

Diamond

Fast Neutron Detection



Response to Mono-energetic Neutrons

Diamond has been characterized using the quasi-monoenergetic neutron fluxes of the Van Der Graaf neutron generator at the IRMM-JRC of Geel (Belgium - <http://irmm.jrc.ec.europa.eu/html/homepage.htm>).

The measurements were carried out recording the Pulse Height Spectrum of the recoiling charged particles produced in the diamond with the neutron interaction.

The diamond was successfully tested for several neutron energies. The list of the used neutron energies is reported in Table I.

The standard monitors of Van Der Graaf neutron generator were used to obtain the absolute fluxes impinging on the diamond detector in order to derive normalized response functions.

The results of the test were very promising, the $^{12}\text{C}(n,\alpha)^9\text{Be}$ reaction in the sample detector shows an excellent linearity to different neutron energies (fig. 1). Examples of the collected PHS measured for neutrons of 8.39 MeV and 18.48 MeV are also shown.

The aim of this work was to determine the response functions of a diamond detector to neutrons with different energies and in particular of the $^{12}\text{C}(n,\alpha)^9\text{Be}$ reaction in order to determine the potentiality of diamond detectors as high resolution fast neutron spectrometers.

In addition work has also been completed to verify the timing and shape for neutron generators diagnostics. This is of particular importance to gate any MCA's that may be connected to gamma devices to determine the presence of carbon etc.

Fast Neutron Spectroscopy



Fig. 1 Energy response of DDL 1523 vs. neutron energy

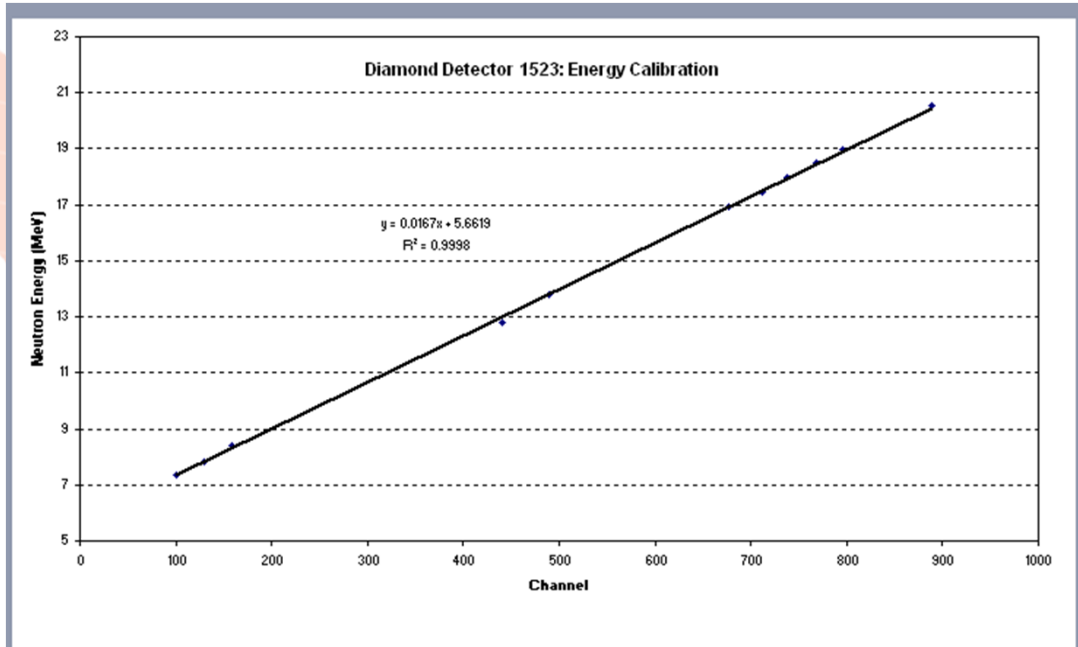


Fig. 2 PHS measured for 8.39 MeV neutrons

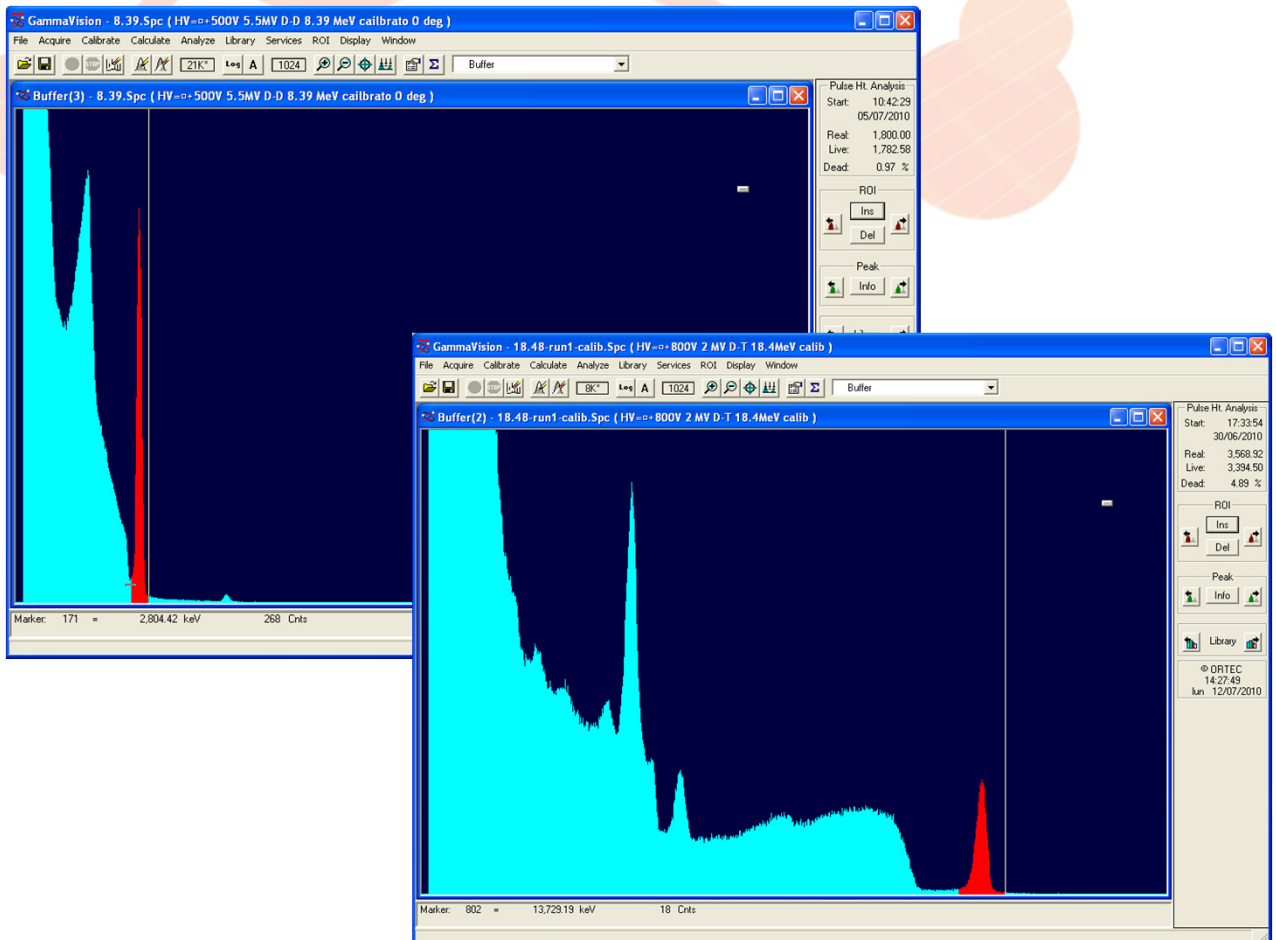
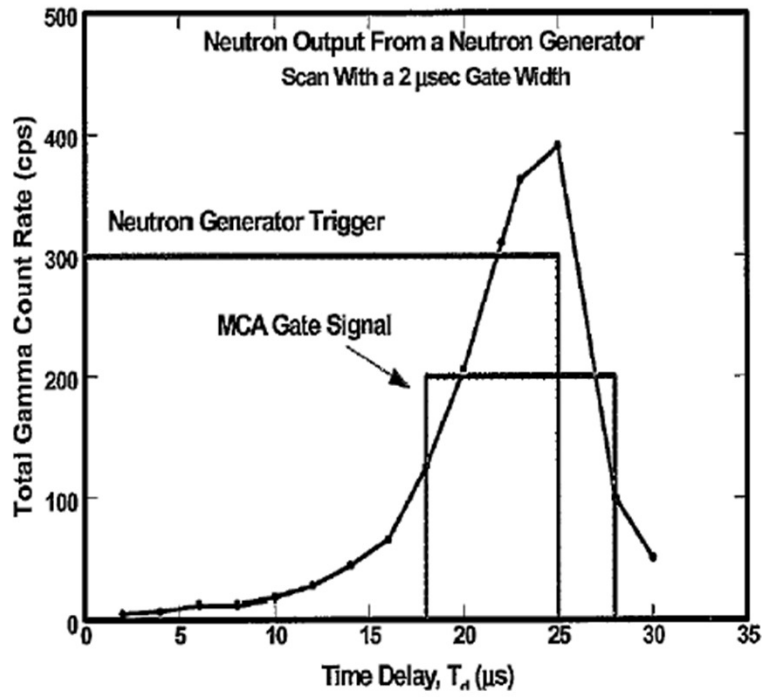
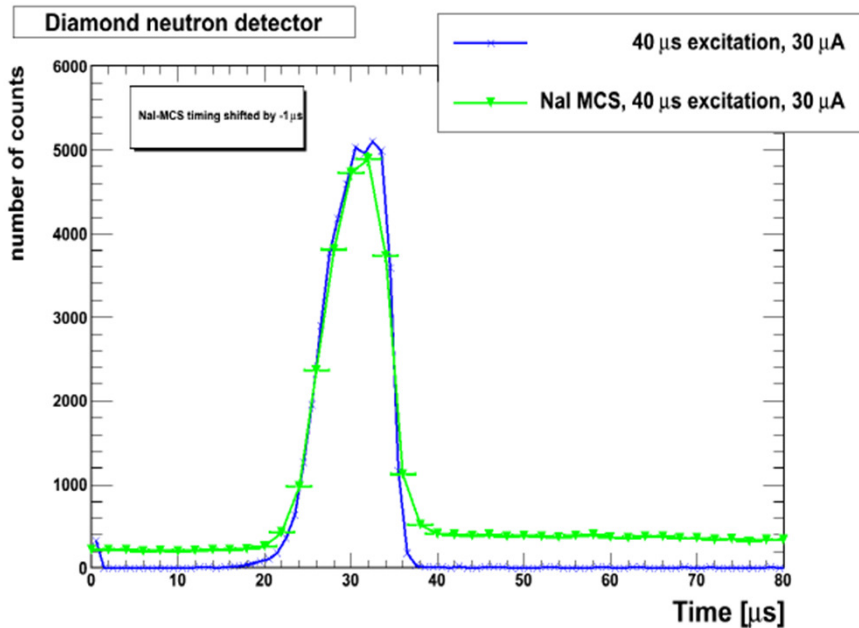


Fig. 3 PHS measured for 18.48 MeV neutrons

Neutron Generator Diagnostics



Results showing timing signal from NG-trigger and the idealised MCA Gate Signal



Response from a Diamond Fast Neutron detector using an EADS- NG courtesy of ANSTO (2011)

Neutron energies Table I.

Beam Type	Beam Energy (MeV)	Target Type	Target Thickness ($\mu\text{g}/\text{cm}^2$)	Mean Neutron Energy (MeV)	E _{min} (MeV)	E _{max} (MeV)
d	1	Gas-Target	100 kPa-40 mm	4.791	4.726	4.862
d	2	Gas-Target	100 kPa-40 mm	5.723	5.645	5.836
d	4.5	Gas-Target	100 kPa-40 mm	5.936	5.901	5.987
d	5	Gas-Target	100 kPa-40 mm	6.301	6.27	6.348
d	4.5	Gas-Target	100 kPa-40 mm	7.355	7.306	7.428
d	5	Gas-Target	100 kPa-40 mm	7.822	7.829	7.939
d	5.5	Gas-Target	100 kPa-40 mm	8.390	8.343	8.443
d	3.5	Tritiated (solid)	2245	12.815	12.813	12.818
d	1	Tritiated (solid)	2245	13.794	13.807	13.807
d	1	Tritiated (solid)	2245	15.515	15.073	16.123
d	1	Tritiated (solid)	2245	15.934	15.376	16.7
d	1.5	Tritiated (solid)	2245	16.441	16.151	16.743
d	2	Tritiated (solid)	2245	16.933	16.722	17.139
d	2.5	Tritiated (solid)	2245	17.478	17.303	17.645
d	3	Tritiated (solid)	2245	17.998	17.856	18.139
d	3.5	Tritiated (solid)	2245	18.482	18.358	18.605
d	4	Tritiated (solid)	2245	18.957	18.847	19.066
d	4	Tritiated (solid)	2245	20.541	20.397	20.68