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The Inverse-Oslo method

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The recent measurement of the Neutron Star Merger event by LIGO [1] and subsequent optical measurements have revealed that Neutron star mergers are probably one of the primary sites for the r-process of nucleosynthesis [2]. An important source of uncertainty in the r-process models is the nuclear data input [3], especially important is the neutron capture cross-section which is directly observable for only a handful of nuclei close to stability.

The Oslo Method provides an alternative, indirect route to constrain the neutron capture cross-sections by providing the nuclear level density (NLD) and γ-ray strength function (γSF) which are important in Hauser-Feshbach calculations. The method requires experiments where the γ-ray distribution is measured as a function of excitation energy. This has been achieved for several years with transfer reactions with light ion beams, eg. p,d,^{3}He,α, at the Oslo Cyclotron Laboratory and more recently in β-decay experiments [4]. A new class of experiments have recently joined the 'Oslo Method family', namely the inverse kinematics experiment. The NLD and γSF of ^{87}Kr was successfully extracted from a experiment with a ^{86}Kr beam hitting a deuterated polyethylene target at iThemba LABS in early 2015. With the addition of inverse kinematics we are now able to probe the NLD and γSF of virtually any nuclei that can be accelerated in the lab. The γSF and NLD of ^{87}Kr will be presented together with Hauser-Feshbach calculations of the neutron capture cross-section of ^{86}Kr.

New developments are also happening at the Oslo Cyclotron Laboratory with the implementation of the Oslo SCintillator ARray (OSCAR), consisting of 30 large volume $LaBr_3$(Ce) detectors (3.5x8"). OSCAR is a substantial upgrade from the old CACTUS array (NaI-detectors) both in terms of improved energy and time resolution and efficiency. To compliment the new array, we have replaced the old analog data acquisition system to a new state-of-the-art digital system consisting of seven Pixie-16 digitizers (2 x 500 MHz, 5 x 250 MHz), allowing for much higher throughput. The new array will allow for new innovations in experimental techniques that could allow for extraction of NLD & γSF above the neutron separation energy and discrimination between neutron and γ-rays.

[1]: B. P. Abbott *et al.*, Phys. Rev. Lett. **119**, 161101 (2017)
[2]: E. Pian *et al.*, Nature **551**, 67-70 (2017)
[3]: M. R. Mumpower *et al.*, Prog. Part. Nucl. Phys. **86**, 86 (2016)
[4]: A. Spyrou *et al.*, Phys. Rev. Lett. **113**, 232502 (2014)

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