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Electric Dipole Response and multi-neutron decay of n-rich weakly bound nuclei

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We propose to study the dipole response of weakly bound neutron-rich nuclei close to the drip line via a measurement of the multi-neutron decay after heavy-ion induced electromagnetic excitation. The experiment will make use of the combination of NEBULA plus NeuLAND at SAMURAI, which allows the efficient detection of multi-neutron events. The physics cases selected are 8He, 24O, and 29F. The most important channels for the selected cases are 4n emission in case of 8He, 1n-4n emission in case of 24O, and 2n emission in the case of the Borromean nucleus 29F. In the latter case, the high 2n efficiency is particular important due to the relatively low beam rate of around 40 pps for 29F. All these measurements will be possible for the first time due to the combination of NEBULA and NeuLAND. Almost nothing is known for the dipole response of 8He due to the difficulty of 4n detection. The low energy part (2n channel to 6He) has been measured previously at GSI with insufficient statistics, while the α+4n channel could not be investigated at all. 8He is on the other hand an extremely interesting case since ab-initio calculations of the dipole response are possible (and will be available by end of the year). A previous GSI measurement of the Oxygen chain did not reach 24O due to too less intensity. For 23O, only the 1n channel could be measured. A completion of the oxygen chain would be very valuable due to the new development of RG ab-initio calculations extending the Lorentz-transform method to this region. These ab-initio calculations have reproduced the low-energy Pygmy peak observed in 22O in the previous GSI experiment. Finally, 29F is the heaviest neutron-rich Borromean nucleus reachable today. The dipole response of this nucleus, which will be reconstructed from the 27F+2n decay, will clarify the valence-neutron structure, its main configurations and extension. The experiment could be performed with the standard SAMURAI setup in neutron-configuration using NEBULA plus NeuLAND. For 8He and 24O, high-statistics high-quality data could be extracted for the B(E1) distribution challenging ab-initio theory. For 29F, the measurement would concentrate on the low-energy part (2n decay).

Primary author: Prof. AUMANN, Thomas (Technische Universitaet Darmstadt)

Presenter: Prof. AUMANN, Thomas (Technische Universitaet Darmstadt)

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