

Theory support

WP2.4

Gert Aarts



This project has received funding from the European Union's Horizon Europe Research and Innovation programme under Grant Agreement No 101057511.

2 pillars:

- **ECT***, European Centre for Theoretical Studies in Nuclear Physics and Related Areas
Trento, Italy – Gert Aarts
- **Theo4Exp**: Virtual Access to well-established computing codes
Manuela Rodríguez-Gallardo (Universidad de Sevilla)

ECT*, European Centre for Theoretical Studies in Nuclear Physics and Related Areas

unique centre in Europe in theoretical nuclear physics in the broadest sense

main activity is annual programme of

- week-long workshops (about 22/year)
- Doctoral Training Programme (3-6 weeks)
- TALENT school (every other year)
- visitor programme

also a local research group with 5 permanent researchers, 3 postdocs and 2 PhD students



bottom-up approach:

- programme based on proposals submitted by the community
- two calls: in May and September, straightforward web form
- decision made at [ECT* Scientific Board](#) meeting in June and October

[ECT*](#) supports workshops via subsistence (coffee breaks, lunches, two dinners) and partial or full support for accommodation

travel pending on conditions of support (ECRs, EU Horizon upon request)

[ECT* Scientific Board](#)

[Almudena Arcones](#) | TU Darmstadt (D)

[Constantia Alexandrou](#) | The Cyprus Institute (CY)

[Carlo Barbieri](#) | University of Milan (I)

[Anna Corsi](#) | IRFU/DPhN (F)

[David Kaplan](#) | University of Washington (USA)

[Denis Lacroix](#) | CNRS/IN2P3 (F)

[Marek Lewitowicz](#) | NuPECC/GANIL (F)

[Barbara Pasquini](#) | University of Pavia (I)

[Urs Wiedemann](#), Board Chair | CERN-TH (CH)

Ex officio: [Sandro Stringari](#) | University of Trento (I)

to apply to organize a workshop:

- submit proposals via standard route (see website)
- mention EURO-LABS (not compulsory)
- **ECT* Scientific Board** selects workshops
- with Director determines which workshops are supported by EURO-LABS

to apply as participant:

- workshop registration opens two months before start of workshop
- key participants are often contacted at submission stage



In 2022: one workshop supported

**EXOTICO: EXOTIC ATOMS MEET
NUCLEAR COLLISIONS FOR A NEW
FRONTIER PRECISION ERA IN
LOW-ENERGY STRANGENESS
NUCLEAR PHYSICS**

October 17-21 2022

Theo4Exp virtual access infrastructure: provide theoretical tools for the EURO-LABS project and wider experimental nuclear physics community

3 installations:

- **MeanField4Exp** (Krakow): access to mean-field theory service in the domain of nuclear structure physics. Deputies: Jerzy Dudek (IPHC Strasbourg)/Piotr Bednarczyk (Krakow)
- **Reaction4Exp** (Sevilla): codes used for nuclear reaction calculations.
Coordinator: Manuela Rodríguez-Gallardo
- **Structure4Exp** (Milano): virtual access to other codes that use advanced tools of nuclear structure theory. Deputy: Gianluca Coló

website: institucional.us.es/theo4exp/

Coordinating Team (CT)

- Coordinator: Manuela Rodríguez-Gallardo
- Deputies: Jerzy Dudek and Gianluca Coló

International Review Panel (IRP)

- Piotr Bednarczyk (Chairperson) and Krzysztof Rusek
- Antonio M. Moro and Ian J. Thompson
- Enrico Viguzzi and Angela Gargano

IRP will meet annually to produce yearly internal assessment reports.

CT will provide the IRP a comprehensive list of results and achievements, access statistics and user feedback.

First IRP meeting: September 8 2022

MeanField4Exp

Theo4Exp

Manuela
Rodríguez
Gallardo

- 1 Static macroscopic nuclear energies and macroscopic energies vs spin (Lublin-Strasbourg-Drop (**LSD**))
- 2 Quasiparticle Routhians and alignments, Yrast and quasiparticle band energies and moments of inertia (**HBF-Cranking**)
- 3 Energies and structures of nuclear K- and yrast-tarp isomers
- 4 Giant Dipole Resonance profiles at increasing spins and temperatures
- 5 Nuclear density functions for deformed nuclei
- 6 Larger sets of pre-calculated results such as potential energy maps, electric and mass moments, reduced probabilities

LSD program: K. Pomorski and J. Dudek, PRC 67 (2003) 044316

Reaction4Exp

Theo4Exp

Manuela
Rodríguez
Gallardo

- 1 Optical Model calculations: **FRESCO**
(<http://www.fresco.org.uk/>)
- 2 Coupled-Channels calculations: **FRESCO**
- 3 Semiclassical calculations (high energy collisions):
EPM_SEV
Example: V. Pesudo et al., Phys. Rev. Lett. 118 (2017) 152502
- 4 Double folding potentials from density distributions:
 - **DFPOT**
J. Cook, Comp. Phys. Comm. 25(2), 125-139 (1982)
 - **SPP**
L.C. Chamon, B.V. Carlson and L.R. Gasques, Comp. Phys. Comm. 267 (2021) 108061

Structure4Exp

Theo4Exp

Manuela
Rodríguez
Gallardo

- 1 Binding energies, density distributions and mean square radii ([skyrme_rpa](#), [hfbcs_qrpa](#))
- 2 Energies and wave functions/transition densities of the excited states, as well as electromagnetic transition probabilities to the ground state ([skyrme_rpa](#), [hfbcs_qrpa](#))
- 3 Calculations of charge-changing transitions
- 4 Beta-decay half-lives

→ [skyrme_rpa](#)

G. Colò et al., Comp. Phys. Comm. 184, 142 (2013)

→ [hfbcs_qrpa](#)

G. Colò and X. Roca-Maza, arXiv:2102.06562 [nucl-th]

Personnel (milestone for month 18):

- **MeanField4Exp** (IFJ PAN, Krakow): 2-year contract
computer scientist to implement mean-field theory codes for large-scale calculations of nuclear structure; responsible for programming and management of user-friendly web interface
- **Reaction4Exp** (U. Sevilla): 2-year contract
computer scientist for programming and management of user-friendly web interface
- **Structure4Exp** (U. Milano): 1-year contract
computer scientist to improve existing nuclear structure codes; responsible for programming and management of user-friendly web interface

Servers: codes will run on new or existing servers, agreed with university computer centres

Access:

- free access contents in the webpage, collect feedback but not counted as unit of access
- possibility to run remotely some codes and download results, download pre-calculated data and some computer codes
- users apply to verify link to institutions; will receive access codes
- **question**: access to users outside of Europe?

Details to be added to website: institucional.us.es/theo4exp/

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