A short introduction to the Oslo method\*

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The Oslo method measures nuclear level density (NLD) and g-ray strength function (gSF) simultaneously in one and the same experiment. These NLD data bridge the energy gap between discrete known levels at low excitation energy and the NLD extracted from neutron capture level spacings (D0) at around the neutron separation energy Sn.

Typically, the experimental set-up for the Oslo method includes particle-gamma coincidences from light-ion reactions on stable enriched target foils with only one charged ejectile. The raw coincidence data are organized in an R(Eg,Ex) matrix, where particle ∆E-E telescopes (SiRi) determine the type of outgoing particle (p, d, t, 3He, and 4He) and its energy that is translated to excitation energy Ex by using the reaction kinematics. The gamma energy (Eg) is measured with 30 LaBr3 detectors (OSCAR) mounted 16 cm from the target. The R(Eg,Ex) matrix is unfolded by the g-ray response functions and stored in the U(Eg,Ex) matrix. Then from this unfolded matrix, we obtain the energy distribution of the first-generation g-rays, which is called the primary matrix P(Eg,Ex). With some assumptions, this 2-dimensional landscape can be fitted by multiplying two vectors: the NLD *r* and transmission coefficient *T*. The various steps of the Oslo method and its assumptions will be explained and more details on the method are found in Refs. (1-4).

For low Ex, the NLDs are characterized by fluctuations due to nuclear structures like levels based on vibration and rotation. However, for higher Ex where Cooper pairs starts to be broken (Ex > 2∆), the excitation energy goes into breaking these pairs without increasing the nuclear temperature of the nucleus (analog to the melting of ice). This mechanism is reflected in the Oslo NLDs that take the form of a constant temperature NLD in the energy gap 2∆ < Ex < Sn. Several experimental NLDs will be shown that obey a constant nuclear temperature behavior. New KSHELL calculations are presented that reveal excellent descriptions of the experimental Oslo data.

The Oslo group may contribute with more than hundred experimental NLDs in the upcoming CRP on Updating Nuclear level densities for Applications.

References:

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