European Network for Novel Accelerators (EuroNNAc$_2$):

WP7

R. Assmann (DESY), M. Ferrario (INFN Frascati),
B. Holzer (CERN), J. Osterhoff (DESY),
A. Seryi (JAI, Oxford), A. Specka (Ecole polytechnique Paris)

EuCARD2 Final Yearly Meeting
28 – 30.3.2017, Glasgow, UK

EuCARD-2 is co-funded by the partners and the European Commission under Capacities 7th Framework Programme, Grant Agreement 312453

Outline

1. Short Review Milestones and Deliverables
2. Major Achievements in EuroNNAc2
3. Outlook

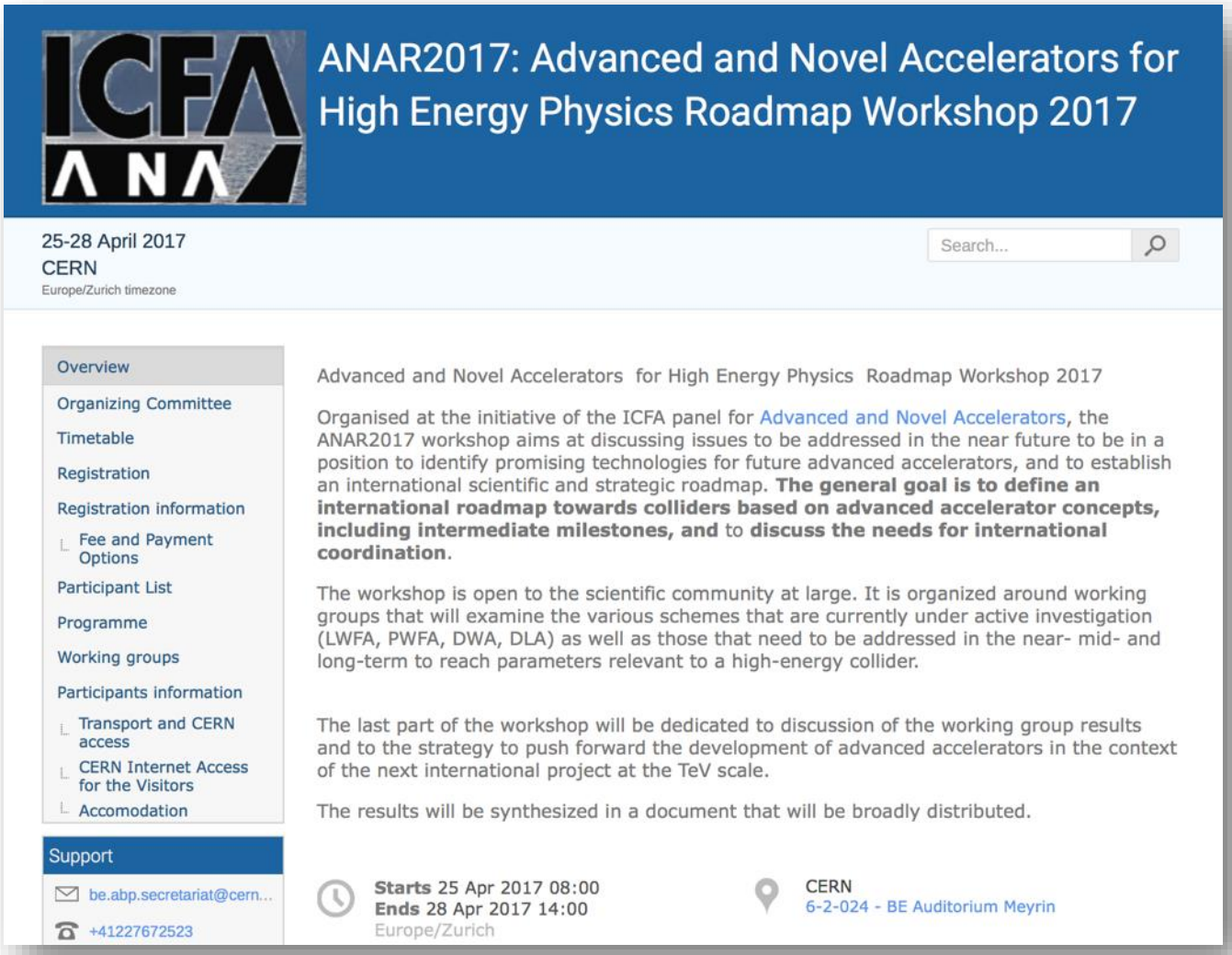
Outline

1. **Short Review Milestones and Deliverables**
2. Major Achievements in EuroNNAc2
3. Outlook

Milestones and Deliverables

Y1	MS58	EuroNNAc2 2013 workshop	7	M12	DONE	M
Y2	MS59	EuroNNAc2 2014 workshop	7	M24	DONE	M
	7.1	Interim EuroNNAc2 report	7	M24	DONE	D
Y3	MS60	EuroNNAc2 2015 workshop	7	M36	DONE	M
Y4	MS61	EuroNNAc2 2016 workshop	7	M48	DONE	M
	7.2	Final EuroNNAc2 report - a European roadmap	7	M46	*ongoing*	D

Strategy Discussions a "Hot Topic"



ANAR2017: Advanced and Novel Accelerators for High Energy Physics Roadmap Workshop 2017

25-28 April 2017
CERN
Europe/Zurich timezone

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Working groups
Participants information
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Accomodation

Support
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Advanced and Novel Accelerators for High Energy Physics Roadmap Workshop 2017

Organised at the initiative of the ICFA panel for Advanced and Novel Accelerators, the ANAR2017 workshop aims at discussing issues to be addressed in the near future to be in a position to identify promising technologies for future advanced accelerators, and to establish an international scientific and strategic roadmap. **The general goal is to define an international roadmap towards colliders based on advanced accelerator concepts, including intermediate milestones, and** to **discuss the needs for international coordination**.

The workshop is open to the scientific community at large. It is organized around working groups that will examine the various schemes that are currently under active investigation (LWFA, PWFA, DWA, DLA) as well as those that need to be addressed in the near- mid- and long-term to reach parameters relevant to a high-energy collider.

The last part of the workshop will be dedicated to discussion of the working group results and to the strategy to push forward the development of advanced accelerators in the context of the next international project at the TeV scale.

The results will be synthesized in a document that will be broadly distributed.

Starts 25 Apr 2017 08:00
Ends 28 Apr 2017 14:00
Europe/Zurich

CERN
6-2-024 - BE Auditorium Meyrin

Chairpersons:
B. Cros
P. Muggli

EuroNNAc strategy will be presented and discussed at this workshop

Then completion of final EuroNNAc report...

Outline

1. Short Review Milestones and Deliverables
2. **Major Achievements in EuroNNAc2**
3. Outlook

Major Achievements

1. Grew and nourished the network further.

EuroNNAc²

European Network for Novel Accelerators

EINDHOVEN University of Technology

University of Oxford
University of Strathclyde
Manchester University
Lancaster University
Cockcroft Institute
STFC Daresbury Laboratory
John Adams Institute
ASTeC
STFC Central Laser Facility
Liverpool University
University College London
Imperial College
Queen's University of Belfast

Instituto Superior
Tecnico de Lisboa

LULI
Soleil
LPGP
LOA
IRAMIS/CEA
IRFU/CEA
Laboratoire Leprince-Ringuet
(Ecole polytechnique - CNRS/IN2P3)
LAL

European Organization for
Nuclear Research (CERN)
PSI

University Düsseldorf
LMU University Munich
Stiftung Deutscher Elektronen Synchrotron (DESY)
Gesellschaft für Schwerionenforschung (GSI)
Max-Planck-Institute for Quantum Optics
Max-Planck-Institute for Physics
Helmholtz Institute Jena
Helmholtz-Zentrum Dresden-Rossendorf (HZDR)
University Hamburg
University Erlangen
Universtity Darmstadt

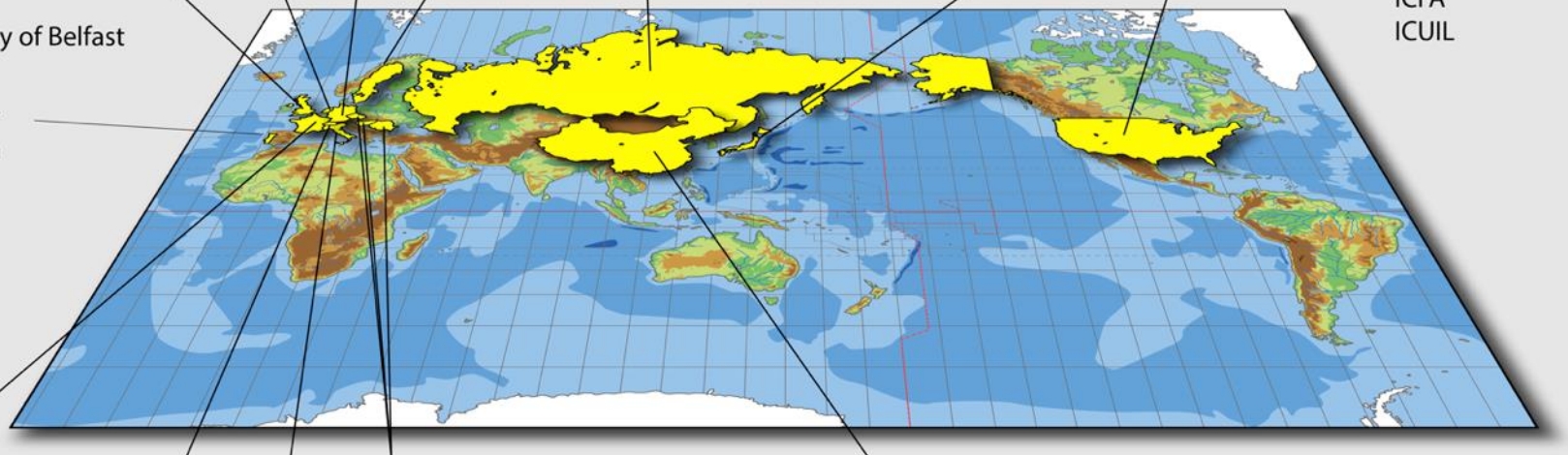
Lund University

Budker INP
Institute of Applied Physics RAS

KEK

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

ICFA
ICUIL



Extreme Light Infrastructures (ELI)
ELI Beams (Czech Republic)
Wigner Research Center (Hungary)

INFN-LNF
Pisa University and INFN
Consiglio Nazionale Delle Ricerche, INO
University of Rome LA SAPIENZA

Inst. of Physics, Chinese Academy of Sciences
Tsinghua University, Beijing
Shanghai Jiao Tong University

EuCARD²


SCAPA
United Kingdom
Isle of Man
Dublin
Ireland
Liverpool
Sheffield
Birmingham
Bristol
London
STFC ASTeC
Lund Laser Centre
Copenhagen
LAOLA
Laboratory for Laser- and beam-driven plasma Acceleration
ILPP
Bremen
Berlin
ELBE.
HELMHOLTZ ZENTRUM DRESDEN ROSSENDORF
JuSPARC
HI Jena
Helmholtz Institute Jena
STFC
Central Laser Facility
Prague
PHELIX
eli
beamlines
Paris
CileX
Centre Interdisciplinaire Lumière Extrême
Munich
CALA
Zurich
Budapest
Switzerland
France
Laboratoire d'optique appliquée
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Turin
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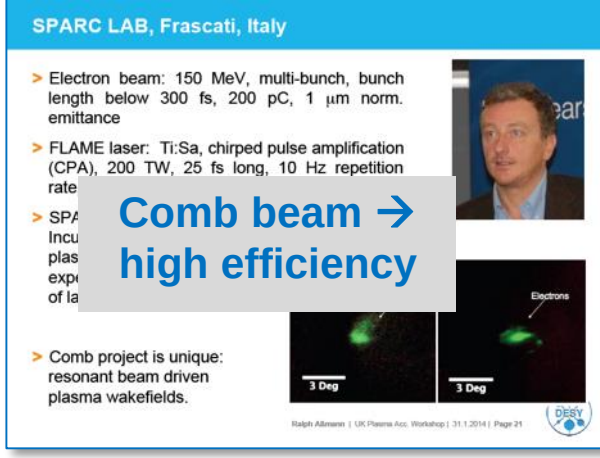
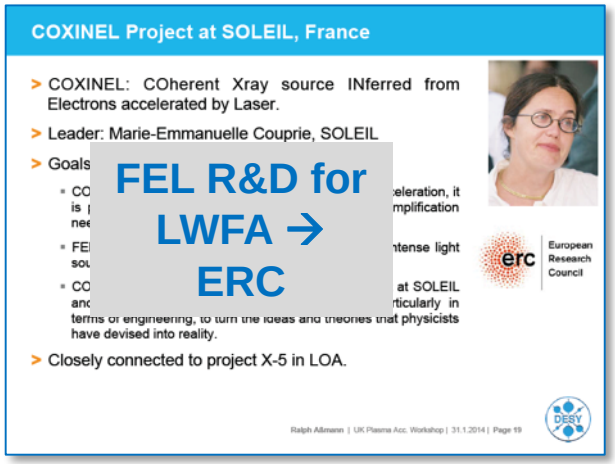
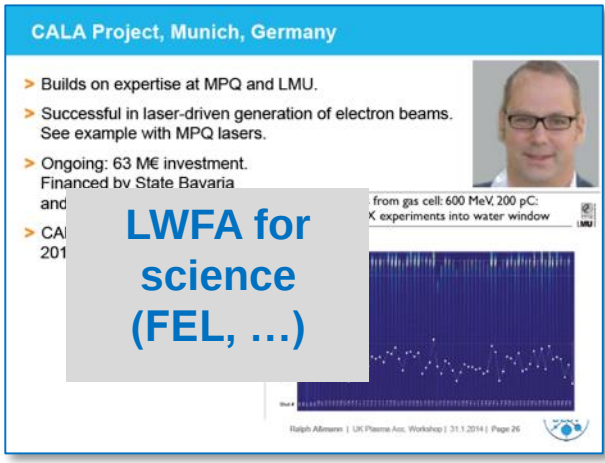
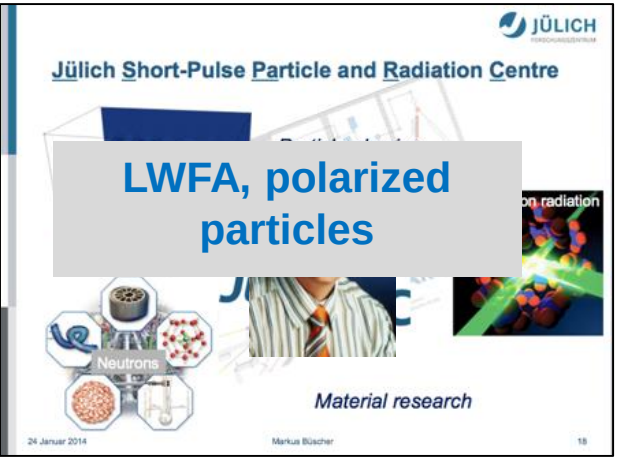


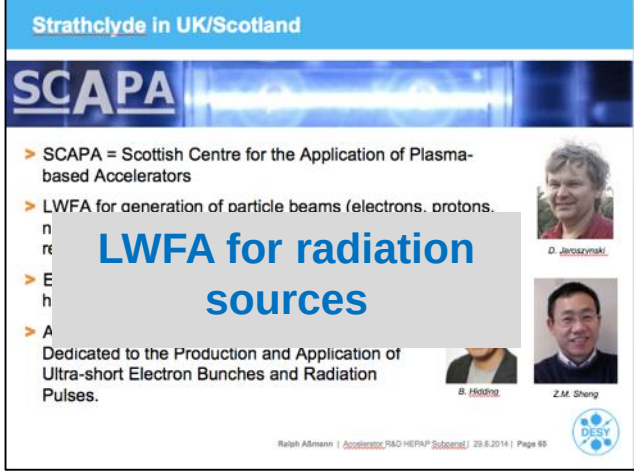


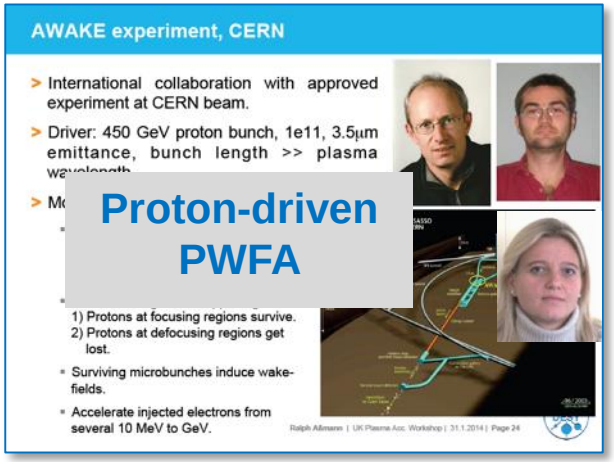


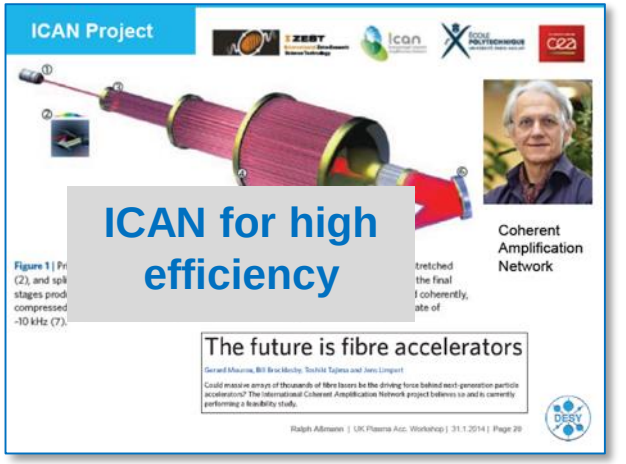
Overview European Plasma Accelerator Activities

R. Assmann, EuroNNAc2 @ EuCARD2, 3/2017



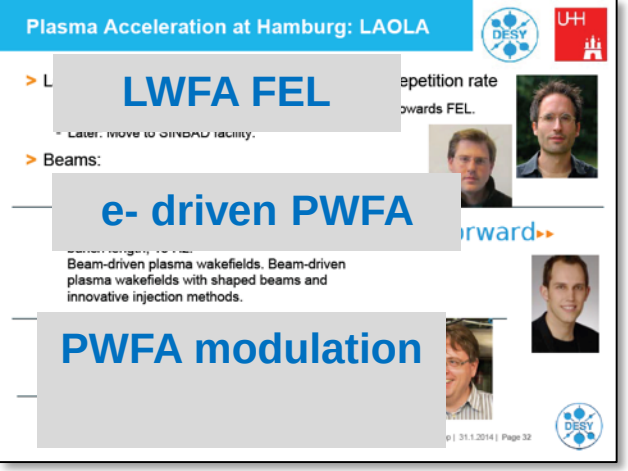


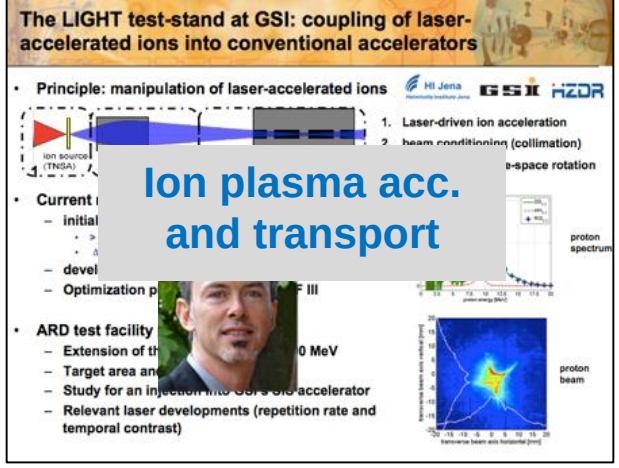


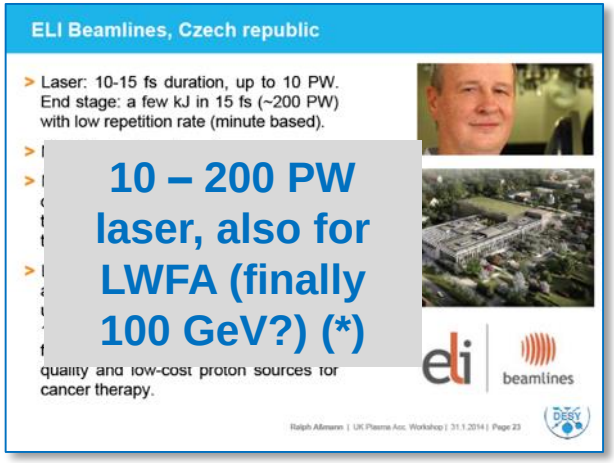


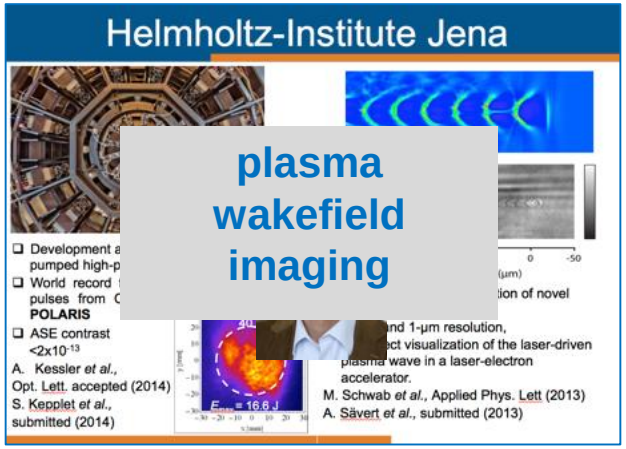
Overview European Plasma Accelerator Activities

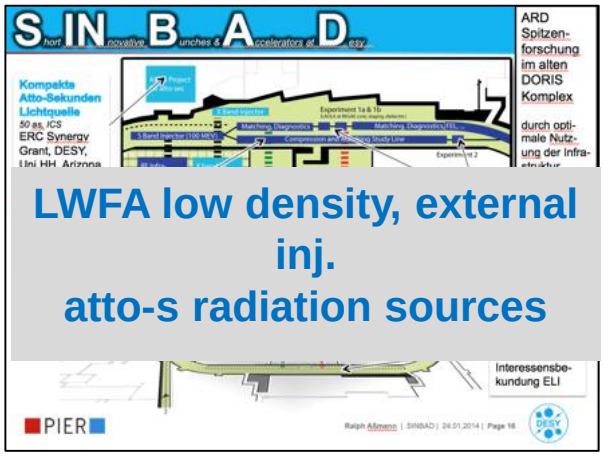
R. Assmann, EuroNNAc2 @ EuCARD2, 3/2017











* Extreme Light Infrastructure is a European research infrastructure (1 B€) at the international forefront of laser research. This research infrastructure is funded by the EU and presently under construction in Hungary, Bulgaria and Romania. ELI is a member of the EuroNNAc2 network and an associated partner in the EuPRAXIA project. This close connection ensures:

- optimal synergetic effects between the accelerator, laser and user communities (FEL, HEP, high density plasma, laser science)
- coordinated strategy for laser-driven plasma accelerators

In particular: ELI is included into site studies for a future European plasma accelerator.

Scope : Novel High Gradient Accelerators

- Original focus: European **plasma acceleration** community
  - Plasma-based electron accelerators
  - Plasma-based hadron accelerators
  - Driven by lasers and/or particle beams (e- and p)
- Grown to include discussions and teams from **dielectric vacuum accelerator** R&D:
  - Dielectric vacuum accelerators driven by THz (more specifically 300 GHz) sources → **AXSIS ERC synergy grant** (DESY/UHH), **CLARA**, ...
  - Dielectric vacuum accelerators driven by optical lasers → **ACHIP international collaboration GBM grant** → Erlangen, PSI, DESY, GSI, TUD, ...

EuroNNAc2
Yearly Meeting Discussions

Decisions:

Next working steps, standards to be set, optimizations for workshop organization, future spending of the network

EAAC2019 will be in Elba, Italy again

Novel Acceleration R&D in Europe

National novel accelerator projects with European network

Independent national projects*, funded by national states. About 16 major facilities for novel plasma acceleration R&D.

Funded by EU FP7 through EuCARD2

European Network EuroNNAc for Novel Accelerators

European novel accelerator projects with international involvement

AWAKE

CER… …tion
unde… …ership of MPI

Talk 2017 YM EuCARD2

AXSIS

ERC Synergy Grant

EuPRAXIA

Fu… …2020
as … Design Study

Talk 2016 YM EuCARD2

** See note on ELI*

Major Achievements

1. Grew and nourished the network further.
2. **Established the European Advanced Accelerator Concepts Workshop (EAAC) as a European forum for discussions and exchange on novel accelerators.**

EAAC2015

- 258 participants + about 50 accompanying persons.
- 45 sponsored students plus non-sponsored students.
- Participants from 23 countries in 4 continents (11 EU member states):
  - EU member states: 188
  - Other Europe + Russia + Israel: 28
  - US: 30
  - Asia: 11
  - Australia: 1
- 218 male (84%), 40 female (16%) participants

Participants and Students

Scientific Work

- Working Groups + Summaries: 7
- Invited Talks: 30
- Special Science Talk: 1
- WG Talks: 138
- Posters: 76

  Thanks to Alban Mosnier + Program Committee

- Proceedings - Special Volume NIM → Published in 2016

  Lead editor: Ulrich Dorda

- **81 papers, peer reviewed** *(from 50 papers at EAAC2013)*
- Already generated **83 citations** → papers are read and used!

HEP 81 records found Search took 1.74 seconds.

1. **Transverse oscillations in plasma wakefield experiments at FACET**
E. Adli *et al.*. 2016. 5 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 94-98
DOI: 10.1016/j.nima.2016.02.054
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
Detailed record

2. **Production of quasi ellipsoidal laser pulses for next generation high brightne photoinjectors**
T. Rublack *et al.*. 2016. 4 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 438-441
DOI: 10.1016/j.nima.2015.12.004
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
Detailed record

3. **Staging optics considerations for a plasma wakefield acceleration linear colli**
C.A. Lindstrøm, E. Adli, J.M. Allen, J.P. Delahaye, M.J. Hogan, C. Joshi, P. Muggli, T.O. Raubenheime Yakimenko. 2016. 5 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 234-238
DOI: 10.1016/j.nima.2015.12.065
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
Detailed record - Cited by 4 records

4. **Laser-plasma-based linear collider using hollow plasma channels**
C.B. Schroeder, C. Benedetti, E. Esarey, W.P. Leemans. 2016. 4 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 113-116
DOI: 10.1016/j.nima.2016.03.001
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
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5. **Recent advances in high-performance modeling of plasma-based accelerato using the full PIC method**
J.-L. Vay, R. Lehe, H. Vincenti, B.B. Godfrey, I. Haber, P. Lee. 2016. 5 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 353-357
DOI: 10.1016/j.nima.2015.12.033
Conference: C15-09-12 Proceedings
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OSTI Information Bridge Server
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6. **BESTIA – The next generation ultra-fast CO 2 laser for advanced accelerator research**
Igor V. Pogorelsky, Markus Babzien, Ilan Ben-Zvi, John Skaritka, Mikhail N. Polyanskiy. 2016. 6 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 432-437
DOI: 10.1016/j.nima.2015.11.126
Conference: C15-09-12 Proceedings
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7. **A "slingshot" laser-driven acceleration mechanism of plasma electrons**
Gaetano Fiore, Sergio De Nicola. 2016. 5 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 104-108
DOI: 10.1016/j.nima.2016.02.065
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
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8. **Investigations of the concept of a multibunch dielectric wakefield accelerator**
I.N. Onishchenko, V.A. Kiselev, A.F. Linnik, V.I. Pristupa, G.V. Sotnikov. 2016. 7 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 199-205
DOI: 10.1016/j.nima.2016.02.060
Conference: C15-09-12 Proceedings
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9. **Injection of electrons by colliding laser pulses in a laser wakefield accelerator**
M. Hansson, B. Aurand, H. Ekerfelt, A. Persson, O. Lundh. 2016. 5 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 99-103
DOI: 10.1016/j.nima.2016.02.070
Conference: C15-09-12 Proceedings
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10. **A preliminary design of the collinear dielectric wakefield accelerator**
A. Zholents *et al.*. 2016. 4 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 190-193
DOI: 10.1016/j.nima.2016.02.003
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
Detailed record - Cited by 4 records

11. **Numerical simulations of recent proton acceleration experiments with sub-100 TW laser systems**
Stefano Sinigardi. 2016. 5 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 167-171
DOI: 10.1016/j.nima.2016.04.001
Conference: C15-09-12 Proceedings
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12. **The SPARC_LAB Thomson source**
C. Vaccarezza *et al.*. 2016. 6 pp.

Published in Nucl.Instrum.Meth. A829 (2016) 237-242
DOI: 10.1016/j.nima.2016.01.069
Conference: C15-09-12 Proceedings
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13. **The electron accelerator for the AWAKE experiment at CERN**
K. Pepitone (CERN) *et al.*. 2016. 3 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 73-75
DOI: 10.1016/j.nima.2015.02.005
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
CERN Document Server; Link to Fulltext
Detailed record

14. **Matching sub-fs electron bunches for laser-driven plasma acceleration at**
J. Zhu, R.W. Assmann, U. Dorda, B. Marchetti. 2016. 4 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 229-232
DOI: 10.1016/j.nima.2015.01.066
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
Detailed record

15. **Progress of plasma wakefield self-modulation experiments at FACET**
E. Adli *et al.*. 2016. 5 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 334-338
DOI: 10.1016/j.nima.2015.02.075
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
Detailed record - Cited by 1 record

16. **Role of laser contrast and foil thickness in target normal sheath accelera**
L.A. Gizzi *et al.*. 2016. 5 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 144-148
DOI: 10.1016/j.nima.2015.01.036
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
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17. **Betatron radiation based diagnostics for plasma wakefield accelerated el beams at the SPARC_LAB test facility**
V. Shpakov *et al.*. 2016. 4 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 330-333
DOI: 10.1016/j.nima.2015.02.074
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
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18. **Summary of working group 1: Electron beam from plasmas**
V. Malka, E. Gschwendtner (CERN). 2016. 3 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 30-32
DOI: 10.1016/j.nima.2015.01.008
Conference: C15-09-12 Proceedings
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19. **The ELIMED transport and dosimetry beamline for laser-driven ion beams**
F. Romano *et al.*. 2016. 6 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 153-158
DOI: 10.1016/j.nima.2016.01.084
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
Detailed record - Cited by 2 records

20. **Summary of Working Group 2: Ion beams from plasmas**
M. Borghesi, U. Schramm. 2016. 4 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 137-140
DOI: 10.1016/j.nima.2016.01.021
Conference: C15-09-12 Proceedings
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21. **High energy electron radiography system design and simulation study of beam angle-position correlation and aperture effect on the images**
Guanbang Zhao *et al.*. 2016. 8 pp.
Published in Nucl.Instrum.Meth. A832 (2016) 144-151
DOI: 10.1016/j.nima.2016.06.103
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
Detailed record

22. **Generation of attosecond electron bunches in a laser-plasma accelerator using a plasma density upramp**
M.K. Weikum, F.Y. Li, R.W. Assmann, Z.M. Sheng, D. Jaroszynski. 2016. 4 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 33-36
DOI: 10.1016/j.nima.2016.01.003
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
Detailed record

23. **High transformer ratio of multi-channel dielectric wakefield structures**
Sergey V. Shchelkunov, Thomas C. Marshall, Gennadij V. Sotnikov, Jay L. Hirshfield. 2016. 8 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 213-220
DOI: 10.1016/j.nima.2016.03.033
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
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Detailed record

24. **Comparison of self-injection thresholds in He and N 2 and role of self-focusing in LWFA**
D. Pella, F. Baffigi, F. Brandi, L. Fulgentini, P. Koester, L. Labate, P. Londrillo, L.A. Gizzi. 2016. 5 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 408-412
DOI: 10.1016/j.nima.2016.03.109
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
Detailed record - Cited by 1 record

25. **Real-time diagnostic for charging and damage of dielectrics in accelerators**
S.V. Shchelkunov, T.C. Marshall, J.L. Hirshfield. 2016. 5 pp.
Published in Nucl.Instrum.Meth. A829 (2016) 194-198
DOI: 10.1016/j.nima.2016.02.014
Conference: C15-09-12 Proceedings
References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
Detailed record - Cited by 1 record

26. **Observations and diagnostics in high brightness beams**
A. Cianchi, M.P. Anania, F. Bisesto, M. Castellano, E. Chiadroni, R. Pompili, V. Shpakov. 2016. 5 pp.

Major Achievements

1. Grew and nourished the network further.
2. Established the European Advanced Accelerator Concepts Workshop (EAAC) as a European forum for discussions and exchange on novel accelerators.
3. **Organized first CAS on plasma acceleration**

CAS "Plasma Wake Acceleration"

The CERN Accelerator School

Dr. Roger Bailey (Head of CAS)
Dr. Werner Herr (Deputy Head of CAS)
Dr. Bernhard Holzer (CAS Member)
Barbara Strasser (CAS Assistant)

The CERN Accelerator School

announces a course on

"Plasma Wake Acceleration"

CERN, Geneva, Switzerland

23 - 29 November, 2014

CERN

- Programme (pdf)
- Application Form (pdf)
- On-line Application Form
- Poster (pdf)
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REGISTRATION IS NOW CLOSED

Chairman: Bernhard Holzer

ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE
CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Plasma Wake Acceleration

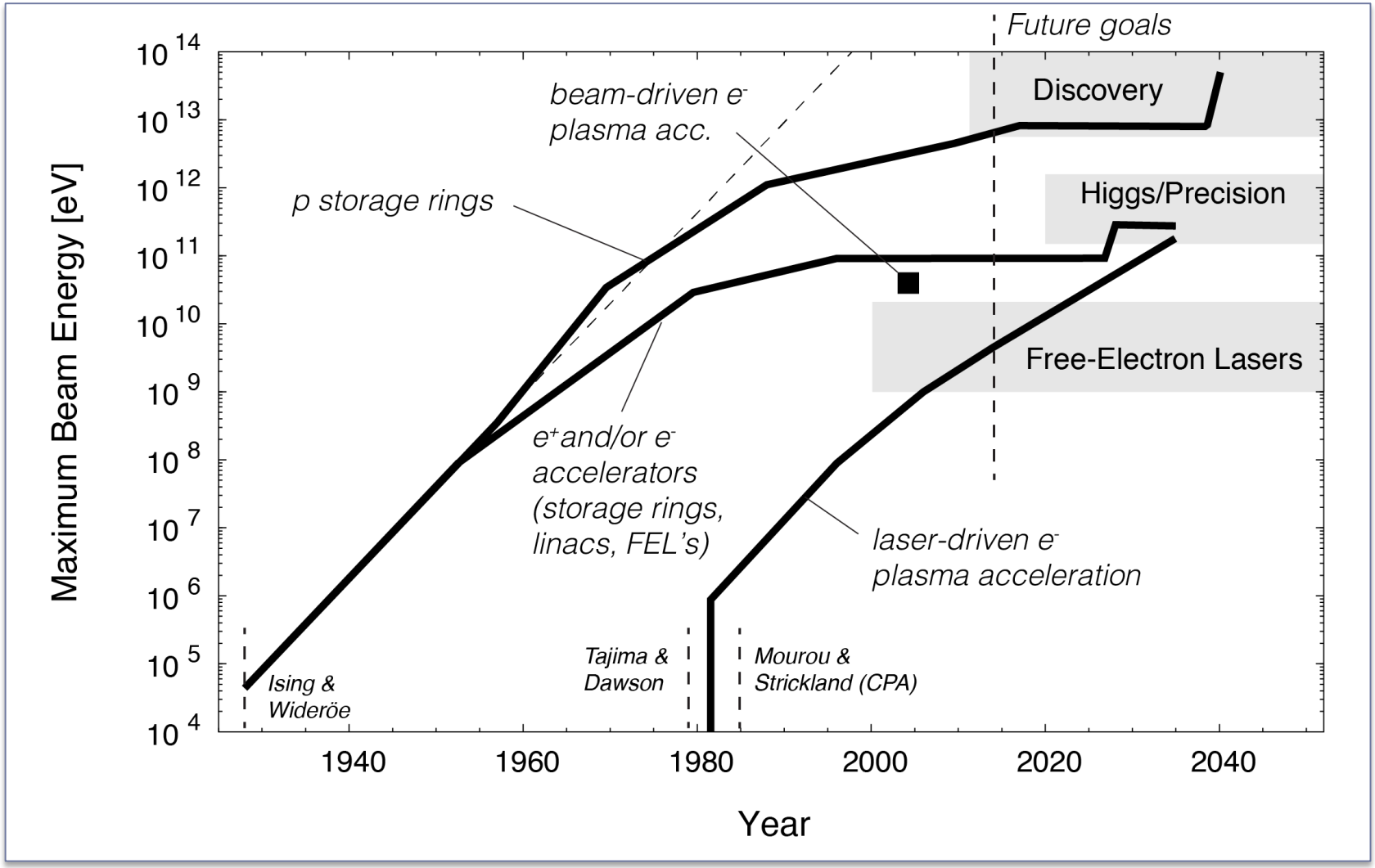
Geneva, Switzerland
23 - 29 November 2014

Proceedings
Editor: B. Holzer

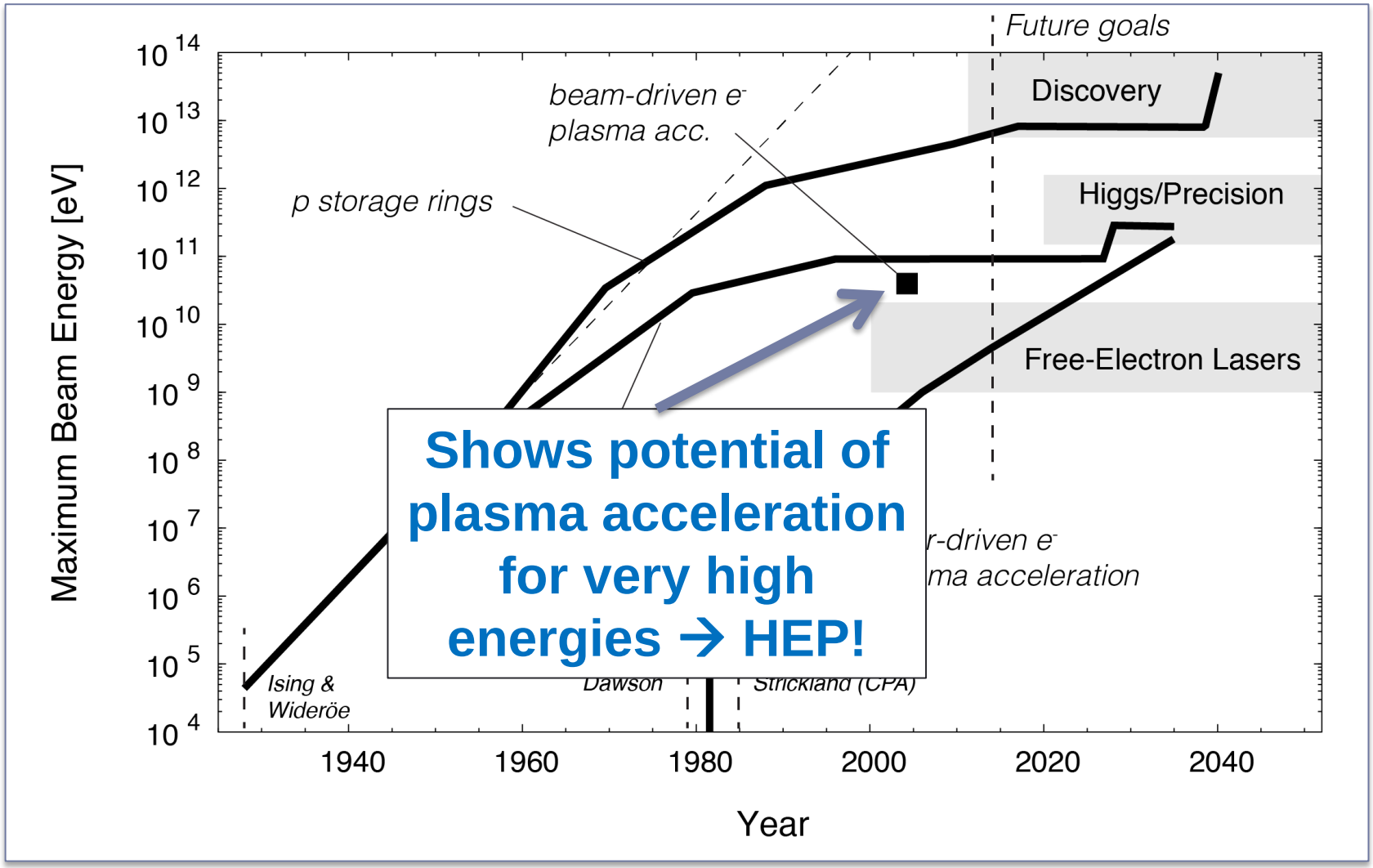
Major Achievements

1. Grew and nourished the network further.
2. Established the European Advanced Accelerator Concepts Workshop (EAAC) as a European forum for discussions and exchange on novel accelerators.
3. Organized first CAS on plasma acceleration
4. **Described an understanding how novel accelerators could contribute to progress in accelerator facilities.**

Livingston Curve



Are There Alternatives?



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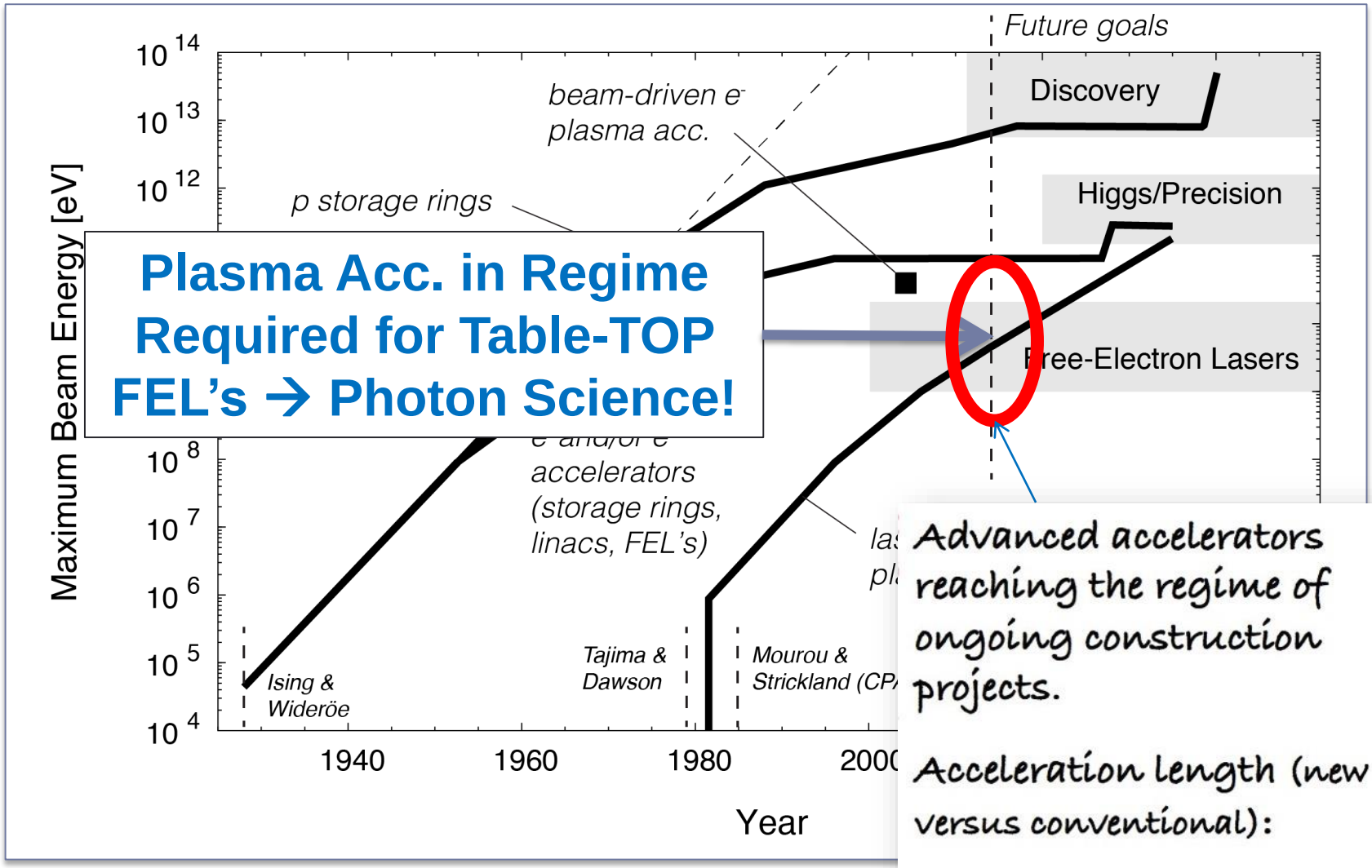


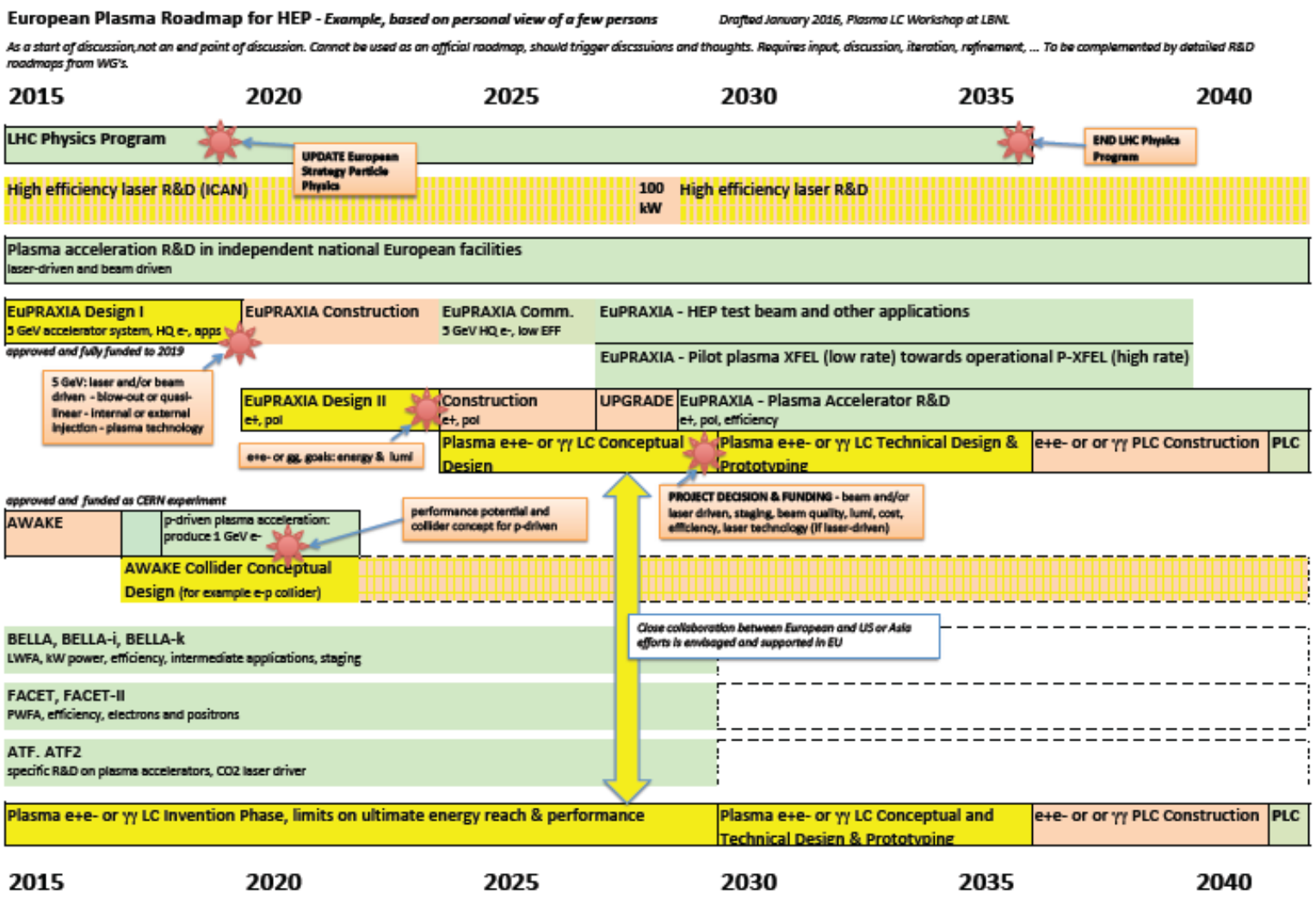
Plasma Acc. in Regime Required for Table-TOP FEL's → Photon Science!

Advanced accelerators reaching the regime of ongoing construction projects.

Acceleration length (new versus conventional):

9 cm versus 100 m

Contributed a Draft HEP Roadmap → ANAC meeting



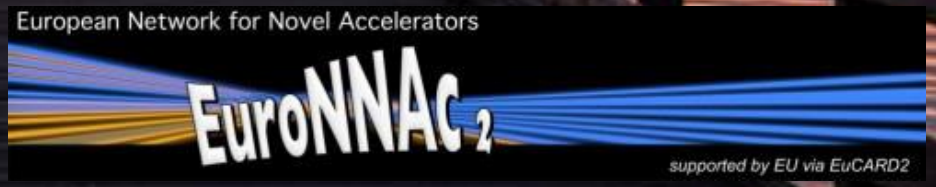
R. Assmann, EuroNNAc2 @ EuCARD2, 3/2017

Focus: Future Frontiers in Accelerators
» F³iA 2016 «

Northern Germany
5 -12 December 2016

Looking beyond FCC
-towards PeV colliders
-advanced concepts
-novel approaches
-ultimate limits

Organizers
Ralph Aßmann DESY
Frank Zimmermann CERN



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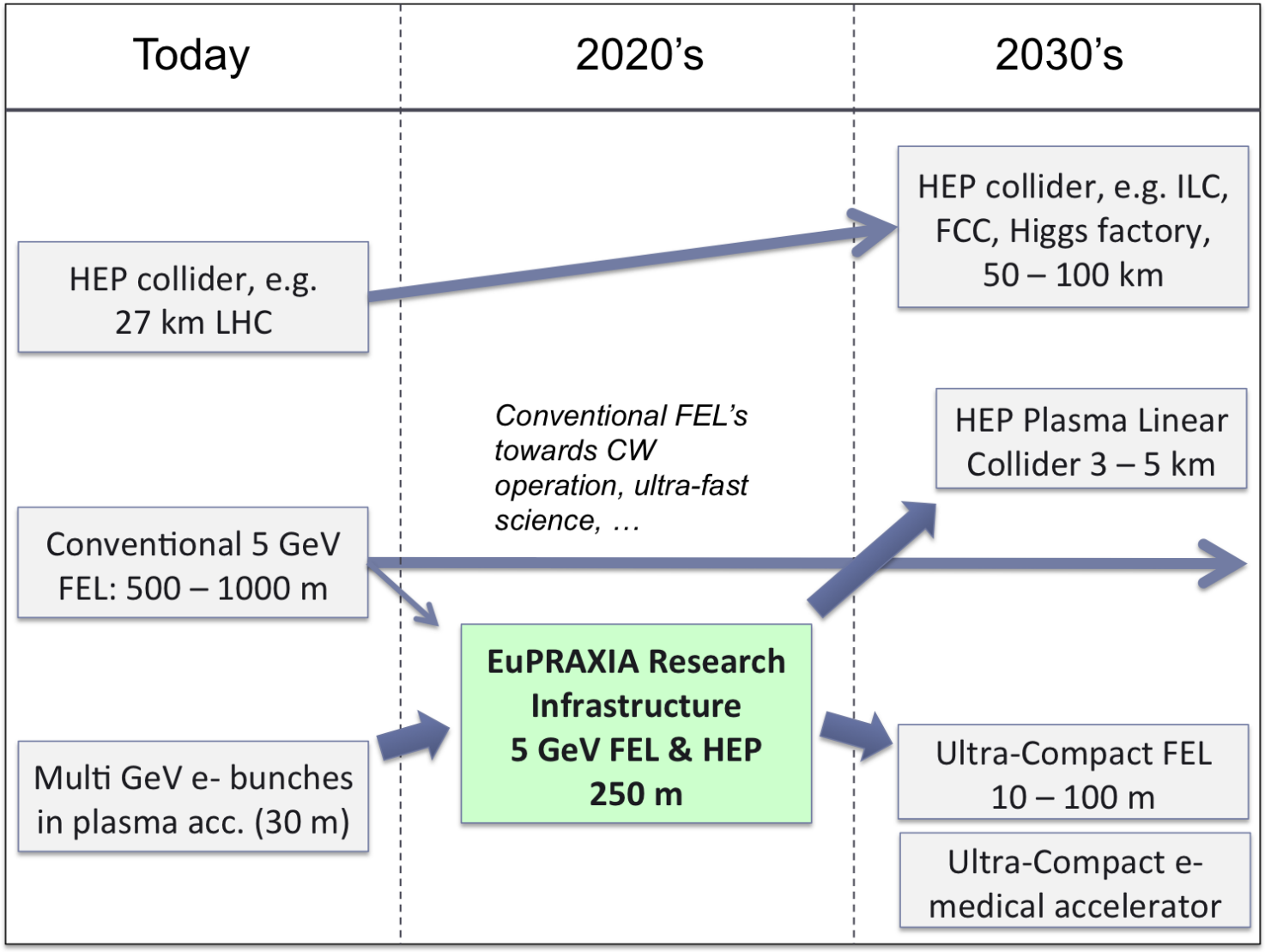
5. **Proposed a common European project to advance plasma accelerators to usability for applications and science → EuPRAXIA**

Horizon2020 Project EuPRAXIA

- EuPRAXIA is a EU design study for a future European research infrastructure (one of 2 accelerator related)
- 38 partners and associate partners from 14 countries in Europe, Asia and the US. **Nov 2015 – Oct 2019**.
- Aim: **European Plasma Accelerator with high quality of the electron beam and excellent applications for pilot users.**

- Necessary intermediate step in the 2020's to production facilities for science, health and industry.
- Connection to industry: Thales (F), Amplitude (F), Trumpf (D).

The European Strategy – Proceed in Steps with Pilot Facility



Pisa Science Meeting

June/July 2016, 120 participants

Outline

1. Short Review Milestones and Deliverables
2. Major Achievements in EuroNNAc2
3. **Outlook**

To ARIES


European Network for Novel Accelerators
EuroNNAc 2
supported by EU via EuCARD2


European Network for Novel Accelerators
EuroNNAc 3
supported by EU via ARIES

EAAC2017


EAAC 2017
Elba, Italy, September 25 – 29, 2017
European Network for Novel Accelerators
September 30, 2017
EuroNNAc 3
supported by EU via ARIES


Thanks to EuroNNAc2 collaborators participants
Thanks to EuCARD2 colleagues for support