TG 11 summary and results of measurements on different GERDA samples

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Ge spectrometers

- Baksan:
  - 4 detector setup (IGEX spectrometers) can be used for material screening
  - New spectrometer under construction (ready: end of 2005)
  - Will be moved from 600 mw.e. to 4900 mw.e. lab
- HADES:
  - see Mikaels talk

Ge spectrometers

- MPIK:
  - 2 spectrometers operational
  - 1 spectrometer under construction (ready in september)
- LNGS
  - New ultralow background spectrometer (GeMPI 2) operational
  - GeMPI 3 to come

Other techniques: ^{222}Rn

- Emanation technique
  - powerful tool to identify ^{226}Ra
  - ideal for surface contamniation analysis
  - also for bulk activity analysis, if
    - sample material is soft
    - sample is thin film
  - sensitivity: 0.5 μBq/m^2 and 10 μBq/kg

- Gas purity analysis
  - sensitivity: 0.5 μBq/m^3

New setup for LNGS under preparation

^{222}Rn in argon

- Rn concentration at the time of truck filling:
  - Argon 5.0: 8.5 mBq/m^3 (STP)
  - Argon 6.0: 0.4 mBq/m^3 (STP)

- Reduction factor in liquid phase: 10-20
  - 60 g activated carbon
  - argon flow rate: 20 m^3/h (STP)

Copper surface purity study

- Simulation of Cu purification with Cu foil
- 1 μBq/m^2 sensitivity for ^{226}Ra

- Rn daugther purification tests
- Test of ^{210}Pb/^{210}Po wash-off
- Cu disks exposed to strong Rn source for 2 month

α-spectroscopy

- Air-filled pulse ionization chamber available at Baksan
  - Quick (1000 s) monitoring at 10 Bq/m^3 sensitivity
- Ion Pulse Ionization chamber for surface impurity analysis
  - 0.002 α/(cm^2*h) background
  - further improvmnet by pulse shape analysis (track reconstruction)

Electrostatic chambers

- For Rn-monitoring in gas at 0.1 mBq/m^3 to 1 mBq/m^3 level
- MPIK:
  - New chamber delivered, will be mounted soon
- JINR:
  - Detector almost ready (2 weeks)
  - Sophisticated calibration procedure under development

ICPMS

- Measurements performed by Axel Gerdes, University of Frankfurt
- U/Th sensitivities in the range of μBq/kg
- K sensitivities much worse – first results will be available soon

- Main problem: secular equilibrium may be broken
- How meaningful for GERDA?

Torlon

Activity measured by	ICPMS [mBq/kg]	NAA [mBq/kg]	Ge spect. [mBq/kg]
uranium chain ($^{238}U/^{226}Ra$)	7.4	< 37	< 7 (MPIK)
thorium chain ($^{232}Th/^{228}Th$)	0.3	< 41	< 7 (MPIK)

Kapton cable

Activity measured by	ICPMS [mBq/kg]	Ge spectrometry [mBq/kg]
uranium chain ($^{238}U/^{226}Ra$)	1.2	8 9 (LNGS)
thorium chain ($^{232}Th/^{228}Th$)	0.05	< 10 < 4 (LNGS)

Steel (Shielding for LArGe)

Activity measured by	ICPMS [mBq/kg]	Ge spectrometry [mBq/kg]
uranium chain ($^{238}U/^{226}Ra$)	49	< 2 (MPIK)
thorium chain ($^{232}Th/^{228}Th$)	2.7	4.5 (MPIK)

PMT glass

Activity measured by	ICPMS [mBq/kg]	Ge spectrometry [mBq/kg]
uranium chain ($^{238}U/^{226}Ra$)	175	1950 (HADES) 2100 (MPIK)
thorium chain ($^{232}Th/^{228}Th$)	15	170 (HADES) 220 (MPIK)

PMT glass

Activity measured by	ICPMS [mBq/kg]	Ge spectrometry [mBq/kg]
^{238}U	175	< 65 (HADES)

Still in agreement?

Superinsulation foil

Activity measured by	ICPMS [mBq/kg]	Ge spectrometry [mBq/kg]
uranium chain ($^{238}U/^{226}Ra$)	28	23 (LNGS)
thorium chain ($^{232}Th/^{228}Th$)	2	5 (LNGS)

Teflon

Activity measured by	NAA [mBq/kg]	Ge spectrometry [mBq/kg]
uranium chain ($^{238}U/^{226}Ra$)	0.74	< 0.16 (LNGS)
thorium chain ($^{232}Th/^{228}Th$)	1.3	< 0.16 (LNGS)
^{40}K	0.7	1.5 (LNGS)

Cu(90%) / P(10%) pellets

Activity measured by	ICPMS [mBq/kg]	Ge spectrometry [mBq/kg]
uranium chain ($^{238}U/^{226}Ra$)	0.9	< 5 (MPIK) < 1.8 (HADES)
thorium chain ($^{232}Th/^{228}Th$)	0.05	< 6 (MPIK) < 1.5 (HADES) 0.9 (Baksan)
40K	?	< 6.4 (HADES) 11.4 (Baksan)

Further ICPMS measurements

	^{238}U [mBq/kg]	^{232}Th [mBq/kg]
Cu/Be wire I	1160	32
Cu/Be wire II	350	105
electr. contact (case)	1120	55
electr. contact (spring)	24	1.4
ASIC (silicon chip)	0.19	0.03
Germanium	0.06	0.01

Conclusions I

- Crucial question: Secular equilibrium
  - Is it broken?
- γ-/ ^{222}Rn-/ α-measurements have immediate influence on GERDA
- ICPMS / NAA measurements require
  - either confidence in secular equilibrium
  - or good model for breaking mechanisms
- Requires deep understand of chemical production processes

Conclusions II

- Not solved: Cable contamination (insulation)
- ≤10 μBq/kg sensitivity required!
- direct gamma measurements can achieve this only for high density materials (copper/lead)
- Possible solutions:
  - ^{222}Rn emanation measurements (for uranium chain)
  - study of secular equilibrium breaking mechanisms

Claudias question marks

- Time schedule for measurements ?
- List of materials to be measured ?
- Required sensitivities ?
- Intercomparison between radioactivity analysis laboratories ?
- Intercomparison between screening techniques ?
- Harmonisation of results (units/upper limits, ...)
- Exchange of reference sample
- All results will be available at TG11 page on *http://www.mpi-hd.mpg.de/ge76/home.html*