Training in Advanced Low Energy Nuclear Theory

First week

Expectations: the student will be exposed to and will develop the formal aspects of scattering theory, and so appreciate the basic ingredients that support more advanced computations.

- Background - from many-body collisions to model descriptions with a few degrees of freedom, reaction classifications and timescales, effective interactions and Hamiltonians, the optical potential and mean-field. Review and hands-on studies of solutions of bound, resonant and continuum quantum two-body problems. (Monday, Week 1) – Lecturer Tostevin

- Scattering theory I: boundary conditions, differential and integral equation forms for single-channel, two-body systems. The R-matrix reaction approach. Study of the role of complex and Coulomb interactions on elastic scattering, examples and exercises. (Tuesday, Week 1) – Lecturer Nunes

- Scattering theory II: The Born series, the two-potential forms, exact and development of perturbative schemes. Comparison of differential and integral equation techniques. (Wednesday, Week 1)– Lecturer Nunes

- Scattering theory III: generalisation of differential and integral forms for many-channel problems, Born approximation and coupled channels, Feshbach P's and Q's, bare and effective channel interactions, illustrative examples and exercises. (Thursday, Week 1)– Lecturers Nunes, Moro

- Coupling interactions: Collective and cluster-like Coulomb and strong interaction couplings, nucleon and cluster-folding models, multipole expansions, B(Eλ) transition strengths and transition densities. Examples: e.g. inelastic reaction for a collective (rotational) nucleus, Coulomb excitation. (Friday, Week 1)– Lecturer Moro