This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 730871.

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

ARIES Yearly Meeting 2018, 09 Apr 2019, Budapest

Ralph W. Aßmann, DESY

EuroNNAc 2019 – 63 Institutes

European Network for Novel Accelerators

Contact: *Ralph Assmann (Network Coordinator)* – ralph.assmann@desy.de

The European Network for Novel Accelerators (EuroNNAc) is part of the EU-funded project ARIES and includes representatives from the following research institutes as members:

Beijing National Laboratory (IOP-CAS), Brookhaven National Laboratory (BNL), Budker Institute of Nuclear Physics (BINP), Center for the Advancement of Natural Discoveries using Light Emission (CANDLE), Commissariat à l'énergie atomique et aux énergies alternatives (CEA), Centre National de la Recherche Scientifique (CNRS), CERN, The National Institute of Optics (CNR-INO), Cockroft Institute, Deutsches Elektronen-Synchrotron (DESY), Ecole Polytechnique, Eindhoven University of Technology, ELI Beamlines, ENSTA Paris Tech, Ferdinand Braun Institut (FBH), Fermi National Accelerator Laboratory (FNAL), Forschungszentrum Jülich, Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Institut national de physique nucléaire et de physique des particules (IN2P3), INFN Frascati, INFN LNF, INFN Milano, INFN Roma1, Institute of Applied Physics of the Russian Academy of Sciences (IAPRAS), Institute of Physics Chinese Academy, Instituto Superior Tecnico de Lisboa (IST-ID), John Adams Institute at Imperial College (JAI), Joint Institute for High Temperatures of Russian Academy of Sciences (JIHT), High Energy Accelerator Research Organization (KEK), KFKI/Wigner Research Centre for Physics, Karlsruhe Institute of Technol-ogy (KIT), Laboratory of the Linear Accelerator (LAL), Lawrence Berkeley National Laboratory (LBNL), Lawrence Livermore National Laboratory (LLNL), Laboratoire de Physique des Gaz et des Plasmas (LPGP), Laboratoire d'Utilisation des Lasers Intenses (LULI), Lund University, Osaka University, Oxford University, Paul Scherrer Institut, PHLAM Université de Lille, Queen's University of Belfast, RIKEN SPring-8, Shanghai Jiao Tong University, SLAC National Accelerator Laboratory (SLAC), Synchrotron SOLEIL, STFC Central Laser Facility (CLF), STFC Rutherford Appleton Laboratory (RAL), Stony Brook University, Tsinghua University, TU Darmstadt, University of California Los Angeles (UCLA), University College Lon-don, University of Bern, University of Düsseldorf, University of Jena, University of Liverpool, University of München and Max Planck Institutes, University of Oslo, University of Pisa, University of Rome Sapien-za, University of Rome Tor Vergata, University of Strathclyde

Input to European Particle Physics Strategy

European Strategy Particle Physcis: 2012 Input

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

July 31st, 2012

Editors: R. Assmann (CERN), A. Caldwell (MPI), M. Ferrario (INFN), J. Osterhoff (DESY), T. Tajima (LMU), H. Videau (Ecole Polytechnique)

2012 Input

I) Summary Statements

Accelerator-based High Energy Physics will at some point become practically limited by the size and cost of the proposed e^+e^- colliders for the energy frontier.

Plasma-based acceleration techniques have demonstrated accelerating gradients up to 3 orders of magnitudes beyond presently used RF technologies.

Plasma acceleration tests have produced energy gains from above 1 GeV with lasers [LEE06, CLA10, LU11, WAN12, MAN12] to 42 GeV with electron beam drivers [BLU07].

Advanced e^- beams reached 1% energy spread, 3% energy fluctuation, 1 π mm-mrad emittance at 150 MeV [WIG10]. High quality 1 GeV beams have been demonstrated [LEE06].

Plasma-based, ultra-high gradient accelerators therefore open the realistic vision of very compact accelerators for scientific, commercial and medical applications.

The R&D now concentrates on beam quality, stability, staging and continuous operation. These are necessary steps towards various technological applications.

Different ways to drive plasma wakefields are being investigated. Lasers, e-beam, p-beam drivers provide a varied and powerful toolbox for the accelerator builder.

A quickly growing, inter-disciplinary community drives the research. It combines laser science, ultra-fast science, plasma science, diagnostics and beam physics.

s benefits from strong synergy with general advances in technolo-

1 GeV compact accelerator ("table-top"). Challenges in repetition
his unit could become a stage in a high-energy accelerator.

plasma acceleration could be a powerful upgrade technology for a
linear collider built with conventional RF technology.

The diverse interests in the field require a presence now from particle physics, to make sure that specific research topics for colliders are addressed.

Specific topics for plasma-based e^+e^- colliders include positron acceleration and technological issues of 100's MW beam power (e.g. efficiency, cooling, polarization, ...).

An increased support from Particle Physics will foster the R&D on advanced acceleration techniques and will provide important help and guidance.

Support should not just be of financial nature but also include technical collaboration on novel detectors, instrumentation, test beams and other areas of common interest.

Ultra-high gradient plasma accelerators should be recognized and listed as essential inter-disciplinary R&D towards future e^+e^- colliders for HEP.

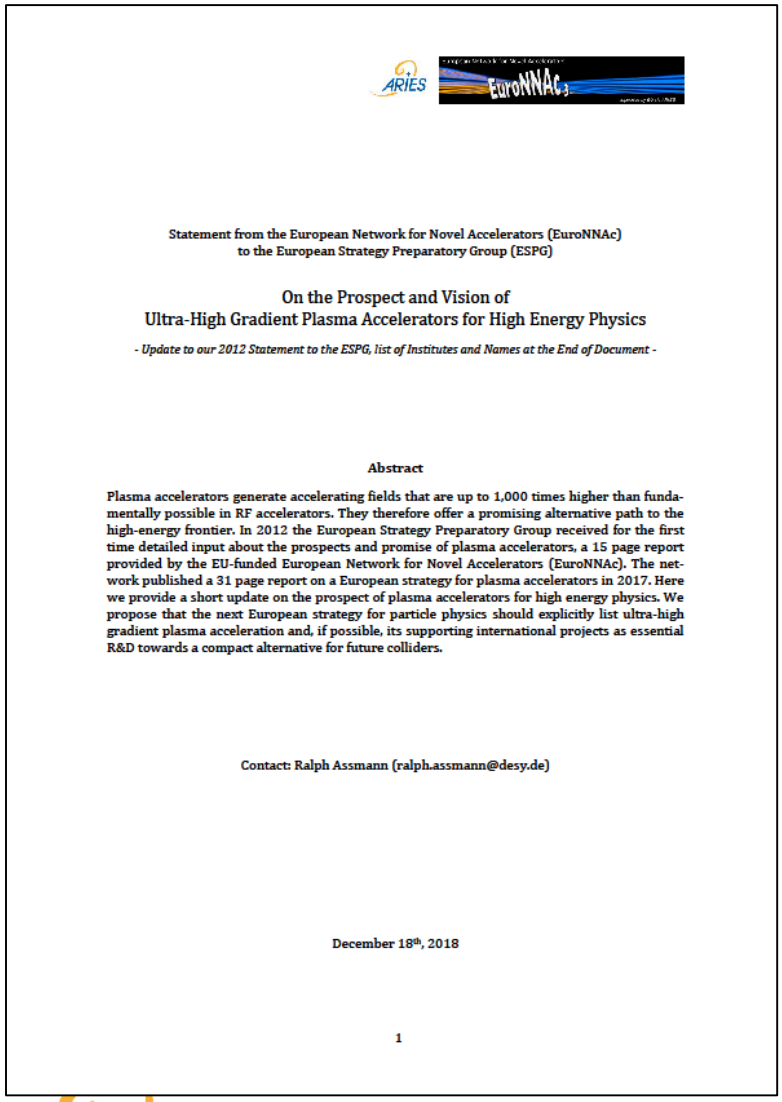
Discussion European strategy for Particle Physics (2017/8)

Not a deliverable of EuroNNAc3 (only at end of ARIES) to provide input – but this is in our work description for European input – probably we want to provide an updated final EuCARD2 final EuroNNAc report as input – coordination ongoing with ICFA ANA panel (international input)…

Comments collected during the meeting

- 5 years with priority and look beyond
- Balance ambition and risk, credibility most important
- Focus not only on e+e- but also on e-ion , e-p, gg
- Goals: get collider experts into novel acc. R&D officially for conceptual design studies
- Goals: Strengthen university based R&D for novel accelerators
- Goals: Plasma for final focus, diagnostics, transport studies
- Goals: intermediate R&D steps – AWAKE run II, EuPRAXIA construction
- Goals: Need for conducting fundamental R&D on several topics in adv. Acc. at universities.
- Goals: training of new generation of physicist/engineers/technicians in innovative technologies
- US: 50-100 GeV intermediate step for 2030 -> 1st international step. AWAKE could be this for physics. Should be same quality as achievable until 2026 at 5 GeV
- Side societal benefits: fusion studies
- ELI
- LC community: point out potential as plasma booster

Input 2018 European strategy for Particle Physics



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

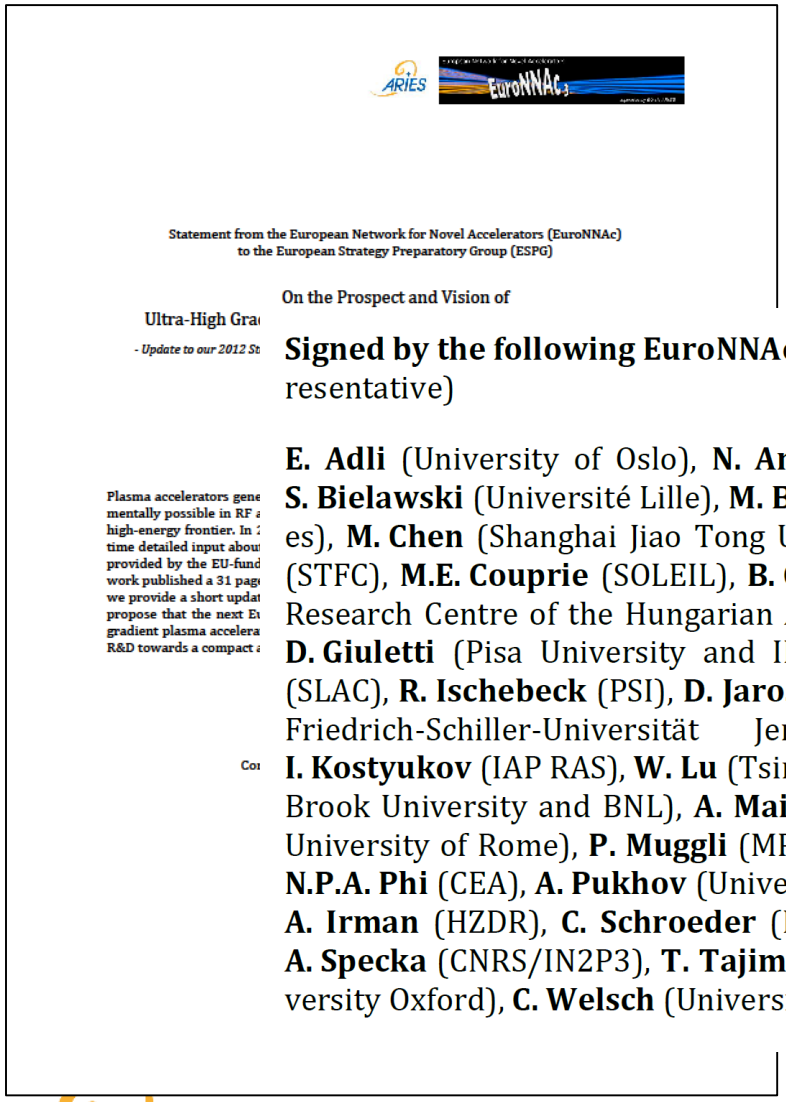
Plasma accelerators generate accelerating fields that are up to 1,000 times higher than fundamentally possible in RF accelerators. They therefore offer a promising alternative path to the high-energy frontier. In 2012 the European Strategy Preparatory Group received for the first time detailed input 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



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

On the Prospect and Vision of

Ultra-High Gra

- *Update to our 2012 St*

Plasma accelerators gene
mentally possible in RF
high-energy frontier. In
time detailed input abou
provided by the EU-fund
work published a 31 pag
we provide a short updat
propose that the next E
gradient plasma accelera
R&D towards a compact

Co

Signed by the following EuroNNAc3 institutional representatives (in alphabetical order of first representative)

E. Adli (University of Oslo), **N. Andreev** (JIHT Russian Academy of Sciences), **R. Assmann** (DESY), **S. Bielawski** (Université Lille), **M. Büscher, A. Lehrach** (FZJ), **L. Chen** (IOP, Chinese Academy of Sciences), **M. Chen** (Shanghai Jiao Tong University), **A. Cianchi** (University of Rome Tor Vergata), **J. Clarke** (STFC), **M.E. Couprie** (SOLEIL), **B. Cros** (Université Paris Sud), **I. Ferenc Barna, K.M. Pocsai** (Wigner Research Centre of the Hungarian Academy of Sciences), **M. Ferrario** (INFN Frascati), **L. Gizzi** (CNR), **D. Giuletti** (Pisa University and INFN), **E. Gschwendtner** (CERN), **C. Haefner** (LLNL), **M.J. Hogan** (SLAC), **R. Ischebeck** (PSI), **D. Jaroszynski, B. Hidding** (University of Strathclyde), **M. Kaluza** (HI-Jena, Friedrich-Schiller-Universität Jena), **S. Karsch** (Ludwig-Maximilians-Universität München), **I. Kostyukov** (IAP RAS), **W. Lu** (Tsinghua University), **O. Lundh** (Lund University), **V. Litvinenko** (Stony Brook University and BNL), **A. Maier** (Universität Hamburg), **P. Martin** (CEA), **A. Mostacci** (Sapienza, University of Rome), **P. Muggli** (MPP, CERN), **A.S. Müller, E. Bründermann** (KIT), **R. Pattathil** (STFC), **N.P.A. Phi** (CEA), **A. Pukhov** (Universität Düsseldorf), **G. Sarri** (Queens University Belfast), **U. Schramm, A. Irman** (HZDR), **C. Schroeder** (LBNL), **L. Silva, J. Vieira** (IST Lisbon), **S. Smith** (STFC Daresbury), **A. Specka** (CNRS/IN2P3), **T. Tajima** (UC Irvine), **V. Tsakanov** (CANDLE), **R. Walczak, S. Hooker** (University Oxford), **C. Welsch** (University Liverpool, Cockcroft), **M. Wing** (UCL)

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**.

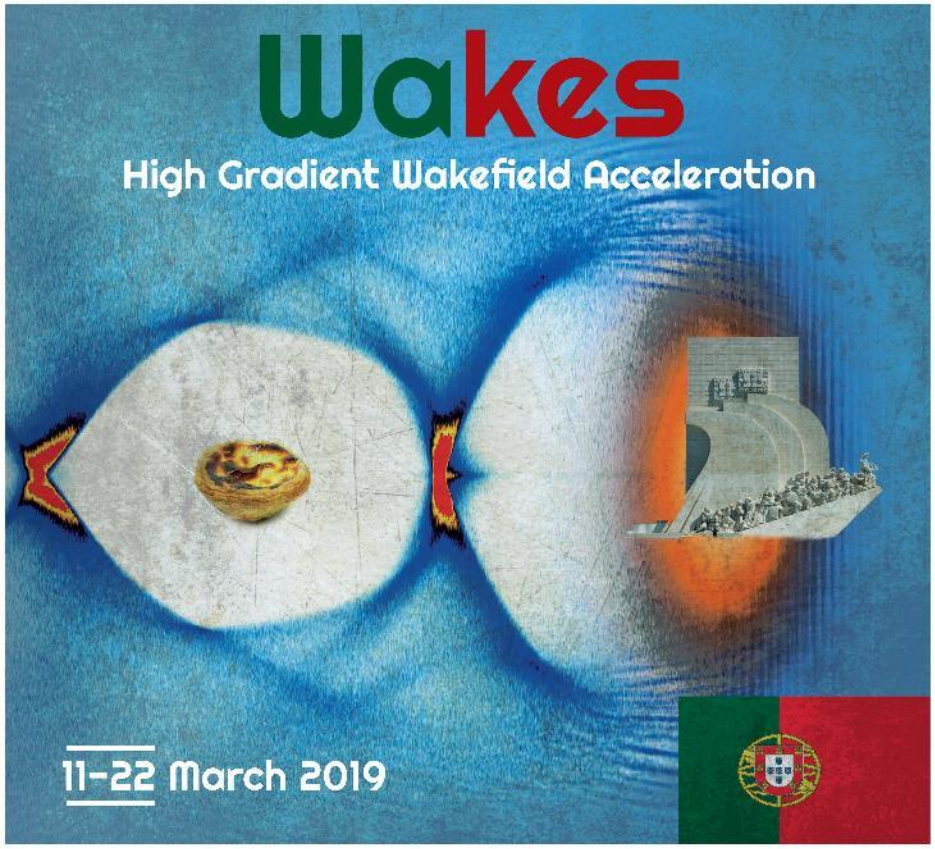
Specialized Accelerator School Novel Acc.

Welcome, Bien Venu,
Hola, Herzlich
Willkommen,
Seja Muito Bem Vindo

School Web page:
http://cas.web.cern.ch/schools/sesimbra-2019

Indico Link:
https://indico.cern.ch/event/759579/

Many thanks to **Bernhard Holzer**
and whole CAS team!
Slides by Bernhard Holzer.



Hotel Do Mar,
Sesimbra, Portugal

Only in the year 2014 CAS organized the previous course on "Plasma Wake Acceleration", which found large interest in the community. Since this field is very rapidly evolving CAS is proposing again a course on "High Gradient Wakefield Acceleration" in spring 2019. This course will cover some fundamentals of Wakefield acceleration, the main classes of laser beam, electron beam and proton beam induced plasmas, plus several technology items related to the subject. The course will be accessible for newcomers in the field, but it will also provide up-to-date information for more advanced students.

Contact: CERN Accelerator School
CH – 1211 Geneva 23
cas.web.cern.ch
Accelerator.school@cern.ch

Time Table of the School

Many thanks to **Bernhard Holzer** and whole CAS team!
Slides by Bernhard Holzer.

Full Program,
46 hours of lecture,
10 hours dedicated for the case studies

Time	Mo, 11.03.2019	Tu, 12.03.2019	Wed, 13.03.2019	Thu, 14.03.2019	Fri, 15.03.2019	Sat, 16.03.2019	Sun, 17.03.2	Mo, 18.03.2019	Tu, 19.03.2019	Wed, 20.03.2019	Thu, 21.03.2019	Fri.22.03.
09:00h		Welcome & Opening *B. Holzer*	Introduction to plasma physics II *P. Gibbon*	Plasma sources I *J. Osterhoff*	Plasma sources II *J. Osterhoff*	Plasma wake generation (non-linear) *L. Silva*		Blow out regime *L. Silva*	Particle beam diagnostics *B. Marchetti*	electron sources from plasma I *B. Cros*	staging (incl. Synchr. & tolerances) *C. Lindstrom*	
10:00h		Conventional Acc. & their limits I *M. Ferrario*	Laser beam physics *L. Corner*	Plasma wake generation (linear) *Z. Najmudin*	Modelling and simulation I *J.L. Vay*	Modelling and simulation II *J.L. Vay*	E x c u r s i o n	laser driver propag. in plasmas *S. Mangles*	Plasma diagnostics *J. Osterhoff*	Dielectrical Acc Structures (Theory) *N. Schoenenberger*	positron acc. in plasmas *S. Corde*	
11:00h		Coffee	Coffee	Coffee	Coffee	Coffee		Coffee	Coffee	Coffee	Coffee	
11:30h		Conventional Acc. & their limits II *M. Ferrario*	laser diagnostics *L. Corner*	Acceleration of e- in a plasma II *A. Thomas*	Injection extraction and matching I *M. Ferrario*	Modelling and simulation III *J.L. Vay*		Beam driven (experiment) *E. Gschwendtner*	Beam driver propogation (beams) *R. Assmann*	electron sources from plasma II *B. Cros*	case study *A. Walker*	
12:30h		Lunch	Lunch	Lunch	Lunch	Lunch		Lunch	Lunch	Lunch	Lunch	
14:30h		Introduction & hist. overview *V. Malka*	Laser driven wakefields I *S. Karsch*		Injection extraction and matching II *M. Ferrario*	Mod & simul hands on II *J. Vieira, R. Fonsecca*		Laser driven (experiment) *S. Mangles*	Beam driven systems (PWFA) I *P. Muggli*	Dielectrical Acc Structures (Exp) *N. Schoenenberger*	Radiation generation *F. Albert*	
15:30h		Introduction to plasma physics I *P. Gibbon*	Acceleration of e- in a plasma I *A. Thomas*	Free	Applications *Z. Najmudin*	Mod & simul hands on III *J. Vieira, R. Fonsecca*		case study *A. Walker*	Beam driven systems (PWFA) II *P. Muggli*	Discussion 2 *B. Holzer*	case study presentations *A. Walker*	
16:30h		Tea	Tea	Afternoon	Tea	Tea		Tea	Tea	Tea	Tea	
17:00h		Introduction to laser physics I *L. Corner*	Laser driven wakefields II *S. Karsch*		Discussion 1 *B. Holzer*	Seminar I *IST*		Seminar: Acceleration of protons & ions *L. Willingale*	case study *A. Walker*	case study *A. Walker*	case study presentations *A. Walker*	
18:00h		1 slide / 1 minute *B. Holzer*	case study Introduction *A. Walker*		Mod & simul hands on I *J. Vieira, R. Fonsecca*	case study *A. Walker*		case study *A. Walker*	Departure Gala Dinner: *19:00h*	case study *A. Walker*	Coherent X-rays and applications *M. Fajardo*	
20:00h		Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Gala_Dinner	Dinner	Dinner	

Case Studies

Gives the students the chance to apply the topics that were explained in the school,
In an interactive way.

Under supervision of tutors (students that are already experienced) 5 different design tasks were defined, to be studied by the students.

Tasks are quite close to real work in the field,
Include simulations, to describe the plasma wake processes,
Encourage team work

Summarise the work done in a little presentation at the last day of the school.

Many thanks to **Bernhard Holzer** and whole CAS team!
Slides by Bernhard Holzer.

Topics presented

Many thanks to **Bernhard Holzer** and whole CAS team!
Slides by Bernhard Holzer.

Adressed Topics:

**** Introduction Lectures:***

Conventional accelerators and their limits
Introduction and historical overview about plasma wake acceleration
Introduction to plasma physics
Laser physics
Laser driven wake fields

**** Plasma physics in Detail***

Plasma Sources
Plasma Wake Generation — linear, non-linear, blow out regime

**** Injection, Extraction & Matching***

**** Modelling & Simulation***

theoretically
“hands-on" … as part of a case study

**** Experiments & Projects***

Laser Driven
Particle Beam Driven

Topics presented

Many thanks to **Bernhard Holzer** and whole CAS team!
Slides by Bernhard Holzer.

Adressed Topics:

**** Experiments & Projects***
- Laser Driven
- Particle Beam Driven

**** Diagnostics***
- Plasma Diagnostics
- Particle Beam Diagnostics
- Laser Diagnostics

**** Dielectric Structures***

**** Staging***

**** Applications***

Hotel do Mar: ideal school venue.

Many thanks to **Bernhard Holzer** and whole CAS team!
Slides by Bernhard Holzer.

Many thanks to **Bernhard Holzer** and whole CAS team!
Slides by Bernhard Holzer.

Statistics of the School

Many thanks to **Bernhard Holzer** and whole CAS team!

70 Students attended
From 26 countries

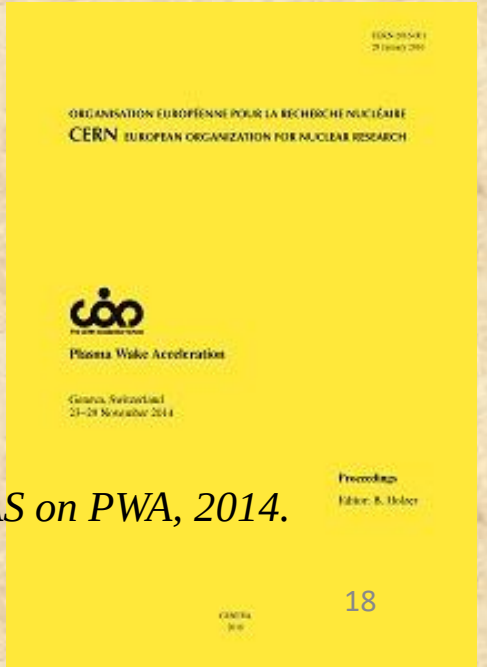
Lecturers:
26 from outside, 6 from IST Lisbon

14 students received a grant,

… a number considerably larger than usual and possible due to the generous contribution of sponsors
These grants cover the school fee and hotel costs, however not the travel.

Publication & Dissemination

Given the relevance of the school topic and the actual development of the field, it has been decided to publish the lectures of the school in a dedicated so-called "yellow report",
where every lecturer will describe in detail his topic.
A typical volume of the book will comprise about 350 pages.
These CERN yellow-reports are well known in the community and they act usually even as reference.
I would like to point out, that these proceedings are not a bare copy of the slides, but rather similar to a
real book, including proof reading, copy editing and referees, to ensure scientific level and correctness.



Many thanks to **Bernhard Holzer** and whole CAS team!
Slides by Bernhard Holzer.

Example:
Proceedings of the last CAS on PWA, 2014.

EuroNNAc Award

Being prepared by Task Leaders Roman Walczak and Bernhard Holzer, with Network Coordinator Ralph Aßmann and ARIES Coordinator Maurizio Vretenar.

Simon van der Meer Early Career Award

Simon van der Meer Early Career Award in Novel Accelerators

(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. During the award ceremony there will be a short laudatio to the selected candidate followed by a presentation given by the laureate.

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der Meer awar
Concepts work

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

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.

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Simon van der Meer Early Career Award

Nominations:

Nominations should be sent to euronnac-award-proposals@desy.de by 20 May 2019 (the whole file cannot exceed 20 MB), and should include:

1. Name and email address of the nominee.
2. Proposed award citation (no more than 35 words).
3. A one-page narrative/introductory statement describing the nominee's novel, pioneering, or leading edge accomplishments, with an emphasis on how their work has been recognised as especially promising.
4. Nominee's resume or CV, listing educational background, positions held, and highlighting key: publications, patents, awards, honours, activities, reports or product releases.
5. Four letters of recommendation; diversity of support is preferred; not all letters of recommendation should come from the nominee's institution. The name and email address is required for each reference.
6. If the candidate has taken a career break, a brief explanation for the nature of the break is requested.
7. The nominee’s agreement that their data is stored and processed for the purpose of the whole award procedure.

EAAC 2019

EAAC 2019 – Preparation in Full Swing

European Network for Novel Accelerators
EuroNNAc3
supported by EU via ARIES

Please reserve the dates for September 2019

We would be very glad to welcome you in Elba

Conclusion

- WP5 progressing well.
- Updated list of institutes → even more members now
- Thanks for all the support from our partners!