Neutron Diagnostics - ENEA Activities

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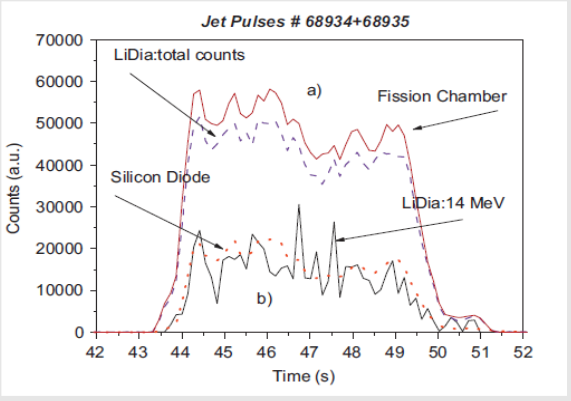
ENEA Proposal

1- Diamond detectors for triton burn-up

- Source of 14 Mev neutrons in a tokamak operating in DD;
- **Two diamond detectors** (one with ^{6}LiF layer) for simultaneously measure DD and 14 MeV neutrons during a single shot;
- **Demonstrated at JET** (both total and time dependent neutron emission measured with a single detector).

➢ To design the diagnostics at JT-60SA it is necessary to know the neutron/gamma field around the cryostat → **MCNP model and simulations needed**



Simultaneous DD and 14 MeV neutron detection with diamond at JET

2- Diagnostic for measurement of dose rate due to neutron activation

- Continue the activity (SDR experiment at JET) of **improvement of numerical tools employed for dose rate calculation**, nuclear data, methodologies in JT-60SA and investigate discrepancies between measurements and predictions;
- Relevant peculiarities of a modern concept of tokamak (double-walled vacuum vessel filled with borated water, superconducting coil system) **never explored in SDR experiments before.**

➢ **Dose rate field around the cryostat needed**

Preliminary feasibility study in 2021

1- Diamond detectors for triton burn-up

- Analysis of the feasibility of the measurement of the 14 MeV neutrons produced by the triton burn-up in JT-60SA;
- Analysis based upon a preliminary study of the Neutron Camera for JT-60SA from where *approximate* information about the uncollided neutron flux was extracted;
- ***Results :*** Demonstration of measurement feasibility with a single diamond detector 500 µm thick located 1 m away from the port plug: *DD neutron yield > 1.0×10^{15} n/s and up to the highest yields foreseen for the scenarios #5.1 and #5.2*;
- Time resolution in between 10-100 ms seems reasonable.

2- Diagnostic for measurement of dose rate due to neutron activation

- Preliminary analysis for the realization of a dosimetry system based on ion chambers for dose rate measurements has been carried out;
- *Extrapolation from another machine* (DTT) with some common characteristics was used in this preliminary analysis to estimate the intensity of the dose rate expected outside cryostat in JT-60SA;
- Some considerations and a tentative layout of the system have been proposed.

Plan for 2022

A thorough assessment for the proposed diagnostics would require a proper nuclear analysis of JT-60SA and it should rely on the most *complete MCNP model of the tokamak;*

On the basis of the information from QST (MCNP input, outputs, CAD models) the following activities are foreseen in 2022:

- Perform precise nuclear analysis to define measuring range of detectors and main requirements;
- Select suitable locations both for diamonds and ion chambers;
- Design of the layout of the detection systems;
- Predict response of detectors.

REQUESTS & NEEDS:

1) neutron/gamma fluxes and spectra around JT60SA (up to 5 m away from the cryostat)
2) MCNP Model (upgraded) including the TH
3) CAD