Relatório Científico Processo No. 2012/15157-0

Pierre Descouvemont

Durante a visita do Professor Pierre Descouvemont ao Instituto de Estudos Avançados da USP no período de 01/02/2013 a 18/05/2013, foram realizados vários atividades que destaco abaixo:

1) **O Professor Descouvemont colaborou comigo e com outros físicos na USP e da UFSP em projetos que constam no plano de trabalho. Inclusive, três trabalhos ja foram concluídos e aceitos/submetidos para publicações. O Professor Pierre e' também um membro do grupo de Astrofísica Nuclear do IEA-USP que coordeno, e a sua visita fortaleceu bastante a sua participação ativa no grupo.**

   Segue, a lista dos três artigos completados durante a visita do professor.

A) **"Nuclear Reactions in Stars: Theoretical and Experimental Aspects"**

Pierre Descouvemont, Mahir S. Hussein, Alinka Lepine-Szily

Abstract: We discuss general properties of nuclear reactions in stars. A brief overview of nuclear inputs required in stellar models is presented. We essentially focus on reactions involving light charged particles. A short description of the different nucleosynthesis processes is presented. We first discuss theoretical aspects, with emphasis on scattering theory, and on the different cross sections relevant in nuclear astrophysics. Different models are briefly described: the optical model, the Resonating Group method (RGM), and the Distorted Wave Born Approximation (DWBA). Then we present an overview of different experimental techniques, direct as well as indirect. In particular we focus on recent experiments involving radioactive beams.

UM CAPITULO NO LIVRO "The Universe Evolution: Astrophysical and Nuclear Aspects" QUE SERA PUBLICADO PELA EDITORA "NOVA" de New York (2013).

B) **"Role of the Hoyle State in ^{12}C + ^{12}C Fusion"**

Marlete Assunção, Pierre Descouvemont

Abstract: The ^{12}C + ^{12}C fusion reaction is investigated in a multichannel folding model, using the density-dependent DDM3Y nucleon-nucleon interaction. The ^{12}C (0^+_1 , 2^+ , 0^+_2 , 3^-) states are included, and their densities are taken from a microscopic cluster calculation. Absorption to fusion channels is simulated by a short-range imaginary potential, and the model does not contain any fitting parameter. We compute elastic and fusion cross sections simultaneously. The role of inelastic ^{12}C + ^{12}C channels, and in particular of the ^{12}C(0^+_1)+^{12}C(0^+_2) channel involving the Hoyle state, is important even at low energies. In the Gamow region, the energy range relevant in astrophysics, inelastic channels increase the S-factor by a factor of three.

ARTIGO ACEITO PARA PUBLICAÇAO NA REVISTA "PHYSICS LETTERS B" (2013).

C) **"Toward a microscopic description of reactions involving exotic nuclei"**

Pierre Descouvemont, Mahir S. Hussein

Abstract: We propose an extension of the Continuum Discretized Coupled Channels (CDCC) method, where the projectile is described by a microscopic cluster model. This microscopic generalization (MCDCC) only relies on nucleon-target interactions, and therefore presents an important predictive power. Core excitations can be included without any further parameter. As an example we investigate the ^{7}Li + ^{208}Pb elastic scattering at Elab = 27 and 35 MeV. The ^{7}Li nucleus is known to present an α+t cluster structure, and is well described by the Resonating Group Method. An excellent agreement is obtained for the ^{7}Li + ^{208}Pb cross sections, provided that breakup channels are properly included. We also present an application to inelastic scattering, and discuss future applications of the MCDCC.

ARTIGO A SER SUBMETIDO PARA PUBLICAÇAO NA REVISTA "PHYSICAL REVIEW LETTERS" (2013).

2) **O Professor Descouvemont apresentou uma palestra no IEA-USP com titulo "Nuclear Astrophysics: from Stars to Nuclei" no dia 22/04/2013 e um colóquio no IF-USP com o mesmo titulo no dia 03/05/2013. Além disso, Professor Pierre participou em discussões com bolsistas de doutorado na área de Física Nuclear no IFUSP.**

Mahir Saleh Hussein

São Paulo, 26 de maio de 2013