

TITLE: “Dark Matter investigation with crystal scintillators”

Period: From 2/12/2013 to 5/12/2013 - every day from 10 to 11:15 hrs plus an additional hour

Venue: GSSI Room -

Programme:

Introduction to scintillation processes, crystal growth methods, detector performances, inorganic crystals and their properties, read-out by PMTs and their features, pulse shape capability as a function of energy, main applications in rare processes, from a scintillator to a low background scintillator: main requirements, dependence of low background scintillators on many parameters, pure metals, examples. The case of gamma spectrometry and of mass spectrometry. Other methods. Main contaminants and cosmogenic activation. Examples. Suppression of background in underground laboratory: the muon case and the neutron case. The radioactive noble gases. Shielding features. About one century of experimental evidence for Dark Matter in the Universe. The Dark Matter particles: candidates and interactions. Detection approaches. The annual modulation signature; the choice of the target-detector. A full experiment: DAMA/LIBRA, technical and scientific aspects; properties, procedures, model independent result. Model dependent analyses, uncertainties and assumptions. Elements on other experiments and comparisons. Indirect investigation: complementarity and uncertainties. Some prospects with NaI(Tl).

After studying this course the students should:

obtain a positive score in an examination which can be performed either on all the arguments of the program given above or presenting a written relatively small dissertation on an argument agreed with the teacher of the course together with a related oral discussion

Syllabus

1. Crystal scintillators
2. Low background techniques
3. Dark Matter
4. Dark Matter annual modulation signature
5. Approaches and comparisons

Bibliography

- Crystal Growth for Beginners: Fundamentals of Nucleation, Crystal Growth and Epitaxy Ivan V. Markov, World Scientific, 01/gen/2003 - 546 pag.
- The Atomistic Nature of Crystal Growth (Springer Series in Materials Science) by Boyan Mutaftschiev (24 Apr 2001)

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- Handbook of crystal growth, series of volumes D. T. J. Hurle, North-Holland, 1993 - 1232 pag.
- Radiation detection and measurement, Glenn F. Knoll, Wiley, 2000 - 802 pag.
- Radioactivity and Nuclear Physics by James M. Cork (Mar 30, 2013)
- The references quoted in the given slides for general arguments and DAMA/LIBRA and the references in TAUP2013 for others which have been introduced.