

WP2.4: Research infrastructures offering theoretical support for experiments

> Manuela Rodríguez Gallardo

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Manuela Rodríguez-Gallardo

On behalf Gert Aarts (ECT*)

Universidad de Sevilla

Krakow, 10th October 2023

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WP2.4: Theoretical support

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→ 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



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ECT*, Trento (Italy)



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



SYMPOSIUM IN OCCASION OF THE 30TH ANNIVERSARY OF ECT*

OCTOBER 4TH, 2023

ECT* | Aula Leonardi

ECT* | Villazzano, Trento, Strada delle Tabarelle 286

Info: staff@ectstar.eu

PROGRAMME 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) **Quantum Fractals** 16:45 - 17:30 Ubirajara Van Kolck (IJCLab Orsay & University of Arizona) Dinner at Villa Tambosi 18:00

9.00 - 10:00 Welcome and introduction by

The ECP's 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 suppor of the Department of Physics of the University of Trento





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

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

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



2023 PROGRAMME OF ACTIVITIES

Structure and topology of RNA in living systems L. TUBIANA (University of Trento), S. PASQUALI (University Paris Cita), A. BOZTO (U.S. Linkhama)	10-28.7	Doctoral Training Program: Ab Initio Methods and Emerging
Cite), A. BOZIC (115, Ljubjiana)		Technologies for Nuclear Structure C. BARBIERI (University of Milan), A. ROGGERO (University of Trento)
	10-14.7	Tensor Spin Observables **
LaVA Meeting		K. SLIFER (University of New Hampshire), D. HIGINBOTHAM
C. BONANNO (INFN Firenze), M. P. LOMBARDO (INFN Firenze),		(JLab), D. KELLER (University of Virginia), E. LONG (Universityof
M. PEARDON (Trinity College Dublin)		New Hampshire)
Halamarkia Barrandian an China I Taranan	17-21.7	Short-Distance Nuclear Structure and PDF *
Holographic Perspectives on Chiral Transport K. LANDSTEINER (IFT-UAM/CSIC Madrid), U. GURSOY (University of Utrecht). M. KAMINSKI (University of Alabama).		N. FOMIN (University of Tennessee), J. ARRINGTON (LBNL), W. COSYN (Florida International University), N. ROCCO (FermiNational Laboratory)
D. KHARZEEV (Stony Brook)	31.7-4.8	Quantum Sensing and Fundamental Physics with Levitated
The Gradient Flow in QCD and other Strongly Coupled Field		Mechanical Systems
Theories C. MONAHAN (William & Mary), R. HARLANDER (University of Aachen), A. HASENFRATZ (University of Colorado, Boulder), O. DUTZEL (Gineme Linducetict)		A. VINANTE (IFN-CNR), D. BUDKER (Johannes Gutenberg University Mainz), G. HETET (École Normal Supérieure Paris), H. Ulbricht (University of Southampton)
O. WITZEL (Stegen University)	AUGUST	
Onsettum Science Concestion OSC	21-25.8	ECT*-APCTP Joint Workshop: Exploring Resonance Structure
D. DE BERNARDIS (INO-CNR BEC Center), V. AMITRANO		S DIFHI. (Justus Lichig University Giessen) V BRAUN (University
(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		Regensburg), K. JOO (University of Connecticut), Y. DRACN (University National University), C. VAN HULSE (University of Alcala, Madrid), C. WEISS (Jlab)
of Trento - INO-CNR), A. NARDIN (University of Trento - INO-	SEPTEMBER	
CNR), L. PAVESI (University of Trento, Italy)	4-8.9	Many-Body Quantum Physics with Machine Learning
Color Glass Condensate at the Electron-Ion Collider* D. TRIANTAFYLLOPOULOS (ECT*), N. ARMESTO (University of Sentiano de Compostela), F. IANCU (University of Basic Seden		A. RIOS HUGUET (Institute of Cosmos Sciences, University ofBarcelona), G. CARLEO (EPFL), E. INACK (PITP), A. LOVATO (ANL & TIFPA)
IPhT), T. LAPPI (University of Jyväskylä)	11-15.9	MICRA2023: Microphysics in Computational Relativistic
From First-Principles OCD to Experiments*		Astrophysics*
M. HUBER (Giessen University), G. EICHMANN (LIP Lisboa),		E. O'CONNOR (Stockholm University), C. FROHLICH (Carolina State
M. P. LOMBARDO (INFN Firenze), P. MARIS (Iowa State University),	19 22 0	Parton Distribution Functions at a Conserved #
J. M. PALOWSKI (Heidelberg University)	18-22.9	M. DING (Helmholtz Centrum Dresden Rosendorf).
2nd CMS Heavy Ion Workshop: Bringing Together the LHC Heavy		J. PAPAVASSILIOU (University of Valencia), C. QUINTANS (LIP,
Ion Community		Lisbon), C. ROBERTS (Nanjing University)
G. KRINTIRAS (The University of Kansas), Y.J. LEE (MIT), W. LI (Rice University), C. LOURENCO (CERN), A. STAHL (CERN)	25-29.9	Strongly Interacting Matter in Extreme Magnetic Fields * S. VARESE (UNICAMP), A. AYALA (UNAM), D. BLASCHKE
Nuclear and Particle Physics on a Quantum Computer:		(University of Wroclaw), G. ENDRODI (University of Bielefeld),
Where do we stand now?	OCTOBER	R. FARIAS (Universidade Federal de Santa Maria)
A. BAZAYON (Mighigan State University), 7, PAXOUDL (University	9.13.10	BOCKSTAR: Towards a ROadman of the Crucial measurements
S SERABRI & HESTERIAR AND LEAST AND A CONTRACT AND	54310	of Key observables in Strangeness reactions for neutron sTARs
Quantum Simulation of Gravitational Problems on Condensed		A. SCORDO (LNF-INFN). D. BOSNAR (University of Zagreb)
Matter Analog Models		C. CURCEANU (LNF-INFN), A. RAMOS (Institut de Ciències del
I. CARUSOTTO (INO-CNR BEC Center), R. BALBINOT (University		Cosmo, Barcelona), F. SAKUMA (RIKEN) O. VAZQUEZ-DOCE (LNF-
of Bologna), G. FERRARI (University of Trento), M. RINALDI		INFN), I. VIDANA (INFN Catania)
(University of Trento)	23-27.10	Critical Stability of Few-Body Quantum Systems *
Machine Learning for Lattice Field Theory and Beyond		A. KIEVSKY (INFN Pisa), T. FREDERICO (Instituto Tecnologico
D. HACKETT (MII), G. AARIS (Swansea University & ECT*), D. BACHTIS (Swansea University), B. LUCINI (Swansea		de Aeronautica), O. FYNBO (Aathus University), J.M. RICHARD (Institut de Physique des 2 Infinis de Lyon)
University). P. SHANAHAN (MIT)	NOVEMBER	
	20-24.11	ALPACA: modern ALgorithms in machine learning and data
COLMO: Quantum Collapse Models investigated with Particle, Nuclear, Atomic and Macro systems		analysis: from medical Physics to research with ACcelerAtors and in underground laboratories **
C. CURCEANU (INFN-LNF), A. BASSI (University and INFN Trieste), M. DERAKHSHANI (Rutgers University), L. DIOSI (University		F. NAPOLITANO (INFN Frascati), R. DEL GRANDE (TU Munich), F. GROSA (CERN), M. SKURZOK (Jagiellonian University Krakow)
Budapest), S. DONADI (INFN Trieste), K. PISCICCHIA (CREF)		* STRONG-2020 supported workshop ** EUROLABS supported workshop
	M. PEARDON (Trinity College Dablin) Holographic Perspectives on Chiral Transport K. LANDSTEINER (IFT-LAMKSIC Madrá), U. GURSOY (University of Urevch), M. KAMINSKI (University of Alabama), D. KHARZEEV (Stony Brook) The Gradient Flow in QCD and other Strongly Coupled Field Theories C. MONAIAN (William & Mary), R. HARLANDER (University of Anchen), A. HASENFRATZ (University of Colorado, Boulder), O. WITZEL (Siegen University) Quantum Science Generation (QSG D. DE BERNARDIS (MO-CNR BEC Center), V. AMITRANO (University of Theories. No. CKR), I. CAUSOTTO (University of Trento - INO-CKR), I. CAUSOTTO (University of Trento - INO-CKR), I. CAUSOTTO (University of Trento - INO-CKR), I. CAUSOTTO (University of Trento. INO-CKR), I. CAUSOTTO (University of Trento. INO-CKR), I. CAUSOTTO (University of Trento, InJay) Color Giass Condensate at the Electron- Ion Collider* D. TRIANTAFYLLOPOULOS (ECT*), N. ARMESTO (University of Staniago de Compatella), E. LANCU (University of Trento - INO- CKR), I. FAVESI (University of Trento, InJay) Color Giass Condensate at the Electron- Ion Collider* D. TRIANTAFYLLOPOULOS (ECT*), N. ARMESTO (University of Staniago de Compatella), E. LANCU (University of Trento-Saclay, IPHT), T. LAPFI (University of Zeris Saclay) (PHT), T. LAPFI (University of Causotta), B. M. FLUBER (Giassen University) 2nd CMS Heavy Ion Workshop: Bringing Together the LHC Heavy Ion Commutity G. KAINTRAS (The University of Kanasa), Y.J. LEE (MIT), W. LI (Rice University), C. LOURENCO (CERN), A. STAHL (CERN) Nuclear and Particle Physics on a Quantum Computer: Where do we stand awa? A. HADA WSKI (Heidelberg University) 2nd CMS Heavy Ion Workshop: Bringing Together the LHC Heavy Ion Commutition of Cavatisticanal Problems on Condensed Matter Analog Model 1. CARUSOTTO, H. DERCH (CERN), A. STAHL (CERN) Machine Learning for Lattice Field Theory and Beyond D. HACKETT (MIT), G. AARTS (Swansea University & BCT*), D. BACHTTS (Swansea University), B. LUCINI (Swansea University), P. SHANAHAN (MIT)	M. PEARDON (Trainty College Dablin) Holographic Perspectives an Chiral Transport K. LANDSTEINER (IT-LUANCISCI Madrid), U. GURSOY (University of Unceth), M. KAMINSKI (University of Alabama), D. KHARZEEV (Story Brook) The Gradient Flow in QCD and other Strongly Coupled Field Theories C. MONATAN (William & Mary), R. HARLANDER (University of Aacham), A. HASENFRATZ (University of Colonado, Boulder), O. WITZEL (Jagen University) Quantum Science Generation [QSC D. DE BERNARDIS (INO-CNR BEC Center), V. AMITRANO (University of Tranto - INO-CNR), A. BALDAZZI (University of Trento), A. BERTI (University of Trento - INO-CNR), I. CARUSOTTO (University of Trento - INO-CNR), I. CARUSOTTO (University of Trento, Inaly) Corr Gasa Condensate at the Electron-Ion Collider ⁴ D. THAUNARYLLOPOULOS (ECT-), N. ARMESTO (University of Trento), A. BERTI (University of Trento. INO-CNR), I. CARUSOTTO (University of Trento. INO-CNR), I. CARUSOTTO (University of Anata), Y. J. LEE (MIT), W. LI GLOW Gasa Condensate at the Electron-Ion Collider ⁴ D. THAUNTAFYLLOPOULOS (ECT-), N. ARMESTO (University of Trento), A. DERTI (University of Yanis-Saelay, IT-15.9 From First-First-Bies QCD to Experiments ⁴ M. FUDBER (Giesseu University) of Kansab, Y. J. LEE (MIT), W. LI GLOW UNIVERSITY, C. LOUR INCO. (CERN), A. STAHLI (CERN) Neclear and Particle Physics on a Quantum Computer: Where do we stand and? A. MARDON (No-CNR BEC Center), R. BALEINOT (University), M. PLOMBARD, J. LERCH (FBU Talabasee) Quantum Situation of Gavitational Problems on Condensed Matter Analog Modds I. CARUSOTTO (NO-CNR BEC Center), R. BALEINOT (University of MITTER), V. MITS (Swanese University), B. LUCINI (Swanese) University). P. SHANAHAN (MIT) NOVEEMBER 20-24.11 COLMC: Quantum Calapse Models Investigated with Particle, Noclear, Anata Marca Marca Systems C. CIECREANU (INFY): The AASSI (Iniversity and INTY Tiste), J. URIVERSI (MINGU Revense) Interviety and INTY Tiste), J. D. BACHITS (Swanese University), B. LUCINI (University of Departments

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 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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institucional.us.es/theo4exp



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Theo4Exp Virtual Access Infrastructure

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- → 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. <u>Coordinator</u>: Manuela Rodríguez-Gallardo
 - Structure4Exp (Milano): will provide virtual access to other codes that use advanced tools of nuclear structure theory. <u>Deputy</u>: Gianluca Coló

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Contracted personnel

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→ 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): <u>1-year contract</u>
 Dr. Imane Moumene, from 03/2023.



International Review Panel (IRP)

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- → 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.

EURO:LABS User authentication

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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

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Welcome to indigo-dc

Sign in with

eduGAIN 🔀

EURO:LABS User authentication

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Welcome to indigo-dc



→ We hope soon to include other identity networks like ORCID



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

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Welcome to indigo-dc

Sign in with

eduGAIN 🕺



Sign in with your IdP

You will be redirected for authentication to:

Universidad de Sevilla

Proceed?



Sign in with your IdP

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What about the platform for each installation?

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MeanField4Evn



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What about the platform for each installation?

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Meanfield4Exp platform (Kraków)



Manuela Rodríguez Gallardo



Contact Us: MeanField4Exp@ifl.edu.pl



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W/P2 4. Research

Meanfield4Exp: Single particle energy (1)

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infrastructures
offering
theoretical
support for
experiments
Manuela
Rodríguez

List of propositions	for the user choice Guidelines	
\downarrow	↓	
	MeanField4Exp Home MeanField	Login 🔆
	Single Particle Energy Generator	
Proton Number:		
144Zx118 (2)	The web page allows you to calculate the single particle energies for a given nucleus using Neetstic Phenomenological Mean-Field Theory with the universal Woods-Saxon Hamiltonian. The generated plot will show the single particle	
Neutran Number:	energies for protons and neutrons as a function of the selected deformation, providing insight into the shell structure	
14×N×200	versus nuclear snape.	
	Instructions	
Woode-Saxon Parameters:	To generate a single periode energy proc	
	 Enter the proton and neutron numbers of the nucleus of interest. Only even-even nuclei are supported. Select the Woode-Sixon parameter set to use in the calculations from the dropslown menu. 	
Choose the Deformation:	Choose the nuclear deformation parameter (e.g. quadrupole, octupole, hexadecapole) to explore from the "Deformation" dropdown menu.	
a20 v Step: 0.025 0	4. Select the labeling scheme for the single particle energies:	
a22 - Volue: 0 0	 Nilsson: [H, n₂, A] D 	
	 Spherical: (N, I, J) Iz Specify the minimum, maximum, and step values for the deformation axes. This controls the range deformations 	
Choose the Type of Labers	plotted. 5. Once you have entered the required information, click the "Generate" button to submit the run.	
 Caracian (n_p, n_p, n_p) 	For more details, where deliver this lists Manda Person Many Field Calculations	
 Nilsson [Ν, n₂, Λ] Ω 	For more details, please follow this link: woods-saxon wean-Field Calculations.	
○ Spherical [N, I,]] _R		
Deformation axis:		
Min: 40.3 C Max: 0.3 C Step: 0.1 C		
Proton energy:		
Min: -10 0 Max 4 0 Step: 2 0		
Neutron energy:		
Min: ins 0 Max: 4 0 Step: 2 0		
Generate		

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Meanfield4Exp: Single particle drawings

WP2.4: Research infrastructures offering theoretical support for experiments

Piolon Number:	This web page allows you to calculate the single particle energies for a given nucleus using Realistic Phenomenologica
32 🔅	Mean-Field Theory with the universal Woods-Saxon Hamiltonian. The generated plot will show the single particle
Neutron Number:	energies for protons and neutrons as a function of the selected deformation, providing insight into the shell structure versus function share.
40 🔅	Instructions
Woods-Saxon Parameters:	To generate a single particle energy plot
Universal Woods-Saxon Parameters v	1. Enter the proton and reutron numbers of the nucleus of interest. Only even-even nuclei are supported.
	 Select the Woods-Secon parameter set to use in the calculations from the dropdown meru. Choose the nuclear deformation parameter (a.e. nucleurole, parameter set) to exclose the parameter from the
choose the Deformation:	"Deformation" dropdown menu.
a32 - Step: 0.025 0	 Select the labeling scheme for the single particle energies: Cardination (e. p. o.)
a22 - Volum: 0	 Nilsson: [N, n₂, A] Ω
	 Spherical: (N, I, j) /z
choose the Type of Labels	Specify the minimum, maximum, and step values for the deformation axes. This controls the range deformations nivited
 Cartesian [n_p, n_p, n₂] 	6. Once you have entered the required information, click the "Generate" button to submit the run.
 Nilsson [N, n_b, Λ] Ω 	For more details, please follow this link: Woods-Saxon Mean-Field Calculations.
O Spherical (N, I, J) /z	
Parlamentary and a	
sent -du o seate da o despe da o	
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Deformation and

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[MeV] 2 ž -0.1 0.0 0.1 0.2 72Ge Deformation and



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



Meanfield4Exp: Macro-micro energy (2)

Home MeanField Login -O-

WP2.4: Research
infrastructures
offering
theoretical
support for
experiments

Manuela Rodríguez Gallardo

	IFJ PAN, KRAKOW, POLAND and IPHC and UNIVERSITY OF STRASBOURG, FRANCE
Macr	ro-Micro Energy - Spaghetti Plots Generator
oton Number:	
40 0	This form allows you to generate spaghetti plots of the macro-micro energy for a chain of isotopes and isotones using
utron Number:	Realistic Phenomenological Nuclear Mean-Field Theory Calculations
40 0	with the Universal Woods-Saxon Hamiltonian.
	Instructions for Formatting the Plot
ΔZ: ΔN:	instructions for Formatting the Flor
	1. Specification of the Nucleus and Parametrisation
oods-Saxon Parameters:	Choose a central nucleus by entering the proton and neuron numbers.
Universal Woods-Saxon Parameters +	Select the range of nuclei by adjusting ΔZ and ΔN .
cose the Type of Energy:	"Woods-Saxon Parameters" allows you to select a parameter set for the Woods-Saxon Hamiltonian from the dropdown meru
tal energy = E(FYU) + Shell(e) + Correlation(~	a Every SevelSeview
nose the Deformation	2. Energy opecanications
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ato y Volum: 0 0	Het = EMacro + Hahel + Haaing
	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 _{abel} .
eformation axis:	whereas the pairing term, E _{pair} , can be chosen in the form of the so-called pairing correlation energy with a simple (BCS) anonyximation or a more advanced Particle Number Decision (PND) economication
in: -0.8 C Max: 0.3 C Step: 0.1 C	Those interested can find the opticinal references clicking "Reference List"
ctopes energy:	 Recorded or of Mandaco Referencias
ctopes eperate	3. Description of Nuclear Deformation "Choose the Deformation" Alove you to relate the purpless deformation from the directory many
in: -4 0 Max: 12 0 Step: 2 0	Performance and a second performance and testions and testions allowing and testion and a second
	Lenumaturi axis, isotope energy, and isotone energy and you to adjust the x and y axes.
Generate	4. Execution
	Unce all input data is specified, cick "Generate" to submit the run.
	For more details, please follow the link: Woods-Saxon Mean-Field Calculations.

MeanField4Exp

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Meanfield4Exp: Total energy drawings

WP2.4: Research infrastructures offering theoretical support for experiments

Manuela Rodríguez Gallardo

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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

Chocee a central nucleus by entering the proton and neutron numbers

Select the range of nuclei by adjusting ΔZ and ΔN .

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

2. Energy Specifications

Choose the variant of the total energy formula according to which

Elot = EMacro + Eshell + Epairing

The macroscopic energy, E_{Mean}, appears in two variants, the so called Yukawa folded [E[PPU]] and the Lubin-Strastovarg Dreg (E(SD)) [louid dray models. The standard Structuriky shall-correction energy is denoted E_{statis}, whereas the pairing term E_{pair}, can be chosen in the form of the so-called pairing correlation energy with a simple (IRCS) approximation or a more advanced Patricle Number Polycidan (PKP) 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: Potential energy maps (3)

WP2.4: Research infrastructures offering theoretical support for experiments

Bartan Marakan	
Proton Number:	
32	2
Neutron Number:	
40	
Choose the Type of Energy: Total events a EUTULIA Statistic Correlat	inel -
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Deformation:	
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Choose a range of deformation	•
X-axis:	
Mirc: 0 0 Max: 12 0 Step: 0.2	
Y-axis:	
Min: -0.8 C Max: 0.8 C Step: 0.2	
Table of the Energy Minima	

Nuclear Potential-Energy Maps Generator

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 formating 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

End = Etterm + Exhed + Ensiring

The macroscopic energy, E_{Macro}, appears in three variants, the so-called Yukawa-folded [E(FYU)], Lublin-Strasbourg Drop (F(LSD)), and 'traditional' Mwars-Swiatecki (F(M-SI) liquid drop models. The standard Studinsky shell-correction energy is denoted Eabel, whereas the pairing term, Epsil, 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 discosal. 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 herihis 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 app. app and app (also known under the notation (beta, gamma) and betap).

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

WP2.4: Research infrastructures offering theoretical support for experiments

> Manuela Rodríguez Gallardo





Meanfield4Exp: Shape evol. with spin (4)

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At high spir	n, microscopic effects are negligible	a		
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displays self-explanatory input fields for the minimum, maximum, and step values for the x- and y-axes

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Meanfield4Exp: Drawing at spin= $56\hbar$

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Meanfield4Exp: New options being considereed/elaborated

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- 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)

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Reaction4Exp: Breakup probability

WP2.4: Research infrastructures offering theoretical support for experiments

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Reaction4Exp: BU angular distribution

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



Angular distribution of differential cross section

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Reaction4Exp: BU energy distribution

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



Energy distribution of cross section

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Reaction4Exp

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- Optical Model calculations: FRESCO (http://www.fresco.org.uk/)
- Oupled-Channels calculations: FRESCO
- Semiclassical calculations (high energy collisions): EPM_SEV

Example: V. Pesudo et al., Phys. Rev. Lett. 118 (2017) 152502

- 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

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EURO:LABS Structure4Exp platform (Milano)

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FOR ACCELERATOR BASED BOILENCES

Manuela Rodríguez Gallardo The web address : https://ns4exp.mi.infn.it

The Main Page

NS4EXP

NS4EXP

Description

of the code

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This virtual access (VA) facility is a part of the TheodSay VA Infrastructure and, as such, is intended to provide theoretical tools for the URIG-LAB spoiler, as well as for the wider experimental nucleus physics community. The by macher structure codes available protocol enguine for basic observable quantifies for spoiler and uncell as eachy of a current experimental activity: 1) binding mergies, density distributions and mean square reality. Discrete conductor the structure code structure of the structure code structure co

In the experimental studies of high-lying Giant resonances and soft-mode states (e.g. Pygny 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 table and exotic nuclei, theoretical calculations can establish the relationship between measured electromagnetic transition probabilities and the underlying bill structure, giving ing the now ress of magic numbers.

Calculation Type

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

Random Phase Approximation(RPA)

Phase Approximation(R Hartree Fock(HF) hfbcs-orna

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Input Form Page

Skyrme_rpa Code				
Input	Parameters for F	PA calculation		
To perform the RPA calculation, please enter the parameter	values for the system uno	ler study		
	Mass Number:	16		
	Atomic Number:	8		
	Skyrme Interaction: Spin:	SLy4 ~		
	Parity :	+1 *		
	Defau	It Parameters		
Back			Submit	

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Structure4Exp: Results for ¹⁶O

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Results Page

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theoretical support for experiments

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Structure4Exp

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- Binding energies, density distributions and mean square radii (skyrme_rpa, hfbcs_qrpa)
- Energies and wave functions/transition densities of the excited states, as well as electromagnetic transition probabilities to the ground state (skyrme_rpa, hfbcs_qrpa)
- **6** 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]

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MileStones (MS)

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- → 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!

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EURO LABS Final remarks

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- → 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

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