

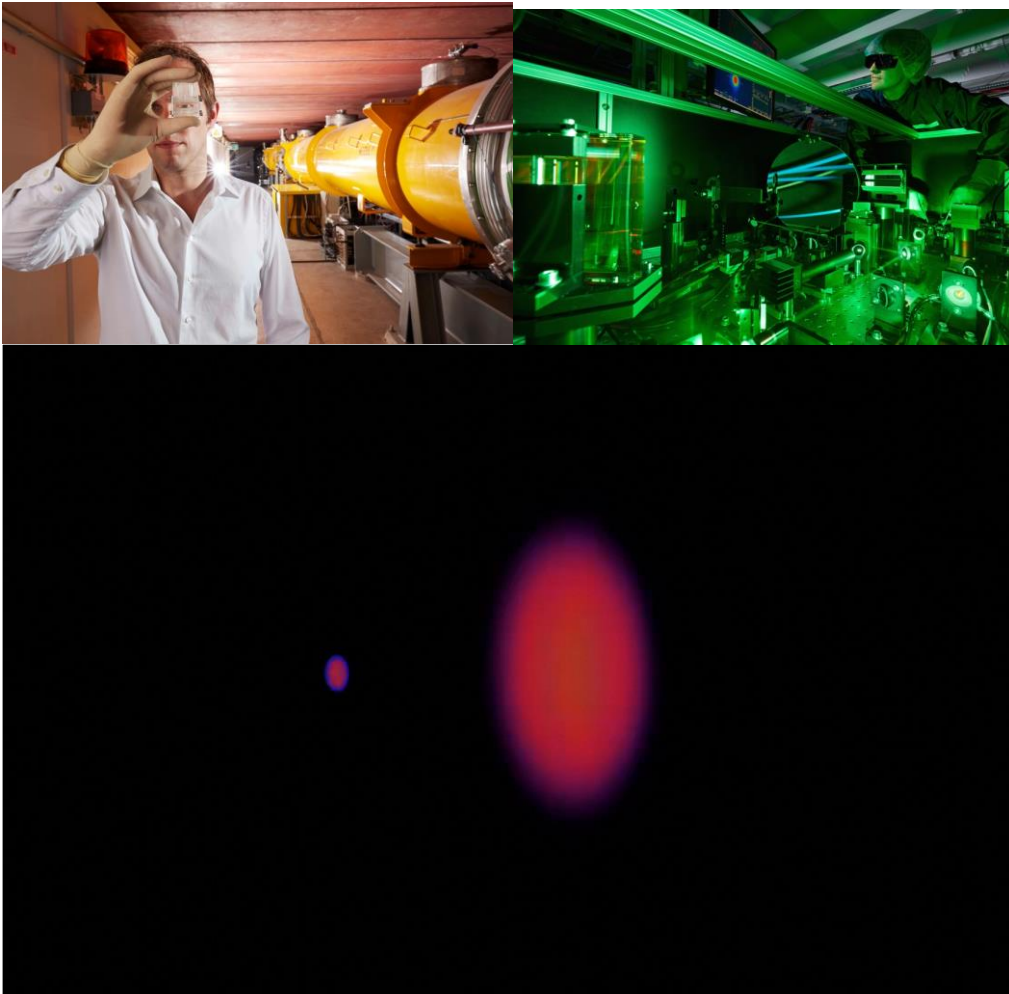


European Network for Novel Accelerators (EuroNNAc) - Report from WP5

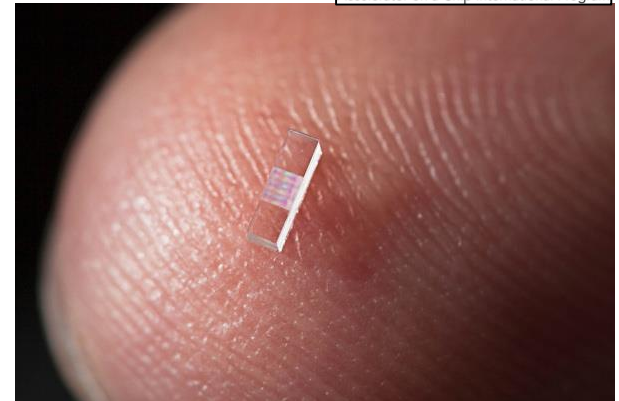
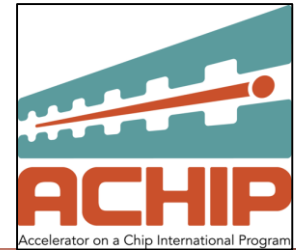
ARIES Final Review Meeting 2022, 15 July 2022, Remote

Ralph W. Aßmann (DESY & INFN), M. Ferrario (INFN), B. Holzer (CERN),
P. Nghiem (CEA), A. Specka (CNRS), R. Walczak (Oxford)

WP5 – Topic: Novel Particle Accelerators



Novel = ultra-strong fields
= extreme acceleration
= ultra compact



Accelerator on a Chip - DLA

Plasma accelerator, the 100 billion Volt/m machine



EuroNNAc

> 65 institutes

→ diverse community



EUROPEAN NETWORK FOR NOVEL ACCELERATORS
EuroNNAc₃
supported by EU via ARIES

Armenia
CANDLE

China
Beijing National Laboratory IOP CAS
IOP, Chinese Academy of Science
Shanghai Jiao Tong University
Tsinghua University

Czech Republic
ELI Beams

France
CEA/CNRS
Ecole Polytechnique
ENSTA Paris tech
IN2P3
LAL
LPGP
LULI
PHLAM Université de Lille
Soleil

Germany
Deutsches Elektronen-Synchrotron (DESY)
Ferdinand Braun Institut
Forschungszentrum Jülich
Fraunhofer ILT
Gesellschaft für Schwerionenforschung (GSI)
Helmholtz Institutes Jena
Helmholtz-Zentrum Dresden-Rossendorf
Karlsruhe Institute of Technology
LMU University Munich
Max-Planck-Institute for Quantum Optics
Max-Planck-Institute for Physics
TU Darmstadt
University Düsseldorf
University Erlangen
University Hamburg
University Jena

Hungary
Wigner Research Center

Italy
CNR, Istituto Nazionale di Ottica – Pisa
INFN Frascati
INFN Milano
INFN Roma1
University of Rome Tor Vergata
University of Rome La Sapienza
University of Pisa

Japan
Kansai Photon Science Institute
KEK
Osaka University
RIKEN Spring-8

Netherlands
Eindhoven University of Technology

Norway
University of Oslo

Portugal
Instituto Superior Tecnico de Lisboa

Russia
JIHT of Russian Academy of Sciences
Budker Institute of Nuclear Physics
Institute of Applied Physics RAS


Sweden
Lund University

Switzerland
University of Bern
Paul Scherrer Institut

UK
ASTeC
Cockroft Institute
JAI - Imperial College
Lancaster University
Manchester University
Oxford University
Queen's University of Belfast
STFC Rutherford Appleton Laboratory
STFC Daresbury Laboratory
University College London
University of Liverpool
University of Strathclyde

USA
Brookhaven National Laboratory
Fermi National Accelerator Laboratory
Lawrence Berkely National Laboratory
Lawrence Livermore National Laboratory
SLAC National Accelerator Laboratory
University of California Los Angeles

International
European Organization for Nuclear Research (CERN)
ELI Beamlines
International Committee for Future Accelerators
International Committee on Ultra High Intensity Lasers



WP5 – Tasks

Task 5.1. Coordination and Communication

- Efficient coordination of the network including monitoring work progress and managing WP budget and use of resources
- Provide a central service to the novel accelerator community
- Management of the common pot for organizing an open exchange platform – including workshops - and a coordinated European strategy
- Discuss and support common applications for external funding out of the EuroNNAc context

Ralph W. Aßmann (DESY & INFN), M. Ferrario (INFN), B. Holzer (CERN), P. Nghiem (CEA), A. Specka (CNRS), R. Walczak (Oxford)

Task 5.2. European Strategy Plasma Accelerators

- Develop further the European strategy for a plasma accelerator for electron beams
- Follow up on the EuPRAXIA proposal after the end of the H2020 design study
- Foster discussions on a European strategy for plasma accelerators for hadron beams

Task 5.3. European Strategy Dielectric Accelerators

- Foster discussions on a European strategy for dielectric structures, driven by beams or lasers
- Foster discussions on applications of dielectric structures, their promise and their limitations

Task 5.4. European Advanced Accelerator Concepts WS (EAAC)

- Develop further the scope and scientific depth of the EAAC
- Organize the EAAC
- Organize timely publication of the proceedings as a reference report of the state of this field

WP5 Deliverables (Milestones: All Done)

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D5.1	Specialized school on Novel Accelerators for young scientists	1 - CERN	Report	Public	36
D5.2	Final EuroNNAc and EAAC Report	9 - DESY	Report	Public	46

Description of deliverables

D5.1 : Specialized school on Novel Accelerators for young scientists [36]

Organization of a topical lecture series, report to summarize presentations and attendance (Task 5.5)

D5.2 : Final EuroNNAc and EAAC Report [46]

Final report to summarize the outcome of the work progress in tasks, including the status of European strategies for plasma accelerators and dielectric accelerators (Task 5.1, 5.2, 5.3)

All DONE



Website: <https://www.euronnac.eu>

EUROPEAN NETWORK FOR NOVEL ACCELERATORS



supported by EU via ARIES

Home	Members/Facilities	Achievements	Contact/Org	ARIES	EuroNNAc Award
EAAC 2019 , 4th Europ. Advanced Acc. Workshop, Elba, Italy		15.-21.09.2019	Link		What is EuroNNAc? The European Network for Novel Accelerators EuroNNAc brings together more than 60 institutes and aims at federating the significant European and international efforts in plasma-based accelerators. Goal is to prepare a roadmap for an efficient use of this novel technology in full-scale accelerators.
LPAW 2019 - Int. Conf. on Laser Plasma Acc., <i>Split, Croatia</i>		5.-10.05.2019	Link		
2019 CAS on Plasma Acceleration, Sesimbra, Portugal		11.-22.03.2019	Link		Simon van der Meer Early Career Award in Novel Accelerators The Simon van der Meer Award is being established in 2019 to recognize outstanding early career contributions (theoretical, experimental, computational or technical) in novel accelerator science. It is sponsored by the European Network for Novel Accelerators (EuroNNAc) which is part of the EU project ARIES. Read more
2018 yearly EuroNNAc meeting , Frascati, Italy		23.11.2018	Link		
EAAC 2017 , 3rd Europ. Advanced Acc. Workshop, Elba, Italy		24.-30.09.2017	Link		
2017 yearly EuroNNAc meeting , Elba, Italy		30.09.2017	Link		
2016 yearly EuroNNAc meeting , Pisa, Italy		01.07.2016	Link		
EAAC 2015 , 2nd Europ. Advanced Acc. Workshop,					

EAAC 2019 – Elba, Italy, 15 – 21 Sep 2019

Had to limit participation for the first time



- Number of participants: 267 (> 70 applications not accepted)
- Number of countries: 17
- Male/Female: 84 % / 16 %



Scientific Work EAAC 2019

- Number of presentations: **301**
 - Number of plenary talks: 28 (*86%/14 % male/female*)
 - Simon van der Meer talk 1
 - Number of WG's: 8
 - Number of WG talks: 138 (160 in 2017)
 - Number of posters: 121 (92 in 2017)
 - Number various: 5
- Program committee: 28 (*82%/18% male/female*)

Proceedings: IOP Volume 1596

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Journal of Physics: Conference Series

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Volume 1596 2020

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4th European Advanced Accelerator Concepts Workshop 15-20 September 2019, Isola d'Elba, Italy. Edited by A. Cianchi et al.

Accepted papers received: 14 July 2020
Published online: 18 September 2020

Papers

OPEN ACCESS 012001
Summary of European Advanced Accelerator Workshop (EAAC) Working Group 1: Electron Beams from Plasma
Sebastien Corde, Arie Irman and Marlene Turner
[Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012002
Tunable and precise two-bunch generation at FLASHForward
S Schröder, K Ludwig, A Aschikhin, R D'Arcy, M Dinter, P Gonzalez, S Karstensen, A Knetsch, V Libov, C A Lindström *et al*
[Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012003
Towards experimental investigation of hosing instability mitigation at the PITZ facility
G Loisch, M Gross, C Koschitzki, O Lishilin, A Martinez de la Ossa, J Osterhoff and F Stephan
[Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012004
Angstrom wavelength FEL driven by 5 GeV LWFA beam with external injection
A R Rossi, V Petrillo, A Bacci, E Chiadroni, A Cianchi, M Ferrario, A Giribono, M Rossetti Conti, L Serafini and C Vaccarezza
[Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012005
Determination of the Charge per Micro-Bunch of a Self-Modulated Proton Bunch using a Streak Camera
A.-M. Bachmann and P. Muggli
[Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012006
Setup and Characteristics of a Timing Reference Signal with sub-ps Accuracy for AWAKE
Fabian Batsch
[Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012007
Study of external electron beam injection into proton driven plasma wakefields for AWAKE Run2
L. Verra, E. Gschwendtner and P. Muggli
[Open abstract](#) [View article](#) [PDF](#)

- Many thanks to Lead Editor A. Cianchi and the editor team
- **66 peer-reviewed publications, all open access**
- For many students the first peer-reviewed publication: important lesson in publishing

Simon van der Meer Award: 1st Time

Simon van der Meer Early Career Award in Novel Accelerators

Got permission of son of Simon van der Meer to use name for this award!

(sponsored by the European Network for Novel Accelerators through the EU project ARIES)

The Simon van der Meer Award is being established in 2019 to recognize outstanding early career contributions (theoretical, experimental, computational or technical) in novel accelerator science. It is sponsored by the European Network for Novel Accelerators (EuroNNAc) which is part of the EU project ARIES. EuroNNAc is coordinated by DESY, CERN, Ecole Polytechnique, University of Oxford, INFN Frascati and CEA.

The Simon van der Meer Award will be awarded every two years at the European Advanced Accelerator Concepts workshop (EAAC). Eligible candidates must be within 12 years of the completion of their first university degree or equivalent, excluding career breaks (e.g. maternity or paternity leave, adoption). There is no restriction as to nationality. The research recognized could be either a single piece of work, or the sum of contributions. The award recognizes one individual researcher and consists of a stipend of € 3000 and a certificate citing the contributions of the recipient.

The announcement of the Award Winner will be made at the EAAC19 workshop on Elba.

Mr. Spencer Gessner (CERN)



ARIES Final Review Meeting - July 2022



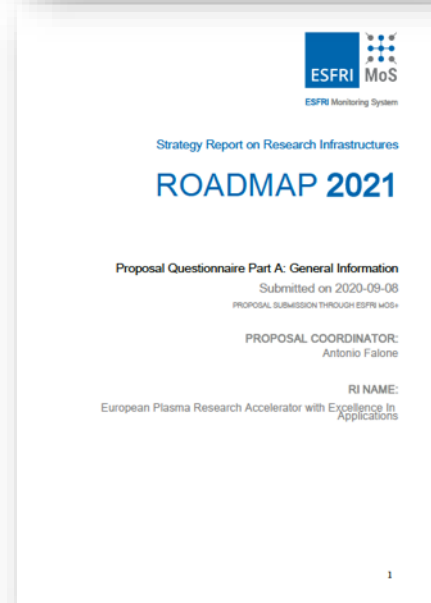
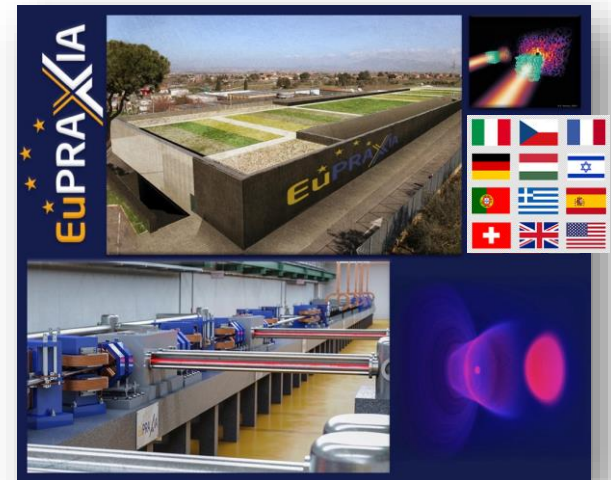
EuPRAXIA Project – Outcome of EuroNNAc



- First ever conceptual design of a plasma accelerator facility
- Funded by EU as Horizon2020 design study
- CDR published after peer review in European Physics Journal – Special Topics
 - 255 contributors, almost all also in EuroNNAc
 - > 650 pages
 - Two construction sites: beam-driven (Frascati) and laser-driven (ELI-Beamlines OR EPAC/Rutherford/STFC OR CNR Pisa)
- Cost of 570 M€ out of which 140 M€ have already been obtained.
- ESFRI application submitted, found eligible and defended last week in hearing. Decision in July.

EuPRAXIA – Towards ESFRI

- Sep 2020 Submitted
- Nov 2020 Found eligible for ESFRI Roadmap
Detailed assessment through ESFRI panels
- 30 Mar 2021 Critical questions received
- 6 Apr 2021 Dry run with INFN president plus Italian representatives
- 12 Apr 2021 Additional support letters on financial side submitted (CNRS, STFC, Queen's University)
- 15 Apr 2021 ESFRI Hearing
- June 2021 Decision: Placed on 2021 Update of ESFRI roadmap (only acc. project, 1st plasma acc. project ever)
- Nov 2022 Start of EU Preparatory Phase project



WP5 Strategic Input to the Science Community



Statement from the European Network for Novel Accelerators (EuroNNAC)
to the European Strategy Preparatory Group (ESPG)

On the Prospect and Vision of
Ultra-High Gradient Plasma Accelerators for High Energy Physics

- Update to our 2012 Statement to the ESPG, list of Institutes and Names at the End of Document -

Abstract

Plasma accelerators generate accelerating fields that are up to 1,000 times higher than fundamentally possible in RF accelerators. They therefore offer a promising alternative path to the high-energy frontier. In 2012 the European Strategy Preparatory Group received for the first time detailed input about the prospects and promise of plasma accelerators, a 15 page report provided by the EU-funded European Network for Novel Accelerators (EuroNNAC). The network published a 31 page report on a European strategy for plasma accelerators in 2017. Here we provide a short update on the prospect of plasma accelerators for high energy physics. We propose that the next European strategy for particle physics should explicitly list ultra-high gradient plasma acceleration and, if possible, its supporting international projects as essential R&D towards a compact alternative for future colliders.

Contact: Ralph Assmann (ralph.assmann@desy.de)

December 18th, 2018

1

Input 2018 European strategy for Particle Physics

New Major Plasma Acceleration Projects since the last European Strategy Update:

Important new projects were funded since the last strategy update in Europe and beyond. These include the Horizon2020 EU Design Study for a “European Research Plasma Accelerator with eXcellence In Applications” **EuPRAXIA** involving 41 institutes [3], the international **AWAKE** experiment [4] at CERN involving 18 institutes and the international **ALEGRO** study [5] on a possible future plasma linear collider. New national activities in Europe since 2012 are the Plasma Wakefield Accelerator Steering Committee (PWASC) in the UK [6], the multi-institutional laser plasma acceleration project **ATHENA** [7] in the Helmholtz Association in Germany, the ELBE center at HZDR, CILEX in France, CLARA and SCAPA in the UK, **EuPRAXIA@SPARC_LAB** at INFN-LNF in Italy [8], Lund in Sweden, JuSPARC at FZJ and FLASHForward and SINBAD at DESY. There are strong activities with new funding on plasma acceleration in Japan (ImPACT), in China (Synergetic Extreme Condition User Facility SECUF) and in the US (FACET-II, BELLA).

Our Proposal for the Strategy Update:

The next European strategy for particle physics should **explicitly list ultra-high gradient plasma acceleration** and, if possible, its supporting international projects (see above in bold) as **essential R&D towards a compact alternative for future colliders**.

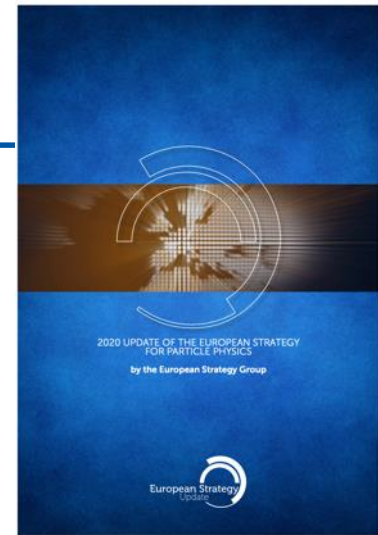
→ **Followed up with various talks, e.g. in ECFA seminar and newsletter late 2019**

Outcome Particle Physics Strategy

3



High-priority future initiatives



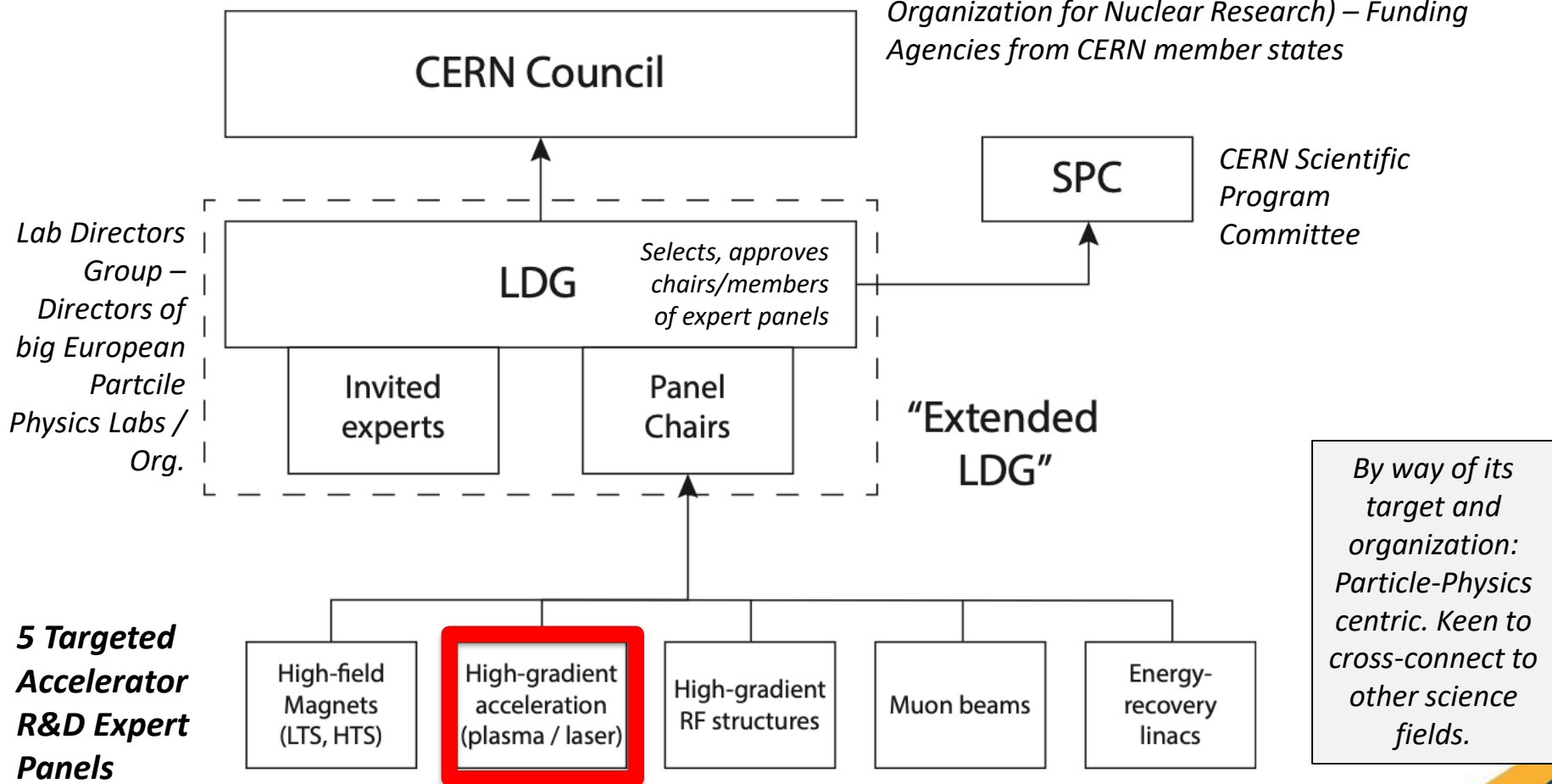
B. Innovative accelerator technology underpins the physics reach of high-energy and high-intensity colliders. It is also a powerful driver for many accelerator-based fields of science and industry. The technologies under consideration include high-field magnets, high-temperature superconductors, plasma wakefield acceleration and other high-gradient accelerating structures, bright muon beams, energy recovery linacs.

The European particle physics community must intensify accelerator R&D and sustain it with adequate resources. A roadmap should prioritise the technology, taking into account synergies with international partners and other communities such as photon and neutron sources, fusion energy and industry. Deliverables for this decade should be defined in a timely fashion and coordinated among CERN and national laboratories and institutes.

Expert Panel: High Gradient Acceleration Plasma and Laser

Organization *adapted from D. Newbold*

Council = Governing body of CERN (European Organization for Nuclear Research) – Funding Agencies from CERN member states



Expert Panel: High Gradient Acceleration Plasma and Laser

Expert Panel – Panel chairs:

Chair: Ralph Assmann (DESY/INFN)

Deputy Chair: Edda Gschwendtner (CERN)

Panel members:

Kevin Cassou (IN2P3/IJCLab), Sebastien Corde (IP Paris), Laura Corner (Liverpool), Brigitte Cros (CNRS UPSay), Massimo Ferarrio (INFN), Simon Hooker (Oxford), Rasmus Ischebeck (PSI), Andrea Latina (CERN), Olle Lundh (Lund), Patric Muggli (MPI Munich), Phi Nghiem (CEA/IRFU), Jens Osterhoff (DESY), Tor Raubenheimer (SLAC), Arnd Specka (IN2PR/LLR), Jorge Vieira (IST), Matthew Wing (UCL).

Panel associated members:

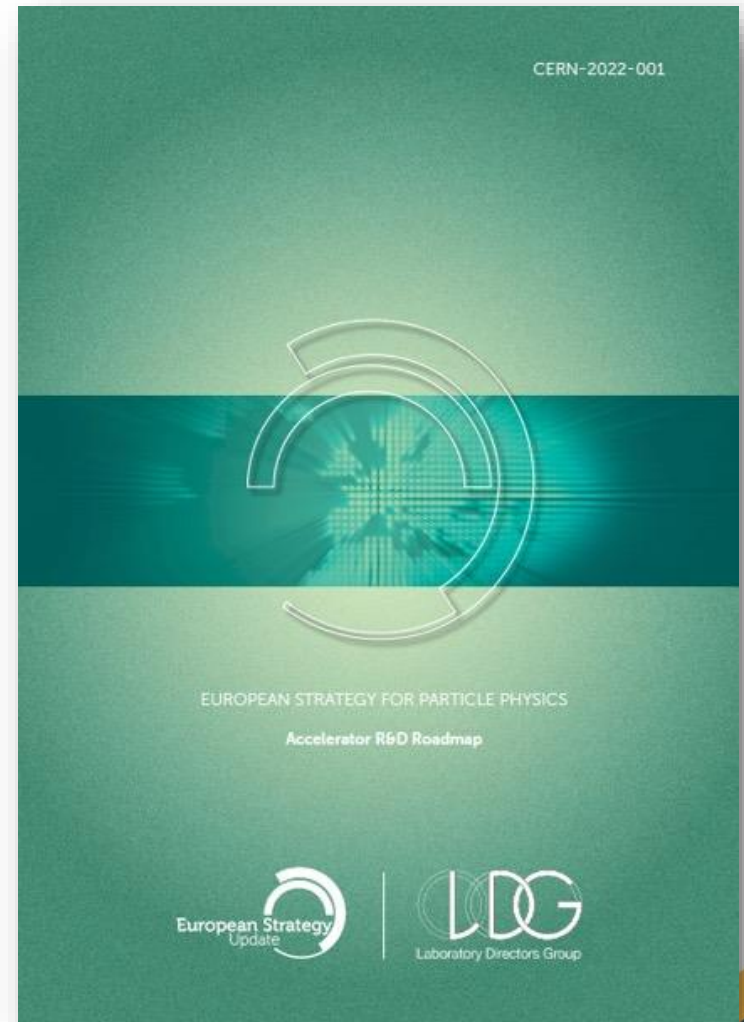
Cameron Geddes (LBNL), Mark Hogan (SLAC), Wei Lu (Tsinghua U.) , Pietro Musumeci (UCLA)

Work performed:

Jan 2021 – Feb 2022

Final report:

Yellow Report CERN-2022-001



Conclusion

- ARIES WP5 ran over 4 years of ARIES:
 - Novel accelerators became a much bigger activity, visible by large workshops, important publications and “big” proposals (e.g. EuPRAXIA on ESFRI?)
 - Several major efforts ongoing in Europe: EuPRAXIA, AWAKE, ALEGRO, ...
 - ARIES/EuroNNAc-sponsored EAAC as a central discussion forum for this field
 - Many good young scientists and students involved and supported
 - First explicit mentioning of plasma and laser accelerators in the 2020 update of the European strategy for particle physics
 - Formed a European expert panel for defining an accelerator R&D roadmap
- ARIES WP5 and its EU sponsored meetings were fundamental for setting up Europe as a world-wide leading contender in novel accelerators:

working together – helping the young scientists

defining common goals – generating synergy

