

Nuclear Science and Technology Division

Multiplicity-Dependent Energy Spectra of Neutrons from Fission

Sara A. Pozzi  
Oak Ridge National Laboratory

Imre Pazsit  
Chalmers University of Technology  
Goteborg, Sweden

Submitted to:  
INMM 46<sup>th</sup> Annual Meeting  
July 10-14, 2005

“The submitted manuscript has been authored by a contractor of the U.S. Government under contract No. DE-AC05-00OR22725. Accordingly, the U.S. Government retains a nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or allow others to do so, for U.S. Government purposes.”

Prepared by the Oak Ridge National Laboratory,  
P. O. Box 2008, Oak Ridge, Tennessee 37831-6050,  
managed by UT-Battelle, LLC, for the U.S. Department of Energy  
under contract DE-AC05-00OR22725

Multiplicity-Dependent Energy Spectra of Neutrons from Fission  
Sara A. Pozzi and Imre Pázsit\*

Sara A. Pozzi  
Oak Ridge National Laboratory

Imre Pázsit  
Chalmers University of Technology  
Goteborg, Sweden

Analytical and Monte Carlo calculations of the statistics of the neutron and photon population in a multiplying medium (such as fissile material) rely on information on the secondary particles emitted in fission and other interactions. The calculation of the higher-order moments of the distribution of the number of neutrons and photons requires that the single interactions emitting multiple neutrons and photons be described as accurately as possible (Pázsit et al. and Pozzi et al.).

The energy spectra of neutrons and photons emitted by fission have been extensively measured in the past. Typically, such measurements report the quantity  $\chi(E)$  which is the average energy spectrum of the particles emitted by many fission events. The number of neutrons or photons emitted in fission is also a well known quantity; i.e., the distributions  $p(n)$  or probability that a given fission emits  $n$  particles. The average spectrum  $\chi(E)$  of the neutrons emitted by a given fission can be expressed as the sum of the partial spectra  $f_n(E)$  which are the energy spectra of the neutrons in fissions that emit  $n$  neutrons.

In the present paper we describe an experiment that has the aim of measuring the partial spectra  $f_n(E)$  of the neutrons emitted by the spontaneous fission of Cf-252. These results have direct application in the analytical formulation of a theory describing the higher-order moments of the neutron and photon population in a multiplying medium. The measurement of the partial spectra has bearing in the basic physics of neutron and photon-induced fission and provides insight in other processes in which multiple particles are emitted in a single event, such as spallation. Moreover, the results of this work are necessary to simulate particle multiplicities using Monte Carlo codes, such as MCNP-PoliMi, and to simulate fluctuations in energy-dependent transport. The knowledge of the partial spectra of neutrons from fission is also of interest in nuclear safeguards applications that rely on the measurement of fission multiplicity.

Paper justification:

The paper presents an attempt to determine the partial spectra of neutrons from the spontaneous fission of Cf-252. To our knowledge, such measurements have not been done before.

Paper significance

The knowledge of the partial spectra will aid in analytical and Monte Carlo calculations of the statistics of the neutron and photon population in a multiplying medium.