Laser-Plasma Accelerators for Multi-TeV Lepton or Gamma-Gamma Colliders

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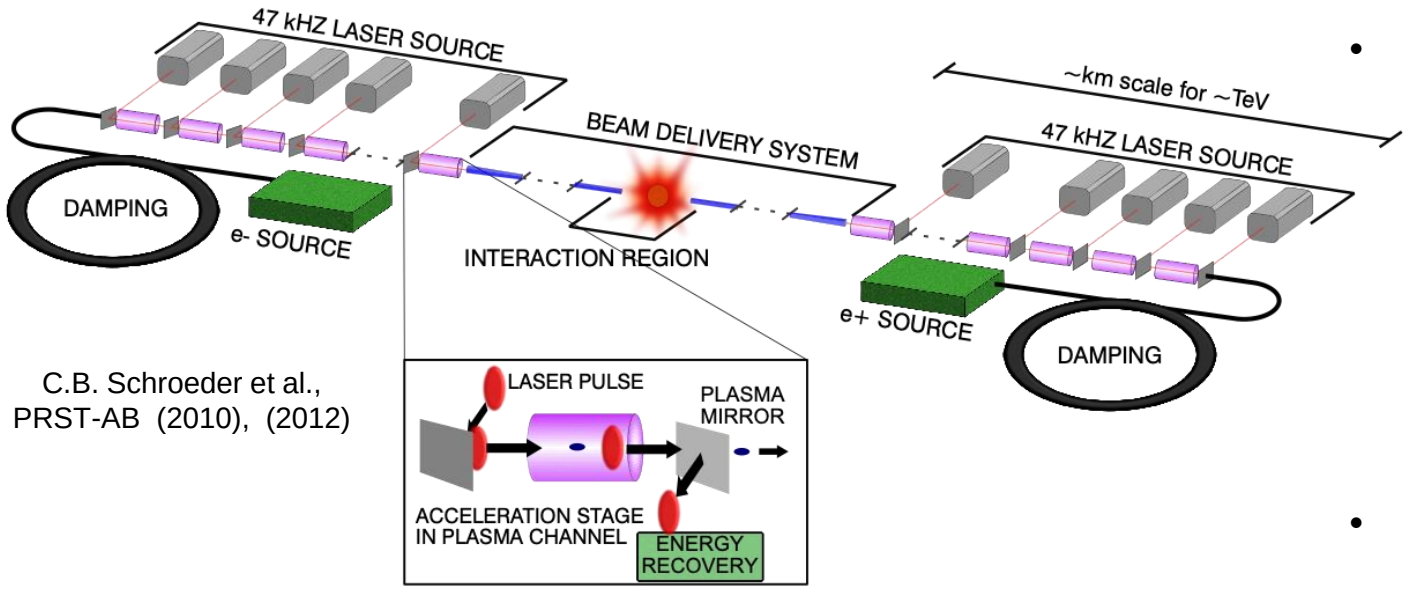
- Laser-plasma accelerators (LPAs)
  - Ultrahigh fields 10-100 GV/m (1000x conventional)
    - Small footprint, reduced cost
  - Ultrashort bunches ~ few fs
  - Rapidly evolving laser tech (2018 Nobel Prize)
  - Vigorous international research program (100s papers/yr)
    - 8 GeV high quality e^- bunches (BELLA)
    - Stable operation many hours (DESY)
    - LPA driven FEL (China, Italy, Germany)



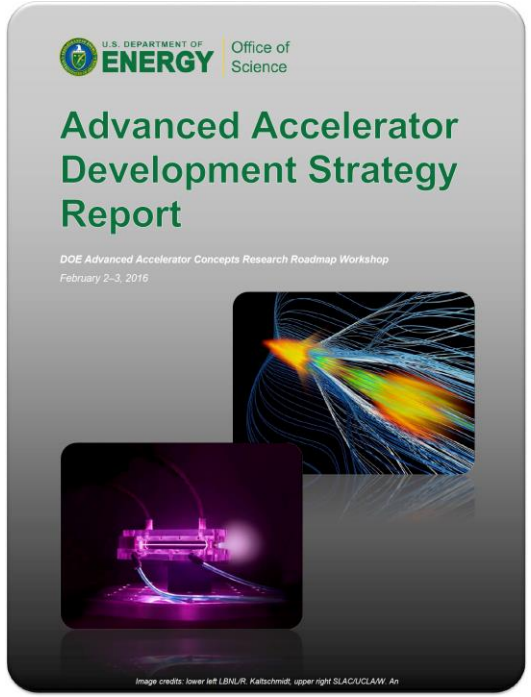
C.B. Schroeder et al., PRST-AB (2010), (2012)

- Collider based on staged LPAs
  - Stages (~10 GeV in 1 m) with compact coupling
  - Each stage: ~10 J laser driver
  - Few GV/m average gradient: compact linacs
  - Short bunches improve interaction and reduce overall power required (reduced Beamstrahlung)
  - Laser and plasma energy recovery proposed
  - Rep-rate for luminosity: ~10's of kHz
    - Fiber lasers: high efficiency + high average power
- Additional R&D required
  - More efficient methods for positron acceleration
  - Low emittance injectors + emittance preservation
  - Compact cooling methods
  - Compact beam delivery systems
  - High-average power laser technology
  - Integrated design study
- Serious investments overseas
  - Challenges US leadership

Competitive Progress along LPA-Collider R&D Roadmap Requires Investments

The Advanced Accelerator Community recommends (see Snowmass White Papers)

- Continue and enhance the General Accelerator R&D program
- Upgrades to the US Beam Test Facilities that serve the community
  - BELLA at LBNL
    - *kBELLA: mid-scale project*
    - *kHz precision LPA facility proposed*
  - FACET II at SLAC
  - Argonne Wakefield Accelerator at ANL
  - Accelerator Test Facility at BNL
  - University programs
- Enhanced support for high power laser drivers
- Initiation of an integrated design study for an advanced collider



2016 R&D Roadmap

Please join us for a tour of the BELLA PW laser facility Friday afternoon