# Multi-channel neutron emission and triton burn-up measurement on JT-60U using Digital-Signal-Processors


K. Ishii, K.Shinohara [a], M. Ishikawa [a], T.Okuji [b], M.Baba [b], M. Isobe [c], S. Kitajima, M. Sasao

*Department of Quantum Science and Energy Engineering, Tohoku Univ., Sendai 980-8579, Japan*
*[a]Japan Atomic Energy Agency, 801-1, Mukoyama, Naka 311-0193, Japan*
*[b]Cyclotron and Radioisotope Center, Tohoku Univ., Sendai 980-8578, Japan*
*[c]National Institute for Fusion Science,322-6 Oroshi-cho, Toki 509-5292, Japan*

e-mail: keiichi.ishii@ppl2.qse.tohoku.ac.jp


The multi-channel neutron profile monitors in JT-60U measure the neutron emissivity over a poloidal cross-section of the plasma, viewing vertically and radially [1,2]. The line-integrated neutron emissivity is recorded by a neutron detector viewing the plasma along a collimated chord. To avoid contamination of γ-rays and the scattering component, it is important to use a detector that discriminates neutrons from γ-rays and is insensitive to low-energy neutrons [3]. A stilbene crystal is used in JT-60U as a scintillation detector, which allows pulse shape discrimination between neutrons (longer decay time) and γ-rays (shorter decay time).

A pulse electronics using Digital Signal Processors (DSP) has been developed and applied to the multi-channel neutron profile monitors on JT-60U [4,5]. This system requires a neutron-γ discrimination logics, which is fast enough to enable data analysis between discharges, and is robust against the background noises, rapid change of the counting rate and so on. A new pulse-shape analysis method is developed and applied to all stilbene detectors. This pulse-shape analysis system has following functions: (1) digitizes pulse shape, (2) finds top of peaks, (3) produces 3 integrals for each pulse, i.e., fast, slow and total pulse integral, (4) produces two dimensional maps for n-γ discrimination. Fig.1 shows a 2D map in fast-slow space normalized with total. Neutrons are discriminated from γ-rays clearly. This system enables routine measurement of DD neutron emission rate with time resolution of ms range, and also routine measurement of triton burn-up[#] simultaneously.

The time evolution of DD neutron emission rate basically shows classical behaviour of energetic deuterons injected. However, it sometime shows anomaly on some channels when the magnetics shows the MHD activities. Therefore, the time evolution of triton burn-up can be used to predict 3.5 MeV α-particle behaviour.

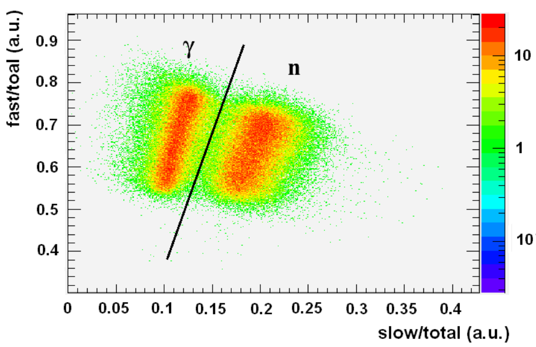


Fig.1 A 2D map in fast-slow space normalized with total.

References


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[#] The 1 MeV tritons, which are produced in the d(d,p)t reaction at approximately the same rate as the 2.5 MeV neutrons from the d(d,n)$^3$He , slow down and may undergo a DT fusion reaction, emitting 14 MeV neutrons.