The NUPECC Long Range Plan 2024

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EIC RRB – Washington, DC 12/7/2023

From the NuPECC 2017 LRP :

HADRON PHYSICS:

…Therefore, the best short-term option to pin down the Colour Glass Condensate (CGC) is by performing DIS experiments on nuclei at a future Electron-Ion Collider (EIC), a project currently under consideration in the US. …

…A significant step towards the full tomography of the nucleon will come from the realization of the EIC that will greatly extend the coverage in x and Q^2 while significantly increasing at the same time the accuracy of the measurements. …

…The large communities working on hadron structure both in Europe and the US are working towards and eagerly waiting for the approval of the first polarised Electron-Ion Collider (EIC). This machine will enable precision measurements over a largely extended kinematic phase-space with light polarised and heavy unpolarised ions. The EIC will be capable of accessing the gluon content of the proton and make significant progress on the knowledge of the proton spin content, TMDs and GPDs. It may also advance our understanding of the non-perturbative structure of the strong interaction by discovering evidence for the mixed quark-gluon condensate….

PROPERTIES OF STRONGLY INTERACTING MATTER AT EXTREME CONDITIONS OF TEMPERATURE AND BARYON NUMBER DENSITY:

…A more comprehensive study of this regime of large nuclear gluon density will be possible at the Electron-Ion Collider (EIC) currently planned in the USA, by allowing a direct measurement of nucleonic and nuclear structure functions, and in particular the longitudinal one which is most directly sensitive to the gluon content….

From the NuPECC 2017 LRP :

INTERNATIONAL CONTEXT:

…The European groups working at JLAB and COM- PASS provide a very valuable contribution to the R&D for the EIC project which is expected to have a worldwide dimension. NuPECC highly recognizes the science of the EIC project, presently under study, representing an opportunity for a major step forward in the field of hadron physics….

LRP Recommendations for Hadron Physics

1. **First recommendation: Completion of the PANDA experiment at FAIR without further delays**
2. **Second recommendation: Support for a research programme in precision physics at existing (European) facilities**
3. **Third recommendation: Support for theory and computing**

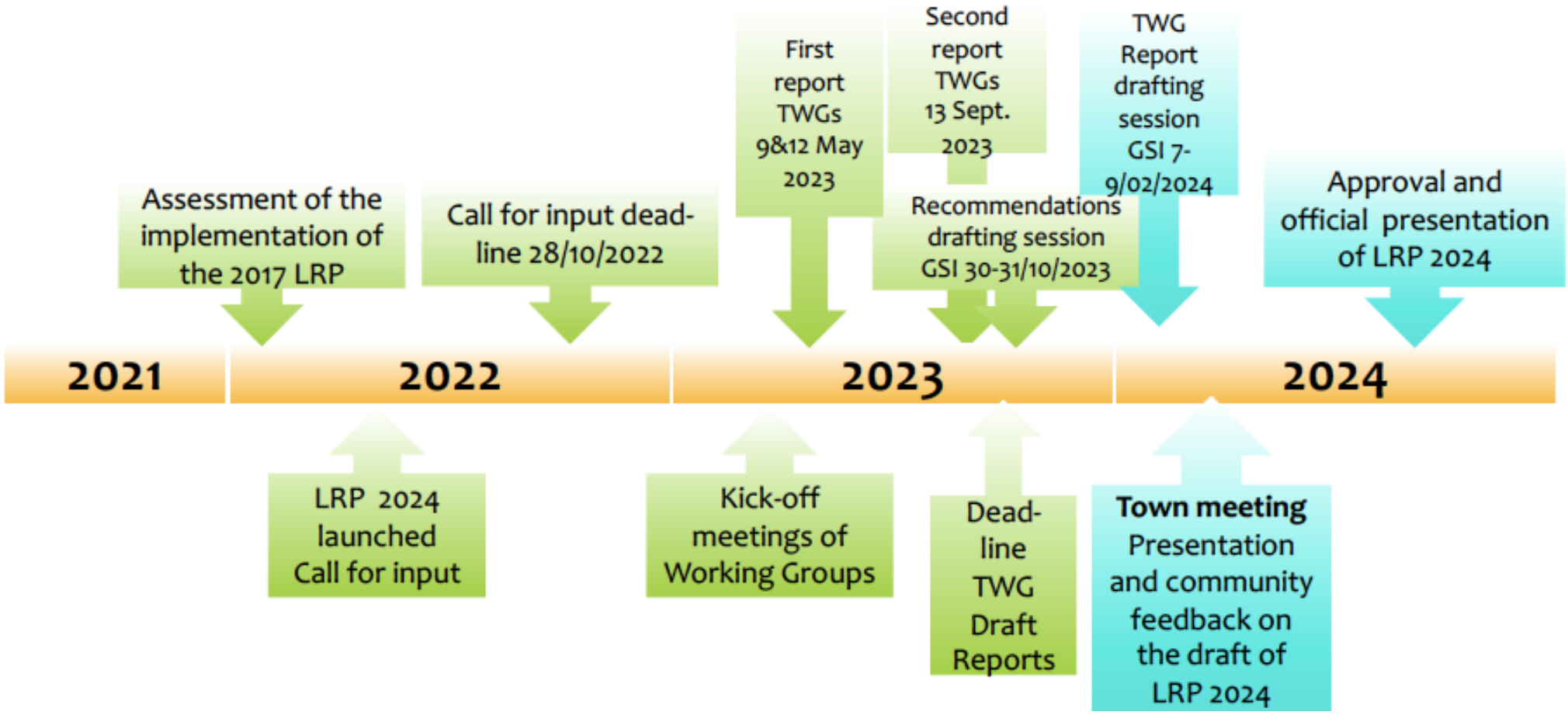
NuPECC & EIC

- Presentation of Tim Hallman at the NuPECC meeting in Valencia in March 2020
- Presentation of E. Nappi “European participation in EIC” at the NuPECC meeting in Valencia in March 2020

- A dedicated NuPECC working group composed of Dave Ireland, Franck Sabatié and Eugenio Nappi was formed in July 2020 in order to explore a possibility that European users/institutions join their efforts and present a coherent view on the participation in the EIC experiments for example expressed through one or several EoI.

- NuPECC can play in this initiative a catalyzing role, for example organizing dedicated meetings and facilitate contacts with European funding agencies and DOI representatives.

NUPECC LRP Timeline



Steering Committee of NuPECC LRP 2024

28 members

NuPECC Members
Associated Members
and Observers

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

Community Input

153 total inputs, of which 3 directly related to the EIC:

- n. 64 The Electron Ion Collider – Exploring the mysteries of the building blocks of matter – BNL & JLAB – Contact Elke Aschenauer
- n. 135 The Electron Ion Collider: a U.S. facility for the european community to explore the mysteries of the building blocks of matter EICUG – contact: M. Radici, S. Dalla Torre, D. Sokhan
- n. 143 Input of the INFN community to the NUPECC LRP 2024 included the EIC – INFN – Contact P. Antonioli, M. Radici
- n. 67 French input on Hadron Physics - contact C. Muñoz Camacho

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10	Nuclear Science - People and Society Training, Careers & Diversity Education and Outreach	María García Borge (Madrid)	mj.borge@csic.es	Rolf-Dietmar Herzberg	rdh@liverpool.ac.uk
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TWG1 Hadron Physics

- Introduction
- Hadron Spectroscopy – EIC mentioned in the context of exotic states photoproduction
- Hadron Structure – EM form factors, polarizabilities, proton gluonic radius, PDF, GPD, TMD
- Hadron Interactions
- Precision Measurements
- Recommendations

+ boxes on Lattice QCD/EFTs, proton charge radius, g-2

TWG6 Infrastructures

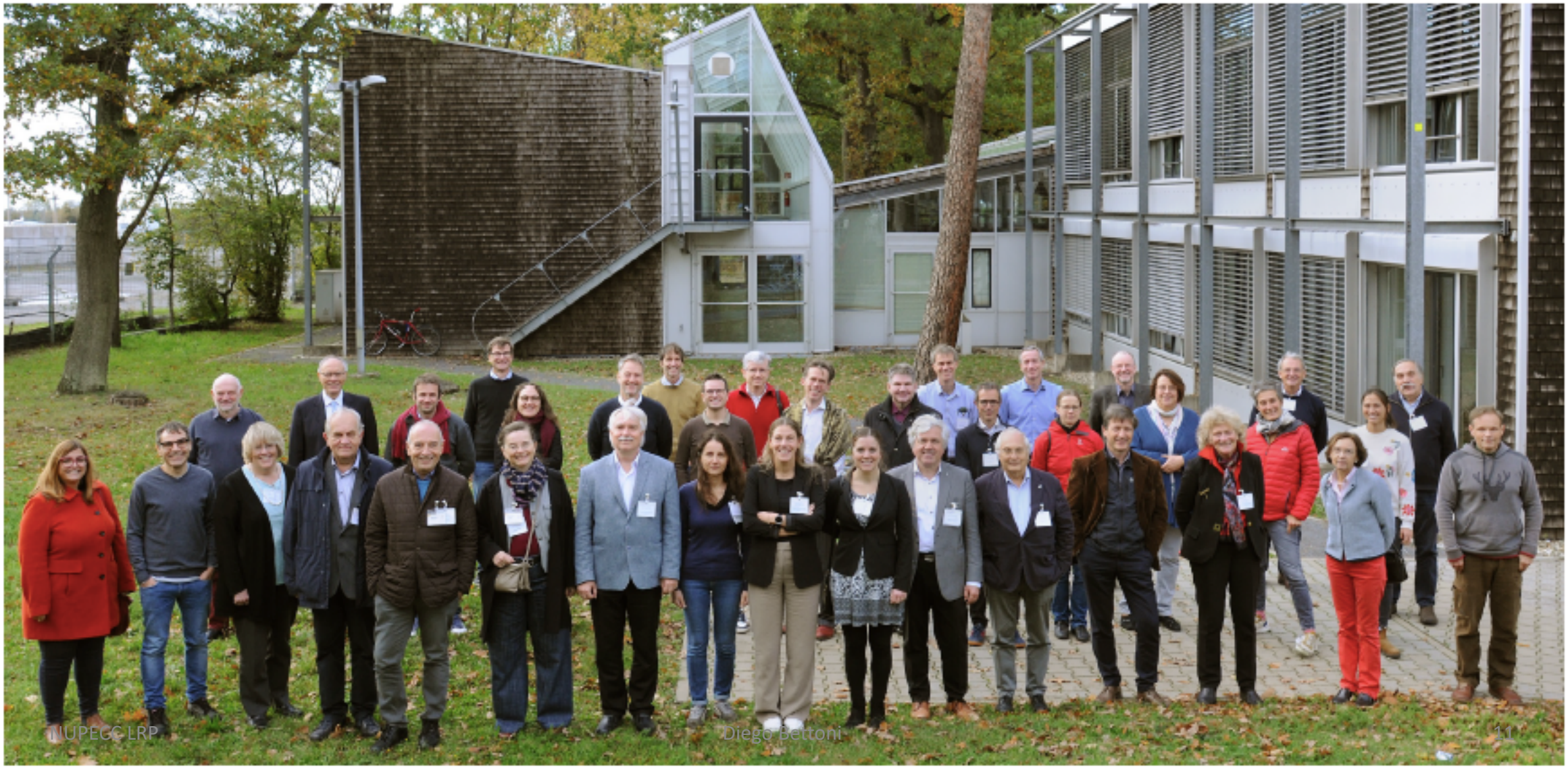
- Lepton and Photon facilities
- Hadron and Ion facilities
- Neutron facilities
- Small scale facilities
- International facilities (EIC, JLAB etc.)

TWG6 will focus on Reserach Infrastructures without mention of detectors or experimental techniques

TW6 will include RI in Europe plus those international RIs for which there is a strong interest from the corresponding TWG

Recommendations Drafting Session

30-31 October, 2023 at GSI



Layout of the General LRP Recommendations

INTRODUCTION (to be added) .

To be prepared by the NuPECC MG and discussed at a dedicated NuPECC LRP2024 SC meeting by Jan.-Feb. 2024

Fundamental Nuclear Physics.....
- Hadron Physics.....
- Strongly Interacting Matter at Extreme Conditions .....
- Nuclear Structure and Reaction Dynamics.....
- Nuclear Astrophysics .....
- Symmetries and Fundamental Interactions .....

Applications and Societal Benefit .....

Nuclear Physics Tools .....
- Detectors and experimental techniques .....
- Computing, Machine Learning, Artificial Inteligence,Quantum Computing

Open Science and Data .....

Nuclear Science - People and Society .....

European Integrating Initiatives (to be added) .....

To be prepared by the NuPECC

Sustainability (to be added).....

A dedicated working group to be formed

Goal: Link General Recommendations with Scientific Case

- **Support of existing facilities and experiments**
- **Future flagship facilities and experiments**
- **Theory developments**

LRP 2024 Town Meeting

- Date: 15-17 April 2024
- Venue: Bucharest, Romania
- Program: 2,5 days with ample time for discussion
- Invited: Nuclear Physics community and ESFRI

Thank You