

Welcome to the 3rd Townhall Meeting

of the

Expert Panel “High Gradient Plasma and Laser Accelerators”

31 May 2021

<https://indico.cern.ch/event/1041900/>

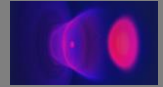
Expert Panel HGPL “High Gradient Acceleration (Plasma/Laser)”

Scope:

- Accelerator R&D Roadmap for **plasma and laser accelerators** (includes beam-driven options and **dielectric** structures).
- Roadmap to support establishing compact, high gradient accelerator technology (> 1 GV/m) as a **viable option for HEP**.
- Enable **intermediate HEP experiments** and on the longer-term a **compact, cost-effective plasma linear collider** design.

Expert Panel:

Chair: Ralph Assmann (DESY/INFN), Deputy Chair: Edda Gschwendtner (CERN)



Panel members:

Kevin Cassou (IN2P3/IJCLab), Sebastien Corde (IP Paris), Laura Corner (Liverpool), Brigitte Cros (CNRS UPSay), Massimo Ferarrio (INFN), Simon Hooker (Oxford), Rasmus Ischebeck (PSI), Andrea Latina (CERN), Olle Lundh (Lund), Patric Muggli (MPI Munich), Phi Nghiem (CEA/IRFU), Jens Osterhoff (DESY), Tor Raubenheimer (SLAC), Arnd Specka (IN2PR/LLR), Jorge Vieira (IST), Matthew Wing (UCL).

Associated members:

Cameron Geddes (LBNL), Mark Hogan (SLAC), Wei Lu (Tsinghua U.), Pietro Musumeci (UCLA)

Meetings already organized:

- 5 expert panel meetings (see INDICO <https://indico.cern.ch/category/13717/>)
- 1st townhall TH meeting (30 Mar) – **setting the scene** (> 110 participants) <https://indico.cern.ch/event/1017117/>
- 2nd townhall TH meeting (21May) - **community input** (> 110 participants) <https://indico.cern.ch/event/1040116/>

Upcoming meetings:

- Weekly panel meetings
- 3rd TH meeting - **community input** (31 May) : <https://indico.cern.ch/event/1041900/>
- 4th TH meeting **discussing roadmap** (23 Jun)

Expert Panel HGPL: Feasibility Issues and Questions to Community

Feasibility issues identified:

- emittance, tolerances, mitigation of instabilities
- efficiency including drive beam, laser issues
- energy spread
- IP issues, pile-up, background
- maximum bunch intensity / charge
- time structure of beam (rep rate)
- round or flat beams, beam shaping
- staging with in/outcoupling
- polarisation
- positrons
- test facilities
- simulation code development and outreach
- Hybrid, new or alternative schemes
- Low emittance beam sources, incl e+ sources
- Plasma stability / repeatability (incl. targetry)
- Synchronization systems, other support systems

*Discuss, group,
order, filter with
TH input*



Questions to community (selected):

- Where do you see HEP applications of advanced accelerators in 30 years?
- What are the **important milestones for the next 10 years** to get there from today?
- What should be proposed as **deliverables until 2026**? Please list in order of priority.
- Is the R&D work ... already funded and, if not, what additional resources / support would be needed?
- What key R&D needs **can be achieved in existing R&D facilities**?
- What is the role of the already planned future facilities in Europe and world-wide?
- Is a completely new facility needed?
- Are additional structures needed beyond existing networks and projects, e.g. a design study for a collider or an advanced accelerator stage?

Expert Panel HGPL: Note on Parameters and Study Cases

4 May 2021

Examples of Beam Parameters Relevant for Particle Physics at High and Low Energy

Expert Panel on High-Gradient Acceleration (Plasma/Laser)

I The **high-energy particle linear collider regime**, for which CLIC has already established an optimized set of parameters. We use here the CLIC parameters of the final 15 GeV of the CLIC 380 GeV main linacs [1].

The relevant study case is the design of an **advanced accelerator module (two or more acceleration stages) accelerating** electron or positron beams from **175 GeV (incoming) to 190 GeV** (after acceleration in the advanced accelerator module).

II A *parameter regime for fixed-target experiments, which might already be realized in the nearer future with more relaxed beam parameters compared to HEP colliders: The example we use here are the beam parameters for a fixed-target experiment for light dark matter search as proposed by the CERN eSPS design study [2].*

The relevant study case is the design of an **advanced accelerator (can include injector)** to accelerate electrons to a final beam energy in the **regime of 15 GeV to 20 GeV**.

Could form part of deliverables!
→ discuss...

Parameter	Units	eSPS (**)
bunch charge, at injection	pC	50
rep. rate, injection	Hz	100
polarization	-	not required
initial energy	GeV	0.2
bunch charge	pC	20
polarization	%	1
initial energy	GeV	0.01
final energy	GeV	0.150
initial relative energy spread	%	0.4
final relative energy spread	%	0.25
initial bunch length	μm	70
final bunch length	μm	70
initial normalized emittance H/V	μm / nm	0.890 / 19
emittance growth budget H/V	μm / nm	0.010 / 1
final normalized emittance H/V	μm / nm	0.900 / 20
bunch separation	ns	0.5
number of bunches per train	-	352
rep. rate	Hz	50
beamline length	m	250
Efficiency: wall-plug to drive beam	%	58
Efficiency: drive beam to main beam	%	22
Luminosity	10 ³⁴ cm ⁻² s ⁻¹	1.5

Expert Panel HGPL – Roadmap Report Structure

- *~40 page report*
- *Structure adopted in discussion with chair of expert panel HFM (PV)*
- *Focusing space-wise on challenges, program structure and deliverables for developing roadmap*
- *Embedding into larger context, including synergy (applications)*

• Executive Summary	2 p
• Abstract	0,5 p
• Motivation for a Plasma and Laser Accelerator R&D Program	1 p
• State of the Art	2 p
• Objectives of a Plasma and Laser Accelerator R&D Program	2 p
• Challenges of Plasma and Laser Accelerators	6 p
• Plasma and Laser Accelerator R&D Program Drivers	2 p
• Proposed Program Structure and Deliverables	12 p
• Roadmap, Work Plan and Timeline	4 p
• Impact of a Plasma and Laser Accelerator R&D Program	4 p
• Applications to Other Fields and Society	2 p
• Scenario of Engagement and Investments	2 p
• Sustainability	1 p

**Many thanks to the 50 colleagues
who provide input to our roadmap in the 2nd and
3rd Townhall meetings!**

Ask everybody to stick to allocated time.

3 page inputs will be very useful in addition to provide more details,
references and suggestions to the expert panel!