APPLICATION OF THE STOCHASTIC TRANSPORT THEORY TO 
REACTIVITY MEASUREMENTS IN A SUBCRITICAL ASSEMBLY 
DRIVEN BY A PULSED SOURCE 

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ABSTRACT 

Using the stochastic transport theory formalism developed by Muñoz-Cobo for a radioactive source and for a spallation source, we derive an expression for the Cross Power Spectral Density (CPSD) for a subcritical system driven by an external pulsed neutron source. The derivation of this expression has been done in a rigorous and general way including the energy and spatial dependency. The CPSD shows some peaks at the source frequency together with its harmonics. The final expression containing some approximations (fundamental mode analysis; Dirac delta pulses for the source) is compared with calculations using a Monte Carlo code. In the future, comparisons with measurements in the MUSE project are planned. 

Key Words: Noise, Stochastic, Pulse, Subcritical 

1. INTRODUCTION 

The control of Accelerator Driven Systems (ADS) requires the development of methods to monitor the reactivity of the reactor while not interfering with its normal operation. Because the ADS presents many challenges for fluctuation based measurements, the MUSE project was proposed to study these methods, Gandini and Salvatores [1]. In order to do so, a deuterium accelerator (GENEPI) that can operate with either a deuterium or tritium target has been coupled to a subcritical reactor core containing MOX fuel (MASURCA). In this paper, a deuterium target producing neutrons with energy of 2.45 MeV at a maximum frequency of 5KHz has been considered. 

Several authors, Pazsit and Ceder [3]; Kuang and Pazsit [4]; Degweker [2], and Rugama et al [5] proposed the use of random noise techniques in ADS, which differ from the classical noise techniques because of the non-Poissonian neutron source. In this paper, a theoretical framework to compute the covariance between two neutron detectors has been derived. The method is based on the stochastic neutron transport theory and determines various kinetics parameters through the analysis of neutron detector signals. From these parameters the value of the $K_{eff}$ can be extracted. Although at the end, the fundamental mode approximation has