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Séminaire de Physique Nucléaire Théorique

Advances in microscopic modeling of (n,xnγ) reactions for actinides

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Recent developments in nuclear structure approaches offer a great mean to improve various aspects of nuclear reaction modeling and to further understand reaction mechanisms from a microscopic point of view. Recently, direct and pre-compound nucleon emission, for nucleon induced reaction on spherical and axially deformed nuclei, have been successfully modeled [1] using a description of target states provided by fully consistent axially-symmetric deformed quasi-particle random-phase approximation (QRPA) calculations [2]. Direct inelastic scattering to target excitations built from one-phonon QRPA states accounted simultaneously for direct inelastic scattering to discrete states, and pre-equilibrium emission as far as second order processes, that involve more complex excitations such as two-phonon states, and multiple emission remain negligible. The QRPA nuclear structure approach has also been applied recently to determine, for a large pannel of even-even nuclei, E1 and M1 photon strength functions [3], that play a key-role in the modeling of statistical reactions.
We will review the status on the ongoing work on direct/pre-compound neutron emission for neutron induced reaction below 20 MeV for even-even actinides. Target states are described as rotational bands built from each state in the target intrinsic frame, described as QRPA one-phonon excitation of the intrinsic correlated ground state. QRPA excitations which display a collective character can thus be viewed as vibrational band heads. Couplings between states of the GS band and states belonging to an excited band are accounted for within a coupled channel framework.

Our approach in then applied to the modeling of (n,n'γ) reactions and for both intra- and inter-band gamma transitions [4]. For these reactions, the role played by the present microscopic approach for direct/pre-equilibrium emission is discussed. We finally focus on the impact on the determination of (n,n'γ) cross sections of newly calculated QRPA E1- and M1-photon strength functions, that enter the description of statistical decay from compound nucleus states in the continuum.

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