



ALEGRO
2025 WORKSHOP

ADVANCED
LINEAR
COLLIDER
STUDY GROUP

ALEGRO 2025 Workshop

Mar 4 – 6, 2025
SLAC
America/Los_Angeles timezone



ALEGRO
Advanced LinEar collider study GROup

WELCOME!

Patric Muggli
Max Planck Institute for Physics
Garching/Munich
muggli@mpp.mpg.de
<https://www.mpp.mpg.de/~muggli>

Brigitte CROS
Laboratoire de Physique des Gaz et des Plasmas
CNRS Université Paris-Saclay, France

ALEGRO, the Advanced LinEar collider study GROUp, is driven by a panel of ICFA ...

ICFA (<https://icfa.hep.net/>), the International Committee for Future Accelerators, was created to **facilitate international collaboration** in the construction and use of **accelerators for high energy physics**. It was created in 1976 by the International Union of Pure and Applied Physics. Its purposes, as stated in 1985, are as follows:

- ✧ **To promote international collaboration** in all phases of the construction and exploitation of very high energy accelerators
- ✧ **To organize regularly world-inclusive meetings** for the exchange of information on future plans for regional facilities and for the formulation of advice on joint studies and uses.
- ✧ **To organize workshops for the study of problems related to super high-energy accelerator** complexes and their international exploitation and to foster research and development of necessary technology.

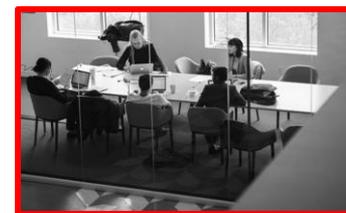
The Committee has 16 members, selected primarily from the regions most deeply involved in high-energy physics.

ICFA has six active panels

- ✧ ILC International Development Team (Chair – Tatsuya Nakada, EPFL, Lausanne)
- ✧ ICFA Instrumentation Innovation and Development Panel (Chair — N.N.)
- ✧ ICFA Beam Dynamics Panel (Chair — Yuan He, IMPCAS)
- ✧ **ICFA Panel on Advanced and Novel Accelerators (Chair — Patric Muggli, Max Planck Institute for Physics)**
- ✧ ICFA Panel on Sustainable Accelerators and Colliders (Chair — Thomas Roser, BNL)
- ✧ ICFA Panel on the Data Lifecycle (Chair — Kati Lassila-Perini / Helsinki Institute of Physics)

ALEGRO is driven by the ICFA-ANA panel:

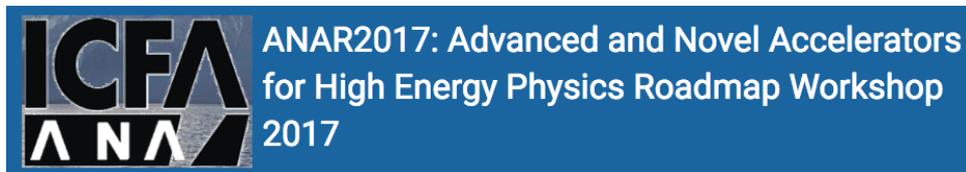
- ✧ Bruce Carlsten, Los Alamos National Laboratory (LANL), USA: **open seat**
- ✧ Brigitte Cros, Centre National de la Recherche Scientifique (CNRS), Université Paris Saclay, France: 2008-...
- ✧ Massimo Ferrario, Istituto Nazionale di Fisica Nucleare (INFN), Italy: 2013-...
- ✧ Simon Hooker, University of Oxford, UK: **open seat**
- ✧ Asia: **open seat**
- ✧ Masaki Kando, National Institutes for Quantum Science and Technology (QST), Japan: 2020-...
- ✧ Carl Linstrøm, University of Oslo, Norway: 2024-...
- ✧ Patric Muggli, Max Planck Institute for Physics (MPP), Germany, (chair, May 1, 2024): 2008-...
- ✧ Jens Osterhoff, Lawrence Berkeley National Laboratory (LBNL), USA: 2021-2024 (as DESY), 2024-.. (as LBNL)
- ✧ Americas: **open seat**
- ✧ James Rosenzweig, University of California, Los Angeles (UCLA), USA: 2006-...
- ✧ Chuanxiang Tang (previous chair), Tsinghua University, Beijing, China: 2010-...



- ✧ Asia: 3 members
- ✧ Americas: 4 members
- ✧ Europe: 5 members



Up-coming European Strategy for Particle Physics (ESPP) and Snowmass (US) ...



... is one of the major outcomes of the ANAR 17 workshop!

ALEGRO is a study group towards Advanced Linear Colliders.

ALEGRO's general charge is to coordinate the preparation of a proposal for an advanced linear collider in the multi-TeV energy range.

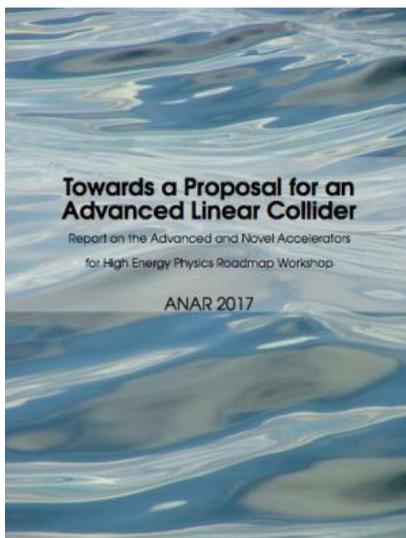
Focus on high-gradient acceleration methods, GeV/m, for application to HEP
Consider structures and plasmas driven by a laser pulse or a particle bunch

ANA's*

	Medium	Dielectric	Plasma
Driver			
Laser Pulse		Dielectric Laser Accelerator DLA	Laser Wakefield Accelerator LWFA
Particle Bunch		Structure Wakefield Accelerator SWFA	Plasma Wakefield Accelerator PWFA



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

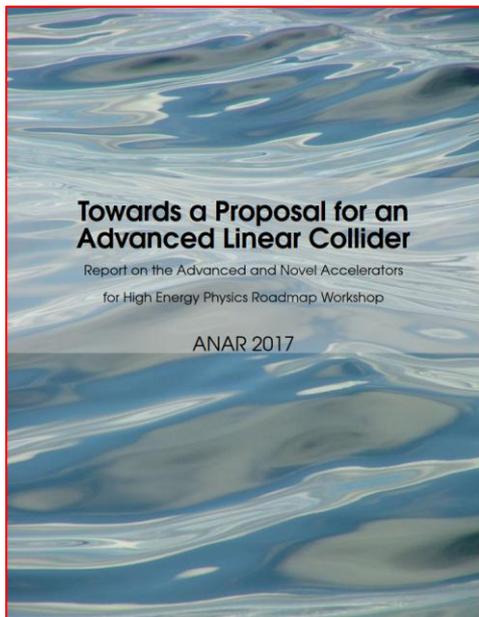


**Document broadly distributed to
laboratories management and funding or
deciding agencies...
to demonstrate the existence of a
community and of a plan for ANA*
applications to high-energy physics**

... is another major outcome of the ANAR 2017 workshop!

*Advanced and Novel Accelerators

OUTCOME OF ANAR 2017




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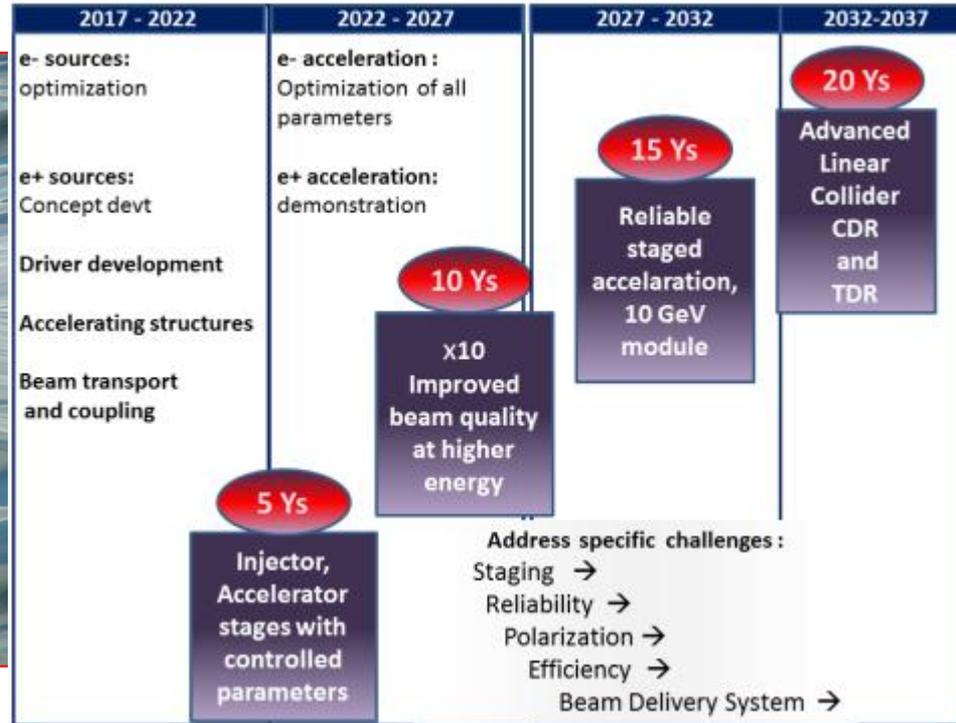
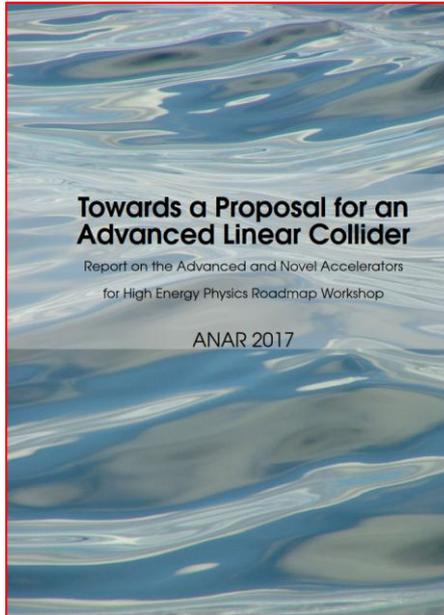
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Document

- ❖ Summary of the workshop
- ❖ Broad roadmap
- ❖ Report of each working group (WG)
- ❖ Was broadly distributed

OUTCOME OF ANAR 2017



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Towards an Advanced Linear International Collider

ALEGRO collaboration

Abstract

This document provides additional information to support the ALEGRO proposal for R&D relevant to an Advanced Linear International Collider, ALIC, based on high gradient acceleration concepts.

Keywords

Advanced and Novel Accelerators, multi-TeV electron-positron linear collider

Editing Board

Brigitte Cros, Patric Muggli, Carl Schroeder, Simon Hooker, Philippe Piot, Joel England, Spencer Gessner, Jorge Vieira, Edda Gschwendtner, Jean-Luc Vay, Michael Peskin

ALEGRO collaboration members as of September 2018: Erik Adli¹, Weiming An², Nikolay Andreev³, Ozmur Apsimon⁴, Ralph Assmann⁵, Jean-luc Babigean⁶, Robert Bingham⁷, Tom Blackburn⁸, Christopher Brady⁹, Michael Bussmann¹⁰, Bruce Carlsten¹¹, James Chappell¹², Jian Bin Ben Chen¹³, Sebastien Corde¹⁴, Laura Comer¹⁵, Benjamin Cowan¹⁶, Brigitte Cros¹⁷, Joel England¹⁸, Eric Esarey¹⁹, Ricardo Fonseca²⁰, Brian Foster^{21,22}, Spencer Gessner¹³, Leonida A Gizzi²², Daniel Gordon²¹, Edda Gschwendtner¹³, Anthony Hartin⁵, Bernhard Hidding²⁴, Mark Hogan¹⁸, Simon Hooker²¹, T. Hughes²⁵, Alexei Kanareykin²⁶, Stefan Karsch²⁷, Valentin Khoze²⁸, Pawan Kumar²⁹, Wim Leemans¹⁹, Francois Lemeris⁵, Ang Li³⁰, R. Li¹⁸, Vladyslav Libov⁵, Emily Sistrunk Link³¹, Michael Litos³², Gregor Loisch⁵, Nelson Lopes^{20,33}, Olle Lundb³⁴, Alexey Lyapun³⁵, Edu Marin³⁵, Mattias Marklund⁸, Timon Mehrling¹⁹, Patric Muggli^{13,27}, Pietro Musumeci², Zulfikar Najmudin³³, Uwe Niedermayer³⁶, Jens Osterhoff⁵, Marc Palmer¹¹, Rajeev Panat¹⁷, Michael Peskin¹⁵, Philippe Piot³⁸, John Power³⁹, Alexander Pukhov⁴⁰, Heather Ratcliffe⁴¹, Marc Riemban⁴², Veronica Sanz⁴³, Gianluca Sarri⁴⁴, Yuri Savelyev⁷, Levi Schachter⁴⁵, Lucas Schaper⁵, Norbert Schoonenberger³⁰, Carl Schroeder¹⁹, Sarah Schroeder⁵, Daniel Schulte¹³, Andrei Seryi⁴⁶, Sergey Shchelkunov³⁶, Craig Siders¹², Evgenya Simakov¹¹, Christophe Simon-Boisson⁴⁷, Michael Spannowsky²⁸, Christina Swinson³⁷, Andrzej Szczepkowicz⁴⁸, Roxana Tarkeshian⁵, Johannes Thomas⁴⁰, Junping Tian⁴⁹, J.V. Tilborg¹³, Paolo Tomassini²², Vasilii Tsakanov⁵⁰, Jean-Luc Vay¹⁹, Jorge Vieira²¹, Henri Vincenti⁵¹, Roman Walczak²¹, Dan Wang⁵², Stephen Webb⁵³, Glen White¹⁸, Guoxing Xia⁴, Hitoshi Yamamoto⁵⁴, Tevong You⁵⁵, Igor Zagorodnov⁵

¹ Univ Norway, Oslo, Norway

² UCLA, Los Angeles, California, USA

³ IHED, Moscow, Russia

⁴ Univ. Manchester, UK

⁵ DESY, Hamburg, Germany

⁶ LAL, Orsay, France

⁷ STFC, UK

⁸ Chalmers, Sweden

⁹ Warwick, UK

¹⁰ HZDR, Germany

¹¹ LANL, Los Alamos, New Mexico, USA

¹² University College London, UK

ALEGRO input for the 2020 update of the European Strategy for Particle Physics: comprehensive overview

Contacts: B. Cros¹, P. Muggli²
on behalf of ALEGRO collaboration,

member list at <http://www.lpgp.u-psud.fr/icfaana/alegro/alegro-members>

¹ LPGP, CNRS, Université Paris Sud, Orsay France, email: brigitte.cros@u-psud.fr

²Max Planck Institute for Physics, Munich, Germany, email: muggli@mpp.mpg.de

International
ANA
Community

Planning for a document(s) to
be submitted for the next ESPP
March 31, 2025
(see later ...)

arXiv.1901.10370

arXiv:1901.10370v2 [physics.acc-ph] 30 Jan 2019

PRINCIPAL ACTIVITY: SERIES OF WORKSHOPS



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

2017



2018



2024

2019



2023



Endorsed by
ICFA

PRINCIPAL ACTIVITY: SERIES OF WORKSHOPS

Advanced and Novel Accelerators for High Energy Physics Roadmap Workshop 2017 (<https://indico.cern.ch/event/569406/>)

ALEGRO 2018, Oxford (<https://confs.physics.ox.ac.uk/alegro2018/index.asp>)

ALEGRO 2019, CERN (<https://indico.cern.ch/event/732810/>)

ALEGRO 2023, DESY (<https://indico.cern.ch/event/1193719/>)

ALEGRO 2024, IST-Lisbon (<https://indico.cern.ch/event/1364999/timetable/?print=1&view=standard>)



CERN 2017



OXFORD 2018



DESY 2022



IST 2024



Report on the Advanced Linear Collider Study Group (ALEGRO) Workshop 2024

ALEGRO 2024

[J. Vieira](#), [B. Cros](#), [P. Muggli](#), [I. A. Andriyash](#), [O. Apsimon](#), [M. Backhouse](#), [C. Benedetti](#), [S. S. Bulanov](#), [A. Caldwell](#), [Min Chen](#), [V. Cilento](#), [S. Corde](#), [R. D'Arcy](#), [S. Diederichs](#), [E. Ericson](#), [E. Esarey](#), [J. Farmer](#), [L. Fedeli](#), [A. Formentj](#), [B. Foster](#), [M. Garten](#), [C.G.R. Geddes](#), [T. Grismayer](#), [M. J. Hogan](#), [S. Hooker](#), [A. Huebl](#), [S. Jalas](#), [M. Kirchen](#), [R. Lehe](#), [W. Leemans](#), [Boyuan Li](#), [C.A. Lindström](#), [R. Losito](#), [C. E. Mitchell](#), [W. B. Mori](#), [P. Piot](#), [D. Terzani](#), [M. Thévenet](#), [M. Turner](#), [J.-L. Vay](#), [J. Vieira](#), [D. Völker](#), [Jie Zhang](#), [W. Zhang](#)



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Summary of the workshop

“One-pager” from each presenter

Was distributed: arxiv, ICFA panel, etc.

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Mar 4 – 6, 2025
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ALEGRO



Advanced LinEar collider study GRoup

2023



Endorsed by



- ✧ Very fragmented community: more universities than national laboratories
- ✧ Diversity of schemes: particle and laser beams in plasmas and structures
- ✧ Novelty and lower technical readiness level (TRL)
- ✧ No institutional funding in Europe or Asia (e.g., DoE in the US)

	Medium	Dielectric	Plasma
Driver			
Laser Pulse		Dielectric Laser Accelerator DLA	Laser Wakefield Accelerator LWFA
Particle Bunch		Structure Wakefield Accelerator SWFA	Plasma Wakefield Accelerator PWFA

- ✧ Organize ALEGRO workshops to gather the community ...
 - ✧ Support ALL applications of ANAs* to HEP
 - ✧ Encourage contributions to PP and HEP
- ✧ Your active contributions are essential!

This workshop

- ✧ Focus of 10TeV collider design study
 - ✧ Recommendation of the (US) P5
- ✧ Other ALEGRO themes included ...
 - ✧ R&D on novel acceleration techniques recommended in the last ESPP ...
- ✧ Prepare document to be submitted as input for the ESPP

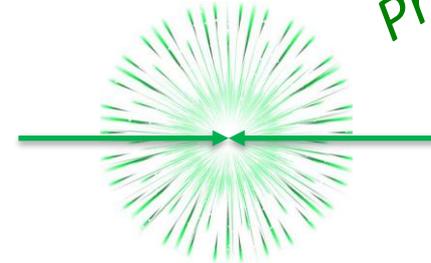
ALEGRO

- ✧ Strengthen the US/World collaboration on the 10TeV collider design study
- ✧ Apply funding to support European activities ...
- ✧ Prepare document as input for ESPP, including ALL HEP-related ANA activities
- ✧ Prepare ALEGRO 2026 ...
- ✧ Continue to support and promote worldwide activities: ANAs for particle and high-energy physics



THE (ALEGRO) CASE FOR ANAs

Preliminary



ANAs:
the most sustainable acceleration schemes
to reach very high energies
with a linear accelerator

more SUSTAINABLE!!

- ✧ Broadly: structure or plasma accelerator driven by laser pulse or particle bunch
- ✧ Promote application of ALL ANAs to particle physics (PP) and high-energy physics (HEP)
- ✧ Advantageous features of ANAs:
 - ✧ High acceleration gradient (\sim GV/m)
 - ✧ Smaller footprint
 - ✧ geographical
 - ✧ environmental
 - ✧ Short bunches: more luminosity to power ratio?

- ✧ Many intermediate (to an energy frontier collider) applications:
 - ✧ Compact injector for a collider (CEPC) or a light source (PETRA IV)
 - ✧ Higgs factories (HALHF, ALIVE)
 - ✧ Fixed target experiments (AWAKE)
 - ✧ ...
- ✧ Significant number of projects/facilities/collaborations developing ANAs:
 - ✧ Brookhaven ATF, ALIVE, Argonne AWA, AWAKE, CEPC Injector, DESY Flash Forward, DESY-kaldera, ELI ERIC, EuPRAXIA, HALHF, LBNL-BELLA, LBNL-kBELLA, PETRA IV Injector, 10\,TeV Collider design, SLAC FACET II, ...
- ✧ Large laboratories involved: Argonne, Berkeley, Brookhaven, CERN, DESY, ELI, INFN, SLAC
- ✧ Significant progress: lasers (kBELLA, kaldera), plasma sources, computational methods, etc.
- ✧ ANA as possible "upgrade" for a lower energy collider? E.g., "CLIC" Higgs factory, CLIC TeV, ANA-CLIC 10⁺TeV



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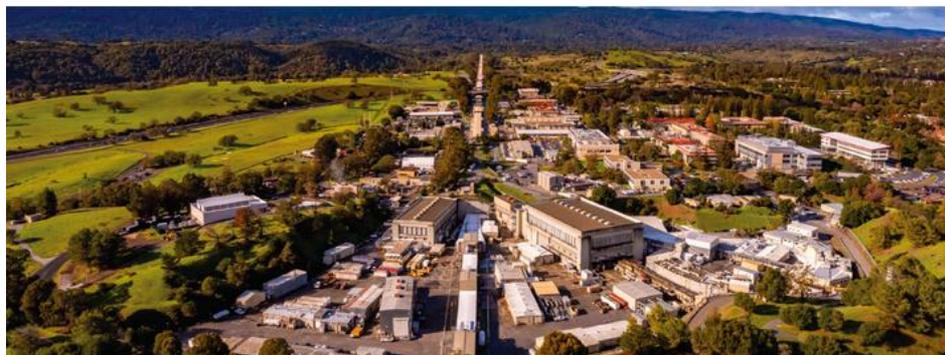
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ALEGRO
Advanced LinEar collider study GROUp

Thank you for participating!
ENJOY!



A HUGE THANK YOU to Spencer and LOC

See you at ALEGRO 2026 ...
Please contribute till then ...