

NuPECC and EIC

Franck Sabatié



Saclay



What is NuPECC ?

The European Expert Board for Nuclear Physics
hosted by European Science Foundation

Representing
about 6000 scientists

Composition:

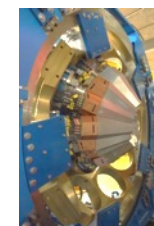
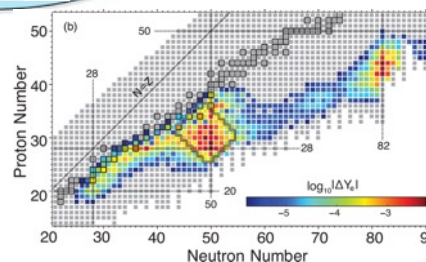
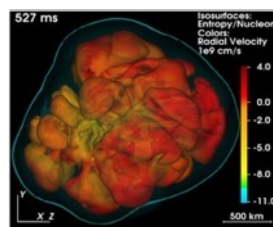
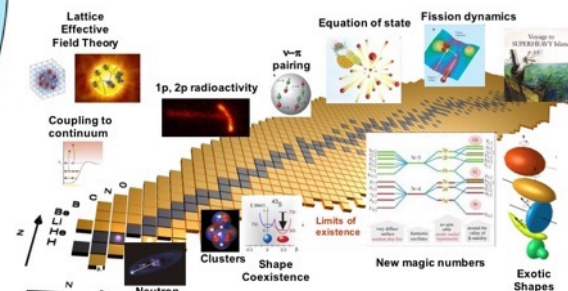
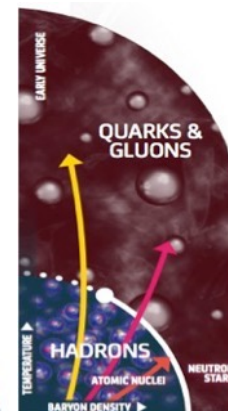
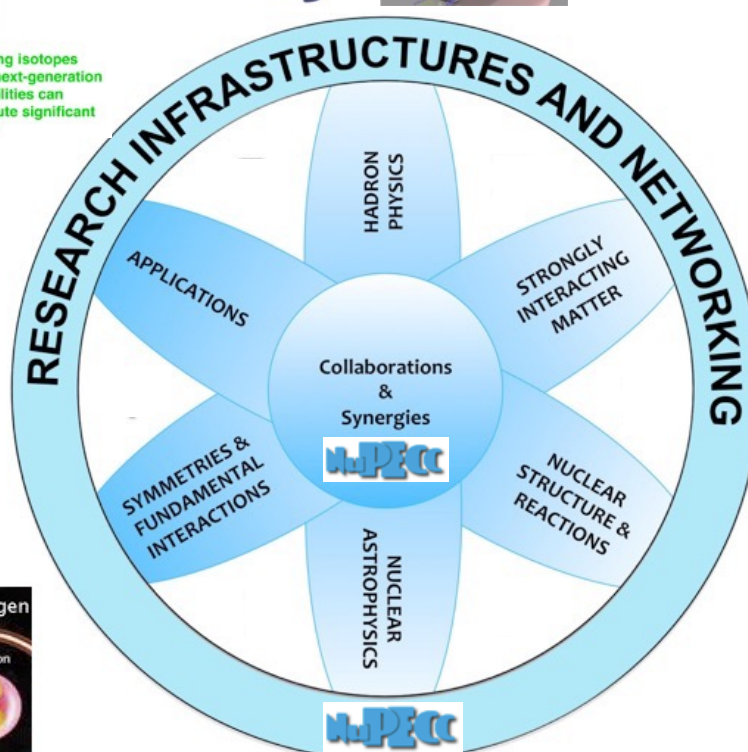
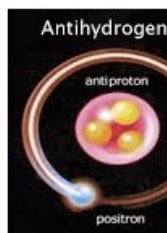
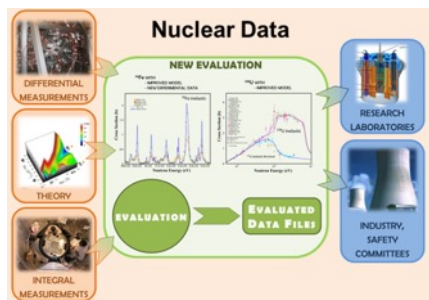
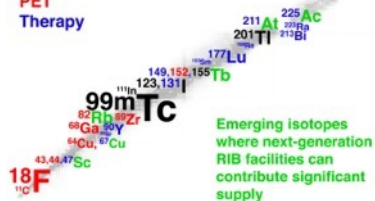
- 34 representatives from 22 countries
- 4 associated members
 - CERN
 - Israel
 - iThemba Labs
 - Nishina Center
- 9 observers (ESF, NPD/EPS, ECFA, NSAC, ANPhA, ALAFNA, CINP, IAEA, APPEC)



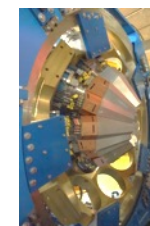
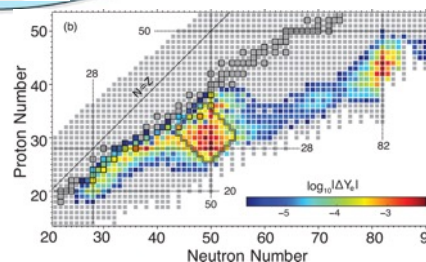
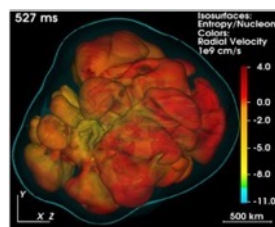
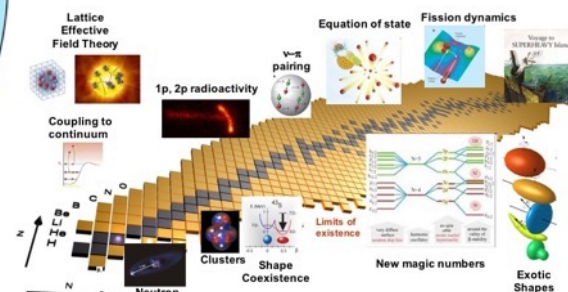
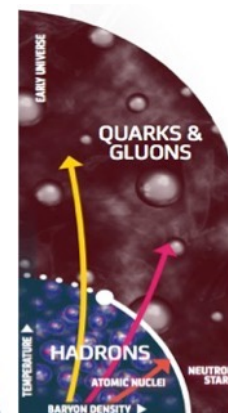
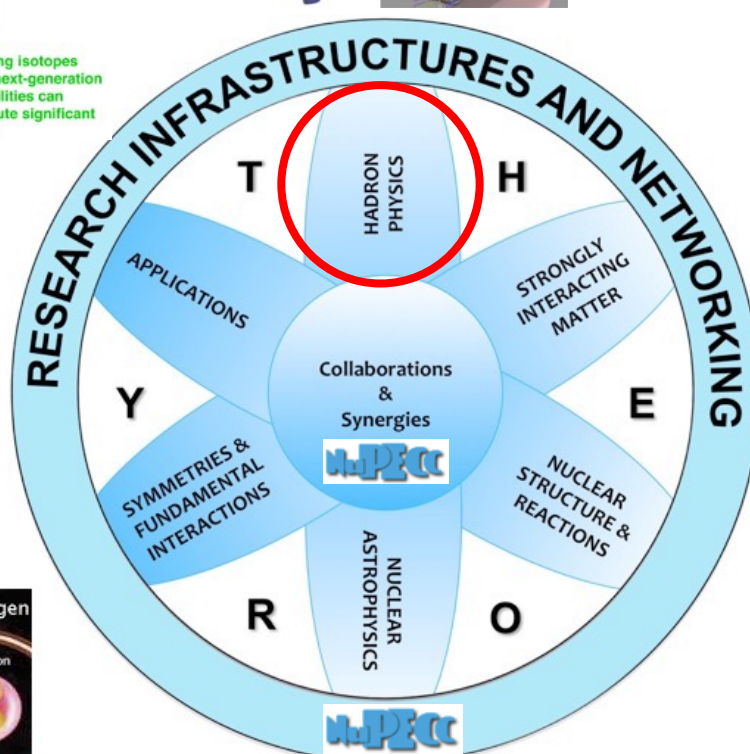
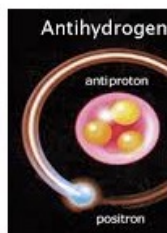
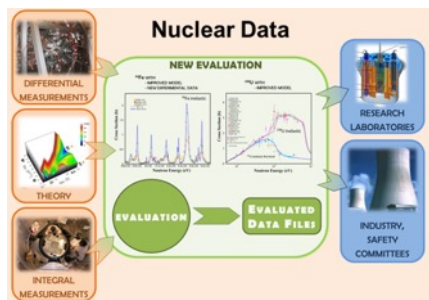
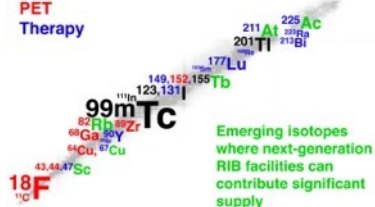
3 regular Committee meetings/year

33 Years of NuPECC activities

Nuclear medicine perspective

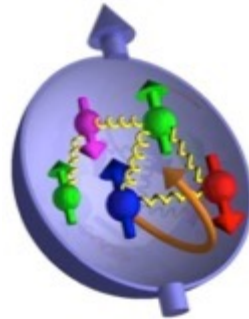
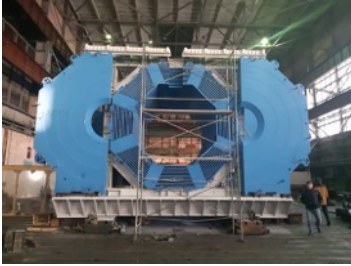


Nuclear medicine perspective



The Physics of Hadrons

- How is mass generated in QCD and what are the static and dynamical properties of hadrons?
- How does the strong force emerge from the underlying quark-gluon structure of nucleons?



**High resolution experiments
with antiprotons (PANDA) at
FAIR to test QCD in detail**

*European contribution to
the EIC project in US*

*-> NuPECC EIC Task Force
D. Ireland, E. Nappi, FS*

**Eol 6 - Synergies
between EIC and LHC
experiments**

kick off workshop June 20-21, 2022

Main NuPECC LRP 2017 priority for this topic:

The antiproton programme at the FAIR/PANDA facility combined with programmes with polarised protons in Dubna (NICA) and those with lepton and hadron beams at existing facilities (MAMI, Bonn, INFN-Frascati).

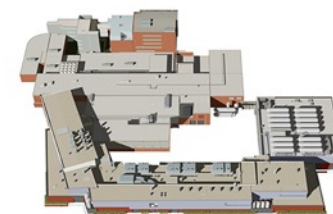
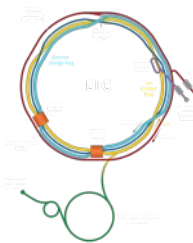
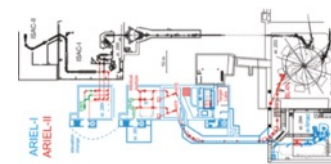
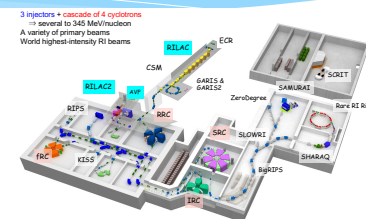
RIBF RIKEN, Japan (operational) – strong involvement including advanced detectors

TRIUMF, Vancouver, Canada (operational & construction of ARIEL) - involvement in experiments & instrumentation

iThemba Labs, South Africa (operational & construction of SAIF) – involvement in experiments

EIC, Brookhaven, New York, US (construction) – strong interest of the European community

FRIB, East Lansing, Mi, US (beginning of operation) – involvement of European groups





New! Joint Particle Physics – Nuclear Physics EU project EURO-LABS

Contract 2022-2026 (14,5M€)

Starts on September 1st 2022

Coord. Navin Alahari
GANIL, France

Coordinating institution INFN, Italy
39 Research Infrastructures

- CERN
- GANIL (France)
- LNL-LNS (Italy)
- JYFL (Finland)
- IJCLab (CNRS, France)
- FAIR/GSI (Germany)
- NLC (HIL/IFJ PAN, Poland)
- IFIN-HH(Romania)
- ECT* (Italy)
- ...



Hadron physics STRONG-2020

Contract 2019 -2023 (10M€)

Coord. Barbara Erazmus IN2P3, France
Coordinating Inst. IN2P3/CNRS, France

- CERN
- LHC & fixed target exp.
- GSI/FAIR (Germany)
- LNF, Frascati (Italy)
- MAMI, Mainz (Germany)
- ECT*, Trento (Italy)
- ELSA, Bonn (Germany)
- COSY, Jülich (Germany)

**Many WP strongly focused on EIC,
among which Next-DIS
(PIs: F. Bossù, D. Sokhan)**

Lobbying for Hadron Physics

Hadron physics (especially overseas) is however coming more into focus.

One of the important contributors was the lobbying achieved during the 2020 update of the **European Strategy for Particle Physics:**

The European Strategy for Particle Physics is the cornerstone of Europe's decision-making process for the long-term future of the field. Mandated by the CERN Council, it is formed through a broad consultation of the grass-roots particle physics community, it actively solicits the opinions of physicists from around the world, and **it is developed in close coordination with similar processes in the US** and Japan in order to ensure coordination between regions and optimal use of resources globally.

Deliberation Document on the 2020 update of the European Strategy for Particle Physics

* 5. Synergies with neighbouring fields

a) A variety of research lines at the boundary between particle and nuclear physics require dedicated experiments and facilities. **Europe has a vibrant nuclear physics programme at CERN**, including the heavy-ion programme, and at other European facilities. In the global context, a new electron-ion collider, **EIC**, is foreseen in the United States to study the partonic structure of the proton and nuclei, in which there is interest among European researchers. **Europe should maintain its capability to perform innovative experiments at the boundary between particle and nuclear physics, and CERN should continue to coordinate with NuPECC on topics of mutual interest.**

The synergies between particle and nuclear physics are driven by the ambition to achieve first-principle understanding of strong dynamics based on QCD. In addition, they share similar experimental tools. The CERN baseline programme includes not only the ISOLDE and n_TOF facilities but also the heavy-ion programme at the SPS and the LHC. Future European facilities such as FAIR, NICA and ESS envisage research programmes that are of interest to particle physics. The nuclear physics roadmap in Europe is coordinated by the Nuclear Physics European Collaboration Committee (NuPECC) and **there are well established communication lines between the nuclear and the particle physics communities. NuPECC has expressed strong support for the extension of the heavy-ion programme into the HL-LHC era and beyond, should a high-energy hadron collider be built at CERN in the future.** Electron-proton colliders, such as LHeC or FCC-ep, with the option of including ion-targets, are also of interest to NuPECC, which is preparing a support statement for the participation of Europe in the Electron-Ion Collider in the United States.

Synergies between the Electron-Ion Collider and the Large Hadron Collider

Kick-off meeting of the JENA Eol: «Synergies between the Electron-Ion Collider and the Large Hadron Collider »



Monday, June 20th

09:00	Welcome and introduction	Daniel Boer et al.
	Room Bohr, CERN	09:00 - 09:05
	EIC Project Overview & Snowmass 2021 conclusions	Prof. Abhay Deshpande
	Room Bohr, CERN	09:05 - 09:35
	Proton and nuclear structure at the cross-road between LHC and EIC	Dr Juan Rojo
	Room Bohr, CERN	09:35 - 10:00
10:00	Latest constraints on proton PDFs with LHC data	Prof. Paul Newman
	Room Bohr, CERN	10:00 - 10:25
	TMD global fits	Alessandro Bacchetta
	Room Bohr, CERN	10:25 - 10:50
11:00	Coffee Break	
	Room Bohr, CERN	10:50 - 11:20
	Latest constraints on nuclear PDFs with LHC data	Prof. Michael Murray
	Room Bohr, CERN	11:20 - 11:45
12:00	Latest results on photon-induced processes with heavy-ions at the LHC	Prof. Iwona Grabowska-Bold
	Room Bohr, CERN	11:45 - 12:10
	Heavy Ions & Saturation Physics	Heikki Mäntysäari
	Room Bohr, CERN	12:10 - 12:35
	Photon-hadron (jet) production in pA collisions at the LHC and its connection to DIS at EIC	Dr Jamal Jalilian-Marian
	Room Bohr, CERN	12:35 - 13:00
15:00	The EIC detector and R&D plans	Dr Dalla Torre Silvia
	Room Bohr, CERN	14:30 - 15:00
	ECFA detector R&D roadmap and synergy with EIC	Philip Patrick Allport
	Room Bohr, CERN	15:00 - 15:30
	ALICE ITS3 project and R&D	Dr Magnus Mager
	Room Bohr, CERN	15:30 - 15:55
16:00	SIPM R&D roadmap for LHC and EIC	Prof. Samo Korpar
	Room Bohr, CERN	15:55 - 16:20
	Coffee Break	
	Room Bohr, CERN	16:20 - 16:45
	Far-forward BSM and neutrino physics program at the LHC and beyond	Dr Sebastian Trojanowski
	Room Bohr, CERN	16:45 - 17:10
17:00	Muon puzzle in air showers and its connection to the LHC	Dr Hans Dembinski
	Room Bohr, CERN	17:10 - 17:35
	Charm production in collisions at the EIC, LHC, and in the atmosphere	Maria Vittoria Garzelli
	Room Bohr, CERN	17:35 - 18:00

Tuesday, June 21st

09:00	High-x proton PDFs: current status and expected LHC&EIC constraints	Dr Lucian Harland-Lang
	Room Bohr, CERN	09:00 - 09:25
	EW and BSM physics between the LHeC and the EIC	Prof. Stefano Forte
	Room Bohr, CERN	09:25 - 09:50
10:00	Lepton Flavor Violation results at the LHC	Giulia Frau
	Room Bohr, CERN	09:50 - 10:15
	QGP in small systems at the LHC: synergies among eA, p-p and pA systems	Dr David Dobrigkeit Chinellato
	Room Bohr, CERN	10:15 - 10:40
11:00	Coffee Break	
	Room Bohr, CERN	10:40 - 11:15
	GPDs and GTMDs	Dr Cédric Mezrag
	Room Bohr, CERN	11:15 - 11:40
	Exotic XYZ states at the LHC	Liupan An
	Room Bohr, CERN	11:40 - 12:05
12:00	Quarkonia photo- and electro-production	Jean-Philippe Lansberg
	Room Bohr, CERN	12:05 - 12:30
	Physics with tagged forward protons at the LHC	Prof. Christophe Royon
	Room Bohr, CERN	12:30 - 12:55
15:00	Fixed target at LHC	Dr Cynthia Hadjidakis
	Room Bohr, CERN	14:15 - 14:40
	Jets as a tool at LHC and EIC	Ignazio Scimemi
	Room Bohr, CERN	14:40 - 15:05
	Fragmentation Functions (ee,SIDIS at EIC)	Valerio Bertone
	Room Bohr, CERN	15:05 - 15:30
	Discussion and Closing	
	Room Bohr, CERN	15:30 - 16:00

- ☐ Hybrid meeting
- ☐ Up to 90 participants, 60 in-person
- ☐ Lively discussions



<https://indico.ph.tum.de/e/EIC-LHC>

EICUG, July 28th, 2022, Stonybrook

Highlights

Synergies - topics of mutual interest

D. Boer

- The flavor and spin structure of the proton: PDFs
- Three-dimensional structure of nucleons and nuclei in momentum and configuration space (TMDs, GPDs, GTMDs) and their evolution
- QCD in nuclei: nuclear PDFs and gluon saturation phenomena
- Heavy Ion Collisions: Quark-Gluon Plasma studies & Ultra-Peripheral Collisions
- Diffractive processes and distributions
- Jet physics, Jet substructure
- Heavy flavor physics, quarkonia, exotic states
- Electroweak physics and beyond the Standard Model physics
- EFT studies, SMEFT
- Neutrino cross-sections at low and high-energy
- High energy cosmic rays and Dark Matter
- Detector R&D
- Computational physics, Monte Carlo simulations, machine learning techniques

SUMMARY

S. Forte

“Nature does not distinguish ‘Nuclear’ vs. ‘High Energy’ physics”

(Abhay Deshpande)

- **RICH SET OF OPPORTUNITIES FOR EW AND BSM STUDIES AT EIC UNRELATED TO PDFs/NUCLEON STRUCTURE**
- **CURRENT EIC STUDIES ONLY SCRATCHED THE SURFACE OF FUTURE OPPORTUNITIES**
- **EXPLOIT KNOW-HOW ACCUMULATED OVER 15 YEARS OF LHEC STUDIES**

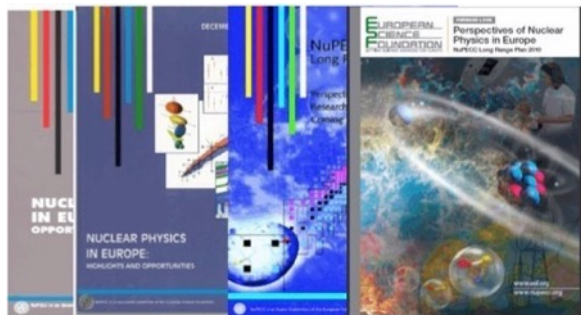
Conclusions and Observations

- Major R&D funding for the LHC detector R&D programme was in place from 1986.
- The **ECFA Detector R&D Roadmap** starts from the principle of needing to identify the mission critical detector R&D for all the future programmes considered as viable options in the 2020 Update to the European Strategy for Particle Physics.
- Mission critical for different facilities means different things:
 - For **HL-LHC** beyond LS2, (mainly ALICE and LHCb) **ultra-thin sensors and supports; PID + ToF; high rate gaseous detectors; rad-hard CMOS; ultra-fine granularity timing; rad-hard LGAD; rad-hard ECAL; SiPMs; fast-timing R/O; 28nm CMOS; low power; 100Gbps; ...** (see presentations by **C. Parkes** and **L. Musa** at <https://indico.cern.ch/event/994685/>).
 - For **EIC**, given the high precision physics targets, the issue is not to be systematics limited by the detector performance and to extract maximum information from every collision event.
 - However, many requirements (apart from extreme rad-hardness) overlap with R&D priorities for the LHC programme, as well as requirements for future lepton colliders and other strong interaction physics facilities.
- **Of order decadal R&D lead-times should be anticipated for most demanding technology aspects for future facilities, so, for the most critical EIC requirements (eg PID, fast timing, ultra-low mass vertexing & tracking, ...), suggest R&D programme should link closely with work for other facilities.**

P. Allport

The Nuclear Physics Long Range plan process in Europe

1991 1997 2004 2010



- The LRP identifies opportunities and priorities for the nuclear physics in Europe
- The LRP provides national funding agencies, the European Strategy Forum on Research Infrastructures (ESFRI) and the European Commission with a framework for coordinated advances in nuclear science in Europe



Assessment of Implementation of the NuPECC Long Range Plan 2017

February 2022

LIAISONS: G. AARTS, D. BETTONI, S. COURTIN, P. GIUBELLINO, J. GÓMEZ CAMACHO, A. GÖRGEN, R.-D. HERZBERG, D. IRELAND, B. KRUSCHE, M. LEWITOWICZ, A. MAJ, U. MEISSNER, E. NAPPI, G. NEYENS, L. POPESCU, B. SHARKOV, E. WIDMANN,

Contributors: H. Abele, N. Alahari, W. Barth, D. Bemmerer, K. Blaum, F. Bossi, A. Bracco, M. Chiossi, A. Denig, M. Doser, S. Freeman, M. Gazdzicki, F. Gélis, H. Goutte, M. Grecco, M. Harakeh, M. Hori, G. Imbriani, E. Khan, K. Kirch, W. Korten, A. Laird, J. P. Lansberg, D. Lunney, F. Maas, G. Martinez-Pinedo, S. Masciocchi, A. Mengoni, O. Navillat-Cuncic, D. Rifuggiato, P. Rossi, E. Scomparin, J. Simpson, H. Schmieden, O. Schneider, N. Severijns, Th. Stöhlker, J. Stroth, H. Ströher, U. Thoma, S. Ulmer, C. A. Ur, Ch. Weinheimer, U. Wiedner, H. Wittig



NuPECC LRP 2017

<http://www.nupecc.org/lrp2016/Documents/lrp2017.pdf>

February 2022

http://nupecc.org/2017_LRP_Assessment_of_Implementation_final.pdf

NuPECC LRP 2024

Launched in May
Call for inputs
dead-line Oct. 1st, 2022

Strategy Pillars

- **Science: Interplay between strong Theory & ambitious Experiments**
- **Applications - societal impact**
- **Facilities – in Europe (FAIR, SPIRAL2, ELI-NP, ISOLDE, SPES,...) and at other continents (RIBF, TRIUMF, iThemba, **EIC**, FRIB)**
- **Detectors - ex. ALICE3 and AGATA**
- **Data and Open Science – ex. ESCAPE H2020 program**
- **Synergies with neighbouring fields - DM, GW, neutrinos, EDMs, detectors,...**

Strategy Development

- The 2017 NuPECC Long Range Plan defined an ambitious strategy for European Nuclear Physics
- NuPECC efforts to transform the LR Plan into reality -> Task Force meetings in European countries
- **Next NuPECC LRP 2024 begins now!**
 - **Call for inputs with a dead-line on October 1st, 2022**

<http://nupecc.org/?display=lrp2024/main>

Steering Committee of LRP2024 will supervise the whole process of preparation of LRP.

In the coming months:

- SC will follow the submission of inputs and if necessary trigger additional contributions from the community
- SC will perform initial analysis of inputs, define sub-topics and select conveners and members of thematic working groups

In 2023-2024

- In 2023 the Steering Committee will prepare a draft version of the LRP2024 recommendations which will be largely consulted with the European nuclear physics community and approved by NuPECC
- SC will define the program of the Town Meeting to be held in 2024

Publication of the final version of LRP2024 is expected in the second half of 2024

Name	Country/Institution
Gert Aarts	UK/ECT*
Daniel Bemmerer	Germany
Diego Bettoni	Italy
Sandrine Courtin	France
Paolo Giubellino	Germany
Joaquin Gomez-Camacho	Spain
Paul Greenlees	Finland
Andreas Haungs	APPEC
Rolf-Dietmar Herzberg	UK
Dave Ireland	UK
Karl Jakobs	ECFA
Sissy Koerner	NuPECC
Marek Lewitowicz	NuPECC (Chair)
Adam Maj	Poland
Ulf Meissner	Germany
Joachim Mnich	CERN
Eugenio Nappi	Italy
Lucia Popescu	Belgium
Patricia Roussel-Chomaz	France
Franck Sabatié	France
Hiroyoshi Sakurai	Japan
Raimond Snellings	The Netherlands
Martin Venhart	Slovakia
Jelena Vesic	Slovenia
Vladimir Wagner	Czech Republic
Eberhard Widmann	Austria

- **June 2021 – March 2022:** Assessment of the implementation of the 2017 LRP - **DONE**
- **Beginning of May 2022:** *Nomination of the LRP Steering Committee chosen among the NuPECC representatives* - **DONE**
- **May 2022:** *Call for inputs from the community (new)* - **DONE**
 - call prepared by the Steering Committee
 - Steering Committee will follow the submission of inputs and if necessary trigger additional contributions from the community
- **Beginning of October 2022:** Submission of community inputs closed
- **October 2022 – November 2022:**
 - initial analysis of inputs by the Steering Committee;
 - definition of topics and organisation of LRP by the Steering Committee;
 - selection of Conveners by the Steering Committee
 - selection of Working Group (WG) members by the Steering Committee and Conveners
- **November 2022 - beg. of Dec. 2022:** Conveners and the list of WG Members to be approved at the NuPECC meeting and to be announced; *Call for venues of the Drafting Session and Town Meeting*
- **January 2023 – February 2023:** Kick-off meetings of the WG

- **March 2023 – June 2023:**
 - analysis of community inputs by the WG, request of additional inputs if needed and interaction with the community
 - April 2023: Progress report by Conveners at the Steering Committee meeting
 - writing of a draft of each chapter
- **June 2023:** Status report of WG by Conveners at the NuPECC meeting
- **September 2023:** *Drafting session of Steering Committee and Conveners (with representatives of the funding agencies ?) to elaborate general LRP recommendations (new)*
- **October 2023:** Presentation and approval of Final Draft + Draft Recommendations at the NuPECC meeting
- **November 2023 - January 2024:** Layout and editing of the LRP Draft
- **February 2024:** Final Draft + Draft Recommendation to be put on the NuPECC Website for community feedback
- **May 2024:** Town Meeting - presentation and feedback from the community
- **June 2024 – September 2024:** final editing of LRP by the Steering Committee
- **October 2024:** Finalisation and approval of the LRP at the October NuPECC meeting
- **November/December 2024:** LRP presentation in Brussels

NuPECC is launching the process of creating a new Long Range Plan (LRP) for Nuclear Physics in Europe, identifying opportunities and priorities for nuclear science in Europe, with the aim of publishing the document in 2024. The previous Long Range Plan can be found at <http://nupecc.org/pub/lrp17/lrp2017.pdf> and an assessment of its implementation at http://nupecc.org/2017_LRP_Assessment_of_Implementation_final.pdf.

With the intention of strengthening the bottom-up approach that has always played an important role in its LRPs, NuPECC is opening a call for inputs to the next LRP in form of short (5 page) documents describing the view of collaborations, experiments, or communities on the key topics for the next 10 years to be included in the upcoming LRP. We also solicit new ideas going beyond the topics considered in the LRP 2017 or exploring synergies with the particle physics and astroparticle physics communities and considering new developments such as gravitational waves and multi-messenger astronomy. Contributions related to novel applications in cross disciplinary fields are also welcome.

The call will be open until **1 Oct 2022**. Details concerning the submission procedure and the format of inputs can be found at the submission site <https://indico.ph.tum.de/e/LRP2024-input> .

Proposed actions to solicit inputs

- Contact labs, big projects and funding agencies directors directly
 - SC will contact key persons in their field of expertise/facilities
 - Reminders for inputs: one sent on 4 July, second 1 August, third 1 September
 - Ask ANPhA, ALAFNA, IAEA, iThemba, Nishina Centre, Israel & CINP Canada to contribute
- Discuss/coordinate with NSAC and DOE LRP in Europe and LRP in US (starting soon)
 - Organize a dedicated meeting(s)?

THANK YOU !