WP2.4: Research infrastructures offering theoretical support for experiments

Manuela Rodríguez-Gallardo

On behalf Gert Aarts (ECT*)

Universidad de Sevilla

Krakow, 10th October 2023

WP2.4: Theoretical support

→ Leading Task 4: Gert Aarts

- 4.1) ECT*, European Centre for Theoretical Studies in Nuclear Physics and Related Areas
  Leading Gert Aarts

- 4.2) Theo4Exp Virtual Access Infrastructure
  Leading Manuela Rodríguez-Gallardo

ECT*, Trento (Italy)

ECT* mission

- ✓ to be a Centre at the frontline of research in theoretical nuclear physics
- ✓ to promote active contacts between theory and experiments, and to related areas of research
- ✓ to further the training of young researchers

- established in **1993 (30 years ago!)**
- Institutional member of ESF-Expert Committee NuPECC (Nuclear Physics European Collaboration Committee)
- community-driven, bottom-up approach

FONDAZIONE BRUNO KESSLER
ECT*
EUROPEAN CENTRE FOR THEORETICAL STUDIES IN NUCLEAR PHYSICS AND RELATED AREAS
SYMPOSIUM IN OCCASION OF THE 30TH ANNIVERSARY OF ECT*
OCTOBER 4TH, 2023
ECT* | Aula Leonardi
PROGRAMME
1993-2023
9.00 - 10:00 Welcome and introduction by invited guests
10:00 - 10:45 Computing the Heart of Matter
Sonia Bacca (University of Mainz)
10:45 - 11:15 Coffee break
11:15 - 12:00 Ab-initio Nuclear Physics in Trento
Francesco Pederiva (University of Trento)
12:00- 14:00 Lunch at Villa Tambosi
14:00 - 14:45 Color Glass Condensate in Collider Physics
Dionysios Triantafyllopoulos (ECT*)
14:45 - 15:30 Cosmic Laboratories for Nuclear Physics
Almudena Arcones (TU Darmstadt)
15:30-16:00 Coffee break
16:00 - 16:45 Cosmic Thirty Years of Education and Research on Nuclear Many-Body Physics at the ECT*; from traditional methods to quantum computing and machine learning
Morten Hjorth-Jensen (Michigan State University, USA and University of Oslo, Norway)
16:45 - 17:30 Quantum Fractals
Ubirajara Van Kolck (IJCLab Orsay & University of Arizona)
18:00 Dinner at Villa Tambosi
ECT* | Villazzano, Trento, Strada delle Tabarelle 286
Info: staff@ectstar.eu
The ECT* is part of the Fondazione Bruno Kessler. The Centre is funded by the Autonomous Province of Trento, funding agencies of EU Member and Associated states, and by INFN-TIFPA and has the support of the Department of Physics of the University of Trento

FONDAZIONE BRUNO KESSLER
ECT*
EUROPEAN CENTRE FOR THEORETICAL STUDIES IN NUCLEAR PHYSICS AND RELATED AREAS
1993-2023
7 OTTOBRE 2023
ORE 17.00
Aula Grande - Fondazione Bruno Kessler
Via Santa Croce 77 - Tento
LAURA FABBIETTI
IL LUNGO VIAGGIO DEGLI ANTINUCLEI
Gli antinuclei sono immagini speculari dei normali nuclei atomici, con la stessa massa ma carica opposta.
Non esistono fonti naturali di antinuclei sulla Terra, ma possono essere prodotti in laboratorio presso grandi acceleratori di particelle.
Gli antinuclei vengono cercati anche nello spazio, perché potrebbero essere la chiave di uno dei più grandi misteri della fisica: la materia oscura. La materia oscura è onnipresente e rappresenta cinque volte la massa di tutta la materia che possiamo osservare sotto forma di stelle nel cielo, pianeti e tutto il gas intermedio nelle galassie. Non è però possibile vedere o toccare la materia oscura perché non interagisce con la luce o con le forze elettriche.
Gli antinuclei offrono un nuovo modo di guardare nello spazio per cercare la materia oscura in quanto essa può interagire per creare antinuclei altrimenti quasi assenti.
Come possiamo trovare queste particelle nello spazio?
Quali proprietà dobbiamo conoscere?
E da dove possono provenire gli antinuclei nello spazio?
Durante l'evento approfondiremo queste domande e seguiremo il lungo viaggio degli antinuclei dal centro della nostra galassia alla Stazione Spaziale Internazionale nello spazio.
EVENTO PUBBLICO IN OCCASIONE DEL TRENTESIMO ANNIVERSARIO DI ECT*
INFORMAZIONI
staff@ectstar.eu
ECT* fa parte della Fondazione Bruno Kessler. Il Centro è finanziato dalla Provincia Autonoma di Trento, dalle agenzie di finanziamento degli Stati membri e associati dell'UE, dall'INFN-TIFPA e gode del supporto del Dipartimento di Fisica dell'Università di Trento.
La Prof.ssa LAURA FABBIETTI si è laureata in fisica all'università Statale di Milano ed è docente di fisica nucleare presso l'Università Tecnica di Monaco (TUM). Nel 2007 ha diretto un gruppo diricerca Helmholtz junior alla TUM in stretta collaborazione con la Gesellschaft für Schwerionenforschung (GSI) e, dal 2008, un gruppo di ricerca junior dell'Universe Cluster of Excellence. Nel 2011 ha vinto la cattedra presso la TUM, dove dirige la divisione di Density and Strange Hadronic Matter. Oggi è uno degli scienziati di punta del Cluster of Excellence ORIGINS e dell'Area Speciale di Ricerca 1258. La Prof.ssa Fabietti conduce i suoi esperimenti all'LHC del CERN nell'ambito della collaborazione ALICE.

ECT* Scientific Board

membership suggested
by ECT* associates
3-year term

Almudena Arcones | TU Darmstadt (D)

Constantia Alexandrou | University of Cyprus & The Cyprus Institute (CY)

David Kaplan | University of Washington (USA)

Denis Lacroix | CNRS/IN2P3 (F)

Marek Lewitowicz | NuPECC/GANIL (F)

Alexandre Obertelli | TU Darmstadt (D)

Barbara Pasquini | University of Pavia (I)

Vittorio Somà | CEA Saclay (F)

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

Ex officio: Albino Perego | University of Trento (I)

FONDAZIONE BRUNO KESSLER
ECT* EUROPEAN CENTRE FOR THEORETICAL STUDIES IN NUCLEAR PHYSICS AND RELATED AREAS

2023 PROGRAMME OF ACTIVITIES

JANUARY
30.1-2.2 **Structure and topology of RNA in living systems**
L. TUBIANA (University of Trento), S. PASQUALI (University Paris Cité), A. BOZIC (IJS, Ljubjlana)

FEBRUARY
20-24.2 **LaVA Meeting**
C. BONANNO (INFN Firenze), M. P. LOMBARDO (INFN Firenze), M. PEARDON (Trinity College Dublin)

MARCH
13-17.3 **Holographic Perspectives on Chiral Transport**
K. LANDSTEINER (IFT-UAM/CSIC Madrid), U. GURSOY (University of Utrecht), M. KAMINSKI (University of Alabama), D. KHARZEEV (Stony Brook)

20-24.3 **The Gradient Flow in QCD and other Strongly Coupled Field Theories**
C. MONAHAN (William & Mary), R. HARLANDER (University of Aachen), A. HASENFRATZ (University of Colorado, Boulder), O. WITZEL (Siegen University)

MAY
2-5.5 **Quantum Science Generation | QSG**
D. DE BERNARDIS (INO-CNR BEC Center), V. AMITRANO (University of Trento - INO-CNR), A. BALDAZZI (University of Trento), A. BERTI (University of Trento - INO-CNR), I. CARUSOTTO (INO-CNR BEC Center), D. CONTESSI (University of Trento - INO-CNR), A. NARDIN (University of Trento - INO-CNR), L. PAVESI (University of Trento, Italy)

15-19.5 **Color Glass Condensate at the Electron-Ion Collider***
D. TRIANTAFYLLOPOULOS (ECT*), N. ARMESTO (University of Santiago de Compostela), E. IANCU (University of Paris-Saclay, IPhT), T. LAPPI (University of Jyväskylä)

22-26.5 **From First-Principles QCD to Experiments***
M. HUBER (Giessen University), G. EICHMANN (LIP Lisboa), M. P. LOMBARDO (INFN Firenze), P. MARIS (Iowa State University), J. M. PALOWSKI (Heidelberg University)

29.5-1.6 **2nd CMS Heavy Ion Workshop: Bringing Together the LHC Heavy Ion Community**
G. KRINTIRAS (The University of Kansas), Y.J. LEE (MIT), W. LI (Rice University), C. LOURENCO (CERN), A. STAHL (CERN)

JUNE
5-9.6 **Nuclear and Particle Physics on a Quantum Computer: Where do we stand now?**
A. BAZAVOV (Michigan State University), Z. DAVOUDI (University of Maryland), D. LEE (Michigan State University), A. ROGGERO (University of Trento)

12-16.6 **Precision Tests of Fundamental Physics with Light Mesons ***
S. SCHADMAND (GSI Darmstadt), I. JAEGLE (Jefferson Lab), B. KUBIS (HISKP Bonn), D. LERSCH (FSU Tallahassee)

19-23.6 **Quantum Simulation of Gravitational Problems on Condensed Matter Analog Models**
I. CARUSOTTO (INO-CNR BEC Center), R. BALBINOT (University of Bologna), G. FERRARI (University of Trento), M. RINALDI (University of Trento)

26-30.6 **Machine Learning for Lattice Field Theory and Beyond**
D. HACKETT (MIT), G. AARTS (Swansea University & ECT*), D. BACHTIS (Swansea University), B. LUCINI (Swansea University). P. SHANAHAN (MIT)

JULY
3-7.7 **COLMO: Quantum Collapse Models investigated with Particle, Nuclear, Atomic and Macro systems**
C. CURCEANU (INFN-LNF), A. BASSI (University and INFN Trieste), M. DERAKHSHANI (Rutgers University), L. DIOSI (University Budapest), S. DONADI (INFN Trieste), K. PISCICCHIA (CREF)

10-28.7 **Doctoral Training Program: Ab Initio Methods and Emerging Technologies for Nuclear Structure**
C. BARBIERI (University of Milan), A. ROGGERO (University of Trento)

10-14.7 **Tensor Spin Observables ****
K. SLIFER (University of New Hampshire), D. HIGINBOTHAM (JLab), D. KELLER (University of Virginia), E. LONG (Universityof New Hampshire)

17-21.7 **Short-Distance Nuclear Structure and PDF ***
N. FOMIN (University of Tennessee), J. ARRINGTON (LBNL), W. COSYN (Florida International University), N. ROCCO (FermiNational Laboratory)

31.7-4.8 **Quantum Sensing and Fundamental Physics with Levitated Mechanical Systems**
A. VINANTE (IFN-CNR), D. BUDKER (Johannes Gutenberg University Mainz), G. HETET (École Normal Supérieure Paris), H. Ulbricht (University of Southampton)

AUGUST
21-25.8 **ECT*-APCTP Joint Workshop: Exploring Resonance Structure with Transition GPDs ***
S. DIEHL (Justus Liebig University Giessen), V. BRAUN (University Regensburg), K. JOO (University of Connecticut), Y. OH (Kyungpook National University), C. VAN HULSE (University of Alcala, Madrid), C. WEISS (Jlab)

SEPTEMBER
4-8.9 **Many-Body Quantum Physics with Machine Learning**
A. RIOS HUGUET (Institute of Cosmos Sciences, University ofBarcelona), G. CARLEO (EPFL), E. INACK (PITP), A. LOVATO (ANL & TIFPA)

11-15.9 **MICRA2023: Microphysics in Computational Relativistic Astrophysics***
E. O'CONNOR (Stockholm University), C. FROHLICH (Carolina State University), A. PEREGO (University of Trento)

18-22.9 **Parton Distribution Functions at a Crossroad ***
M. DING (Helmholtz Centrum Dresden Rosendorf), J. PAPAVASSILIOU (University of Valencia), C. QUINTANS (LIP, Lisbon), C. ROBERTS (Nanjing University)

25-29.9 **Strongly Interacting Matter in Extreme Magnetic Fields ***
S. VARESE (UNICAMP), A. AYALA (UNAM), D. BLASCHKE (University of Wroclaw), G. ENDRODI (University of Bielefeld), R. FARIAS (Universidade Federal de Santa Maria)

OCTOBER
9-13.10 **ROCKSTAR: Towards a ROadmap of the Crucial measurements of Key observables in Strangeness reactions for neutron sTARs equation of state ****
A. SCORDO (LNF-INFN), D. BOSNAR (University of Zagreb), C. CURCEANU (LNF-INFN), A. RAMOS (Institut de Ciències del Cosmo, Barcelona), F. SAKUMA (RIKEN) O. VAZQUEZ-DOCE (LNF-INFN), I. VIDANA (INFN Catania)

23-27.10 **Critical Stability of Few-Body Quantum Systems ***
A. KIEVSKY (INFN Pisa), T. FREDERICO (Instituto Tecnologico de Aeronautica), O. FYNBO (Aarhus University), J.M. RICHARD (Institut de Physique des 2 Infinis de Lyon)

NOVEMBER
20-24.11 **ALPACA: modern ALgorithms in machine learning and data analysis: from medical Physics to research with ACcelerAtors and in underground laboratories ****
F. NAPOLITANO (INFN Frascati), R. DEL GRANDE (TU Munich), F. GROSA (CERN), M. SKURZOK (Jagiellonian University Krakow)

** STRONG-2020 supported workshop ** EUROLABS supported workshop*

The ECT* is part of the Bruno Kessler Foundation. The Centre is funded by the Autonomous Province of Trento, funding agencies of EU Member and Associated States, INFN-TIFPA, and has the support of the Department of Physics of the University of Trento. The Director of the ECT* is Prof. Gert Aarts (Trento and Swansea University)
For information: staff@ectstar.eu | www.ectstar.eu

2023 Activities

full programme:

24 workshops and collaboration meetings from January to November

selected by Scientific Board

DTP: Ab Initio Methods and Emerging Technologies for Nuclear Structure

From hybrid to the new(er) normal

- aim is to stimulate scientific discussion in an informal and creative environment
- hence, ECT* returns to in-person participation as the preferred way of interaction
- to build on the past experiences and to support an inclusive global research community, presentations at workshops may be broadcast via zoom

EURO-LABS supported meetings

- EXOTICO: EXOTIc atoms meet nuclear COllisions for a new frontier precision era in low-energy strangeness nuclear physics 17-21/10 2022, **49** participants, **8** participants supported
- Tensor Spin Observables 10-14/7 2023, **24** participants, **4** participants supported
- DTP Ab Initio Methods and Emerging Technologies for Nuclear Structure 10-28/7 2023, **33** participants, **15** participants supported

DTP 2023: Ab Initio Methods and Emerging Technologies for Nuclear Structure

- 10-28 July 2023

organizers:

- Carlo Barbieri

  (University of Milan, INFN)

- Alessandro Roggero

  (University of Trento)

- 33 participants

supported by

EURO-LABS
EUROPEAN LABORATORIES FOR ACCELERATOR BASED SCIENCES

EURO-LABS supported meetings: comments

- ECT* Scientific Board is selection panel
- only 3 meetings supported so far: preserve financial support until after STRONG-2020 ends (May 2024)
- 2024: 31 workshop proposals submitted, 22 selected, EURO-LABS assignment to follow

WP2.4: Research infrastructures offering theoretical support for experiments

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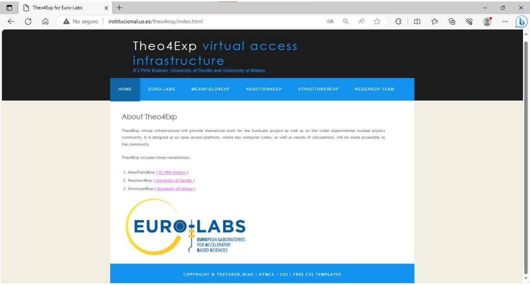
Theo4Exp

institucional.us.es/theo4exp



Theo4Exp Virtual Access Infrastructure

- Theo4Exp virtual access infrastructure will provide theoretical tools for the EURO-LABS project as well as for the wider experimental nuclear physics comm.
- 3 installations:
  - MeanField4Exp (Kraków): will provide access to mean-field theory service in the domain of nuclear structure physics. Deputies: Jerzy Dudek (IHPC/CNRS & Strasbourg U.)/ Piotr Bednarczyk
  - Reaction4Exp (Sevilla): will provide codes used for nuclear reaction calculations. Coordinator: Manuela Rodríguez-Gallardo
  - Structure4Exp (Milano): will provide virtual access to other codes that use advanced tools of nuclear structure theory. Deputy: Gianluca Coló

Contracted personnel

- MeanField4Exp(IFJ PAN, Kraków): 2-year contract
  - Dr. Abdelghafar Gaamouchi, from 02/2023.
- Reaction4Exp (U. Sevilla): 2-year contract
  - Carla Muñoz (Master), from 09/2023.
- Structure4Exp (U. Milano): 1-year contract
  - Dr. Imane Moumene, from 03/2023.

International Review Panel (IRP)

- Members: Piotr Bednarczyk (Chairperson, IFJ PAN), Krzysztof Rusek (UW), Antonio M. Moro (USE), Ian J. Thompson (LLNL), Enrico Vigezzi (UMIL) and Angela Gargano (INFN)
- Second meeting took place (online) on 20th September 2023 with participation of the Coordinating Team (Manuela Rodríguez-Gallardo, Jerzy Dudek and Gianluca Colò) and the Coordinator of WP2 (Adam Maj).
- Two points to highlight:
  - The user authentication has to be the simplest as possible and open to all potential users.
  - It is necessary to make institutions see that this new infrastructure is beneficial to them and therefore it will be necessary to invest on it for maintenance.

User authentication

WP2.4: Research infrastructures offering theoretical support for experiments

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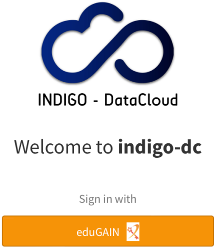
- We have an application developed by WP5.2 EURO-LABS to control the user access: https://iam-eurolabs.ijclab.in2p3.fr



User authentication

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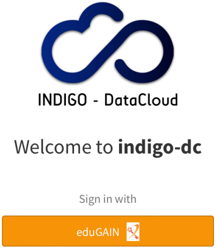
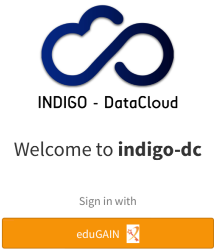
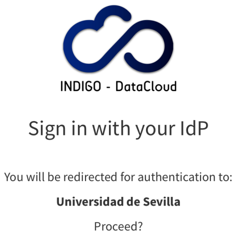
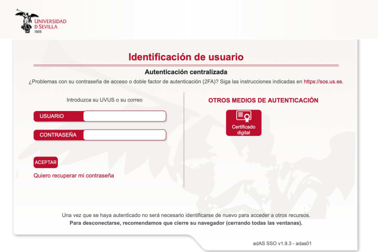


- We hope soon to include other identity networks like ORCID

At the moment, access via institutional identity provider (IdP)







What about the platform for each installation?

WP2.4: Research infrastructures offering theoretical support for experiments

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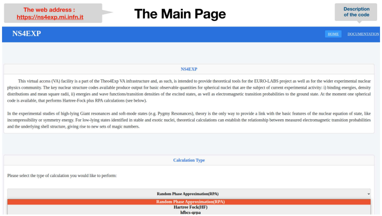

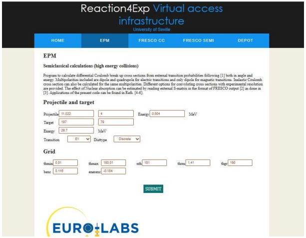

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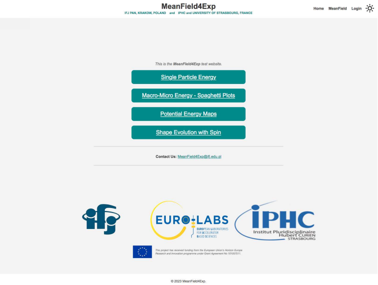
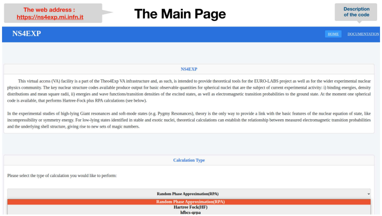
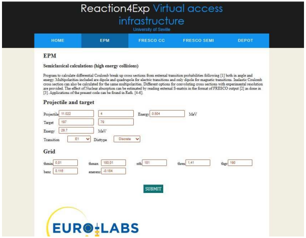
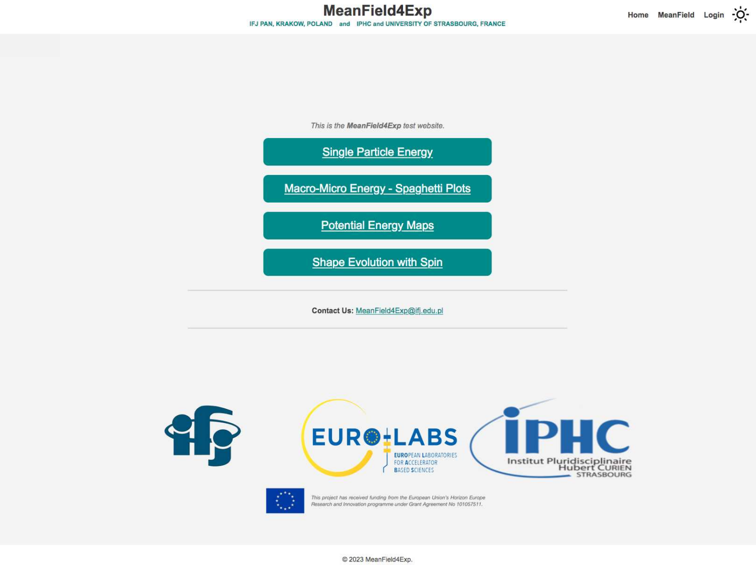






Let's see!

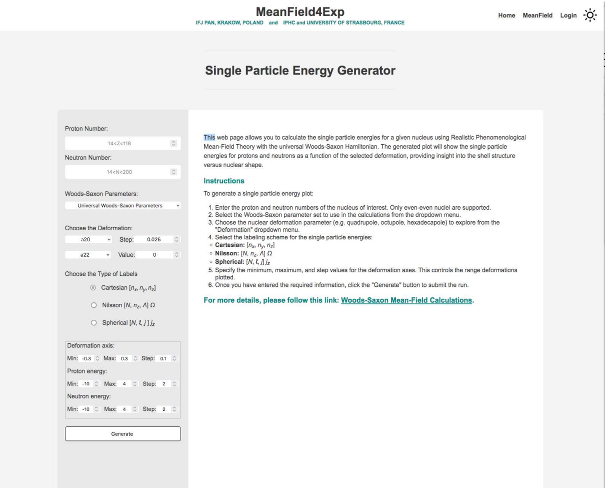
Meanfield4Exp platform (Kraków)



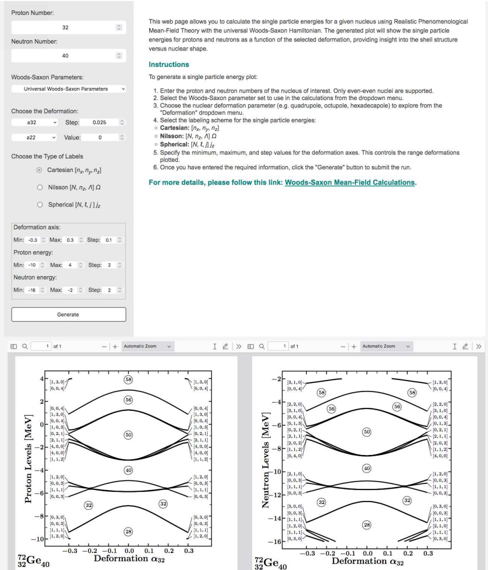
Meanfield4Exp: Single particle energy (1)

List of propositions for the user choice

Guidelines



Meanfield4Exp: Single particle drawings



Example

$Z = 32,\ N = 40$, oct. def.

Meanfield4Exp: Macro-micro energy (2)

MeanField4Exp

IFJ PAN, KRAKOW, POLAND and IPHC and UNIVERSITY OF STRASBOURG, FRANCE

Home MeanField Login

Macro-Micro Energy - Spaghetti Plots Generator

Proton Number: 40

Neutron Number: 40

Δ Z: 6 Δ N: 6

Woods-Saxon Parameters: Universal Woods-Saxon Parameters

Choose the Type of Energy: Total energy = E(FYU) + Shell[e] + Correlation[

Choose the Deformation: a32 Step: 0.025

a20 Value: 0

Deformation axis: Min: -0.3 Max: 0.3 Step: 0.1

Isotopes energy: Min: -4 Max: 12 Step: 2

Isotones energy: Min: -4 Max: 12 Step: 2

Generate

This form allows you to generate spaghetti plots of the macro-micro energy for a chain of isotopes and isotones using

Realistic Phenomenological Nuclear Mean-Field Theory Calculations
with the
Universal Woods-Saxon Hamiltonian.

Instructions for Formatting the Plot

1. **Specification of the Nucleus and Parametrisation**

   Choose a central nucleus by entering the proton and neutron numbers.

   Select the range of nuclei by adjusting Δ Z and Δ N.

   "Woods-Saxon Parameters" allows you to select a parameter set for the Woods-Saxon Hamiltonian from the dropdown menu.

2. **Energy Specifications**

   Choose the variant of the total energy formula according to which

   $$E_{tot} = E_{Macro} + E_{shell} + E_{pairing}$$

   The macroscopic energy, E_{Macro}, appears in two variants, the so-called Yukawa-folded [E(FYU)] and the Lublin-Strasbourg Drop [E(LSD)] liquid drop models. The standard Strutinsky shell-correction energy is denoted E_{shell}, whereas the pairing term, E_{pair}, can be chosen in the form of the so-called pairing correlation energy with a simple (BCS) approximation or a more advanced Particle Number Projection (PNP) approximation.

   Those interested can find the original references clicking "Reference List".

3. **Description of Nuclear Deformation**

   "Choose the Deformation" Allows you to select the nuclear deformation from the dropdown menu.

   Deformation axis, Isotope energy, and Isotone energy allow you to adjust the x and y axes.

4. **Execution**

   Once all input data is specified, click "Generate" to submit the run.

   For more details, please follow the link: Woods-Saxon Mean-Field Calculations.

Meanfield4Exp: Total energy drawings

WP2.4: Research infrastructures offering theoretical support for experiments

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Proton Number: 32

Neutron Number: 40

Δ Z: 6 Δ N: 6

Woods-Saxon Parameters: Universal Woods-Saxon Parameters

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Choose the Deformation: a32 Step: 0.025

a20 Value: 0

Deformation axis: Min: -0.3 Max: 0.3 Step: 0.1

Isotopes energy: Min: -4 Max: 12 Step: 2

Isotones energy: Min: -4 Max: 12 Step: 2

Generate

This form allows you to generate spaghetti plots of the macro-micro energy for a chain of isotopes and isotones using

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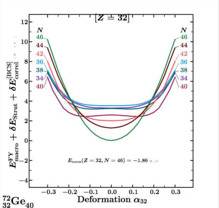
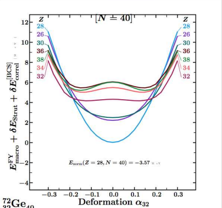




Meanfield4Exp: Potential energy maps (3)

Nuclear Potential-Energy Maps Generator

Proton Number: 32

Neutron Number: 40

Choose the Type of Energy: Total energy = E(FYU) + Shell[e] + Correlation[

Step: 0.5 Smoothing: 0

Deformation:

List of 3D/4D Deformation Spaces: bet, gam, a40

X axis	Y axis	Min1	Min2
bet	gam	a40	

Choose a range of deformation

X-axis:

Min: 0 Max: 1.2 Step: 0.2

Y-axis:

Min: -0.8 Max: 0.8 Step: 0.2

Table of the Energy Minima

Generate

Welcome to the Nuclear Potential-Energy Maps Generator allowing you to explore the elementary shape properties of atomic nuclei using

Realistic Phenomenological Nuclear Mean-Field Theory Calculations
with the
Universal Woods-Saxon Hamiltonian.

To design the appearance of the potential-energy map you are interested in, please employ the formatting table located on the left side of the page. This formatting table will allow you to choose the parameters needed by the algorithms to generate a map of the nuclear potential energy surface for the atomic nucleus which you define to start with.

Instructions for formatting the drawing

1. **Specification of the nucleus**

   Select the proton and neutron numbers of the nucleus needed. For information: our data base contains the results pre-calculated only for even-even nuclei.

2. **Energy specifications**

   Choose the variant of the total energy formula according to which

   $$E_{tot} = E_{Macro} + E_{shell} + E_{pairing}$$

   The macroscopic energy, E_{Macro}, appears in three variants, the so-called Yukawa-folded [E(FYU)], Lublin-Strasbourg Drop [E(LSD)], and `traditional' Myers-Swiatecki [E(M-S)] liquid drop models. The standard Strutinsky shell-correction energy is denoted E_{shell}, whereas the pairing term, E_{pair}, can be chosen in the form of the so-called pairing correlation energy with a simple (BCS) approximation or a more advanced Particle Number Projection (PNP) approximation.

   Those interested can find the original references clicking "Reference List"..

3. **Map appearance and format specifications**

   The size of the colour stripes [in MeV] for the energy contour plotting can be adjusted by using the input box Step. The user can influence the aesthetic aspects such as the smoothness of the contour lines via the input field Smoothing.

4. **Description of nuclear deformation**

   The user can select among the potential energy surfaces calculated using multiprocessor computer systems within an ensemble of 3D and 4D (3-dimensional and 4-dimensional original deformation spaces). The graphical representation corresponds to choosing two deformation variables as x-, and y-coordinates. The total energies are minimised over the remaining variables at the disposal. In particular, in the case of a 3D space of deformations d1, d2 and d3 the user can select projections (d1,d2), alternatively (d1,d3) or (d2,d3). In the case of the 4D spaces the user will have 6 independent choices at her/his disposal.

   Our system is being intensively developed — but at present we offer only one illustrative variant, probably the most often found in the literature, namely a_{20}, a_{22} and a_{40} (also known under the notation (beta, gamma) and $beta_4$).

   By default, our algorithm displays the whole range of the pre-calculated deformation space. However, the user can customise the deformation ranges by selecting the option "Choose the range of deformation". By clicking the user displays self-explanatory input fields for the minimum, maximum, and step values for the x- and y-axes.

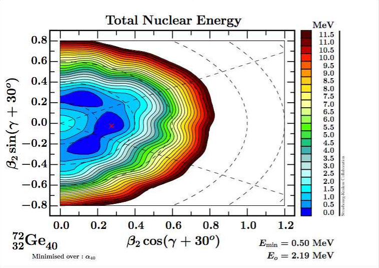
5. **Execution**

   Once all the input data are specified, click the "Generate" button to submit the run.

For more details, please follow the link: Woods-Saxon Mean-Field Calculations.

Meanfield4Exp: Total energy map drawings

Potential energy contour | **Table of minima**



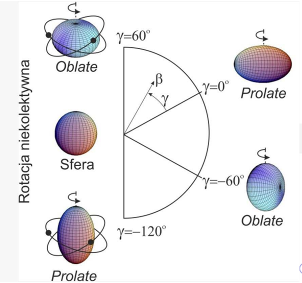
Strasbourg-Krakow Collaboration

Nucleus $^{72}_{32}Ge_{40}$

- **Total Energy:** E(FYU) + Shell[e] + Correlation[BCS]
- **Minimum Energy:** $E_{min} = 0.50$ MeV
- **Spherical-point Energy:** $E_o = 2.19$ MeV

Energy [MeV]	$\beta_2 \cos(\gamma + 30^o)$	$\beta_2 \sin(\gamma + 30^o)$	α_{40}	β	$\gamma(^o)$
0.0000	0.275	-0.025	-0.025	0.276	-35
0.0015	0.125	0.250	-0.025	0.280	33
0.0718	0.150	-0.225	0.000	0.270	-86

Table 1: Map Energy minima for $Z = 32$, $N = 40$; Com-OxCaCANiZrSnGdPb. Dark-red rows mean minimum at the edge of the rectangle



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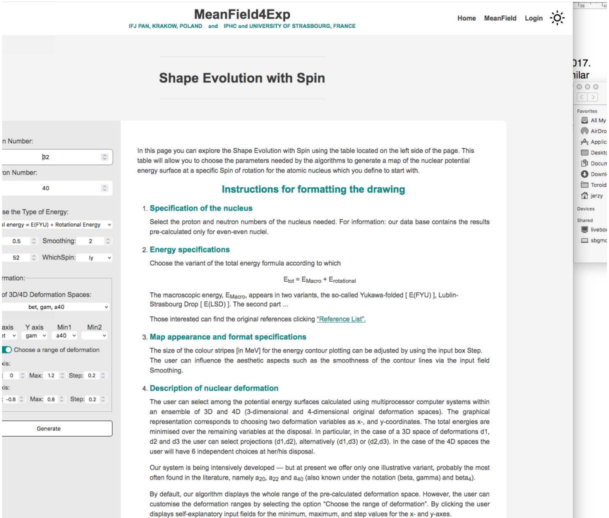
Meanfield4Exp: Shape evol. with spin (4)

WP2.4: Research infrastructures offering theoretical support for experiments

Manuela Rodríguez Gallardo

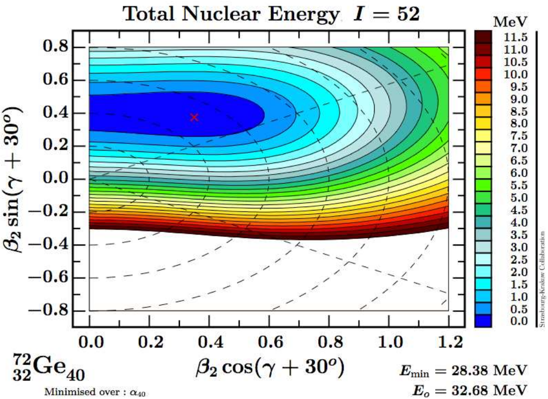
At high spin, microscopic effects are negligible



Meanfield4Exp: Drawing at spin=$56\hbar$

Preliminary

Energy minimized with respect β_4



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Meanfield4Exp: New options being considereed/elaborated

WP2.4: Research infrastructures offering theoretical support for experiments

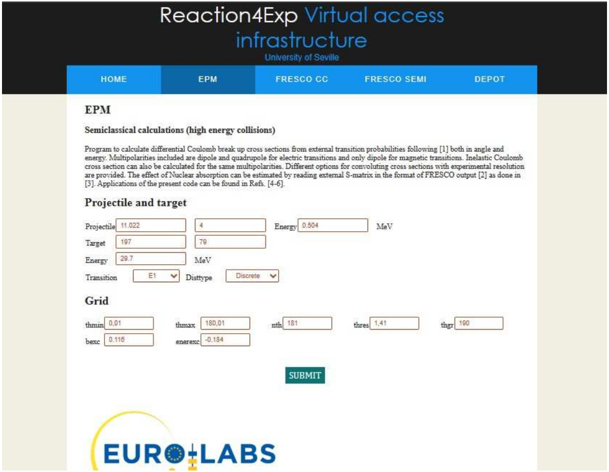
Manuela Rodríguez Gallardo

01. Shape coexistence and evolution with spin and temperature;
02. Pairing and its evolution with spin and temperature;
03. Axial symmetry and related isomers: K-isomers, yrast traps;
04. Many-particle many hole excited configurations – degeneracies;
05. Electromagnetic transitions;
06. Cranking, 3D cranking and chirality;
07. Nuclear point group symmetries;
08. Band crossings, Band termination;
09. Jacobi and Poincare shape transitions;
10. Giant-Dipole Resonances – spin & temperature dependence;
11. Configuration controlled shape evolution;
12. Mass parameters, mass tensor, collective motion;

Reaction4Exp platform (Sevilla)

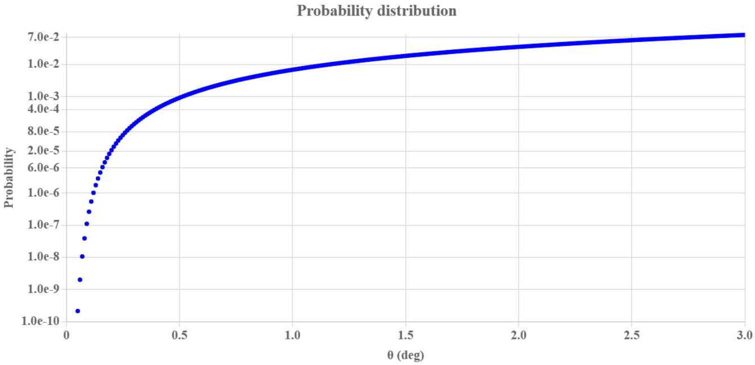
WP2.4: Research infrastructures offering theoretical support for experiments

Manuela Rodríguez Gallardo



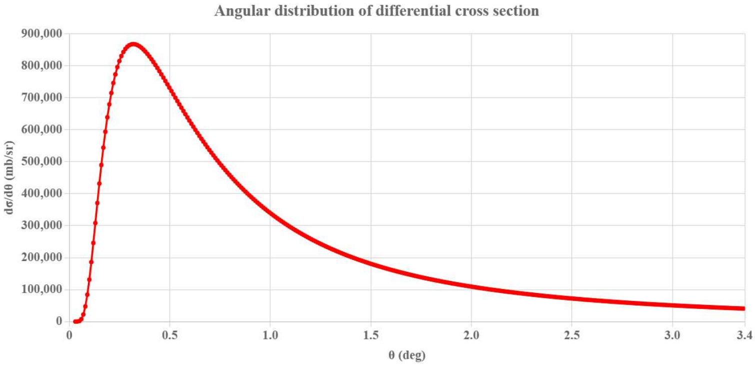
Reaction4Exp: Breakup probability

$^{11}Li+^{208}Pb$ at 759 MeV



Reaction4Exp: BU angular distribution

$^{11}Li + ^{208}Pb$ at 759 MeV



Reaction4Exp: BU energy distribution

WP2.4: Research infrastructures offering theoretical support for experiments

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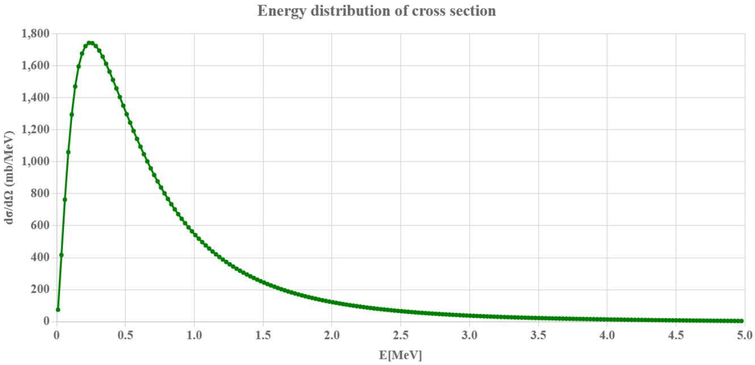
$^{11}Li + ^{208}Pb$ at 759 MeV



Reaction4Exp

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 platform (Milano)

The web address : https://ns4exp.mi.infn.it

The Main Page

Description of the code

NS4EXP

HOME DOCUMENTATION

NS4EXP

This virtual access (VA) facility is a part of the Theo4Exp VA infrastructure and, as such, is intended to provide theoretical tools for the EURO-LABS project as well as for the wider experimental nuclear physics community. The key nuclear structure codes available produce output for basic observable quantities for spherical nuclei that are the subject of current experimental activity: i) binding energies, density distributions and mean square radii, ii) energies and wave functions/transition densities of the excited states, as well as electromagnetic transition probabilities to the ground state. At the moment one spherical code is available, that performs Hartree-Fock plus RPA calculations (see below).

In the experimental studies of high-lying Giant resonances and soft-mode states (e.g. Pygmy Resonances), theory is the only way to provide a link with the basic features of the nuclear equation of state, like incompressibility or symmetry energy. For low-lying states identified in stable and exotic nuclei, theoretical calculations can establish the relationship between measured electromagnetic transition probabilities and the underlying shell structure, giving rise to new sets of magic numbers.

Calculation Type

Please select the type of calculation you would like to perform:

Random Phase Approximation(RPA)

Random Phase Approximation(RPA)
Hartree Fock(HF)
hfbcs-qrpa

Structure4Exp: Options

Input Form Page

Skyrme_rpa Code   HOME   DOCUMENTATION

Input Parameters for RPA calculation

To perform the RPA calculation, please enter the parameter values for the system under study

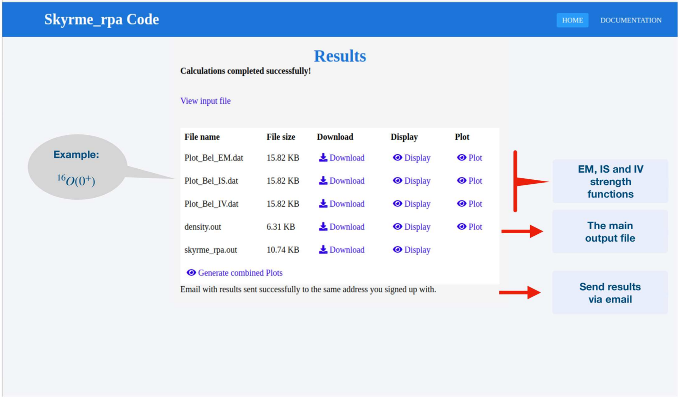
Mass Number:	16
Atomic Number:	8
Skyrme Interaction:	SLy4
Spin:	0
Parity :	+1

Default Parameters

Back   Submit

Structure4Exp: Results for ^{16}O

Results Page



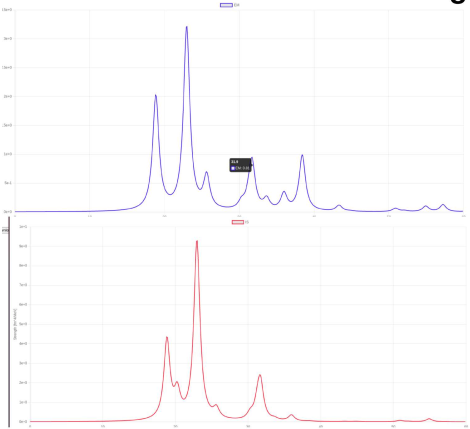
File name	File size	Download	Display	Plot
Plot_Bel_EM.dat	15.82 KB	Download	Display	Plot
Plot_Bel_IS.dat	15.82 KB	Download	Display	Plot
Plot_Bel_IV.dat	15.82 KB	Download	Display	Plot
density.out	6.31 KB	Download	Display	Plot
skyrme_rpa.out	10.74 KB	Download	Display	

Structure4Exp: Strength functions

WP2.4: Research infrastructures offering theoretical support for experiments

Manuela Rodríguez Gallardo

Results Page



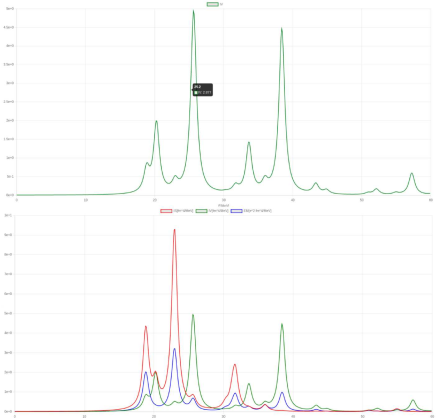
EM strength function

IS strength function

Structure4Exp: Stregth functions

Manuela Rodríguez Gallardo

Results Page



IV strength function

Combined chart (EM, IS, IV)

Structure4Exp

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]

MileStones (MS)

- MS10 (Month 18): Contracted personnel for Theo4Exp VA in place and first codes available for users in the virtual facility
- MS11 (Month 42): All software released and validated by IRP

So we are on time!

Final remarks

- By the end of the year, the calculation platforms will be available with several programs.
- There will be a common portal (institucional.us.es/theo4exp), including the link to the different installations.
- We will start then the users counting (Units of Access).
- The user registration is through (Please, try!) https://iam-eurolabs.ijclab.in2p3.fr.
- Try to favour the use of the installations when available and, in particular, for summer schools, doctoral training.
- Provide feedbakcs!

Time for discussion in Kraków