Update from the Publication and Speakers Committee

Edda Gschwendtner (CERN), Patric Muggli (MPP)
Guoxing Xia (Uni. Manchester), David Cooke (UCL)

AWAKE Collaboration Meeting
6-8th November 2024, CERN
https://indico.cern.ch/event/1456195

Administrative details

- Members: “The PC consists of a chair and typically 3 other members.”
  - Edda Gschwendtner, ex officio as CERN Project Leader
  - Patric Muggli, ex officio as Coordinator of the Physics and Experiment Board
  - Guoxing Xia (Uni. Manchester)
  - David Cooke (UCL)

- Email: awake-pc@cern.ch
- Rules: https://edms.cern.ch/ui/file/2030472/0.2/PubRulesOriginal_19April2021.pdf
  - Manage internal review of papers/talks/posters concerning AWAKE by AWAKE authors
    - Reminder: “all papers mentioning AWAKE, written by a member of the AWAKE collaboration, must be sent to the PC before submission, and also before being put on arXiv”
  - Determine if a paper is signed by “Collaboration”, organize review, maintain Official Author list (to be updated soon)
  - Keep a list of public papers: https://twiki.cern.ch/twiki/bin/view/AWAKE/AwakePublic
- **Please send talks/proceeding papers/posters at least 1 week before conference!**

Recent AWAKE papers

Ion motion analysis
ongoing review with PRL

Experimental Observation of Motion of Ions in a Resonantly Driven Plasma Wakefield Accelerator

M. Turner,[1] E. Walter,[2,3] C. Amoedo,[1] N. Torrado,[1,4] N. Lopes,[4] A. Sublet,[1] M. Bergamaschi,[5] J. Pucek,[5] J. Mezger,[5] N. van Gils,[1] L. Verra,[1,*] G. Zevi Della Porta,[1,5] J. Farmer,[5] A. Clairembaud,[1,5] F. Pannell,[6] E. Gschwendtner,[1] and P. Muggli[5]
(AWAKE Collaboration)

R. Agnello,[7] C.C. Ahdida,[1] Y. Andrebe,[7] O. Apsimon,[8,9] R. Apsimon,[9,10] J.M. Arnesano,[1] V. Bencini,[1,11] P. Blanchard,[7] K.P. Blum,[1] P.N. Burrows,[11] B. Buttenschön,[12] A. Caldwell,[5] M. Chung,[13] D.A. Cooke,[6] C. Davut,[8,9] G. Demeter,[14] A.C. Dexter,[9,10] S. Doebert,[1] A. Fasoli,[7] R. Fonseca,[15,4] I. Furno,[7] E. Granados,[1] M. Granetzny,[16] T. Graubner,[17] O. Grulke,[12,18] E. Guran,[1] J. Henderson,[9,19] F. Jenko,[2] M.A. Kedves,[14] F. Kraus,[17] M. Krupa,[1] T. Lefevre,[1] L. Liang,[8,9] S. Liu,[20] K. Lotov,[21,22] M. Martinez Calderon,[1] S. Mazzoni,[1] P.I. Morales Guzmán,[5] M. Moreira,[4] T. Nechaeva,[5] N. Okhotnikov,[21,22] C. Pakuza,[11] A. Pardons,[1] K. Pepitone,[23] E. Poimendidou,[1] A. Pukhov,[24] R.L. Ramjiawan,[1,11] L. Ranc,[5] S. Rey,[1] R. Rossel,[1] H. Saberi,[8,9] O. Schmitz,[16] E. Senes,[1] F. Silva,[25] L. Silva,[4] B. Spear,[11] C. Stollberg,[7] C. Swain,[9,26] A. Topaloudis,[1] P. Tuev,[21,22] F. Velotti,[1] V. Verzilov,[20] J. Vieira,[4] C. Welsch,[9,26] M. Wendt,[1] M. Wing,[6] J. Wolfenden,[9,26] B. Woolley,[1] G. Xia,[9,8] V. Yarygova,[21,22] and M. Zepp[16]
[1]*CERN, 1211 Geneva 23, Switzerland*

27 Sep 2024

(arXiv:2406.16361v2)

Recent AWAKE papers

Emittance measurement of accelerated e- beam to be submitted to PRAB

Measurement of the emittance of accelerated electron bunches at the AWAKE experiment

D. A. Cooke,[1,*] F. Pannell,[1] G. Zevi Della Porta,[2,3] J. Farmer,[3] V. Bencini,[2,4]
M. Bergamaschi,[3] S. Mazzoni,[2] L. Ranc,[3] E. Senes,[2] P. Sherwood,[1] M. Turner,[2] and M. Wing[1]

(AWAKE Collaboration)

R. Agnello,[5] C.C. Ahdida,[2] C. Amoedo,[2] Y. Andrebe,[5] O. Apsimon,[6,7] R. Apsimon,[7,8]
J.M. Arnesano,[2] P. Blanchard,[5] P.N. Burrows,[4] B. Buttenschön,[9] A. Caldwell,[3] M. Chung,[10]
A. Clairembaud,[2] C. Davut,[6,7] G. Demeter,[11] A.C. Dexter,[7,8] S. Doebert,[2] A. Fasoli,[5]
R. Fonseca,[12,13] I. Furno,[5] N.Z. van Gils,[2,14] E. Granados,[2] M. Granetzny,[15] T. Graubner,[16]
O. Grulke,[9,17] E. Gschwendtner,[2] E. Guran,[2] J. Henderson,[7,18] M.Á. Kedves,[11] F. Kraus,[16]
M. Krupa,[2] T. Lefevre,[2] L. Liang,[6,7] S. Liu,[19] N. Lopes,[13] K. Lotov,[20,21] M. Martinez Calderon,[2]
J. Mezger,[3] P.I. Morales Guzmán,[3] M. Moreira,[13] T. Nechaeva,[3] N. Okhotnikov,[20,21]
C. Pakuza,[4] A. Pardons,[2] K. Pepitone,[22] E. Poimendidou,[2] J. Pucek,[3] A. Pukhov,[23]
R.L. Ramjiawan,[2,4] S. Rey,[2] R. Rossel,[2] H. Saberi,[6,7] O. Schmitz,[15] F. Silva,[24] L. Silva,[13]
B. Spear,[4] C. Stollberg,[5] A. Sublet,[2] C. Swain,[7,25] A. Topaloudis,[2] N. Torrado,[2,13] P. Tuev,[20,21]
M. Turner,[2] F. Velotti,[2] V. Verzilov,[19] J. Vieira,[13] E. Walter,[26] C. Welsch,[7,25] M. Wendt,[2]
J. Wolfenden,[7,25] B. Woolley,[2] G. Xia,[7,6] L. Verra,[2,†] V. Yarygova,[20,21] and M. Zepp[15]

Recent multi-author papers

Filamentation studies
PRE

PHYSICAL REVIEW E **110**, 035208 (2024)

Wakefield-driven filamentation of warm beams in plasma

Erwin Walter[1,2,*] John P. Farmer[3,†] Martin S. Weidl,[1] Alexander Pukhov[4] and Frank Jenko[1]
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[2]*Exzellenzcluster ORIGINS, 85748 Garching, Germany*
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(Received 12 June 2024; accepted 20 August 2024; published 19 September 2024)

Charged and quasineutral beams propagating through an unmagnetized plasma are subject to numerous collisionless instabilities on the small scale of the plasma skin depth. The electrostatic two-stream instability, driven by longitudinal and transverse wakefields, dominates for dilute beams. This leads to modulation of the beam along the propagation direction and, for wide beams, transverse filamentation. A three-dimensional spatiotemporal two-stream theory for warm beams with a finite extent is developed. Unlike the cold beam limit, diffusion due to a finite emittance gives rise to a dominant wave number and a cutoff wave number above which filamentation is suppressed. Particle-in-cell simulations with quasineutral electron-positron beams in the relativistic regime give excellent agreement with the theoretical model. This paper provides deeper insights into the effect of diffusion on filamentation of finite beams, crucial for comprehending plasma-based accelerators in laboratory and cosmic settings.

Thomson scattering in HPS
PPCF

OPEN ACCESS
IOP Publishing
Plasma Physics and Controlled Fusion
Plasma Phys. Control. Fusion **66** (2024) 115011 (15pp)
https://doi.org/10.1088/1361-6587/ad7d36

First Thomson scattering results from AWAKE's helicon plasma source

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Published 30 September 2024

Abstract
We present the first results of electron density and temperature measurements obtained from Thomson scattering at the helicon plasma source (HPS) for the AWAKE project. These measurements are compared to simulation results from a 1D power and particle balance model (PPM), confirming that the plasma can be fully sustained by collisional power dissipation. The variations in plasma parameters under different experimental conditions are evaluated in the PPM framework. We discuss current limitations of the model and propose possible improvements. Additionally, we suggest modifications to the existing HPS setup to enhance axial plasma homogeneity.

Recent multi-author papers

Ionization source rate (PoP)

Direct measurement of the 2D axisymmetric ionization source rate in a helicon plasma for wakefield particle accelerator applications

Cite as: Phys. Plasmas **31**, 070704 (2024); doi: 10.1063/5.0211109
Submitted: 29 March 2024 · Accepted: 11 June 2024 ·
Published Online: 3 July 2024

View Online Export Citation CrossMark

M. Zepp,[a] M. Granetzny, and O. Schmitz

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ABSTRACT

A direct measurement of the particle balance and derivation of the underlying particle source rate distribution in a helicon plasma developed for wakefield particle accelerators is presented. Parallel and radial ion fluxes are measured using laser induced fluorescence on single ionized argon. We find that the radial contribution to the source rate is an order of magnitude larger than the axial contribution. We also find that the axial source rate profile closely matches the radial density gradient axial profile, thus indicating the importance of the radial density profile for the particle balance. Notably, the peak ion source rate is located off-axis, about halfway between the axis and the vacuum wall on both sides of the axial center.

Betatron radiation (PoP)

Elevating electron energy gain and betatron x-ray emission in proton-driven wakefield acceleration

Cite as: Phys. Plasmas **31**, 093104 (2024); doi: 10.1063/5.0216713
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Published Online: 16 September 2024

View Online Export Citation CrossMark

Hossein Saberi,[1,2,a] Guoxing Xia,[1,2,b] Linbo Liang,[1,2] John Patrick Farmer,[3,4] and Alexander Pukhov[5]

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p-driven Higgs factory Accepted by NJP

Submitted to: *New J. Phys.*

Preliminary Investigation of a Higgs Factory based on Proton-Driven Plasma Wakefield Acceleration

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Abstract. A Higgs Factory is considered the highest priority next collider project by the high-energy physics community. Very advanced designs based on radio-frequency cavities exist, and variations on this approach are still being developed. Recently, an option based on electron-bunch driven plasma wakefield acceleration has also been proposed. In this article, we discuss a further option based on proton-driven plasma wakefield acceleration. This option has significant potential advantages due to the high energy of the plasma wakefield driver, simplifying the plasma acceleration stage. Its success will depend on further developments in producing compact high-energy proton bunches at a high rate, which would also make possible a broad range of synergistic particle-physics research.

‡ Corresponding author

Proceedings

Self-modulation study
AAC2024

Development of self-modulation as a function of plasma length

Arthur Clairembaud[a,b], Marlene Turner[c], Patric Muggli[a]

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[c] *CERN, Geneva, Switzerland*

Abstract

We use numerical simulations to determine whether the saturation length of the self-modulation (SM) instability of a long proton bunch in plasma could be determined by measuring the radius of the bunch halo SM produces. Results show that defocused protons acquire their maximum transverse momentum and exit the plasma at a distance approximately equal to the saturation length of the wakefields. This suggests that measuring the radius of the halo as a function of plasma length in the AWAKE experiment would yield a very good estimate for the saturation length of SM.

Plasma light diagnostic
AAC2024

Manuscript - Proceedings AAC24
Implementation of Plasma Light Diagnostics at AWAKE

J. Mezger[a,b], M. Bergamaschi[a,c], L. Ranc[a], A. Sublet[b], J. Pucek[a,b], M. Turner[a], A. Clairembaud[a,b], P. Muggli[a]

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Abstract

We demonstrate the integration of plasma light diagnostics as a tool for studying the self-modulation instability of a long relativistic proton bunch in plasma. The wakefields driven by the proton bunch dissipate their energy in the surrounding plasma. The amount of light emitted as atomic line radiation is related to the amount of energy dissipated in the plasma. Measuring this light would enable us to observe the development of self-modulation of proton bunches along a ten meter long plasma. We describe the setup and calibration of the plasma light diagnostics, configured for a discharge plasma source and a vapor plasma source. We analyze measurements of the discharge plasma and vapor plasma itself. We discuss a simple model for the energy deposited in the vapor plasma by the ionizing laser pulse and show that the amount of light recorded by the cameras is proportional to the energy deposited in the plasma (as indicated by the model). We use the plasma light diagnostic and the fact that the amount of emitted light depends on the plasma density to verify the sharpness, as well as the location and relative height of a density step.

Posters

LCWS in Tokyo (July 2024)

MAX-PLANCK-INSTITUT FÜR PHYSIK

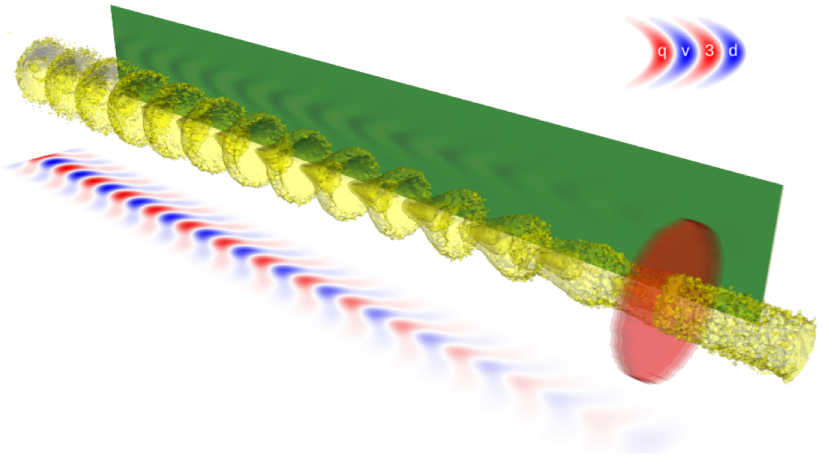
AWAKE

AWAKE: from proof-of-concept towards first particle-physics applications

J. P. Farmer[1], the AWAKE collaboration

[1] Max Planck Institute for Physics, Garching, Germany.

The AWAKE experiment at CERN makes use of a self-modulated proton bunch to excite wakefields and accelerate a witness electron bunch. Run 2c of the experiment will demonstrate stabilization of the wakefield amplitude and control of the witness bunch emittance during injection and acceleration. In this work, we present an overview of the ongoing simulation efforts to support the project as it moves towards controlled acceleration and first particle-physics applications.



Right: The self-modulation of a proton beam (yellow) is seeded by a co-propagating laser pulse, which causes a step in the plasma density (rear projection). This allows the generation of a plasma wakefield (bottom projection) with a reproducible phase, suitable for acceleration of a witness electron bunch.

Talks

The study of high-frequency pick-ups for electron beam position measurements in the AWAKE common beamline

C. Pakuza, M. Krupa, T. Lefèvre, S. Mazzoni, E. Poimenidou, E. Senes, N. Z. van Gils, M. Wendt, CERN, Geneva, Switzerland
P. Burrows, B. Spear, W. Zhang, JAI, Oxford, UK
S. Liu, Fermilab, Batavia, Illinois, USA
V. Verzilov, TRIUMF, Vancouver, Canada

Upgrading the magnetic spectrometer for electron bunch emittance and energy measurements at AWAKE

50th IOP Annual Plasma Physics Conference
8th – 11th April 2024

Fern Pannell and the AWAKE Collaboration

Upgrading the magnetic spectrometer for electron bunch emittance and energy measurements at AWAKE

IOP PAB 2024

F. Pannell[1], D. A. Cooke[1], S. Mazzoni[2], C. Pakuza[2], E. Senes[2], M. Turner[2], G. Zevi Della Porta[2,3], M. Wing[1]

[1] University College London, London, UK [2] CERN, Geneva, Switzerland [3] Max Planck Institute for Physics, Munich, Germany

UCL

Talks

- Patric Muggli, AWAKE: proton driven plasma wakefield acceleration for particle physics, APS-DPP 2024, October 7-11, 2024.
- Patric Muggli, AWAKE: beam-plasma interaction studies, and plasma wakefield acceleration for application to particle physics, 16th May 2024, UK Accelerator Institutes Seminar Series.
- Guoxing Xia, AWAKE experiment at CERN, status and future plan, NanoAc2024, 17th September 2024, Valencia.
- ……

(to be updated)

Proceedings (IPAC24, IBIC24…)

Authors	Title	Conference/Year	Journal/Year	DOI/Link	Slides
C. Pakuza, et al.	The study of high-frequency pick-ups for electron beam position measurements in the AWAKE common beamline	IBIC-2024		DOI	
B. Spear, et al.	Electron bunch position determination using a high frequency button beam position monitor in the AWAKE facility	IBIC-2024		DOI	
N. Z. van Gils, et al.	Preparation for Realisation of External Electron Injection for AWAKE Run 2b	IPAC-2024		DOI	
B. Spear, et al.	Beam studies using a Cherenkov diffraction based beam position monitor for AWAKE	IPAC-2024		DOI	
V. Musat, et al.	Status of the commissioning of the X-band injector prototype for AWAKE Run 2c	IPAC-2024		DOI	
S. Marini, et al.	An LWFA injector for AWAKE Run 2 experiment	IPAC-2024		DOI	
E. Gschwendtner, et al.	Results and plans for run 2 of the advanced proton driven plasma wakefield acceleration experiment AWAKE	IPAC-2024		DOI	

If any paper is missing, please contact me and then I will update this list!
The PhD theses can also be uploaded to our twiki site