Laser-driven Struture Based Accelerators

Snowmass AF6 Meeting Feb 15, 2022

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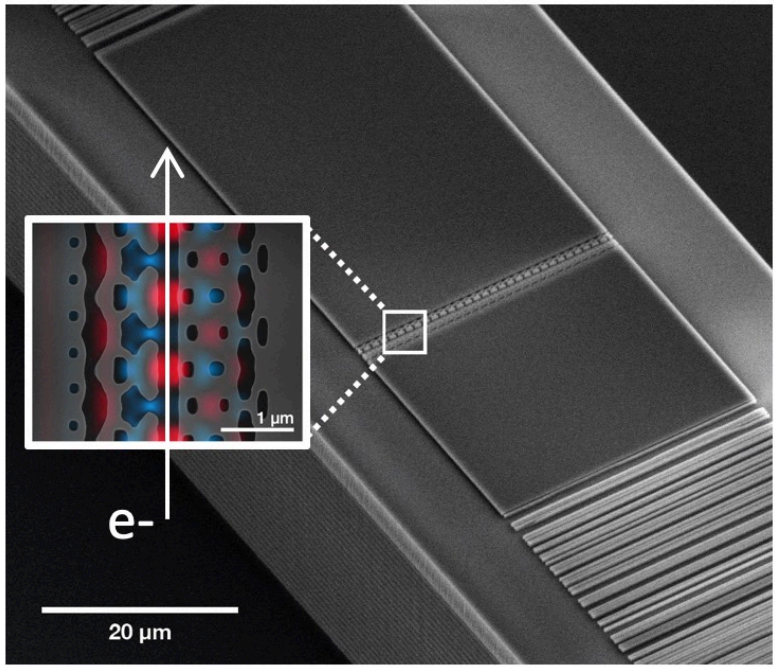

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U.S. DEPARTMENT OF ENERGY
Office of Science

SLAC NATIONAL ACCELERATOR LABORATORY

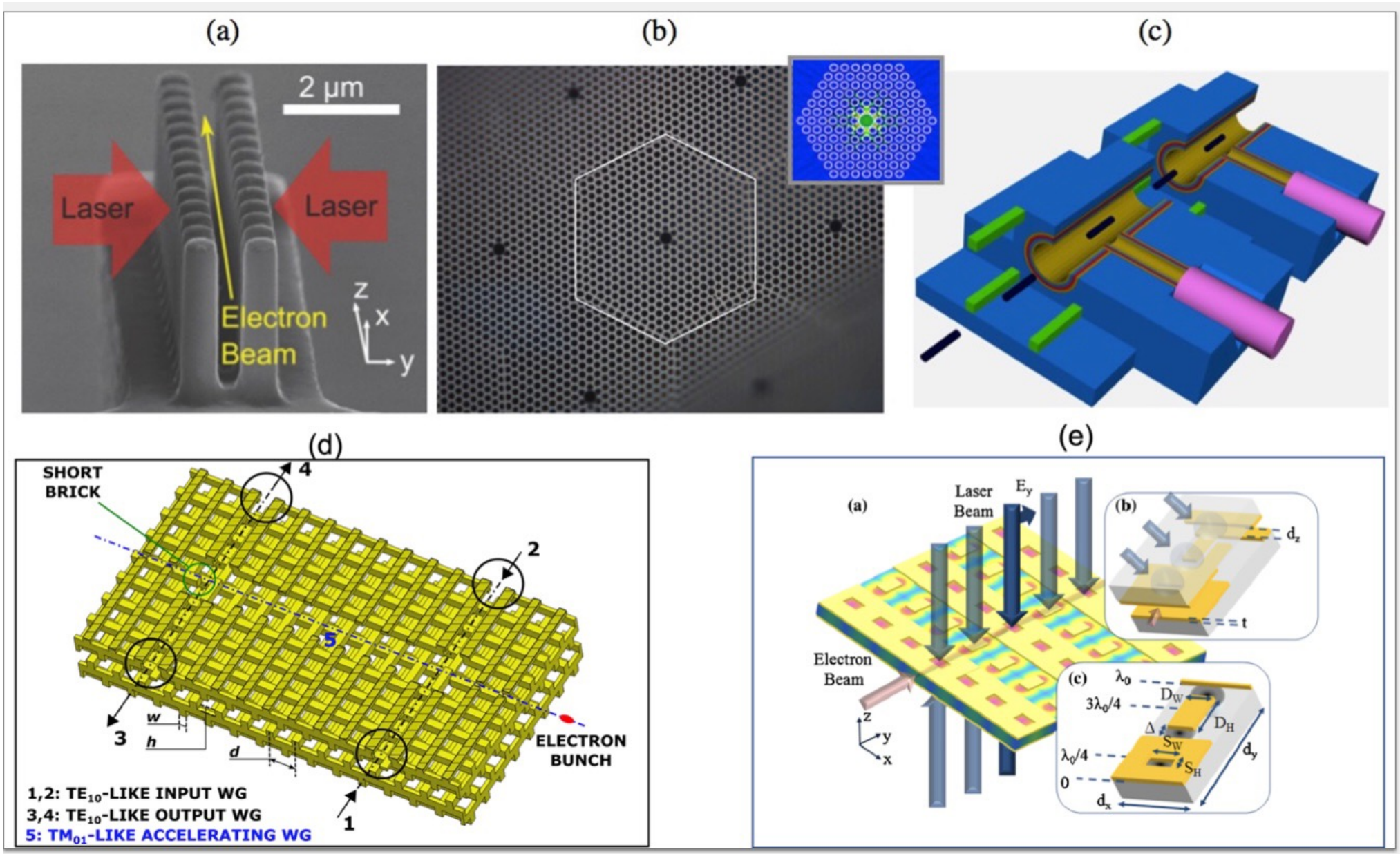
Consolidated Abstract: DLA, Photonic Xtals, Plasmonic

SLAC

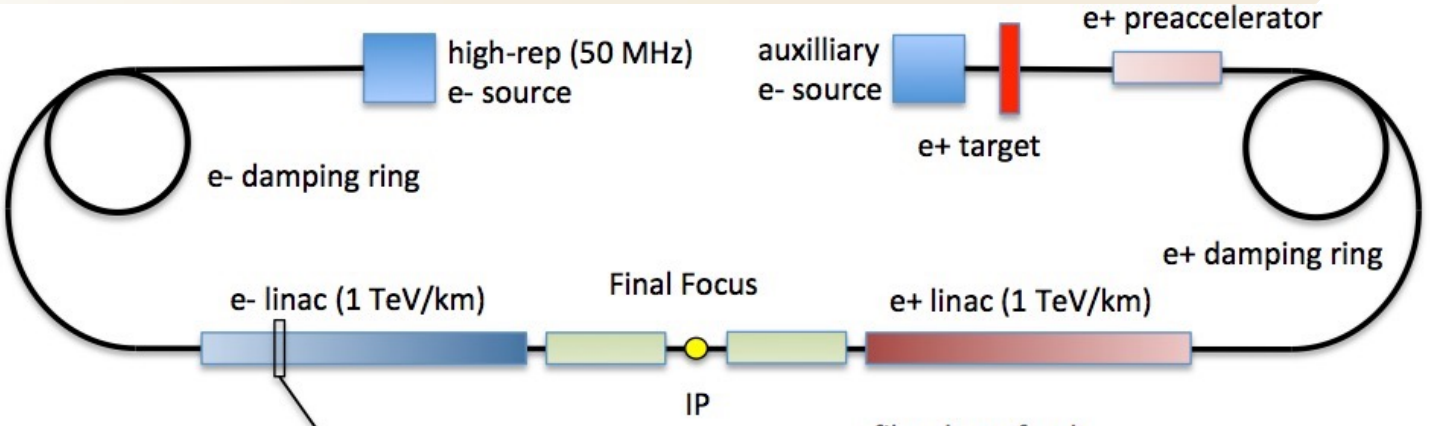
Structure-Based Laser-Driven Accelerators

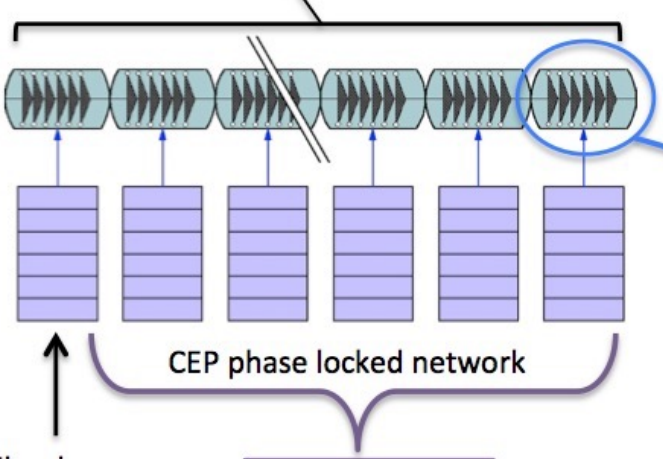
Particle acceleration in microstructures driven by ultrafast solid state lasers is a rapidly evolving area of advanced accelerator research, leading to a **variety of concepts** based on **planar-symmetric dielectric gratings, hollow core fibers, photonic crystals, and plasmonic meta-surfaces**. This approach leverages well-established industrial fabrication capabilities and the commercial availability of tabletop lasers to reduce cost, with demonstrated axial accelerating fields in the GV/m range. Wide-ranging international efforts have significantly improved understanding of gradient limits, structure design, particle focusing and transport, staging, and development of compatible low-emittance electron sources. With a near-term focus on low-current MeV-scale applications for compact scientific and medical instruments, as well as novel diagnostics capabilities, structure-based laser-driven accelerators have several key benefits that warrant consideration for future high-energy physics machines, including low beamstrahlung energy loss, modest power requirements, stability, and readiness of supporting technologies.

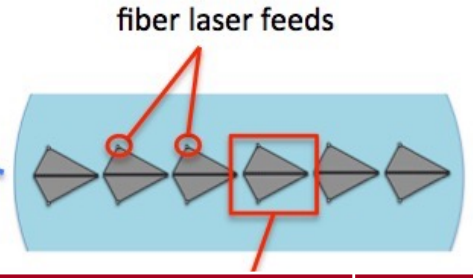
Consolidation of Combined White Paper Topics

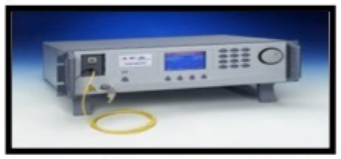


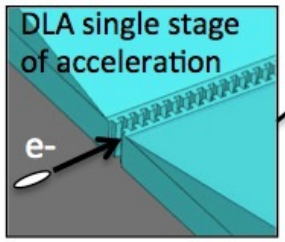
Strawman Collider Parameters








Thulium fiber laser λ=2 μm



Parameter	Units	CLIC 3 TeV	DLA 3TeV	DLA 250 GeV
Bunch Charge	e	3.7e9	3.0e5	3.8e5
Rep Rate	MHz	5e-5	20	60
Beamstrahlung E-loss	%	**28.1**	**1.0**	**0.6**
Enhanced Luminosity / top 1%	cm-2/s	2.0e34	3.2e34	1.3e34
Wallplug Power	MW	582	374	152

General Plan for White Paper Preparation

SLAC

✓ 1. We have created a document on Overleaf for communal editing following the consolidated abstract.

✓ 2. Create sections within the document as a skeleton and develop a first draft between the three primary authors (England, Filippetto, Torrisi) initially.

✓ 3. Significant material specific to DLA and HEP already exists in various formats and can be adapted to include the other laser-driven concepts.

✓ 4. Incorporate new material on the photonic crystal and plasmonic concepts.

5. Iterate and invite the authors of the original consolidated white papers to contribute and edit.

Discussion Points

1. Structured to follow Cameron's outline.
2. Guidance on contents desired for the Executive Summary?
3. Guidance on page limit? (Currently at 17 pages + references)
4. Any other input from the committee.