

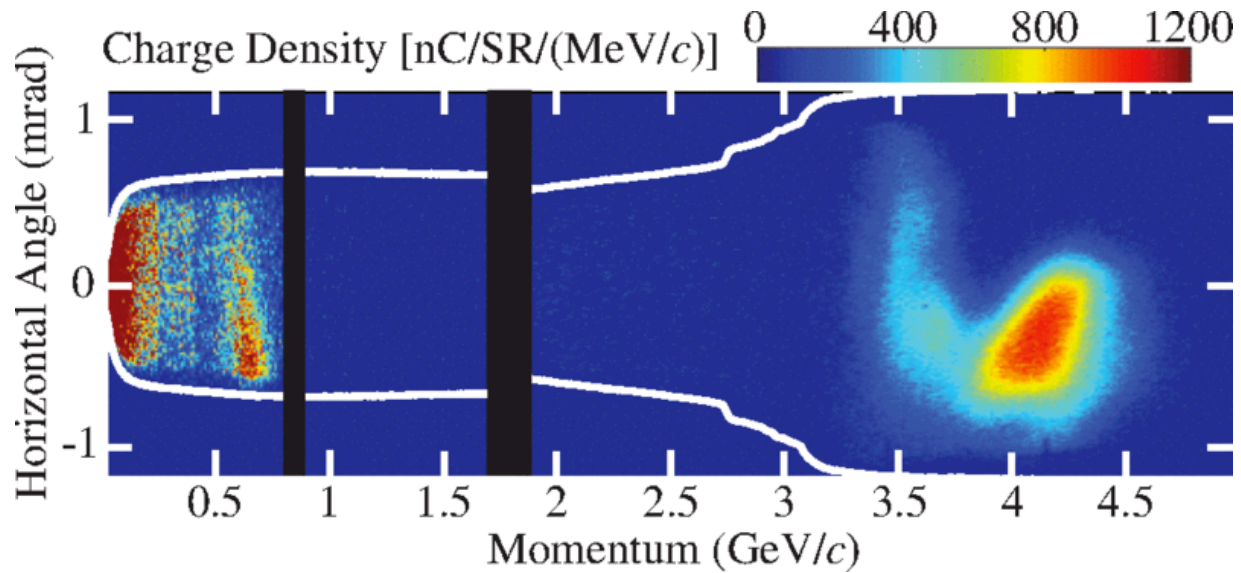
# ALEGRO Mini-Workshop on Positron Acceleration in Plasma

February 9<sup>th</sup>, 2018

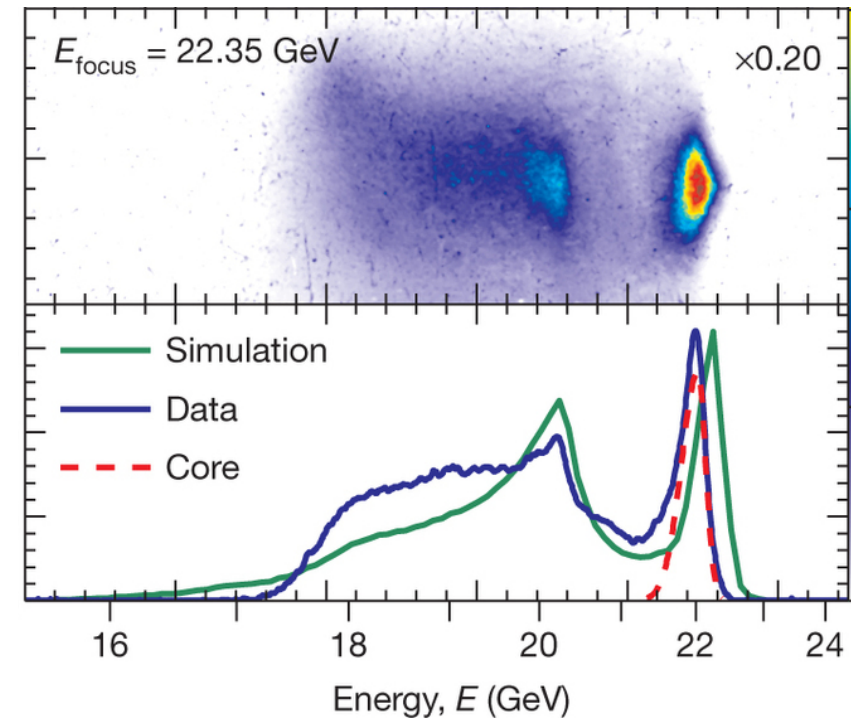
Spencer Gessner, CERN

Sébastien Corde, École Polytechnique

# Progress in Plasma Acceleration Research



W. Leemans *et al.* *PRL* **113**, 245002 (2014)



M. Litos *et al.* *Nature* **515**, 92-95 (2014)

Plasma Acceleration (LWFA and PWFA) experiments have demonstrated many important milestones in the past few years, including multi-GeV acceleration of electron beams . . .

# Progress in Plasma Acceleration Research

## LETTER

doi:10.1038/nature14890

### Multi-gigaelectronvolt acceleration of positrons in a self-loaded plasma wakefield

S. Corde<sup>1,2</sup>, E. Adli<sup>1,3</sup>, J. M. Allen<sup>1</sup>, W. An<sup>4,5</sup>, C. I. Clarke<sup>1</sup>, M. J. Hogan<sup>1</sup>, C. Joshi<sup>4</sup>, N. Lipkowitz<sup>1</sup>, M. Litos<sup>1</sup>, W. Lu<sup>6</sup>, D. Walz<sup>1</sup>, V. Yakimenko<sup>1</sup> & G. Yocky<sup>1</sup>

## ARTICLE

Received 17 Nov 2015 | Accepted 27 Apr 2016 | Published 2 Jun 2016

DOI: 10.1038/ncomms11785

OPEN

### Demonstration of a positron beam-driven hollow channel plasma wakefield accelerator

Spencer Gessner<sup>1</sup>, Erik Adli<sup>2</sup>, James M. Allen<sup>1</sup>, Weiming An<sup>3,4</sup>, Christine I. Clarke<sup>1</sup>, Sebastien Corde<sup>5</sup>, J.P. Delahaye<sup>1</sup>, Joel Frederico<sup>1</sup>, Selina Z. Green<sup>1</sup>, Carsten Haefliger<sup>1</sup>, Carl A. Lindstrøm<sup>2</sup>, Nate Lipkowitz<sup>1</sup>, Michael Litos<sup>1</sup>, Wei Lu<sup>6</sup>, Kenneth A. Marsh<sup>3</sup>, Brendan O'Shea<sup>1</sup>, Navid Vafaei-Najafabadi<sup>3</sup>, Dieter Walz<sup>1</sup>, Vitaly Yakimenko<sup>1</sup> & G. Yocky<sup>1</sup>

## SCIENTIFIC REPORTS

OPEN

### Acceleration of a trailing positron bunch in a plasma wakefield accelerator

Received: 21 June 2017

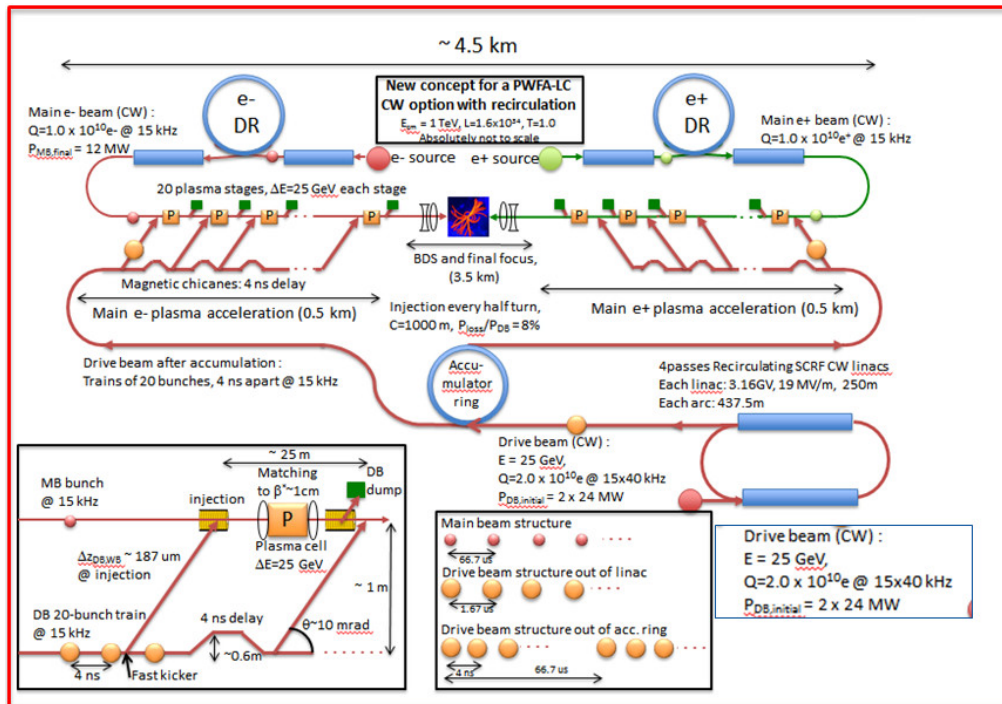
Accepted: 11 October 2017

Published online: 27 October 2017

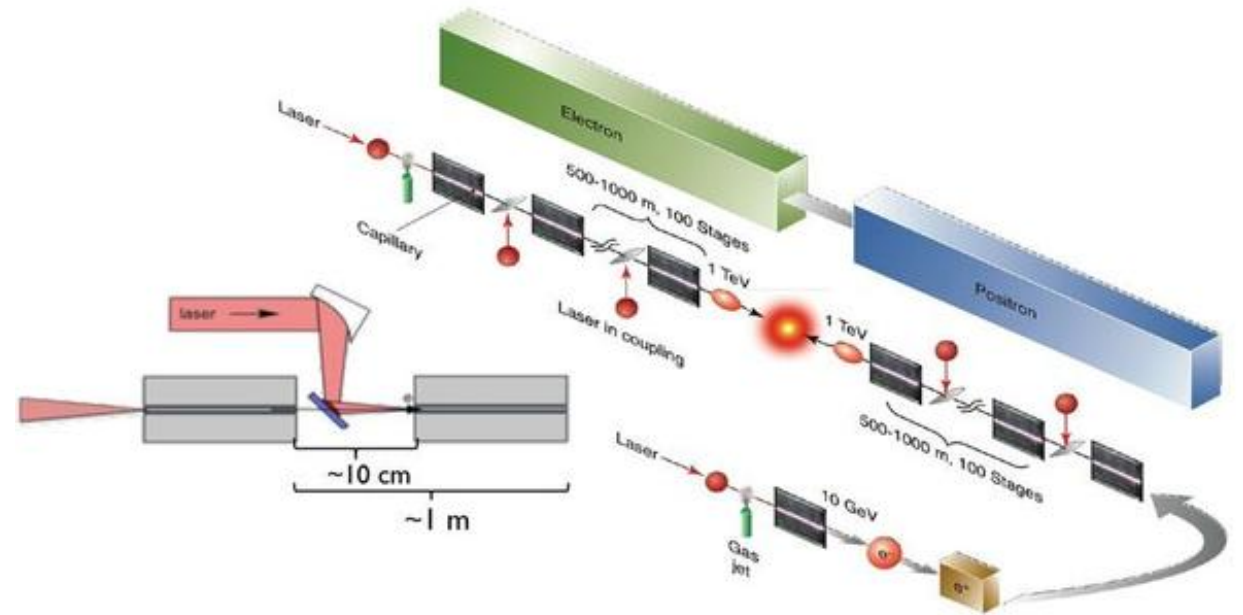
A. Doche<sup>1</sup>, C. Beekman<sup>1</sup>, S. Corde<sup>1</sup>, J. M. Allen<sup>2</sup>, C. I. Clarke<sup>2</sup>, J. Frederico<sup>2</sup>, S. J. Gessner<sup>2</sup>, S. Z. Green<sup>2</sup>, M. J. Hogan<sup>2</sup>, B. O'Shea<sup>2</sup>, V. Yakimenko<sup>2</sup>, W. An<sup>3</sup>, C. E. Clayton<sup>3</sup>, C. Joshi<sup>3</sup>, K. A. Marsh<sup>3</sup>, W. B. Mori<sup>3</sup>, N. Vafaei-Najafabadi<sup>3</sup>, M. D. Litos<sup>4</sup>, E. Adli<sup>5</sup>, C. A. Lindstrøm<sup>5</sup> & W. Lu<sup>6</sup>

... as well as new experiments demonstrating positron acceleration in plasma.

# Plasma-Based Linear Colliders



E. Adli *et al.*, arXiv:1308.1145 [physics.acc-ph]

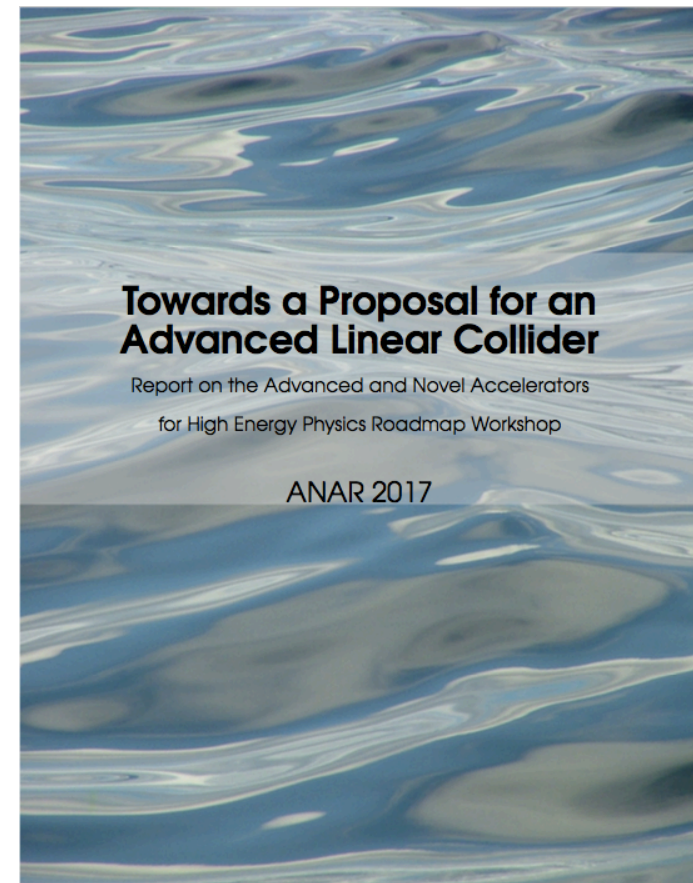
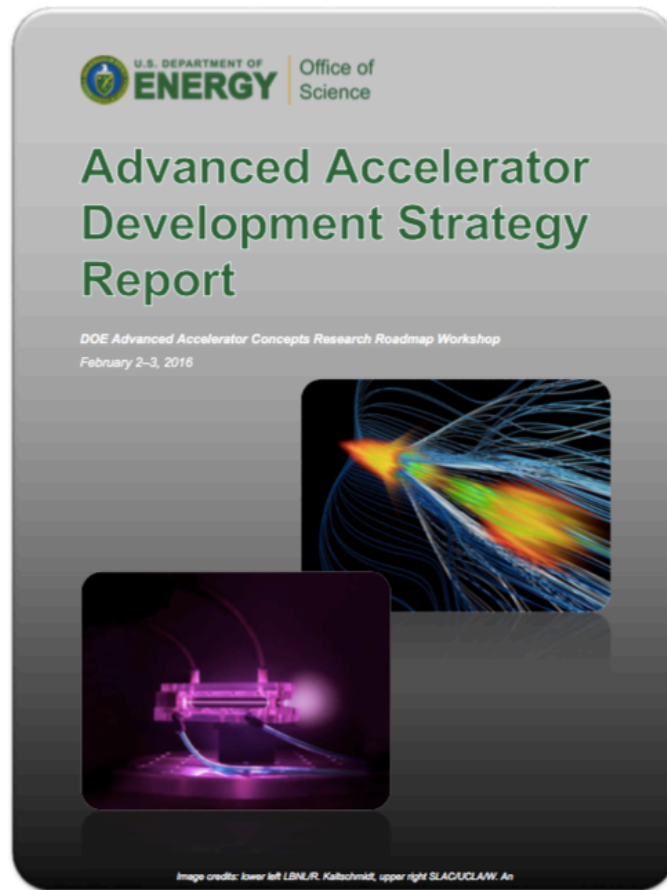


C. B. Schroeder *et al.* Phys. Rev. ST Accel. Beams **13**, 101301

The ultimate goal of this research is a compact, efficient, Plasma-Based Linear Collider (PLC).

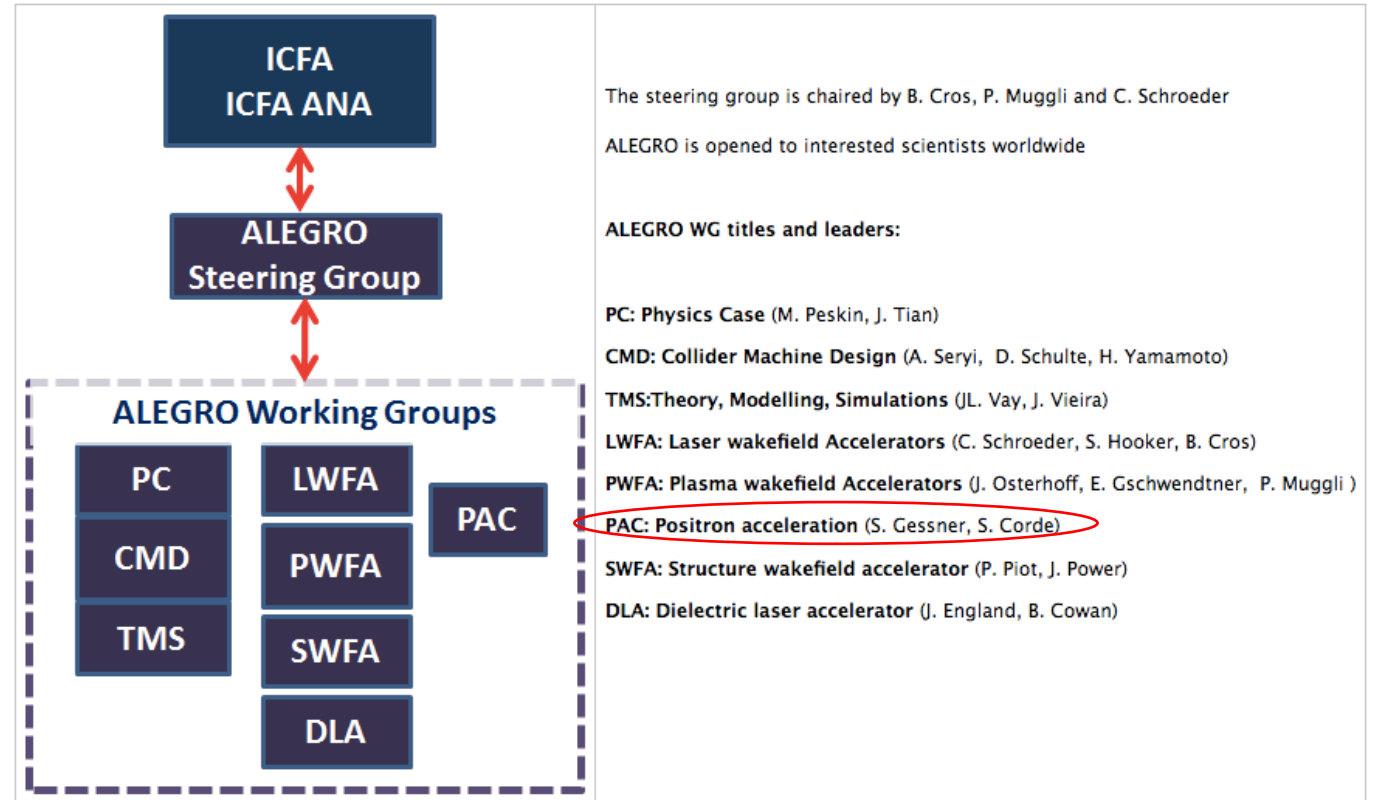
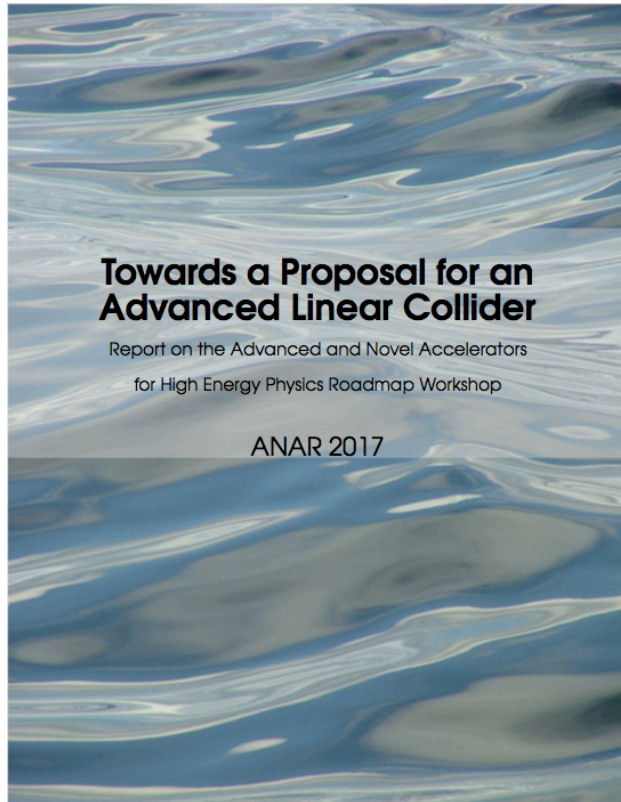
*What do we need to do to demonstrate that these machines are possible?*

# Research Roadmaps



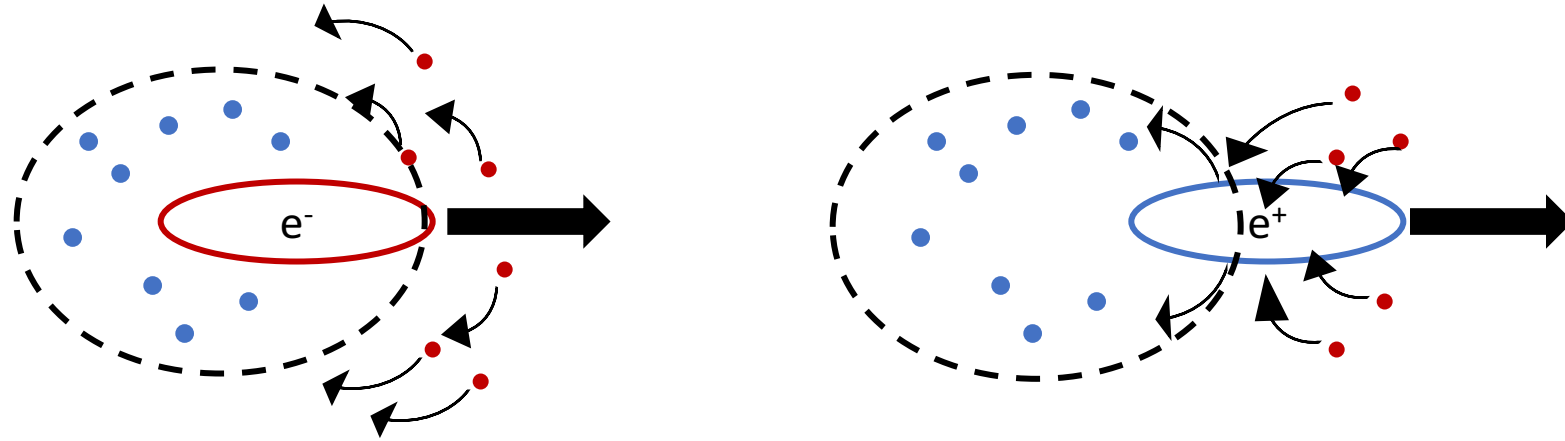
The DOE and ICFA have asked the Advanced Accelerator community to provide input on an R&D “Roadmap” that will lead to a linear collider. The reports were published in 2016 and 2017.

# From ANAR to ALEGRO



In April of 2017, Brigitte Cros (CNRS) and Patric Muggli (MPP) chaired the Advanced Novel Accelerator Workshop and published the ANAR report. ANAR establishes an R&D timeline, but more input is needed. The Advanced LinEar collider study GROup (ALEGRO) was formed to provide this detailed input.

# What makes positron acceleration in plasma challenging?



$$m_i \gg m_e$$

The plasma electrons are mobile but the plasma ions are not. The plasma responds *asymmetrically* to beams of opposite charge. No other accelerating mechanism exhibits this behavior!

# Few Papers/Fewer Experiments

electron plasma wakefield acceleration Brief format Search [Easy Search](#) [Advanced Search](#)  
[find j "Phys.Rev.Lett.,105\\*" :: more](#)

Sort by: earliest date desc. - or rank by - Display results: 25 results single list

[HEP](#) **885** records found 1 - 25 ▶▶ jump to record:

positron plasma wakefield acceleration Brief format Search [Easy Search](#) [Advanced Search](#)  
[find j "Phys.Rev.Lett.,105\\*" :: more](#)

Sort by: earliest date desc. - or rank by - Display results: 25 results single list

[HEP](#) **93** records found 1 - 25 ▶▶ jump to record:

There are 10X more publications on electron PWFA as compared to positron PWFA.

There have been only three experiments on positron PWFA (E162, E200, and E225), all carried out at SLAC.



# Goals for Today's Workshop

## Talks:

- Review results from previous experiments
- Get a common understanding of the challenges and proposed solutions
- Look ahead to future experiments

## Discussion:

- What are the major obstacles to accelerating high-quality positron beams in plasma?
- There are many proposed solutions. What are their advantages and drawbacks?
- How do we approach the construction of “Megatables” for PLC concepts?
- There aren't many facilities of positron PWFA/LWFA research. Is there anything we can do about it? What about novel sources of positron beams for plasma acceleration experiments?

# Today's Agenda

## ALEGRO Positron Acceleration in Plasma Mini-Workshop

Friday 9 Feb 2018, 09:00 → 18:00 Europe/Zurich

6-2-024 - BE Auditorium Meyrin (CERN)

Videoconference  
Rooms

ALEGRO\_Positron\_Acceleration\_in\_Plasma\_Mini-Workshop

Join

BE Auditorium Meyrin

### 09:00 → 10:15 Introduction: Introduction and Review of Experimental Results

#### 09:00 Introduction

Speaker: Spencer Gessner (CERN)

15m

#### 09:15 Experiments at FFTB

Speaker: Patric Muggli (Max Planck Institute for Physics)

30m

#### 09:45 Experiments at FACET

Speaker: Sebastien Corde (Ecole Polytechnique)

30m

10:15 → 10:30

Coffee

15m

### 10:30 → 12:00 Challenges and Solutions: Challenges and Solutions 1

#### 10:30 Proton driven hollow channel

Speaker: Yangmei Li (University of Manchester/Cockcroft Institute)

30m

#### 11:00 Novel Schemes

Speaker: Jorge Vieira (Instituto Superior Técnico)

30m

12:00 → 13:30

Lunch

1h 30m

### 13:30 → 14:30 Challenges and Solutions: Challenges and Solutions 2

#### 13:30 Mitigating transverse wakefields in the hollow channel

Speaker: Carl Andreas Lindstrom

30m

#### 14:00 Difficulties of positron acceleration known from theory

Speaker: Konstantin Lotov (Budker INP)

30m

14:30 → 14:45

Coffee

15m

### 14:45 → 16:15 Future Experiments

#### 14:45 Possible Future Positron Experiments at AWAKE

Speaker: Alexey Petrenko (Budker Institute of Nuclear Physics (RU))

30m

#### 15:15 Planned Positron Experiments at FACET-II

Speaker: Spencer Gessner (CERN)

30m

#### 15:45 Electron beam driven positron acceleration

Speaker: Weiming An (UCLA)

30m

15:45 → 16:00

Coffee

15m

### 16:00 → 17:00 Discussion: What do we want to present in March?

#### 16:00 Megatables, Need for Facilities, Need for Positron Sources

Speaker: All

1h