Laser and Plasma Accelerator Research for High Energy Physics at the BELLA Center

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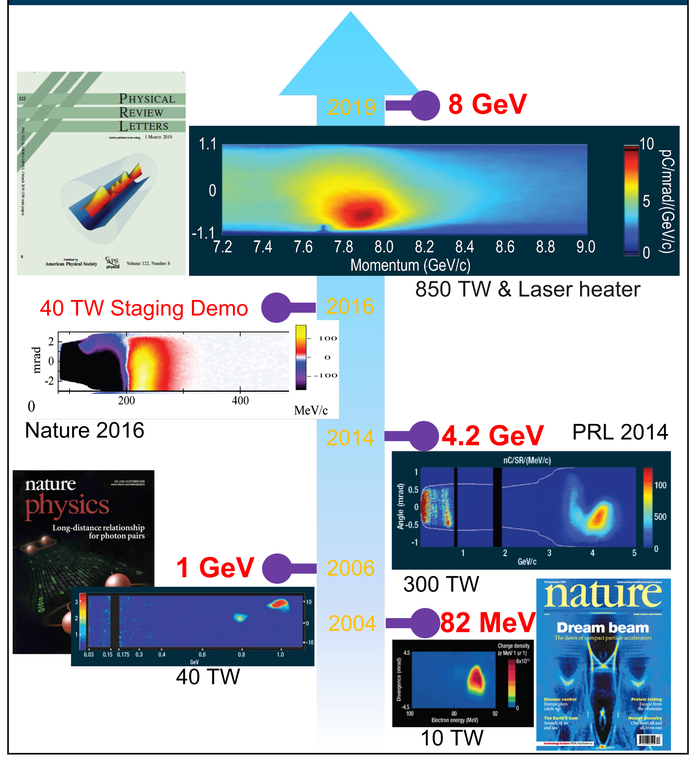
Summary

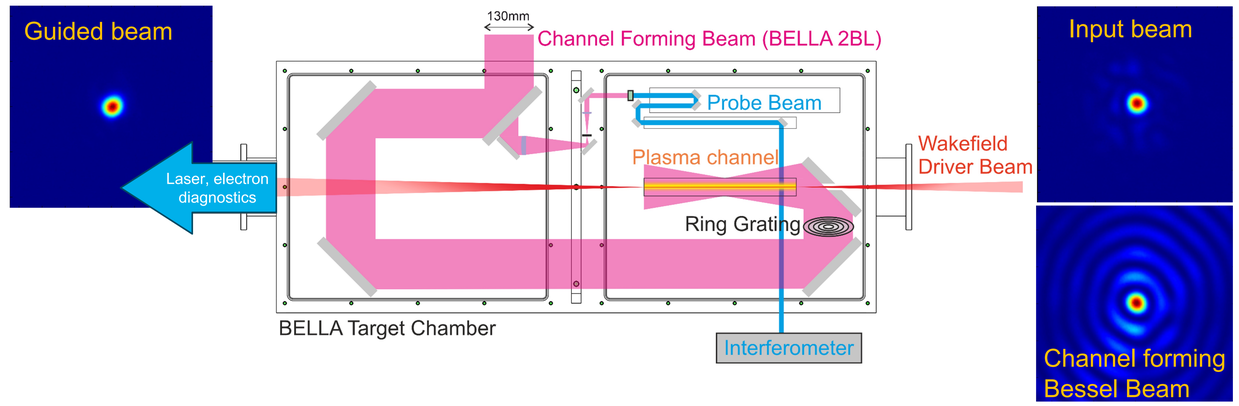
BELLA Center has been pursuing laser-plasma accelerator (LPA) research for high energy physics.

- At the flagship 1-Hz 1-PW laser facility, the development of 10-GeV class LPA modules in ongoing, and such module in series is envisioned as the path to a high energy collider at TeV energies and beyond.
- To achieve the desired luminosities required for such a collider, high repetition-rate (tens of kHz) laser sources are needed. To meet these requirements, the BELLA Center is pursuing a promising technology based on the coherent combining of fiber lasers.

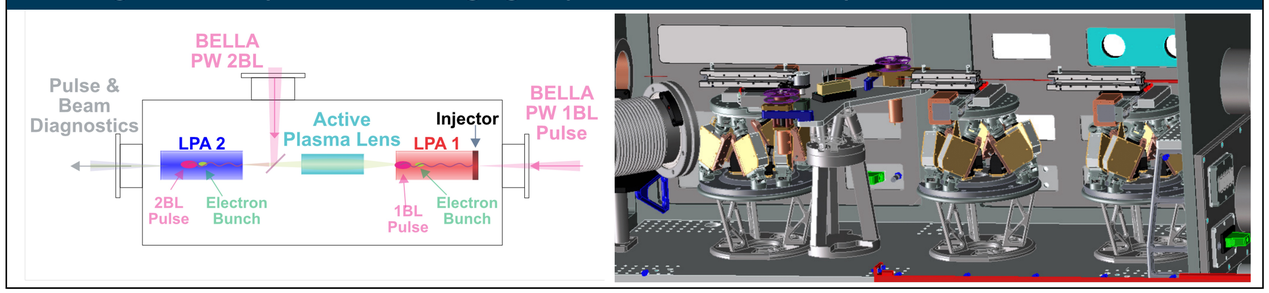
High Energy Electron LPA Development at BELLA



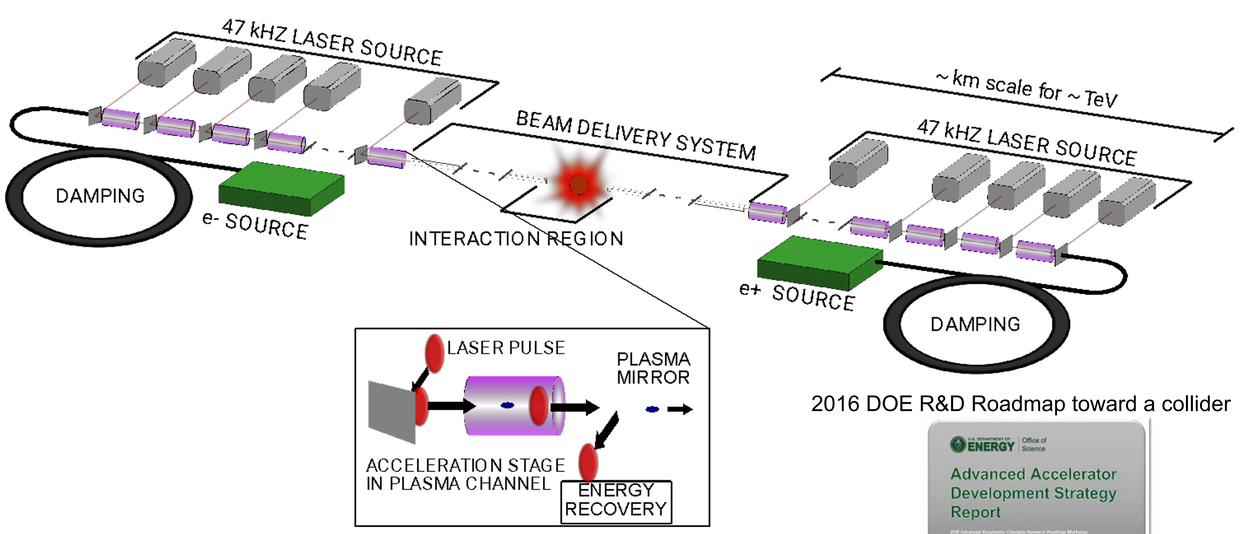
Towards 10 GeV LPA Modules: Matched Guiding Achieved



High-Efficiency Multi-GeV Staging: Experiment to use newly constructed 2nd Beamline

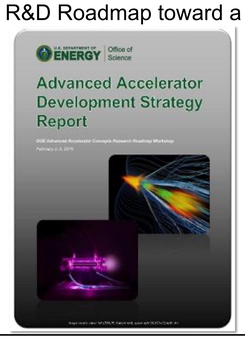


Laser-Plasma Linear Collider

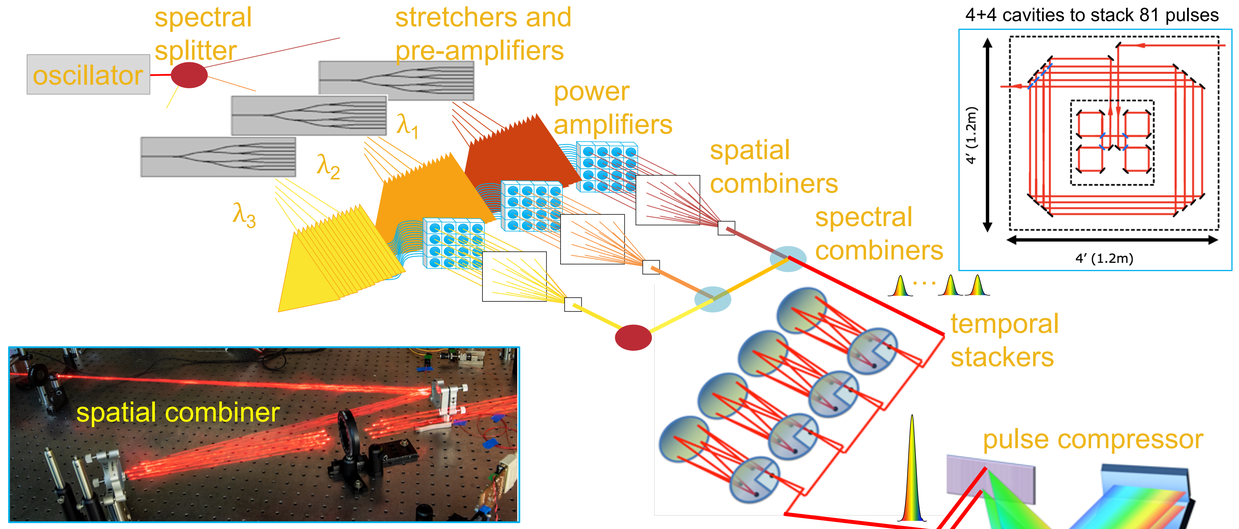


- Ultra-high accelerating gradients: path to energy reach >10 TeV
- Ultra-short bunches to reduce beamstrahlung, reducing power
- High gradients to enable energy recovery, further reduce power
- LPA staging is key technology to reach high energy
- Requires development of high-average and high-peak power laser systems

2016 DOE R&D Roadmap toward a collider



Development of High Average Power, High Wall-Plug Efficiency Laser Technology



- Combine ultrashort laser pulses from optical fibers in space, in time, and in color
- Near term: Enable kBELLA, the next generation laser-plasma accelerator facility
- Long term: Enable novel particle colliders, to discover fundamental physics
- Broader: Enable new laser applications in industry, defense, & medicine
- 200 mJ – 5 kHz with funded project

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