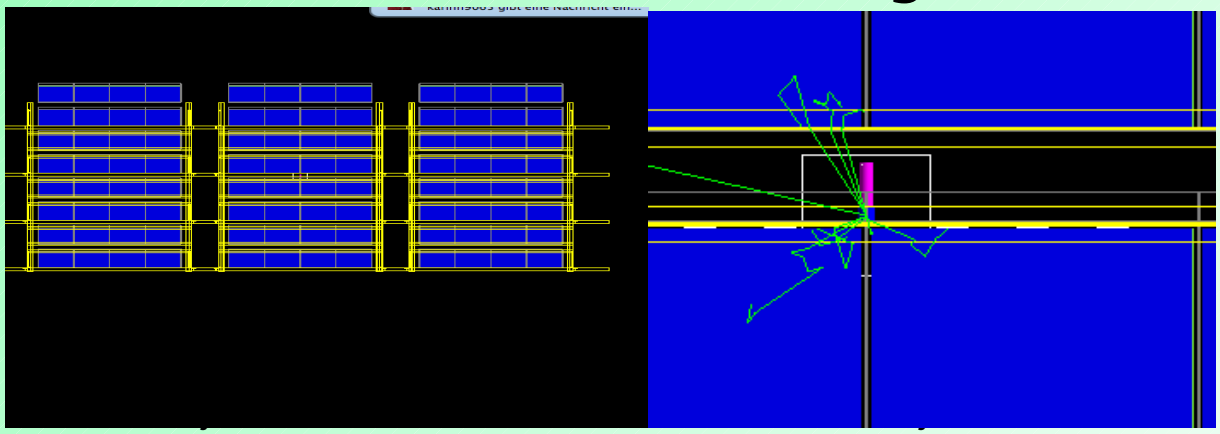

Hall A
Xenon Box
LVD CF
Bi-214
609.3
Bi-214
1120.3
K-40
1460.8
Bi-214
1764.5
Bi-214
2204.2
Tl-208
2614.5
Counts / kg / keV / s
Energy [keV]
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
0
500
1000
1500
2000
2500
3000


Hall A
Xenon Box
LVD CF
Bi-214
609.3
Bi-214
1120.3
K-40
1460.8
Bi-214
1764.5
Bi-214
2204.2
Tl-208
2614.5
LVD CF bis zu Faktor 100 geringere
Gamma-Aktivität
Counts / kg / keV / s
Energy [keV]
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
0
500
1000
1500
2000
2500
3000

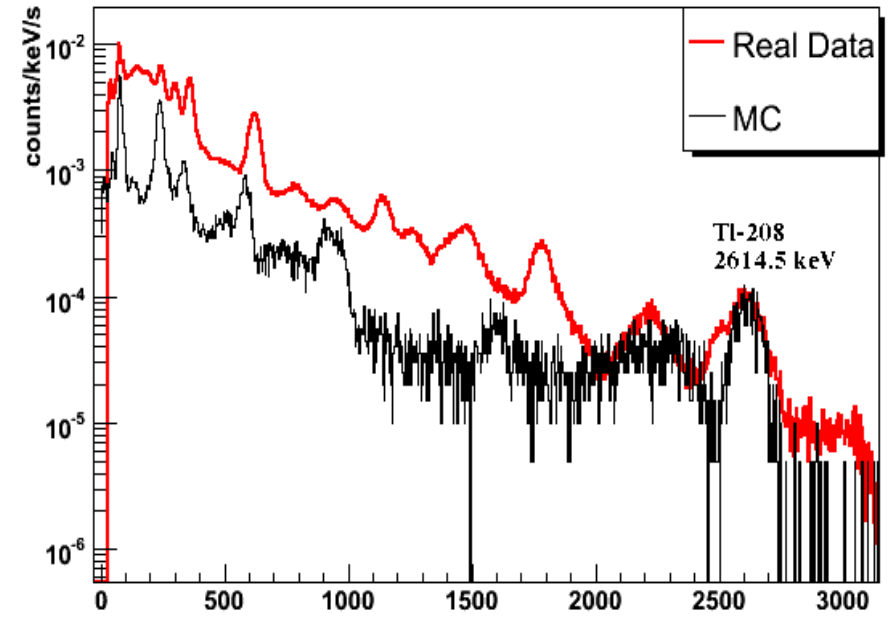
II. Gamma Messungen
Aktivität LVD

- Für MC – Simulationen => Bestimmung der Radioaktivität in der LVD CF

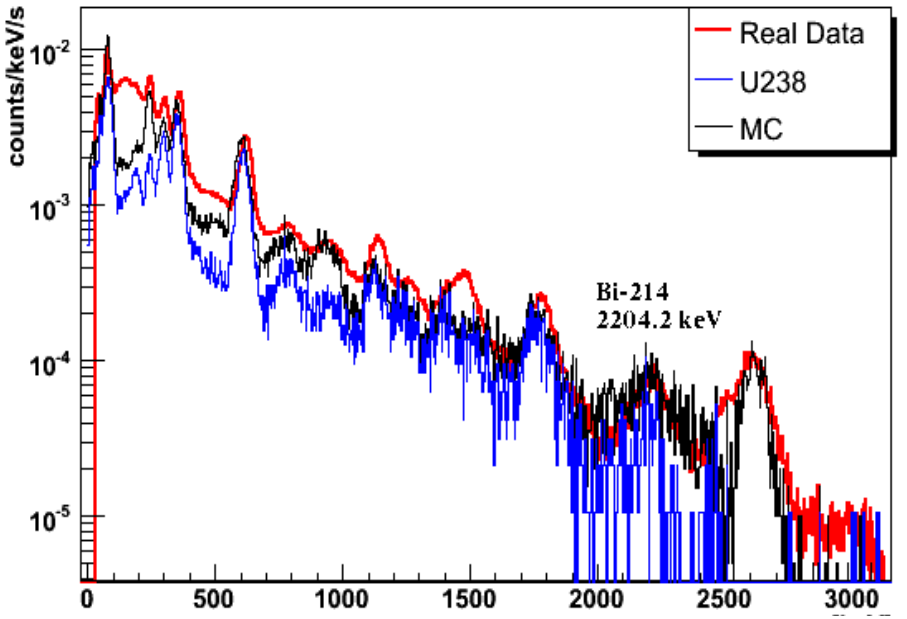
- Monte-Carlo Methode:
  - NaI Detektor im LVD simulieren
  - Spektren mit echten Daten vergleichen



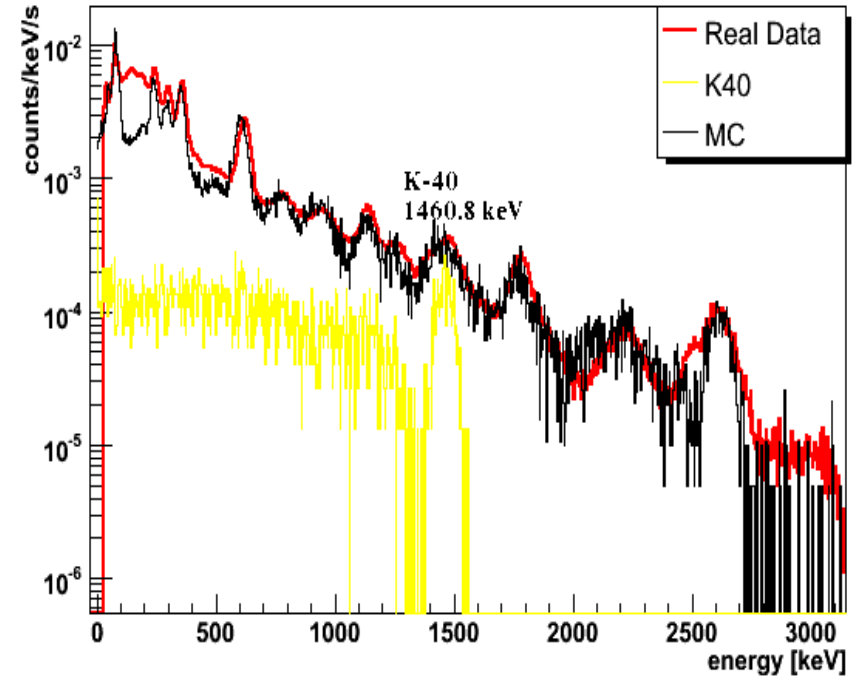
Spectrum of LVD CF



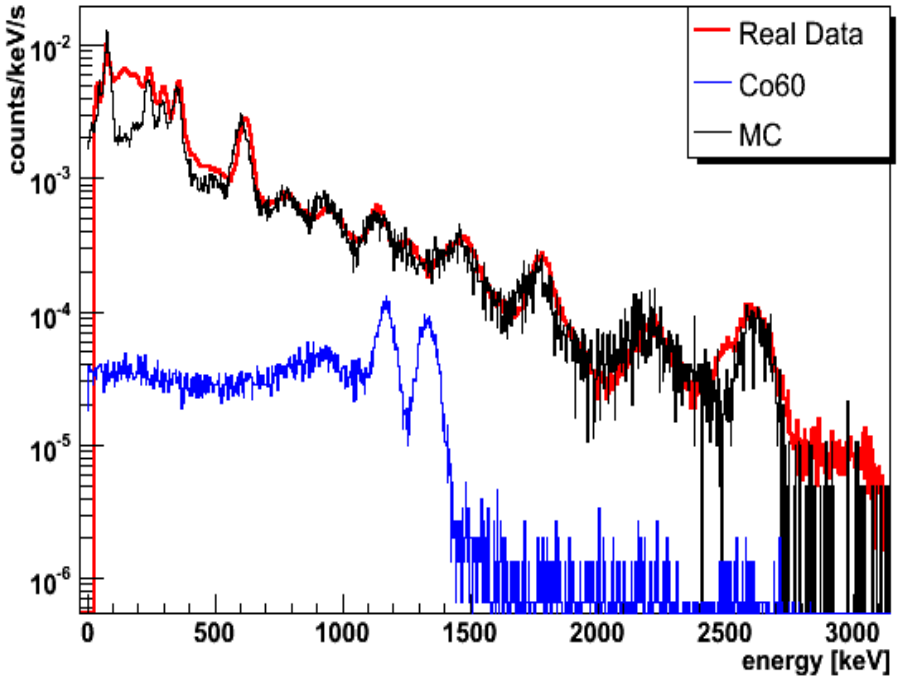
Spectrum of LVD CF

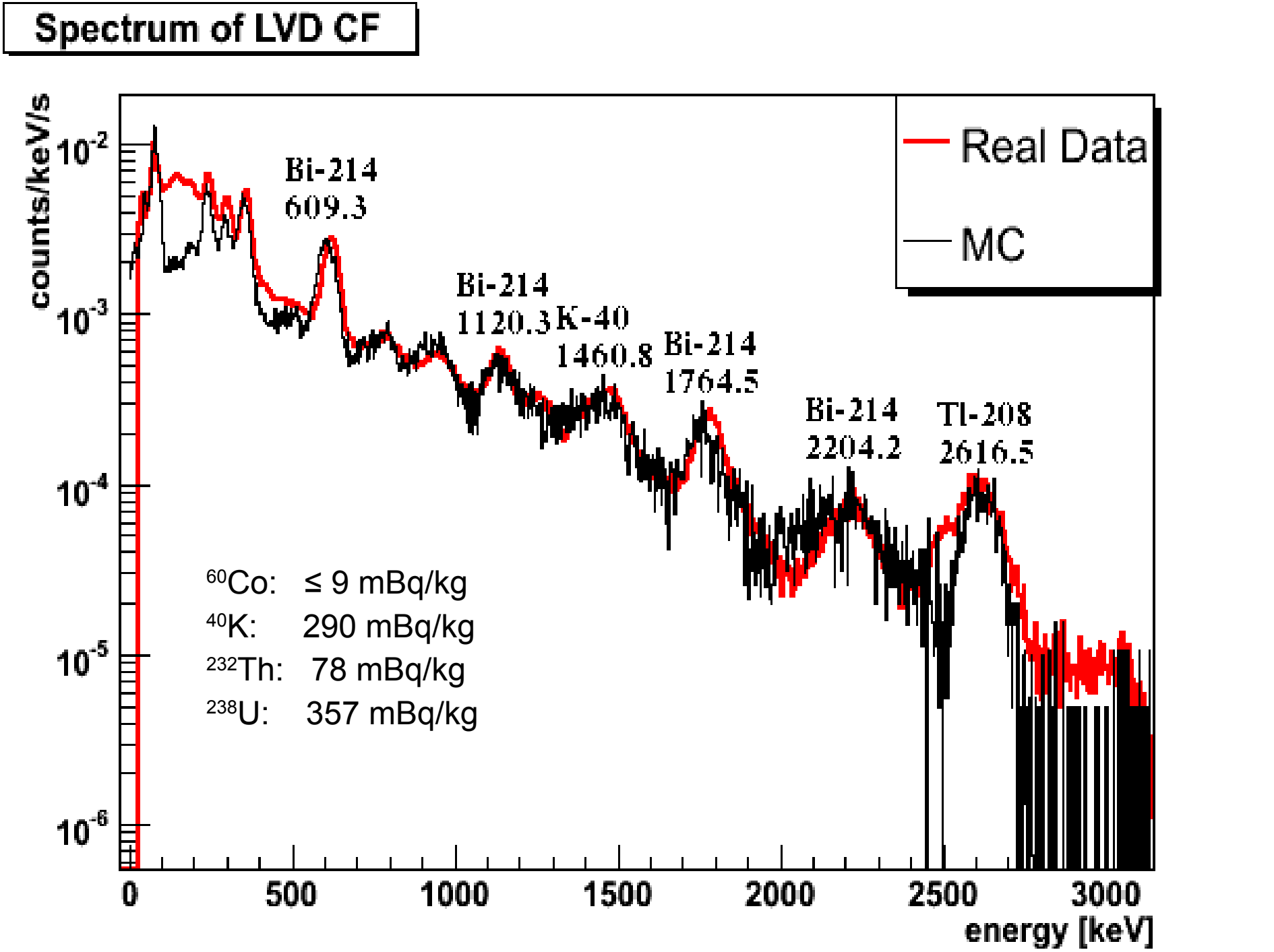


Spectrum of LVD CF



Spectrum of LVD CF




Spectrum of LVD CF
counts/keV/s
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
Real Data
MC
Bi-214
609.3
Bi-214
1120.3
K-40
1460.8
Bi-214
1764.5
Bi-214
2204.2
Tl-208
2616.5
^{60}Co: ≤ 9 mBq/kg
^{40}K: 290 mBq/kg
^{232}Th: 78 mBq/kg
^{238}U: 357 mBq/kg
0
500
1000
1500
2000
2500
3000
energy [keV]

Gliederung

I. Einleitung
- XENON
- LVD

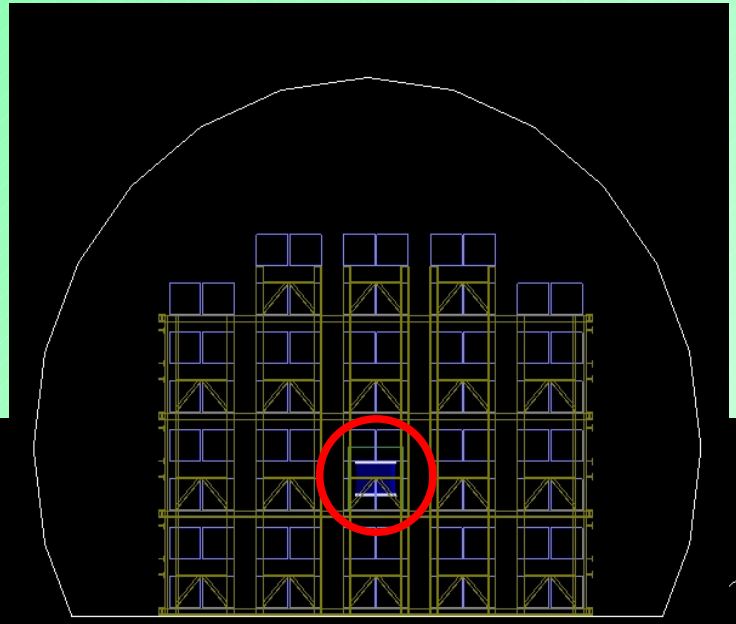
II. Gamma Messungen
- Gammaflüsse
- Aktivität LVD

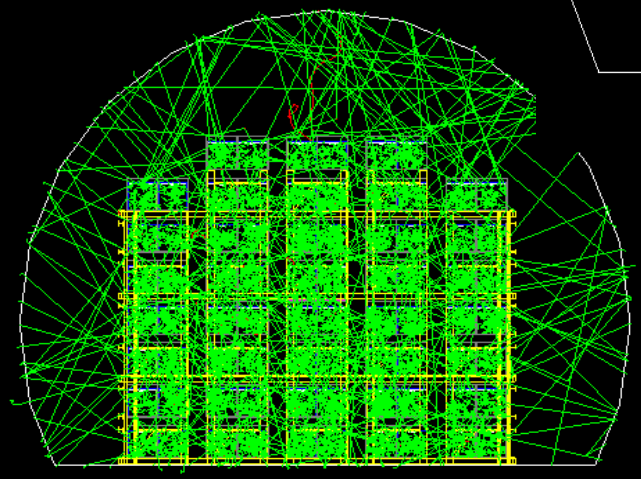
III. Untergrund Simulationen für Xenon1t
- Geometry
- Gamma-Simulationen

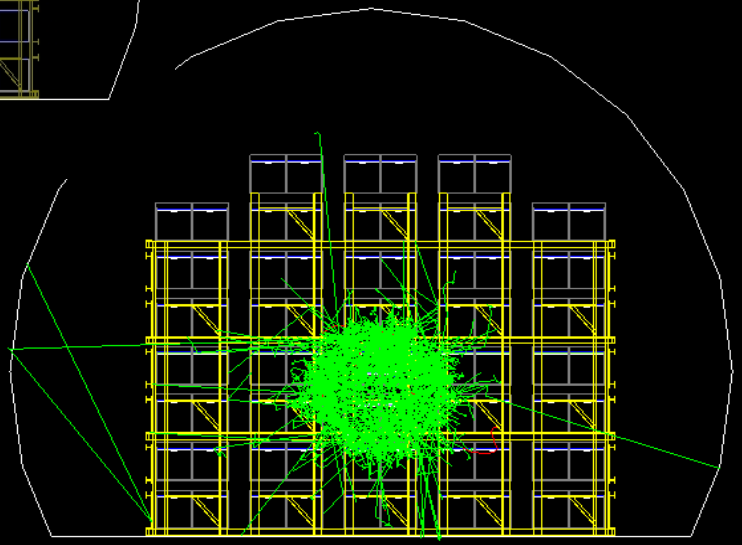
IV. Zusammenfassung

III. Untergrundsimulationen

Geometry

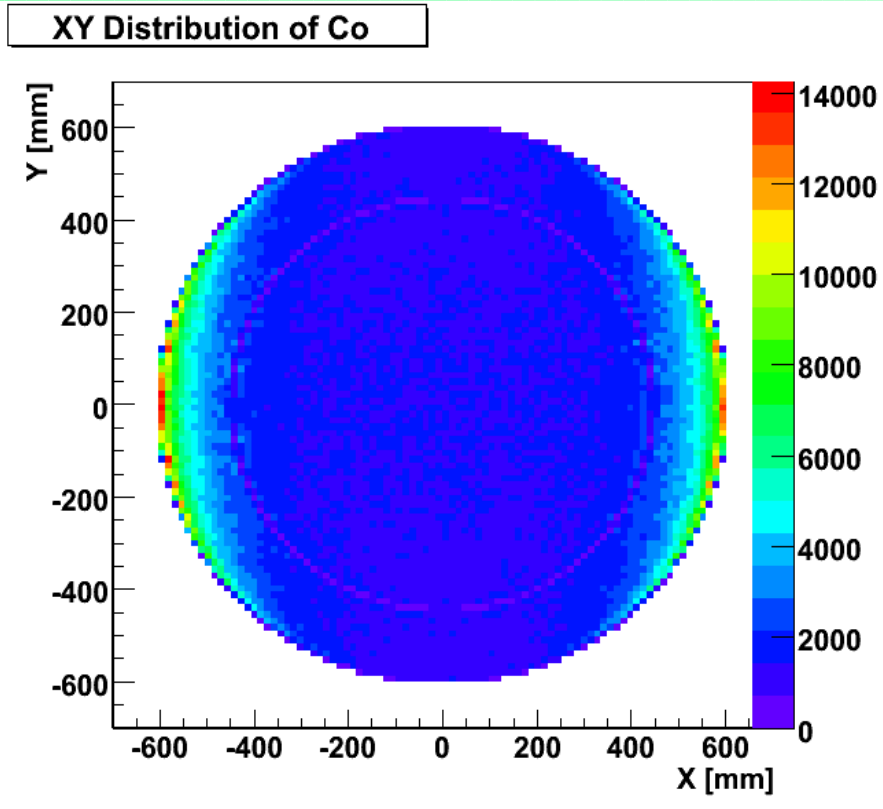






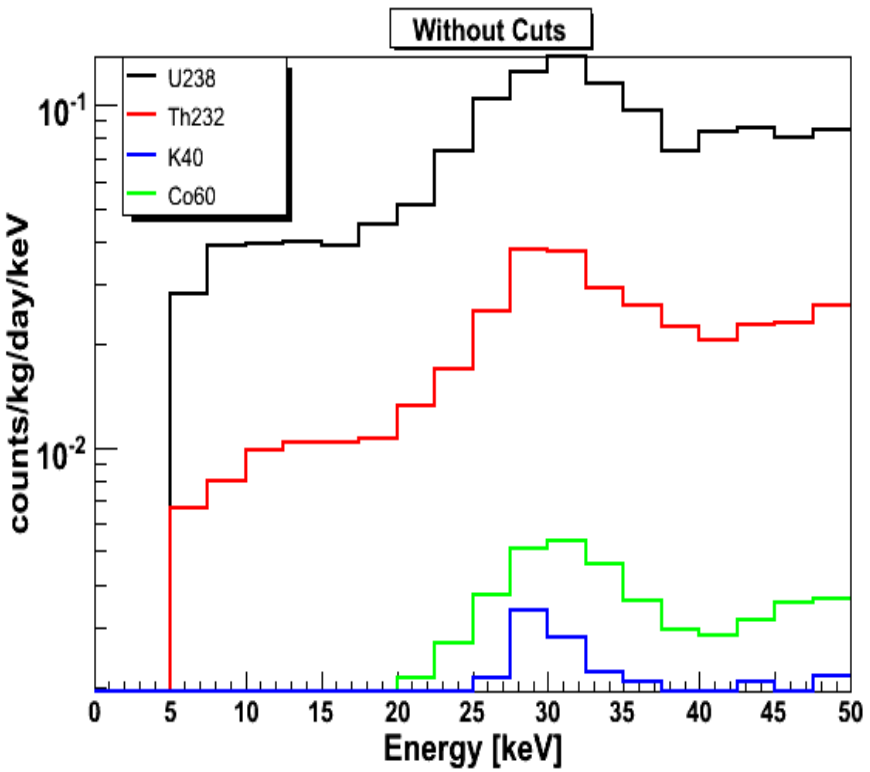
III. Untergrundsimulationen
Gamma-Simulationen

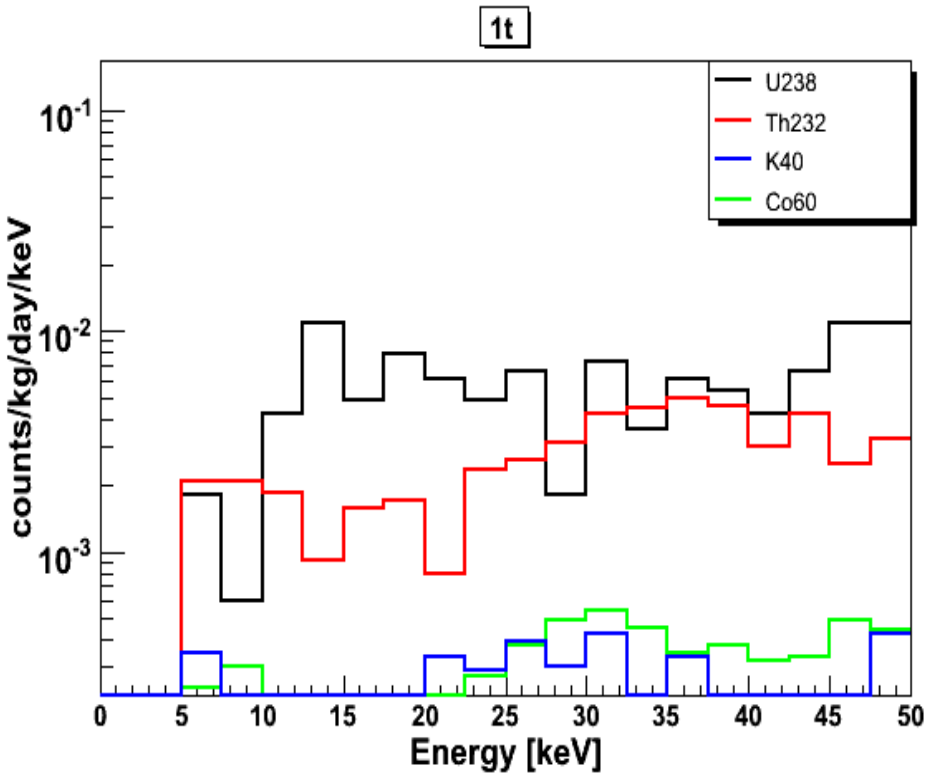
- Simulationen für Gamma-Aktivitäten aus der LVD Struktur: ^{60}Co, ^{40}K, ^{232}Th, ^{238}U



III. Untergrundsimulationen
Gamma-Simulationen

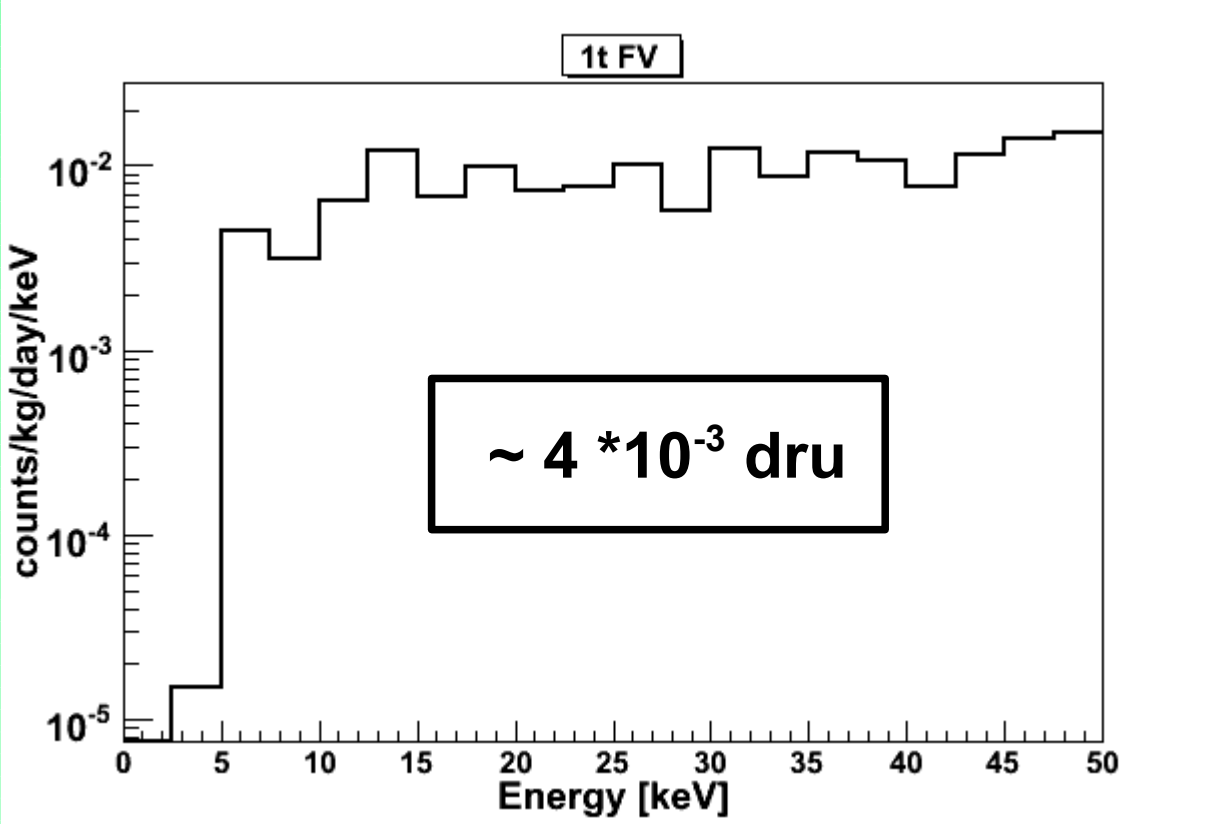
- Totale Ereignisrate in der Region 5 – 50 keV





III. Untergrundsimulationen
Gamma-Simulationen

- Totale Ereignisrate in der Region 5 – 50 keV



Gliederung

I. Einleitung
- XENON
- LVD

II. Gamma Messungen
- Gammaflüsse
- Aktivität LVD

III. Untergrundsimulationen für Xenon1t
- Geometry
- Gamma-Simulationen

IV. Zusammenfassung

IV. Zusammenfassung

- NaI-Gamma-Messungen: LVD CF bis zu 100 mal geringere Gamma-Aktivität
- Erwartete totale Gamma-Ereignisrate (extern) **~ 4 *10^{-3} dru**

Ausblick:

- Single Scatter Rate bestimmen
- Neutronenmessungen mit 8" NaI -> Ende März