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Status and plan for the theoretical research of nuclear levels related to CRP Contract

Tuesday 25 March 2025 14:00 (45 minutes)

We will present three research topics related to the theoretical part of our CRP Contract.
The first topic aims to improve the resolved nuclear levels scheme. To this end, we firstly demonstrate that how the discrete levels can influence the nuclear reaction cross sections and astrophysical reaction rates. Such calculations are performed with both Hauser-Feshbach model and Breit-Wigner formula. Then we propose a procedure to build a dataset of the discrete levels. This includes (1) the compilation of new experimental resonance properties (energy, spin/parity, width), (2) the generation of energy level with the properties derived from known (Porter-Thomas and Wigner) distributions for experimental unknown cases, and (3) the results obtained with the help of machine-learning method. We will also show the preliminary results for this procedure.
For the second topic, we develop a simple method to constrain the nuclear level density (NLD) by using the evaluated cross section data and the recommended database of nuclear structure. In particular, this method is preliminarily demonstrated by using the neutron capture cross sections and the IAEA photon strength function database to constrain the NLD within TALYS calculation. The necessity to continue this study needs to be discussed in accordance with the CRP's goals.
For the third topic, we will show some results of the determination of the most relevant energy range of NLD. The combination of this study and the existing CRP contents can be discussed.
We also want to discuss the necessity to perform the theoretical study of NLD using Nilsson-BCS model, which was present in our CRP Contract. We are open to accept other tasks for the CRP after the discussion of the meeting.

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