

COLISIÓN DE SONDAS ELECTRODÉBILES CON NÚCLEOS Y ÁTOMOS

COLLISION OF ELECTROWEAK PROBES WITH NUCLEI AND ATOMS

Ref: FPA2008-04688

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Collision of electroweak probes with nuclei and atoms

Ref.: FIS2005-03577

Active: till December-2008

Why a 1-year project in FPA?

- to coincide in time with next application of F. Salvat's group

Monte Carlo simulation with PENELOPE: development of interaction models, characterisation of radiation beams and applications in Medical Physics (Ref.: FPA2006-12066)

Active: till end of 2009

- purpose: to apply for a coordinated project

Collision of electroweak probes with nuclei and atoms

Ref.: FIS2005-03577

70 kEuro (+ 13.3 kEuro of indirect costs)

- Nuclear structure
- Monte Carlo simulation of radiation transport

...before

Previous project

Collision of electroweak probes with nuclei and atoms
(FIS2005-03577)

Nuclear structure

1990-2004

- model to calculate cross sections for electron, photon and neutrino scattering by nuclei:
one-body currents + MEC + Short-range NN correlations
Woods-Saxon potential + Continuum + Optical potential
- elastic, inelastic and quasielastic reactions
- inclusive and exclusive (one- and two-nucleon emission)
- simple nuclear structure model:
difficult treatment of long-range correlations (e.g. RPA type)

Previous project

Collision of electroweak probes with nuclei and atoms (FIS2005-03577)

Nuclear structure

- fully self-consistent model with a general interaction:

$$V(r_{12}) = \sum_{i=1,8} V_i(r_{12}) O_i$$

$$O_i(r_{12}) = 1, \sigma \cdot \sigma, \tau \cdot \tau, \sigma \cdot \sigma \tau \cdot \tau, T, T \tau \cdot \tau, L \cdot S, L \cdot S \tau \cdot \tau$$

$$V_i(r_{12}) \equiv \text{zero/finite range}$$

HF + RPA (1p-1h) + (discretized/true) Continuum
+ SRPA (2p-2h) + (discretized/true) Continuum

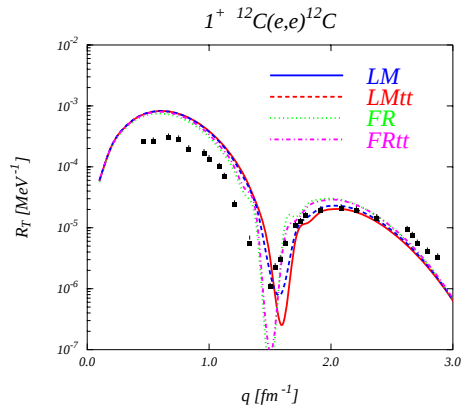
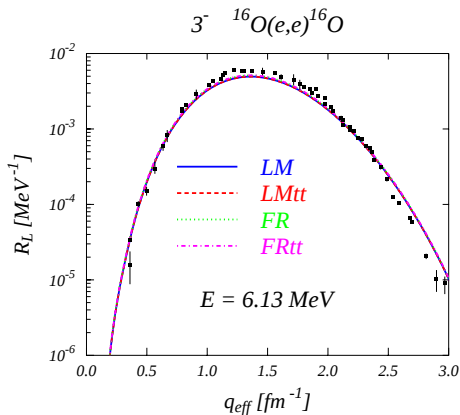
- role of the tensor part of the interaction

Previous project

Collision of electroweak probes with nuclei and atoms (FIS2005-03577)

Nuclear structure

why SRPA (2p-2h)?

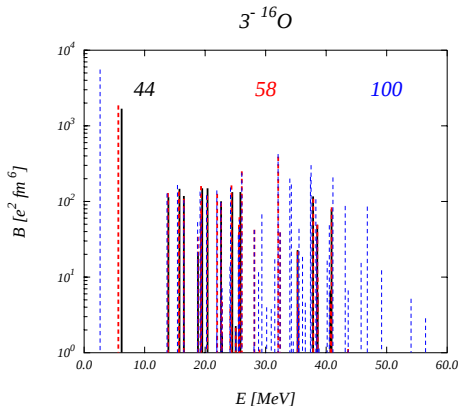


Previous project

Collision of electroweak probes with nuclei and atoms (FIS2005-03577)

Nuclear structure

why true continuum?



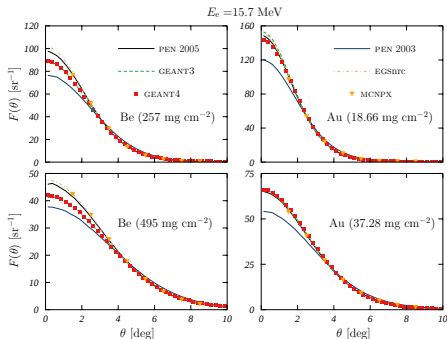
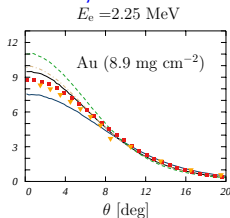
Previous project

Collision of electroweak probes with nuclei and atoms (FIS2005-03577)

Monte Carlo simulation of radiation transport

- comparison between MC codes in simple processes:
**electrons through thin material
slabs and air slabs**

PENELOPE, EGSnrc,
GEANT3, Geant4, MCNPX



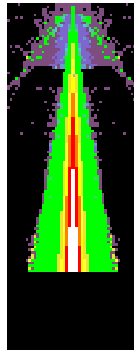
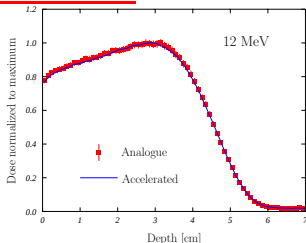
Previous project

Collision of electroweak probes with nuclei and atoms (FIS2005-03577)

Monte Carlo simulation of radiation transport

- development of ant colony algorithms for variance reduction in MC simulations

Simulation	CPU time
Analogue	220.0 h
Accelerated	5.3 h



this project

Collision of electroweak probes with nuclei and atoms (FPA2008-04688)

- Nuclear structure with electroweak probes
- Polarization effect in low-energy electron-atom collisions
- Variance reduction techniques in MC simulation of radiation transport

Model: HF+RPA+SRPA+Continuum

(+ our scattering model)

- nucleon photo- and electro-production reactions with polarization degrees of freedom
- elastic, inelastic and quasielastic electron collisions with exotic nuclei (ELISe@FAIR)
- neutrino-nucleus reactions

Objectives

Polarization effect in low-energy electron-atom collisions

Density functional model

- systematic in electron-atom cross sections
- introduction in the MC simulation code
PENELOPE

Ant colony algorithm applications

- dosimetry problems
(MOSFET and diamond dosimeters, ionization chambers)
- simulation of LINACs
- simulation of other irradiation devices
(Gamma Knife, brachytherapy sources, ...)

