Modern Methods in Collision Theory - Applications in Nuclear Physics and in Few-body Physics

lundi 5 décembre 2011 - vendredi 9 décembre 2011

IPHC - Strasbourg

Programme Scientifique

Titles and short abstracts of the lectures are given below:

DWBA - Optical Models (N. Timofeyuk)

DWBA, Optical models, adiabatic approach to transfer reactions, peripheral reactions, interface with nuclear structure.

The phenomenological and theoretical R-matrix Method (P. Descouvemont)

The R-matrix Method is widely used in theory and experiment to analyze cluster states and in the cross-section calculations.
Lectures and computational sessions will be devoted to both the theoretical and phenomenological approaches of this subject.

Introduction to few-body methods via the Faddeev formalism (R. Lazauskas)

This lecture aims to give a short introduction on few-body methods based on the resolution of the Faddeev-Yakubowski equations. More specifically, the following items will be studied: 1) Numerical methods for bound and scattering state problems: collocation method, inverse iteration method, power method,..
(examples, excercises for 2-body case)
2) 3-body problem
3) Faddeev equation in configuration space
4) Solution of Faddeev equation
(simplistic examples, excercises)

Introduction to the Continuum Discretized Coupled Channel method (Theory) (P. Chau Huu Tai)

The main goal of this lecture is to present a short overview of the coupled channel
approach to compute direct reaction cross section in nuclear Physics.
The formalism will be illustrated by studing deuteron scattering.
The coupled channel equations will be derivate for elastic X(d,d)X,
inelastic X(d,d)X' and transfer X(d,3He)Y)
cross sections. We will also present some approximations commonly used to simplify the calculations of the
cross sections and we will study their effects on the calculated cross sections.

Coupled-channel effects in nuclear reactions induced by heavy ions: an experimental approach (C. Beck)

1) Inelastic and transfer channel couplings in fusion reactions induced by stable heavy ions are presented.
Analysis of experimental fusion cross sections by using standard coupled-channel calculations are discussed.
2) The breakup coupling in both the elastic scattering
and in the fusion process induced by weakly bound stable
projectiles is shown to be crucial. Therefore, data
analysis are performed in the framework of the CDCC
(continuum discretized coupled channel) approach.
3) Finally, we briefly present the most recent CDCC
analysis of nuclear reactions with exotic beams using
either 3-body or 4-body cluster models.

Alpha particle condensation in nuclear system (P. Schuck)

Spectra of lighter nuclei can often be interpreted via the bosonic degrees of freedom formed by the strongly bound alpha particles in contradiction of the fermionic degrees of freedom given by the nucleons in such nuclei. I will review the present situation of the possibility of
alpha particle condensation in self conjugate nuclei with possible
extensions to other non-selfconjugate ones. A short round up of quartet condensation in infinite matter in opposition to the well known pair
condensation will also be given.

Scattering theory on the momentum lattice: ultrafast calculations in few-body scattering (V. Kukulin)

Lecture/seminar consists of two parts:
(i) General formulation of the scattering theory on the momentum lattice.
(ii) Ultrafast calculations with graphics processors in the CUDA-architecture in few-body scattering.