



Contribution ID: 1171

Type: **Invited Speaker / Conférencier invité**

Exploring the exotic landscape with direct reactions

Tuesday 14 June 2016 13:15 (30 minutes)

Nuclei far from stability offer us the scope of exploring new features that surface prominently at large isospin and weak binding. This led to the discovery of the nuclear halo bringing a new era in nuclear science breaking the boundaries of conventional concepts. The halo properties elucidate new features that till date remain a challenge to decipher from fundamental principles. Defining the nuclear force from the foundations built on quantum chromodynamics remains one of the major tasks in nuclear physics. The nuclear force is manifested in the characteristics of the nuclei and hence new efforts are underway to couple experiments of the exotic nuclei to ab initio theories.

Nuclear reactions are highly sensitive and definitive probes to unravel the unknown new features of the exotic nuclei and hence the nuclear interaction.

In this presentation we will introduce a new reaction spectroscopy facility, IRIS, using a novel thin windowless solid hydrogen target. Recent experiments from the facility will be discussed to show observation of halo related excitation modes in the neutron halo nucleus, ^{11}Li . To define the wavefunction of this Borromean halo nucleus, first exploration of its configuration with the unbound ^{10}Li sub-component will be presented. New observations at the proton-drip line exploring the nuclear force will also be discussed.

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Session Classification: T2-1 Nuclear Structure II (DNP) / Structure nucléaire II (DPN)

Track Classification: Nuclear Physics / Physique nucléaire (DNP-DPN)