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Production of highly radio-pure NaI(Tl) crystals applied to dark matter search

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The interest in ultra-high purity, low-background NaI(Tl) crystals for dark matter direct searches has increased in recent years. This is driven by the fact that over the last two decades, the experimental effort to search for particle dark matter in underground laboratories yielded null results with the notable exception of the DAMA/LIBRA experiment at LNGS. DAMA has been observing an annual modulation of the experimental rate in its array of NaI(Tl) crystals: the outstanding radio-purity of such crystals, which drives the background level and ultimately the sensitivity of the experiment, has never been matched so far.

Radio-purity, especially at the very low level of content required by DM searches, is an extremely challenging task, only partially solved so far for NaI(Tl) crystals.

The SABRE experiment aims to deploy arrays of ultra-low-background NaI(Tl) crystals to carry out a model-independent search for dark matter through the annual modulation signature. For over 10 years, SABRE has conducted extensive R&D on ultra-radio-pure NaI(Tl) crystals. Several crystals have been grown and tested in both active and passive shields at LNGS. Recently, in order to achieve an unprecedented level of radiopurity for the crystals, SABRE is employing zone refining purification of the NaI powder prior to growth. In this talk, I will present the status and challenges from the zone refining activities, the obtained results and predictions on the ultimate radio purity achievable for the crystals. Additionally, the status of the SABRE project will be discussed.

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