18 September 2008

Minutes of Workshop on Radiopure Scintillators for EURECA, RPSCINT 2008, 9th - 10th September 2008, Institute for Nuclear Research, Kyiv, Ukraine

A Goal of the workshop was to discuss R&D of radiopure scintillators for low-count rate experiments, and in particular for the EURECA cryogenic dark matter experiment. The idea was to bring together physicists, chemists and experts of crystal scintillators production

The following TOPICS were discussed:
- requirements of low-count rate experiments regarding radiopurity and scintillation properties
- selection and screening of starting materials
- purification of materials
- preparation of raw compounds for crystal growth
- crystal growing, annealing, processing and handling
- crystal testing
- search for and development of new scintillating materials

26 **participants** from 15 institutions and universities

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22 reports on

- EURECA and related projects (4)
- Double Beta Decay (2)
- Scintillator R&D (2)
- Scintillator Characterization (4)
- Important Issue of Low Radioactivity (6)
- Purification and Production (4)

Results and Conclusions

i) scintillators

- EURECA calls for several crystal scintillators exhibiting both extremely high radiopurity and light output
- There is a good potential for raw materials production, crystal growing and testing, R&D on new and the improvement of existing scintillation materials
- At present the most promising cryogenic scintillators with high light output for dark matter search are $ZnWO_4$, $CaWO_4$, $CaMoO_4$, CaF_2 and BGO
- R&D of new scintillation materials promising for dark matter and double beta decay search: Li_2MoO_4, $Li_2Zn_2(MoO_4)_3$, $ZnMoO_4$, $MgWO_4$ and further advance of $CdWO_4$, Al_2O_3, LiF, ZnSe, $PbWO_4$, $PbMoO_4$ is in progress
- Study of luminescence and scintillation properties up to very low temperatures provides important insights toward the improvement of cryogenic scintillators
- Analytical instrumentation is necessary to control chemical impurities in raw materials with sensitivity of ~0.1 ppm mainly for transition metals
- Scintillator performance could benefit from the deep purification required to address the radiopurity issue

ii) radiopurity

- $ZnWO_4$ is a good example of radiopure scintillator (~0.2 mBq/kg level). Nevertheless ~20 times improvement is needed for EURECA that represents significant challenge.
- 1-3 order of magnitude progress in development of radiopure $CaWO_4$, $CaMoO_4$, BGO, CaF_2, $CdWO_4$ was demonstrated, however further improvement by factor of >100 is necessary
- Deep purification of raw materials is supposed to be the most important issue that need to be addressed
- Metal purification by vacuum distillation, zone melting, filtering is a very promising approach, while purification of Ca to the requested level remains complicated task

An extended R&D that might cost as much as ~2-3 Meuro per 3 years is needed. This should include development of technology of production of different radiopure scintillators and also should guarantee the stability of the production

- A list of EURECA crystals should be fixed to start the R&D
- Screening at all stages to produce compounds for crystal growing (choice of raw materials, control of purified elements and compounds) by ultra-low background γ, α, β spectroscopy is needed.

iii) tests

- The low-background scintillation measurements is currently the most appropriate method of examination of the performance of scintillators
- Final test of the scintillators implies their operation as low-background cryogenic

detectors.

- R&D of ultra-low-radioactive instrumentation with the sensitivity at the level of 0.01 mBq/kg (both at room temperature and cryogenic) is desirable.

Next workshop (RPSCINT 2009):

September 15-16, Kyiv, Ukraine (preliminary)