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Novel scintillation screen with significantly improved radiation hardness and very high light output

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That the bombardment with a high energy radiation has an effect on the material properties is well known since many years [1]. Vacancies or disorder incorporated in the material can have a significant influence on the luminous intensity of scintillation material. In the development of scintillation material for high energy particle detection big efforts have been done within the last years [2]. Actually the highly radiation resistant garnets seem to be the state of the art in that field [2].
It is known that neutrons affecting, especially the alpha and triton particle originating from the capture reaction, lead to a degradation of scintillator screens regarding the light output versus neutron fluence. Two different kind of scintillators are commonly used for neutron imaging applications: (i) 6LiF/ZnS scintillation screens with very high light output and reasonable resolution and (ii) Gd2O2S:Tb scintillation screens for very high resolution measurements but 10 times less light output.
Within a 2 years development project with PSI we wanted to understand for the 6LiF/ZnS scintillator type the effects which are responsible for the degradation mechanism and therewith be able to develop a more radiation hard neutron scintillator system. The goal was to not only improve radiation hardness but also to improve the light output in comparison to the traditional 6LiF/ZnS-scintillation screens.
In this talk the results of this development project, leading to a new type of scintillation screen with significantly improved radiation hardness, but still very high light output, are presented.

[1] Kurt E. Sickafus, Eugene A. Kotomin, Blas P. Uberuaga “Radiation Effects in Solids” Springer, 2004. ISBN-10 1-4020-5294-4 (PB) .
[2] P.Lecoq, A.Gektin, M.Korzhik, Scintillation material for detector systems, Springer, 2017, P.408.

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