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New limits on WIMP search with large-mass low-radioactivity NaI(Tl) set-up at Gran Sasso

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Abstract

Improved limits on WIMP search have been obtained by the pulse shape analysis of the data collected with a large-mass low-radioactivity NaI(Tl) set-up at Gran Sasso National Laboratory.

1. Introduction

World-wide efforts are in progress to search for particle Dark Matter by using different detection strategies [1,2]. In particular, several authors have already pointed out the interest in using radiopure NaI(Tl) crystals [3,4] and statistical pulse shape analysis (PSA) [5–7] to look for WIMP-nucleus elastic scattering.

Herewith, we present the results obtained with a large-mass low-radioactivity NaI(Tl) set-up installed in the Gran Sasso National Laboratory. The significant reduction of the residual contaminants and the use of PSA allow to approach the cross section-mass regions expected for neutralino.

The data presented here are referred to a running period labelled: DAMA/NaI-0.

2. Neutron calibrations

To study the detector response to recoils, neutron calibrations have been performed at the ENEA-Frascati Laboratory. Such calibrations are needed to measure the quenching factors (ratio of the amount of light induced by a recoil nucleus to the amount of light induced by an electron of same kinetic energy) for Na and I nuclei and the reference shapes of the nuclear recoil pulses in the keV region [6,7].

Test measurements using crystals of different shapes and sizes – with and without light guides – have shown no significant differences in the PSA capability (within the uncertainties), when operating with the same photomultiplier (PMT), voltage divider, electronic chain and temperature. The events induced by neutron multiple scatterings in the crystal have to be in any case identified and rejected

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