

---

## NEUTRON SPECTRA FROM INTERMEDIATE-ENERGY NUCLEUS-NUCLEUS REACTIONS

Hiroshi Iwase<sup>1</sup>, Yoshiyuki Iwata<sup>2</sup>, Takashi Nakamura<sup>3</sup>, Konstantin K. Gudima<sup>4</sup>, Stepan G. Mashnik<sup>5</sup>, Arnold J. Sierk<sup>5</sup>, Richard E. Prael<sup>5</sup>

<sup>1</sup> *GSI, Planckstr. 1, 64291 Darmstadt, Germany*

<sup>2</sup> *National Institute of Radiological Sciences, 4-9-1 Anagawa, Inage, Chiba 263-8555, Japan*

<sup>3</sup> *Tohoku University, Aoba, Aramaki, Aoba-ku, Sendai 980-8579, Japan*

<sup>4</sup> *Institute of Applied Physics, Academy of Science of Moldova, Chisinau, MD-2028, Moldova*

<sup>5</sup> *Los Alamos National Laboratory, Los Alamos, NM 87545, USA*

---

Double-differential cross sections of neutron production at angles from 0 to 110 degrees from many reactions induced by light and medium nuclei on targets from  $^{12}\text{C}$  to  $^{208}\text{Pb}$ , at several incident energies from 95 to 600 MeV/nucleon have been measured recently at the RIKEN (Institute of Physical and Chemical Research) Ring Cyclotron in Japan and at the Heavy-Ion Medical Accelerator in Chiba (HIMAC) of the National Institute of Radiological Science, Japan using the time-of-flight technique. We have analyzed all these new measurements using the Quantum Molecular Dynamics (QMD) model, the Oak Ridge intranuclear cascade model HIC, the ISABEL intranuclear cascade model from LAHET, and the Los Alamos version of the Quark-Gluon String Model (LAQGSM). On the whole, all four models used here describe reasonably well most of the measured neutron spectra, although different models agree differently with data from specific reactions and some serious discrepancies are observed for some reactions. We present here some illustrative results from our study, discuss possible reasons for some of the observed discrepancies and try to outline ways to further improve the tested codes in order to address these problems.