Discussion on Coordinating International Activities

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ANAR Workshop

CERN, Geneva

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Bottleneck or showstopper? I prefer showstopper...

show-stopper

or **showstopper**

[**shoh**-stop-er]

Spell Syllables

Examples Word Origin

See more synonyms on Thesaurus.com

noun

1. *Theater.* a performer or performance that wins enthusiastic or prolonged applause.

2. a spectacularly arresting or appealing person or thing:
   This bright plaid suit is a real show-stopper.

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nature International weekly journal of science

NATURE | NEWS: Q&A

CERN's next director-general on the LHC and her hopes for international particle physics

Fabiola Gianotti talks to *Nature* ahead of taking the helm at Europe's particle-physics laboratory on 1 January.

Elizabeth Gibney

22 December 2015

Maximilien Brice/CERN

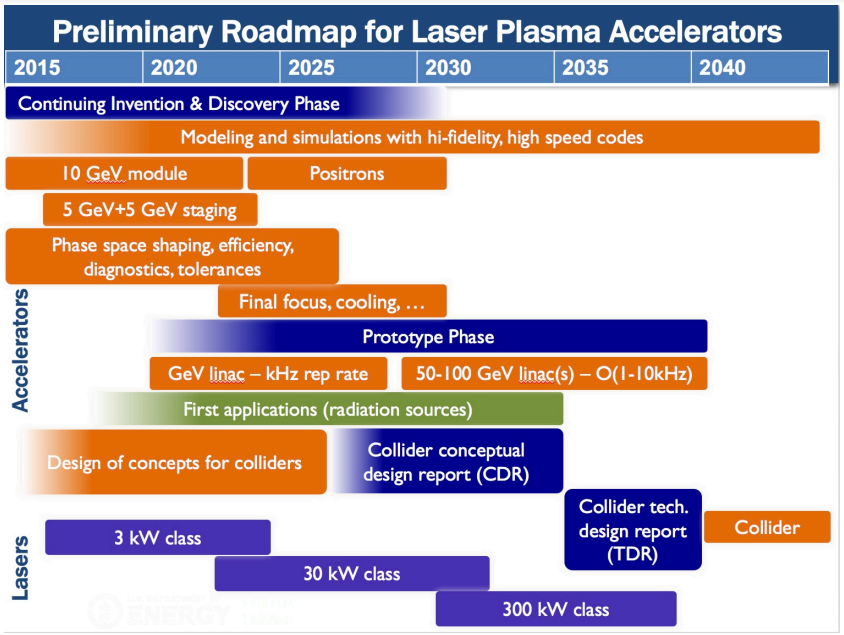
Fabiola Gianotti is the incoming director-general of CERN.

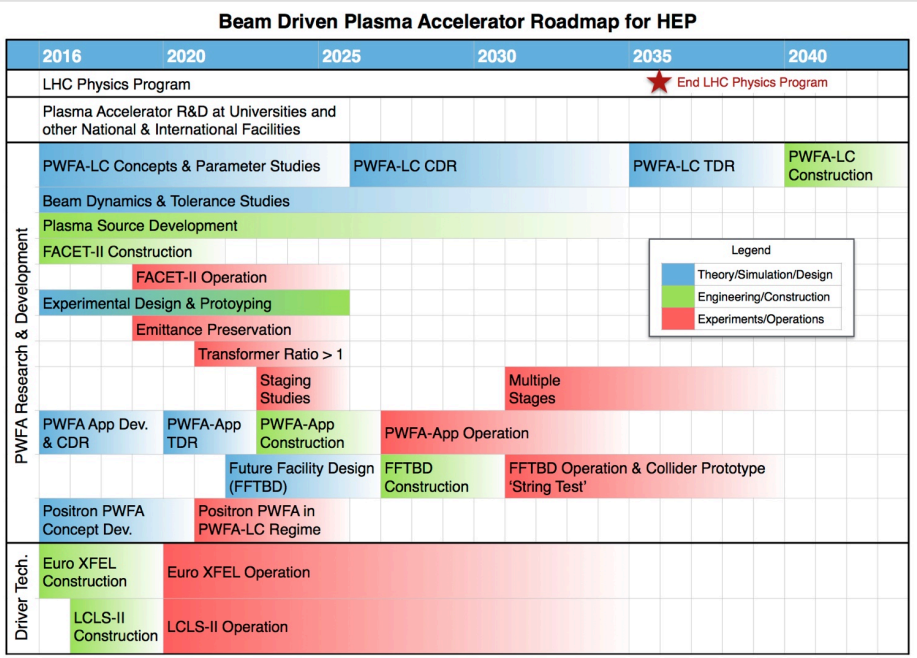
Some people think that future governments will be unwilling to fund larger and more expensive facilities. Do you think a collider bigger than the LHC will ever be built? And will it depend on the LHC finding something new?

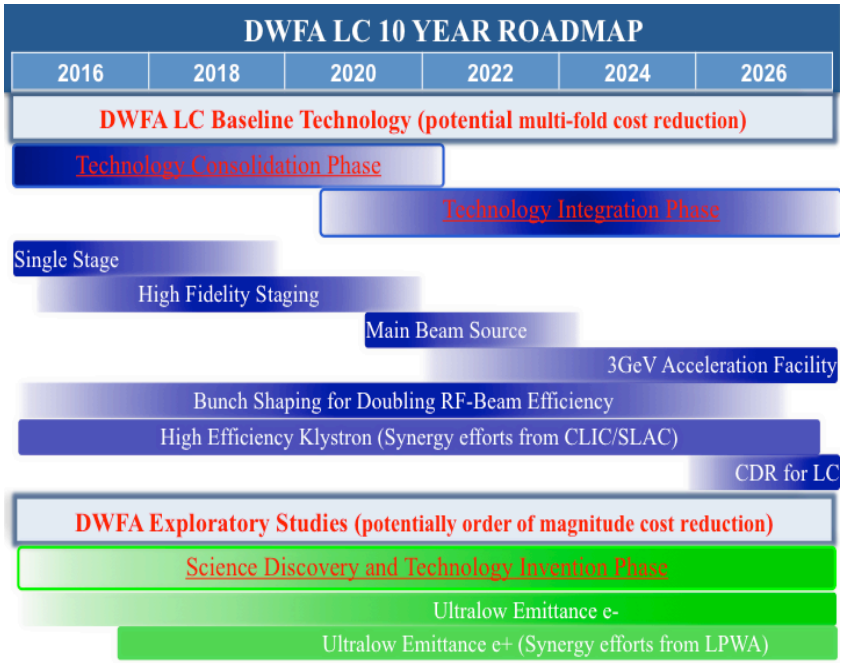
The outstanding questions in physics are important and complex and difficult, and they require the deployment of all the approaches the discipline has developed, from high-energy colliders to precision experiments and cosmic surveys. High-energy accelerators have been our most powerful tools of exploration in particle physics, so we cannot abandon them.

What we have to do is push the research and development in accelerator technology, so that we will be able to reach higher energy with compact accelerators.

Roadmaps have been developed with both a 10 year and even 25 year horizon – coordination is important



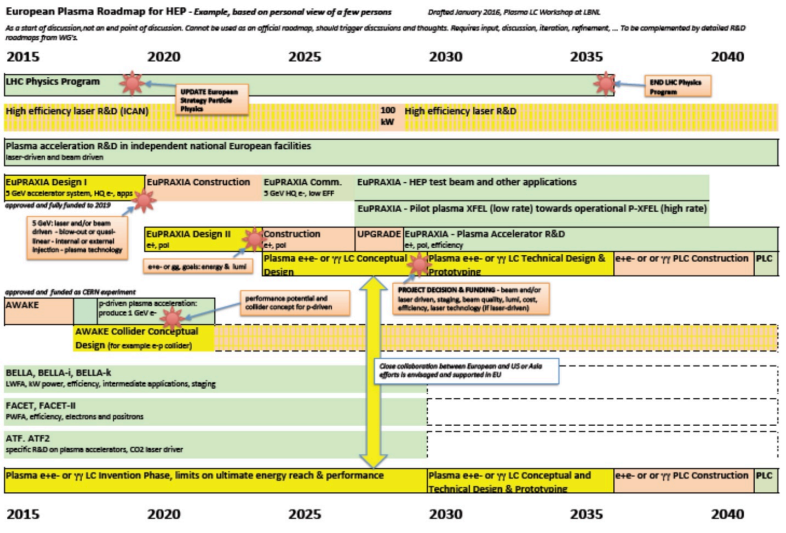




European Network for Novel Accelerators — EuroNNAc — EuPRAXIA

HEP Roadmap from EuroNNAc2
OPTION C → for discussion

Horizon2020



AAC Roadmap – Common Challenges

The workshops identified a set of common challenges as focus for next 10 years:

1. *Staging:*
   Higher energy staging of *e*- acceleration, with independent drive beams, equal energy, and 90% beam capture.

   ("Higher energy" means multi-GeV for LWFA & PWFA and multiple-100 MeV for DWFA.)

2. *Emittance:*
   Understanding mechanisms for emittance growth and developing methods for achieving emittances compatible with colliders.

3. *A complete e- acceleration stage:*
   Completion of a single *e*- acceleration stage at higher energy.

4. *Positron acceleration:*
   Demonstration and understanding of *e*+ acceleration.

5. *Collider parameter set:*
   Continuous, joint development of a comprehensive and realistic operational parameter set for a multi-TeV collider, to guide operating specifications for AAC.

Three-component program: Experiment + Theory + Modeling

What is the best strategy towards the development of future accelerator technology with relevance to colliders?

Focus in the next decade (or so) on fundamental accelerator science and technology questions

In parallel, pursue near term applications:

- Engineering of the devices towards reliable, tunable machines
- Brings in funding from other stakeholders and ideas from other communities

Balance between colliders and other applications is different in the different regions

Community needs to score some “early” successes with advanced accelerators entering the “real world”

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Development of near-term (non-HEP) LPA applications (FEL, medical, radiation sources, etc.) are important part of collider roadmap

From a talk by Michael Peskin (SLAC) at January 6-8, 2016 workshop at LBNL

The era is in view where new accelerator technologies must take over from the current ones.

This makes it very important to take the first steps toward practical plasma accelerators, proving their robustness for few-GeV electron accelerator applications such as FELs.

This is only the beginning of a long road, but that road leads to the future of particle physics.

When does coordination at an international level make sense and how can ICFA help?

- Some of the research already requires significant infrastructure and significant personnel efforts (funding)
- As the field matures, the infrastructure demands will further increase

Detailing what facilities are available across the globe would be useful

- Europe is building three major laser driven facilities – ELI Infrastructure
  - These potentially offer unique opportunities in the near term beyond anything that is on the drawing board anywhere else
- Multiple other laser facilities are available
  - Many are user facilities, some only are set-up for collaborative research
- Multiple accelerator based facilities exist
  - Many are user facilities

ICFA does not have funding but can do advocacy for the importance of support for advanced accelerator research at the major national labs and institutions and with funding agencies

Courtesy of A. Lankford

2015 ARD Subpanel Report - 4

The ARD Subpanel commented:

- *"For any of these approaches to advanced acceleration, the following facilities will likely be needed in order to make significant intermediate steps toward the eventual goal of a multi-TeV e+e- collider:*
  1. *a flexible, dedicated R&D facility, with a witness beam and a number of drive beams, either laser or particle as appropriate to the approach, for staging experiments; and*
  2. *a demonstration facility based upon the advanced acceleration approach, with beam characteristics scalable to future colliders."*

The significant cost of R&D facilities strongly influences the roadmap for advanced accelerator R&D.

- Makes difficult (expensive) pursuit of multiple approaches in parallel.
- Drives early (too early?) down-selection of approaches.
- Cost strongly influenced the ARD Subpanel, which was charged to meet specific budget scenarios.
- An international AARD program, with some level of international coordination, is more capable of mounting the future facilities needed to explore multiple promising approaches.

What lessons can we learn from other large scale international projects – Case study: ILC

From Barry Barish

"I think the keys for the GDE -- ILC R&D and Design effort, were:
• A defined set of design parameters, which came from international physics studies through ICFA. This set our targets.
• A proposal driven international R&D program with mechanisms to define and evolve priorities.
• Mechanisms (internationally) for making technical decisions. This was very important in that the GDE internationally took 'ownership' on both R&D decisions and Technical Design decisions, even when controversial.
• On-going communication with international funding agencies (FALC), international scientific bodies (ICFA), etc.
• Pooled funding of the GDE itself, which helped us move resources where they were most needed."

In my (WL) opinion, we are not at this level of maturity yet that require such a formal structure. We are still in the discovery and innovation phase.

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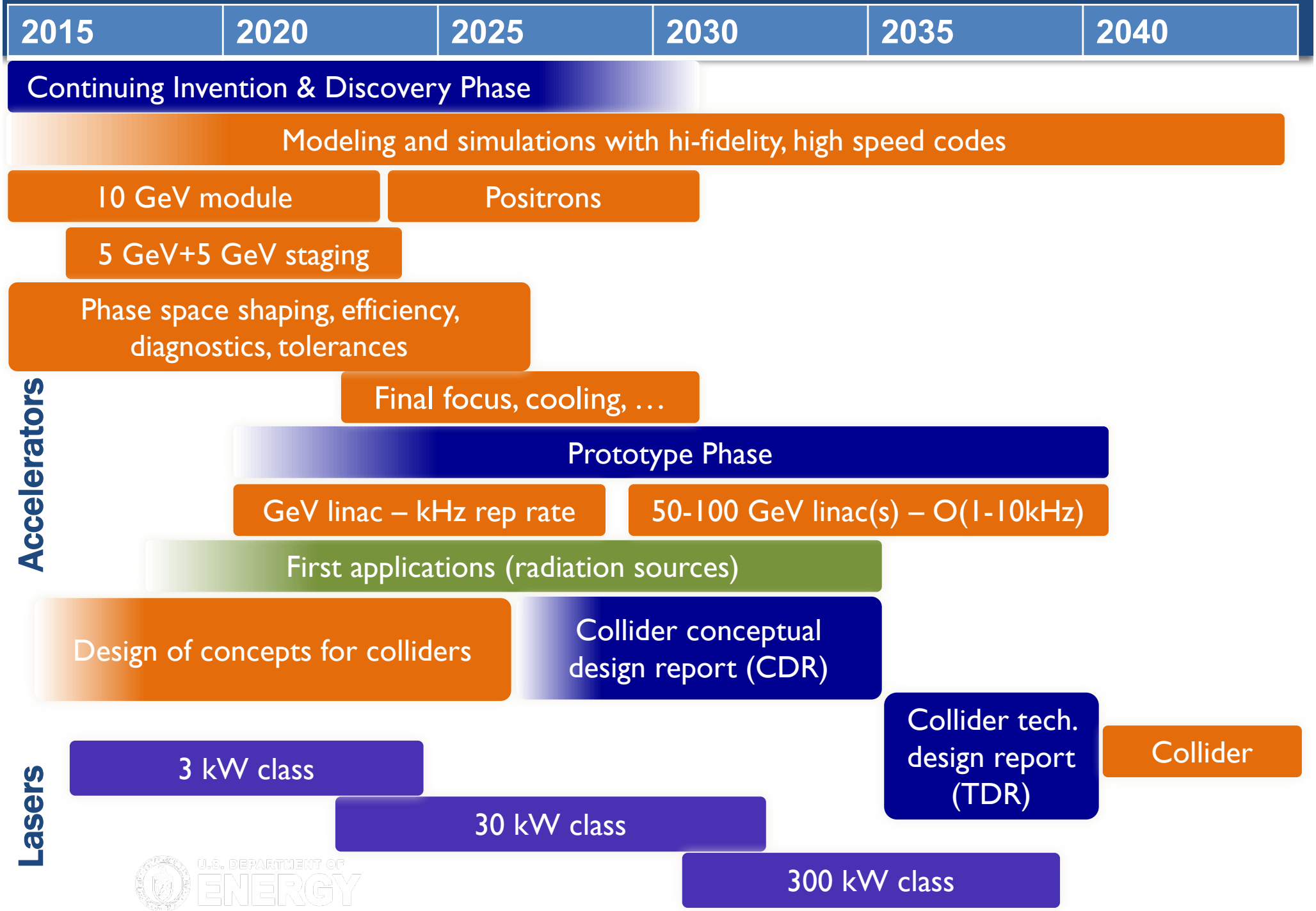
Coordination must respect “regional” priorities

Regional roadmaps should be developed in line with the “local” funding priorities

- US: DOE-Office of Science is the primary steward of accelerators and significant R&D is funded through High Energy Physics office as well as NSF and to a lesser extent DOE-NNSA. Applications are receiving funding through DOE-Basic Energy Sciences as well as NNSA and DoD. Strong national coordination.
- Europe/Asia: primary next steps are funded towards base technology and applications – particle physics community interest is increasing (e.g., CERN’s investment in AWAKE). Many national efforts. Coordination examples are EUPRAXIA.

Roadmap for Laser Plasma Accelerators



Thoughts…continued

Coordination of the roadmaps is important to

- Ensure that the key priorities are in alignment
- Maximize the current investments in available facilities
- Judiciously propose the next facilities as the investments are becoming large
- Advance the field with a common sense of urgency and shared knowledge

ICFA can (and should) help with

- Advocacy of the importance of continued investment into accelerators science and technology
- Establishing a database of available facilities and capabilities on a worldwide level
- Enabling a forum for international groups to exchange ideas and create new collaborations