Community Summer Study AF7: Accelerator Technology - RF

Advanced RF Structures for Wakefield Acceleration and High-Gradient Research

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Structure Wakefield Acceleration (SWFA): Background and synergy with AF7

- Concept:
 - Beam-driven wakefield acceleration in RF structures
- Science mission:
 - Wakefield acceleration with high gradient, high efficiency, and high beam quality
- Three research themes, closely related to AF7
 - Advanced Acceleration
 - Beam Manipulation
 - Beam Production



Advanced structures R&D: three directions

- Advanced wakefield structures
- Terahertz (THz) and sub-THz structures
- RF breakdown physics

Advanced wakefield structures

- SWFA with short RF pulses requires advanced structures for high gradient and high efficiency
 - Desired features:
 - Low RF loss
 - High group velocity
 - High shunt impedance
 - Goals:
 - 1 GW power extraction
 - 500 MeV/m acceleration



THz and sub-THz structures

- Advantages of THz and sub-THz wakefield structures
 - Strong beam-structure interaction (high gradient)
 - Small transverse size (compact and cost-effective)
 - High efficiency when combined with longitudinal bunch shaping



Metallic two-half structure 2



Metallic corrugated waveguide



RF breakdown physics

- Short-pulse operation (a few ns) in SWFA has the potential to dramatically increase the accelerating gradient by mitigating breakdown risks
- New parameter space for RF breakdown physics research
- Early evidence of breakdown insensitive acceleration regime



Collider and other nearer-term applications

WFA linear collider



Compact XFEL

CWA at sub-THz frequencies



 Recent demonstration of sub-GV/m accelerating field in an X-band photoemission electron gun

Recommendation

 Support SWFA R&D on short-pulse TBA structures and high-repetition-rate CWA structures with gradients of 300 MV/m-1 GV/m with damping features