Advanced Accelerator Research

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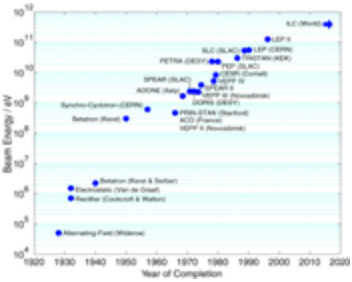
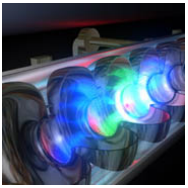
History of particle accelerators Livingston Plot



Exponential increase in the particle energy over 80 years

State-of-the-art accelerators use resonating cavities at radio frequencies



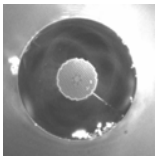
These structures are limited by breakdown on the surface or by the critical magnetic field of the superconductors to accelerating fields around 0.05 to 0.1 GV/m

Advanced accelerator research

As opposed to accelerator technology, accelerator research focuses on the physics of new accelerating schemes, such as:

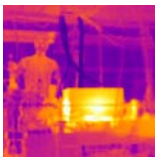
Extending RF to higher frequencies

Higher frequencies could lead to a higher breakdown threshold. Power sources for frequencies above ~15 GHz need to be developed, as klystrons cannot deliver enough power. A possibility is to derive this power from a relativistic beam.



Dielectrics at optical frequencies

At THz or optical frequencies, the damage threshold of dielectrics exceeds 1 GV/m. The fields can be provided by a laser or by an electron beam, and it can be confined by a photonic bandgap structure.



Plasma wakefield acceleration

Plasma waves have a longitudinal electric field component. Accelerating fields of more than 50 GV/m have been measured, and these fields have been sustained for up to 85 cm.

There is More to Accelerating Structures than the Accelerating Field

- Power sources
- Beam loading
- Emittance preservation
  - Non-linear transverse forces
  - Wakefields

There is Much More to an Accelerator than Accelerating Structures

- Particle sources (injectors)
- Bend magnets for storage rings
- Focusing, beam dynamics
- Detectors

Accelerator research is more than just engineering!

Your comments and questions are welcome:
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