UC-XFEL

C-band photoinjector cryostat

36 GHz linearizer

3 m cryo C-band accelerating section

First and second chicanes

IFEL modulator

- Current XFELs: ~km, ~10 GeV, ~\$1B
 - Nation-state scale
 - Scaling previously infeasible
- UC-XFEL: 40 m, 1 GeV, \$40M
 - University scale
 - Still offers the unique benefits of flagship XFELs

Final chicane

5 m cryo C-band accelerating section

Final chicane

- Careful combination of state-of-the-art techniques and technologies
 - Ultra-bright beams
 - Short period undulators
 - Advanced beam transport and manipulation
- Quasi-CDR published in NJP (2020)

Experiment hutch

Electron spectrometer and beam dump

5m, short period

cryo-undulator

5 m focal length

K-B focusing mirrors

Experiment hutch

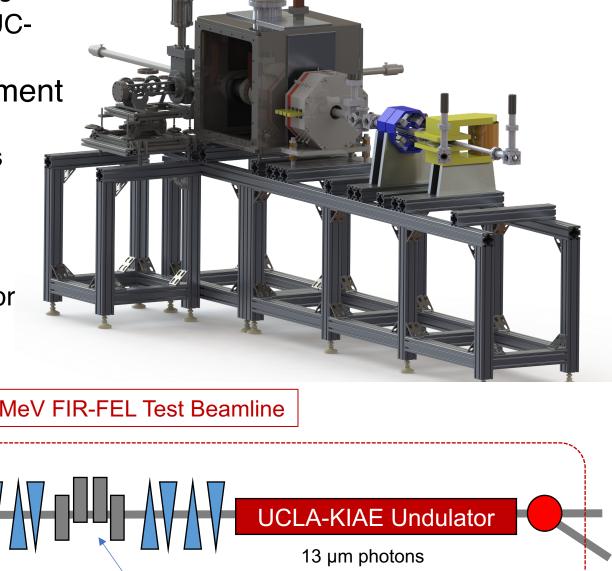
UCLA hosted a conference in July 2021

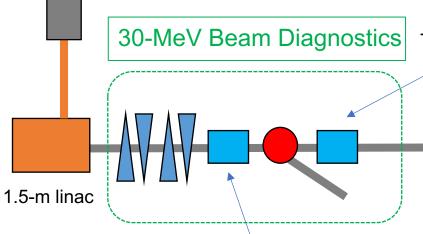
• ~40 speakers, representing interested parties from the photoinjector all the way through photon end-users

· Led to the formation of a consortium to advance UC-XFEL development

 Formalized stepping stone FELs for development at UCLA

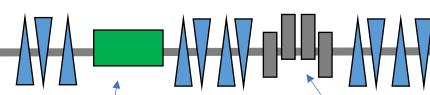
- Considered different funding cases and objectives
- FIR FEL project currently underway
- Continued progress with cryogenic half-cell beamline
 - Developing technologies and expertise required for UC-XFEL





Transverse diagnostics

18-MeV FIR-FEL Test Beamline

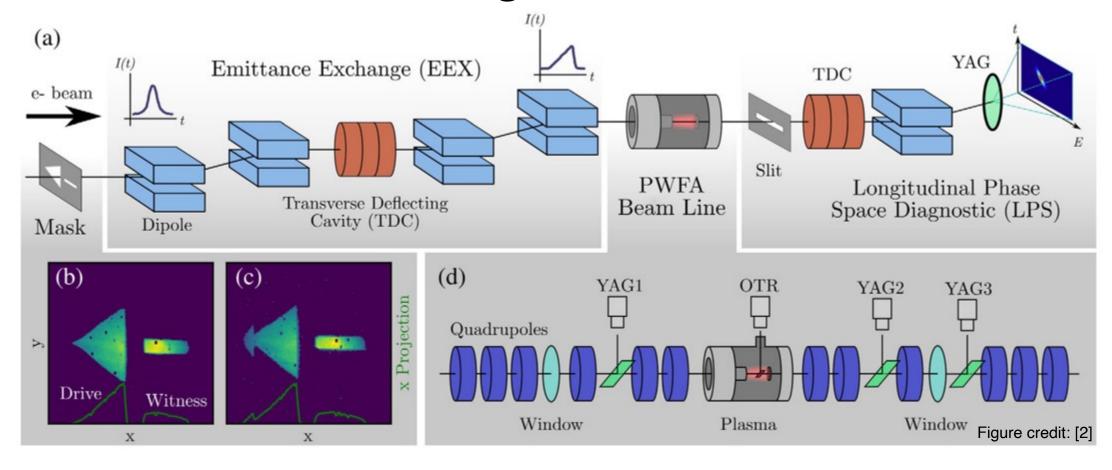


Longitudinal diagnostics

Small chicane Passive de-chirper (Seed injection, possible future upgrade)

[Bottom figure: A. Fukasawa]

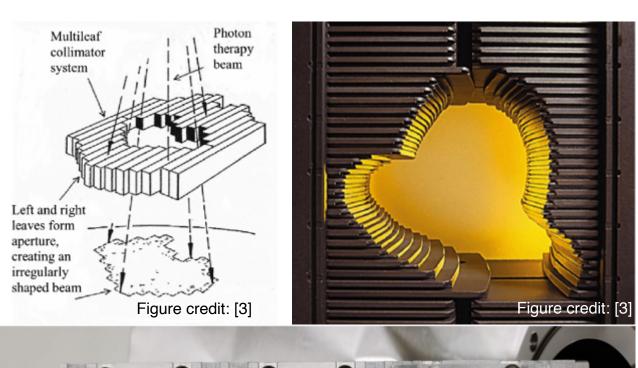
Emittance exchange for advanced PWFA

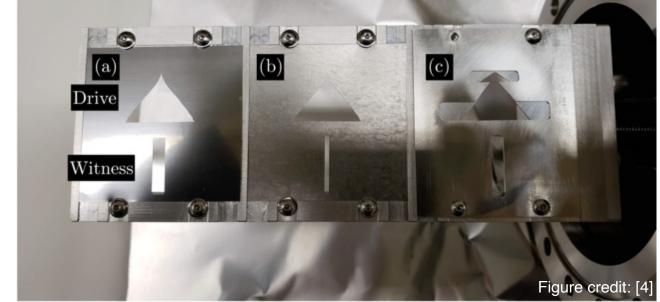


- By transversely masking the beam before the EEX beamline, the final current profile is controlled
- Shaping drive and witness bunches with this approach has yielded recordbreaking transformer ratios [2]

Multileaf collimator masking

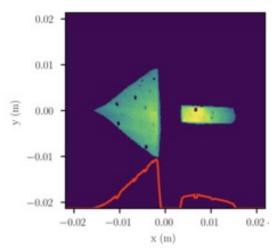
- Propose replacing the laser cut tungsten masks in EEX beamline with a multileaf collimator (MLC)
- MLCs are commonly employed to shape radiotherapy beams
- Real-time, nearly arbitrary drive and witness beam shaping
- Highly synergistic with machine learning
- Extension of UCLA/AWA collaboration to study exotic shaped beams for HTR PWFA

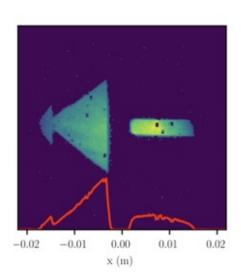




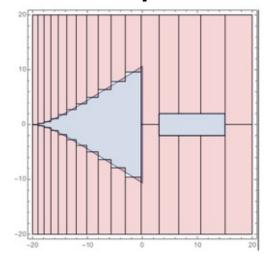
32 leaf, log-spaced MLC

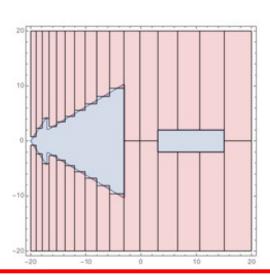
<u>Laser cut mask [1]</u>



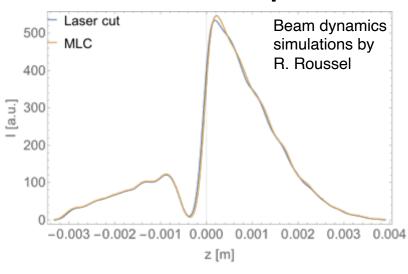


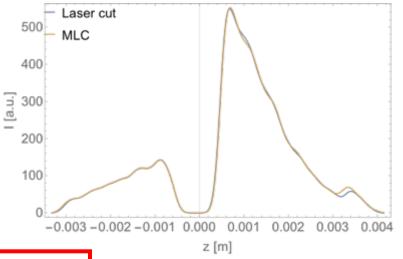
MLC replication





Final current profile





32 leaf MLC functionally equivalent to existing AWA masks

