Callibration of a scintillator detector with CCD sensor for the measurement of the energy deposition of charged particles

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A. Report for the measurements at the Tandem accelerator in the period 15-17 May 2010

We have used α particles incident on a NE-102 scintillator, shown in Fig.1.

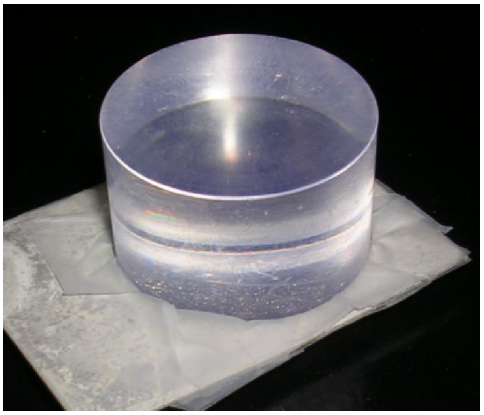

Fig. 1

The crystal was mounted inside a vacuum chamber, and the fluorescence from the scintillator produced by the incident beam could be observed through an optical window, as shown in Fig. 2.

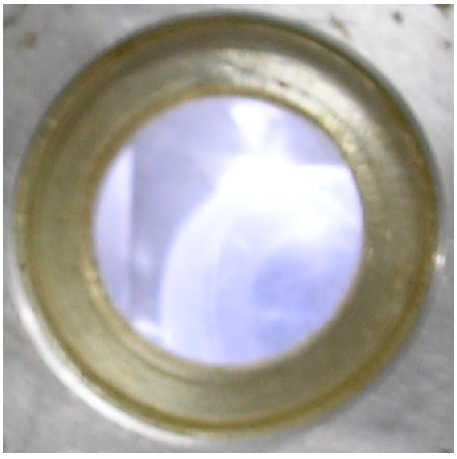

Fig. 2

The optical fluorescence was collected by an optical fiber and measured with the aid of a spectrometer with CCD sensor, as shown in Fig. 3,

Fig. 3

and the optical intensity was displayed as a function of wavelength, showing the characteristic fluorescence of NE-102 scintillator around 420 nm.

Spectra have been collected for 14 MeV α particles incident on the NE-102 scintillator for various orientations of the scintillator inside the vacuum chamber. The fluorescence produced by the α particle beam is shown in Fig. 4, where we can see the incident beam as the bright spot lying on the plane face of the cylindrical scintillator.

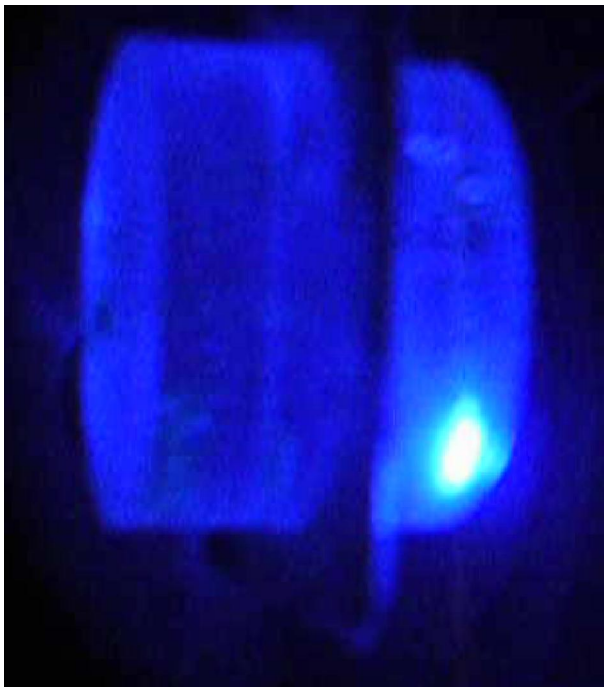

Fig. 4

We have used various acquisition times, but we are primarily interested in very short acquisition times. An optical spectrum recorded over a 100 ms time period is shown in Fig. 5, where it can be seen that the blue fluorescence of the NE-102 scintillator at 420 nm has a well defined peak.

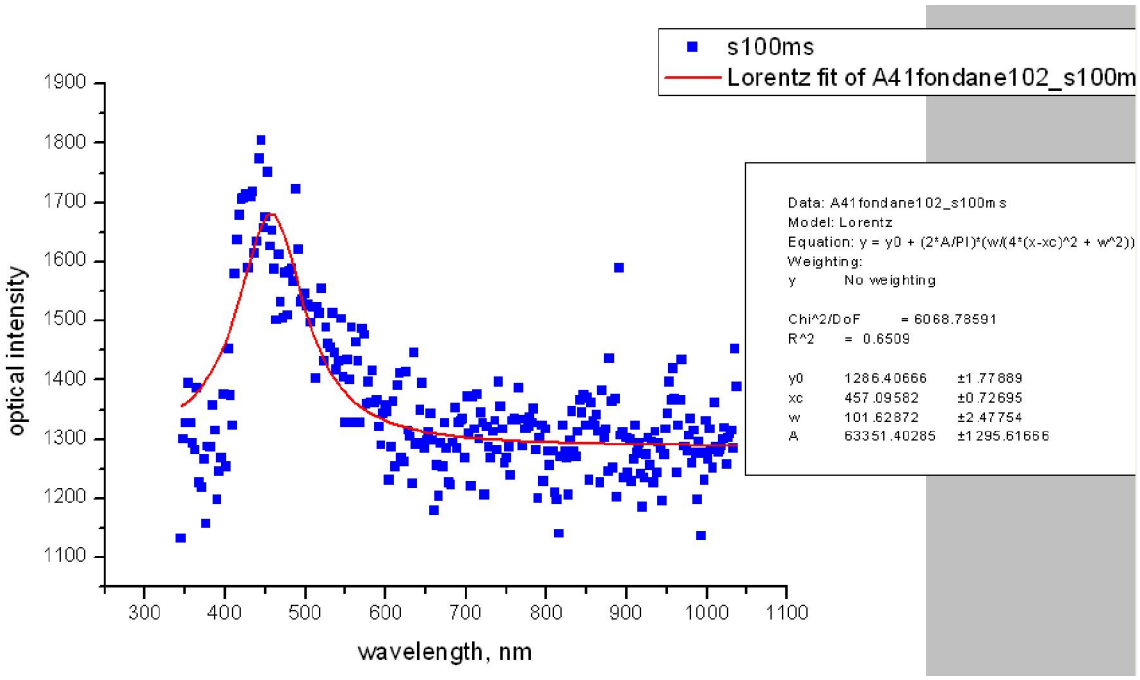

Fig. 5

A spectrum obtained with a 5 ms acquisition time is shown in Fig. 6, where the 420 nm peak is still present.

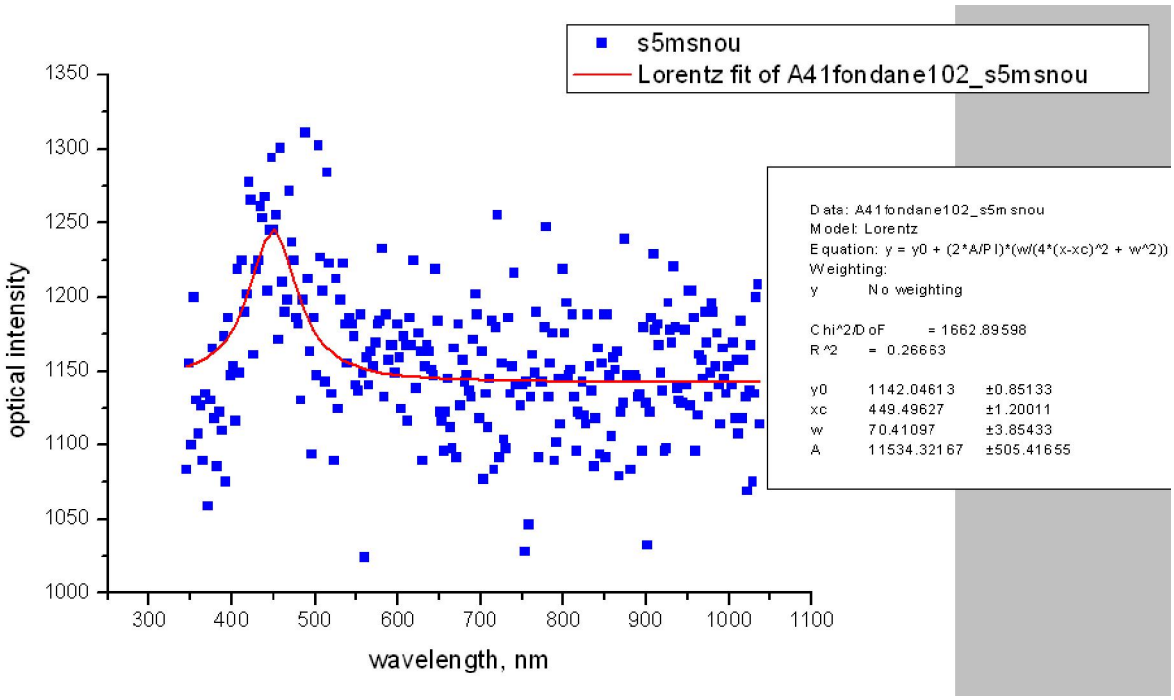

Fig. 6

B. Proposed experiments

We shall study the possibility to use scintillators for the monitoring of the energy deposition by charged particles in nuclear fusion plasmas at the plasma walls. Our study is focused on the energy loss from the fusion plasmas by escaping α particles having energies of a few MeV.

In the proposed experiments, we shall measure the optical intensity produced by the scintillator as a function of the energy of the incident particles and as a function of the incident current. We shall simultaneously measure the gamma-ray and neutron spectra produced by the incident beam on the scintillator, for the monitoring of the beam current.

C. Beam time request

Particles: p, d, α

High voltages: 3-7 MV

Beam line: 5

Duration: 3 days

Period: early December 2010