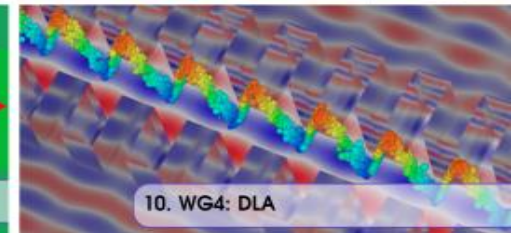
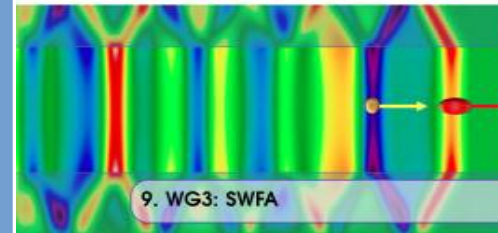
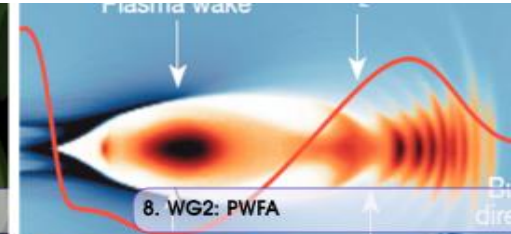
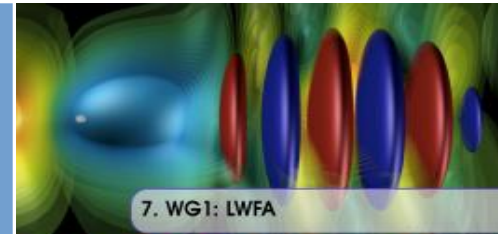


Mission statement: To extend and support the international collaboration and communication in the field of new acceleration techniques.



International Committee for Future Accelerators
Panel on Advanced and Novel Accelerators

A5. ADVANCED & NOVEL ACCELERATORS – SESSION #1 – *Introductory remarks*



Presented by Philippe Piot on behalf of the ICFA/ANA panel

Argonne National Laboratory
& Northern Illinois University

LCWS21 meeting March, 16th 2021

<https://www.lpgp.u-psud.fr/icfaana>

INTRODUCTION TO A5

A5 description (see indico)

■ Motivations

- Last-minute addition to LCWS21 to provide a forum to discuss ANA-related topics and possibly prepare for ALEGRO21? (date TBD)
- Short: only 2 two-hour sessions
 - **Today:** some general talks on various ANA for linear colliders (summary & development – if any – since ALEGRO19)
 - **Thursday [6-8 AM CET/Zurich]:** will discuss “emerging concepts” -- only two talks so far but **this is a workshop and all should feel free to bring up any topics and slides**

■ Zoom info (in case you joined by chance)

- <https://indico.cern.ch/event/995633/sessions/383964/#20210318>

Beam Parameter Evolution

In case that you have a concrete proposal please highlight the beam parameter evolution along the collider. In particular, the bunch charge, length, energy spread, and transverse emittance.

Beam Production

The production of bright beams is a key challenge in linear colliders. Please detail the concept to obtain the beam parameters at the beginning of the main accelerator and identify the key R&D required to achieve this. This may include the development of bright electron and positron sources or advanced phase-space cooling techniques. For beam-driven methods the drive-beam production process and requirement should also be discussed.

Beam Acceleration

Beam break-up is a key limitation of the beam parameters in linear colliders. Please indicate the theoretical and experimental studies that support that your choice of beam parameters is consistent with stable beam acceleration.

In LCs the beam transverse emittance degrades during acceleration. Detail the expected beam quality degradation during acceleration and the associated specifications for maximum imperfections (tolerance on alignment). Depending on the ANA technologies this could include for example:

- the allowed plasma density fluctuations
- the allowed fluctuations of the drive beam or laser pulse intensity and length
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- the tolerance on drive-bunch shaping precision
- the allowed misalignment between the drive beam or laser and the main beam
- the allowed misalignment of components
- the required stability of components

Beam Focusing

The focusing of the full energy beam to the small beam size at the collision point is a key challenge in linear colliders. Please detail the beam parameters before this beam delivery system and at the collision point. Describe the focusing system concept and highlight the studies that will be needed to demonstrate its feasibility. Please also give the tolerances that need to be met to achieve the target performance.

Positron production and acceleration

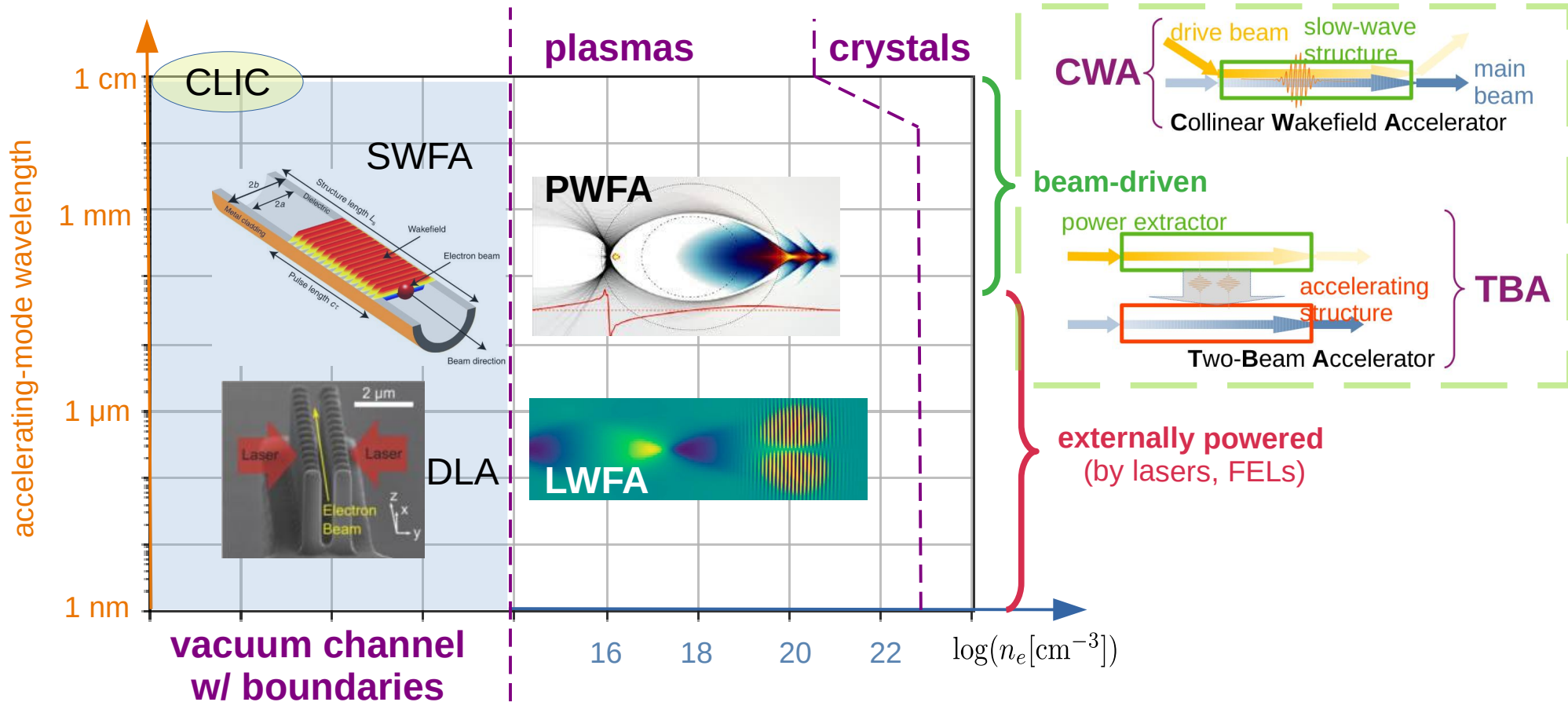
Depending on the technology the production and acceleration of positrons will pose additional challenges and devising solutions toward addressing these limitations should be discussed.

Power Requirement & efficiency

Please detail the target wall-plug to beam power efficiency, compared to the state-of-the-art, and indicate the R&D required to meet the target.

ADVANCED & NOVEL ACCELERATORS (ANA)

Overview



ICFA-ANA PANEL INITIATIVES

Mission: expand & support international collaboration

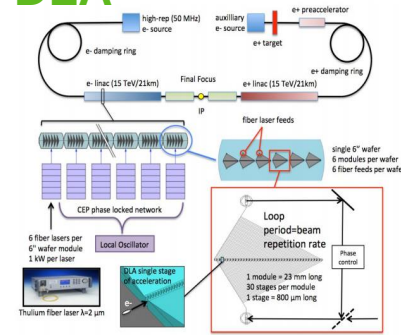
Current status:

- Application of ANA to HEP does require worldwide cooperation
- ANA community is quite fragmented: many straw-man design of ANA-based LCs
- Weak interaction non-ANA-acc. community

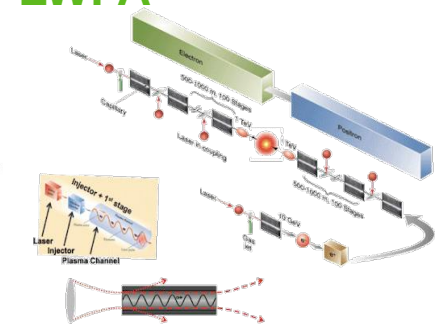
Many challenges & Opportunities

- Joint force/share resources: ANA technologies have similarities
- Devise a global strategy instead of “local” focuses on a particular ANA option (several ANA integrated in one concept?)
- Need to connect with non-ANA accelerator community (joint workshop activities between ICFA/ANA & ICFA/BD panels?)

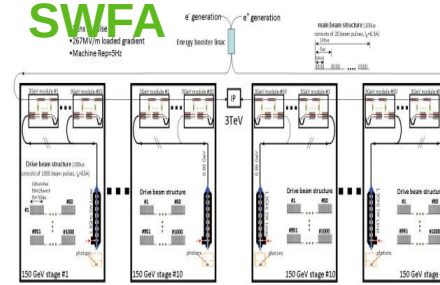
DLA



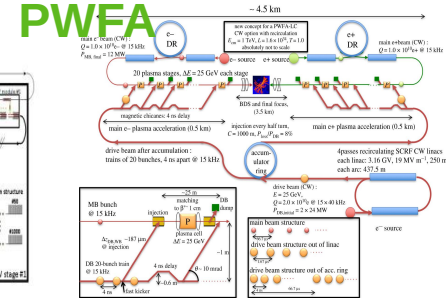
LWFA



SWFA



PWFA



ANA-PANEL INITIATIVES

The ALEGRO initiative

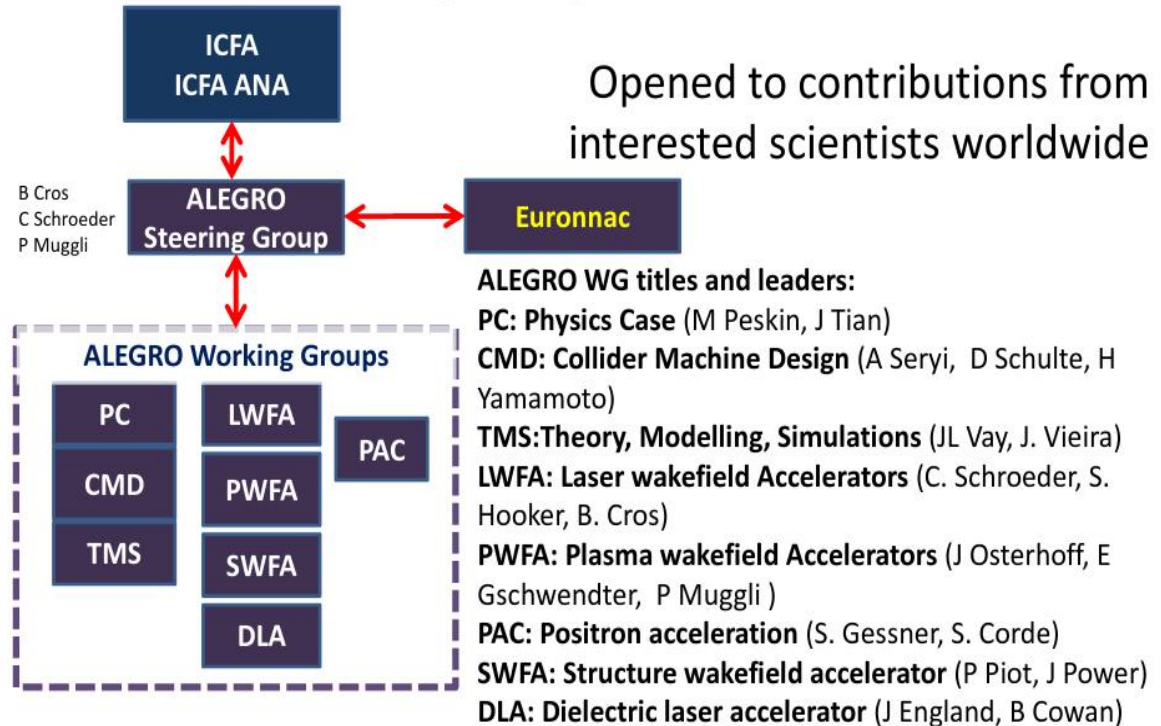
Advanced LinEar collider study GROup (ALEGRO)

- To foster and trigger ANA-based linear-collider activities
- Provide a platform to increase international collaboration
- Broaden community (labs, academia, industry)



(from Brigitte Cros, AAC18)

Advanced LinEar collider study GROup: organisation

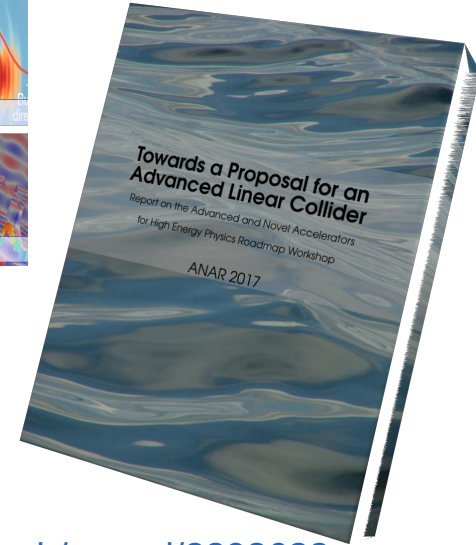
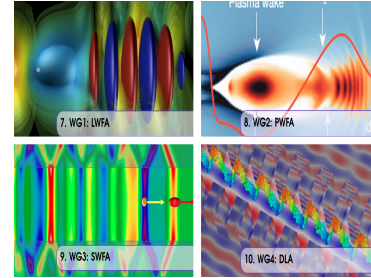


CURRENT ANA-PANEL ACTIVITIES

ALEGRO activities & ALIC

■ ALEGRO activities

- Workshop series 2017-2019 (2020 hiatus)
next workshop in **ALEGRO2021** to be organized by DESY.
- Group coordinates the design of an advanced linear collider based on promising high-gradient technologies (DLA, LWFA, PWFA, SWFA).



<http://cds.cern.ch/record/2298632>

* Towards an Advanced Linear International Collider

■ Advanced Linear International Collider (ALIC)

ALEGRO collaboration

- Grand Challenge:
30 TeV, $10^{36} \text{ cm}^{-2} \cdot \text{s}$ * $e^+e^-/\gamma\text{-}\gamma$ ANA-based collider
- Integration of ANA in a future linear collider.

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.

<https://arxiv.org/pdf/1901.10370.pdf>

ALEGRO

Specific activities & goals



- Main challenges toward ALIC common to most technologies
 - Forming bright e-/e+ main beams (from source after phase-space cooling)
 - Preserving small main-beam emittances
 - Positron acceleration (for some ANA option)
 - Drive-beam production/control for TBA/CWA
 - Efficiency for main-beam acceleration
 - Staging
 - Beam stability and reproducibility
 - Final focus
 - Spin-polarization preservation

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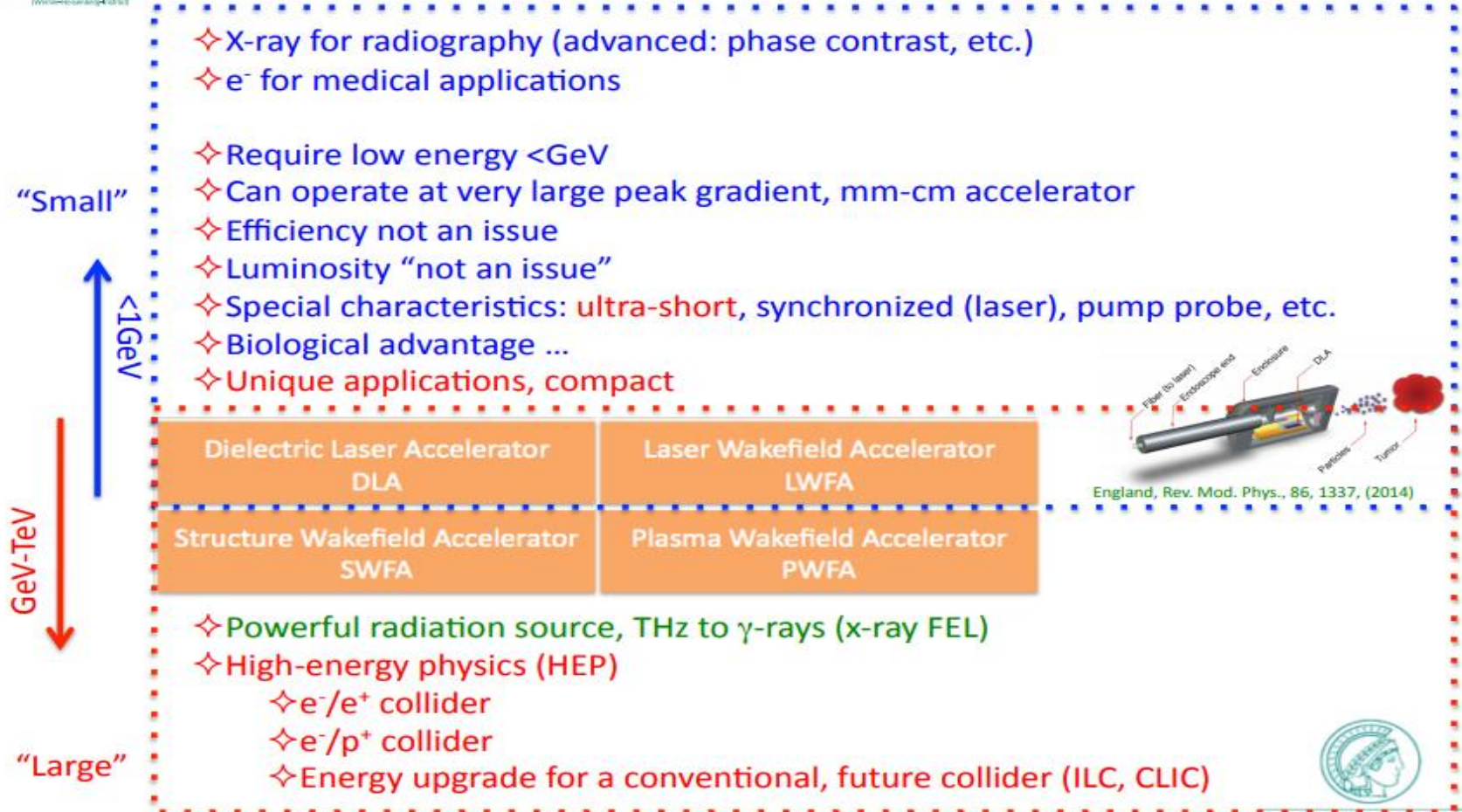
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APPLICATION OF ANA

HEP & BEYOND

(from Patric Muggli, CLIC'18)

Max-Planck-Institut für Physik
Werner-Heisenberg-Institut



GOALS

Outcome of our two session (please add)

- **End Goal:** Ultimately (beyond this meeting) to get a consistent set of parameters for a target luminosity (mb for a few cases 3, 10, 30 TeV?)
- **This workshop:**
 - Discuss commonalities and come up with approximate parameters for some auxiliary systems, e.g., (what I can think of) :
 - Injection emittance required for various ANA (can we use similar injectors for e+/e-? and damping ring?)
 - Drive beam for PWFA and SWFA requirements (from strawman design they seems very similar)
 - Design of a generic(?) beam delivery system that some ANA option could reuse

Table 1: ALEGRO megatable – overall parameters of advanced acceleration collider concepts

Parameter	Concept 1	Concept 2	...	Concept N
Colliding species	e^+e^-
Upgrade or stand-alone
Final E CM, TeV	1.0
Luminosity, $10^{34}\text{cm}^{-2}\text{s}^{-1}$
Effective L^* , m
Detector forward exclusion angle, mrad
Total length, km
Length of beam delivery, km
Repetition rate, Hz
Total wall plug power, MW
Colliding beam power, MW
IP beam sizes, X/Y, nm
IP beam length, Z, mm
IP beam n-emittance, X/Y, nm
IP beam E-spread, %
Colliding bunch population, 10^{10}
Initial E of colliding bunches, GeV
Driver type	laser	e-bunch	p-bunch	...
Adv.acc. media	plasma	diel
Driver E/bunch, J
Adv.acc. transformer ratio
Length of single adv.acc stage, m
Number of adv.acc stages
Effective gradient of adv.acc media

A. Sery's MEGA table (ANAR17)

LOGISTICS

- Speakers:
 - Please send you slide to ppiot@anl.gov and I will post them on indico

 - If you want to show any slide next session let me know we currently have two talks
 - C. Jing, short pulse operation of SWFA
 - S. Tantawi, cryo-cooled high-gradient structure
 - A couple more people were volunteered...

- I hope we can summarize our discussion in a short proceeding report