# NOVEL SCINTILLATOR ARRAYS

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Advances in nuclear physics are driven by advances in detector technology. In order to profit from future facilities, new detector systems will be needed that can exploit the available beam intensities to their best advantage. Scintillator crystals are a well-established technology. The hygroscopic material, NaI(Tl), is the workhorse of this type of material and is exploited widely in nuclear physics and in societal applications such as oil and gas exploration. A typical energy resolution is around 7 % at 667 keV. There is much activity worldwide in developing new scintillator materials. Of interest are crystals with high light output, fast time response, and linearity. In practical terms, nuclear physics commonly requires large crystals especially in terms of building large arrays. The most established of the “novel scintillators” is $LaBr_3$(Ce). This material is very linear and has an energy resolution of around 3% for 667 keV. Importantly, it can be grown to large sizes facilitating the construction of detectors relevant to nuclear physics (although the main driver of all such technology is homeland security). $LaBr_3$(Ce) has already begun to find wide application in nuclear physics from fast timing arrays to large calorimeters such as PARIS. PARIS uses a phoswich design of $LaBr_3$(Ce) coupled to NaI(Tl) to reduce cost while still exploiting the main advantages of the novel scintillator.

Other materials with properties better than NaI(Tl) and approaching $LaBr_3$(Ce) are becoming available in larger sizes. For example, $CeBr_3$ can achieve energy resolution better than 5% [1]. It has the advantage over $LaBr_3$(Ce) of not having internal radioactivity. $SrI_2$ is also available with resolution approaching that of $LaBr_3$(Ce) but is a much slower scintillator with a decay time of ~1.5 us and is currently much more expensive. At the present time, investigations are proceeding on co-doping of crystals such as $CeBr_3$ and $LaBr_3$(Ce) with e.g. Sr. This appears to lead to improved proportionality and energy resolution [2] but this is yet to translate into commercially available crystals. Polycrystalline ceramic materials such as GYGAG are available in small quantities and are attractive in terms of their high density and effective Z. They also offer energy resolution better than 5% at 667 keV and good timing resolution.

This talk will review the current status of R&D into novel scintillator materials for nuclear physics and map out the scope for their implementation in current and future arrays.

REFERENCES

[1] R. Billnert et al., Nucl. Instrum. Meth. A 647, 94 (2011).
[2] F.G.A Quarati et al., Nucl. Instrum. Meth. A 735, 655 (2014).