

A CO₂ Laser-driven LINAC

Status Report

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Outline

- 1. Choosing the Structure Material**
- 2. Design of the Laser-driven LINAC**
- 3. Mode-Excitation**
- 4. Phase Diagnostics**
- 5. Experiment Schedule for This Year**

1. Choosing the Structure Material

CO₂ laser damage threshold experiments conducted at ATF (Jan. 2001)

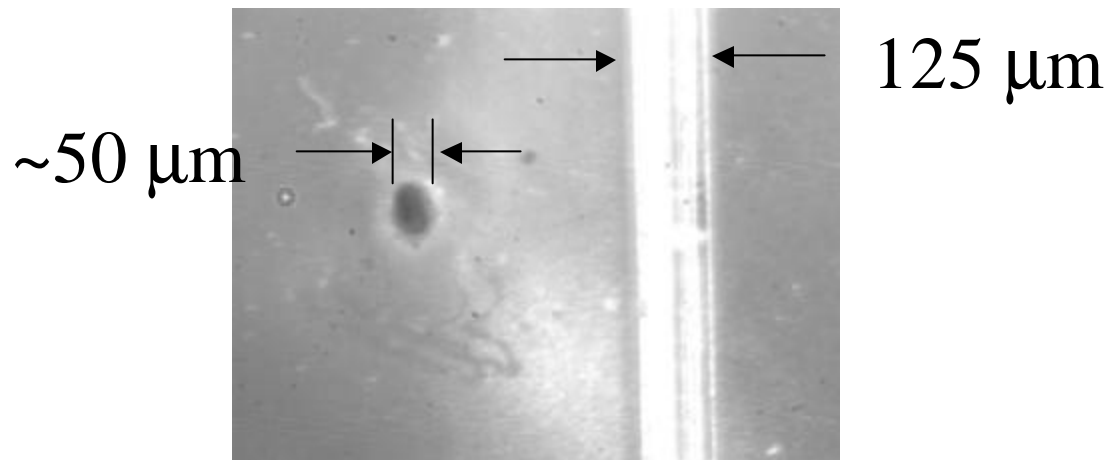
Material	200-psec pulse length			100-nsec pulse length		
	Fluence (J/cm ²)	Intensity (GW/cm ²)	Electric Field (MV/cm)	Fluence (J/cm ²)	Intensity (MW/cm ²)	Electric Field (MV/cm)
Ge	0.19	0.95	0.85	1.7	17	0.11
ZnSe	0.45	2.3	1.32	2.8	28	0.15
CVD Diamond	1.20	6.0	2.13	8.0	80	0.25

Difficulties with CVD Diamond

1. Hard to get $f < 5$ cm diamond lens
→ considering a larger structure
2. Hard to machine a ~ 50 μm hole through Diamond
→ getting a 266-nm pulsed laser at 100 kW, 10 kHz.

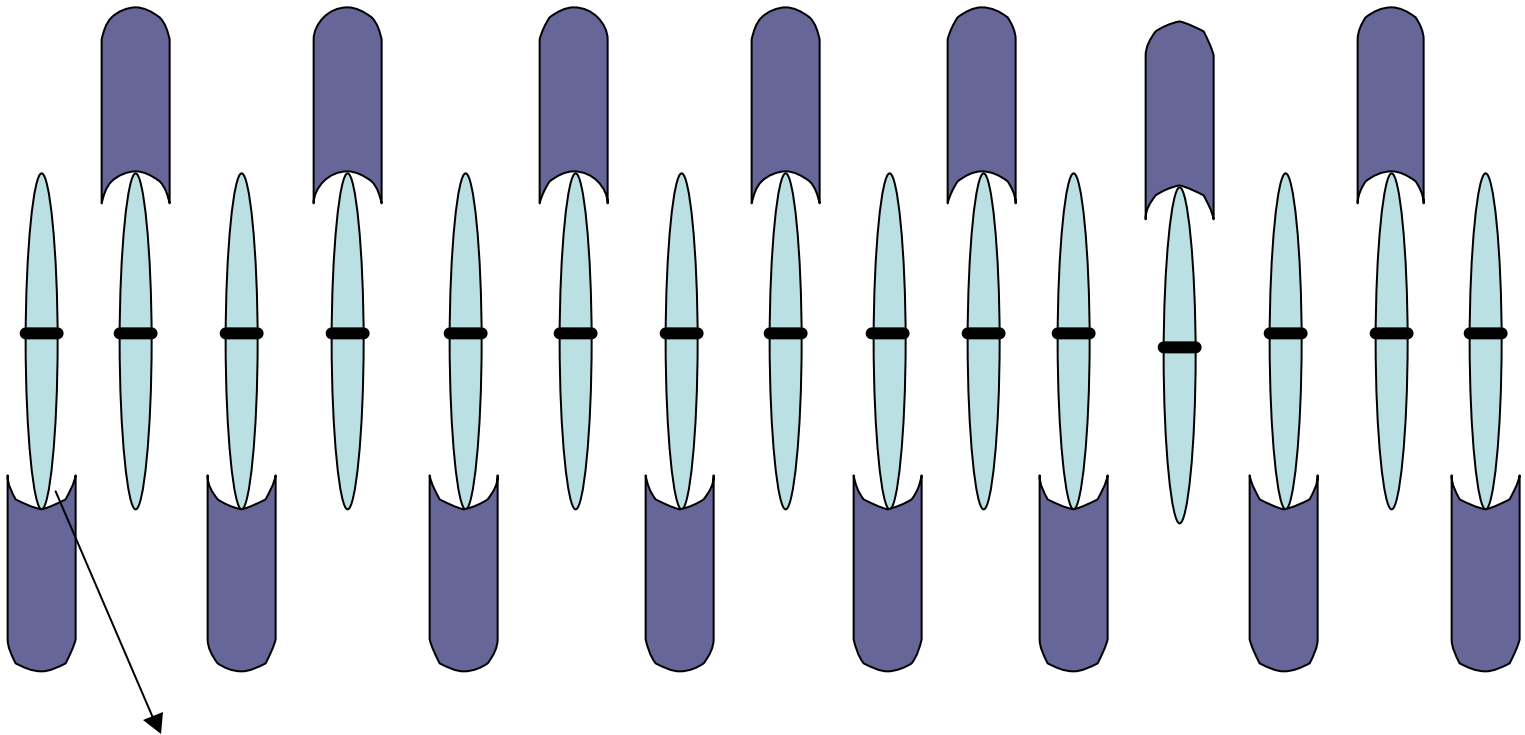
Temporary Solution: Will use ZnSe for the first experiment

acceleration gain $\sim 60\%$ of diamond



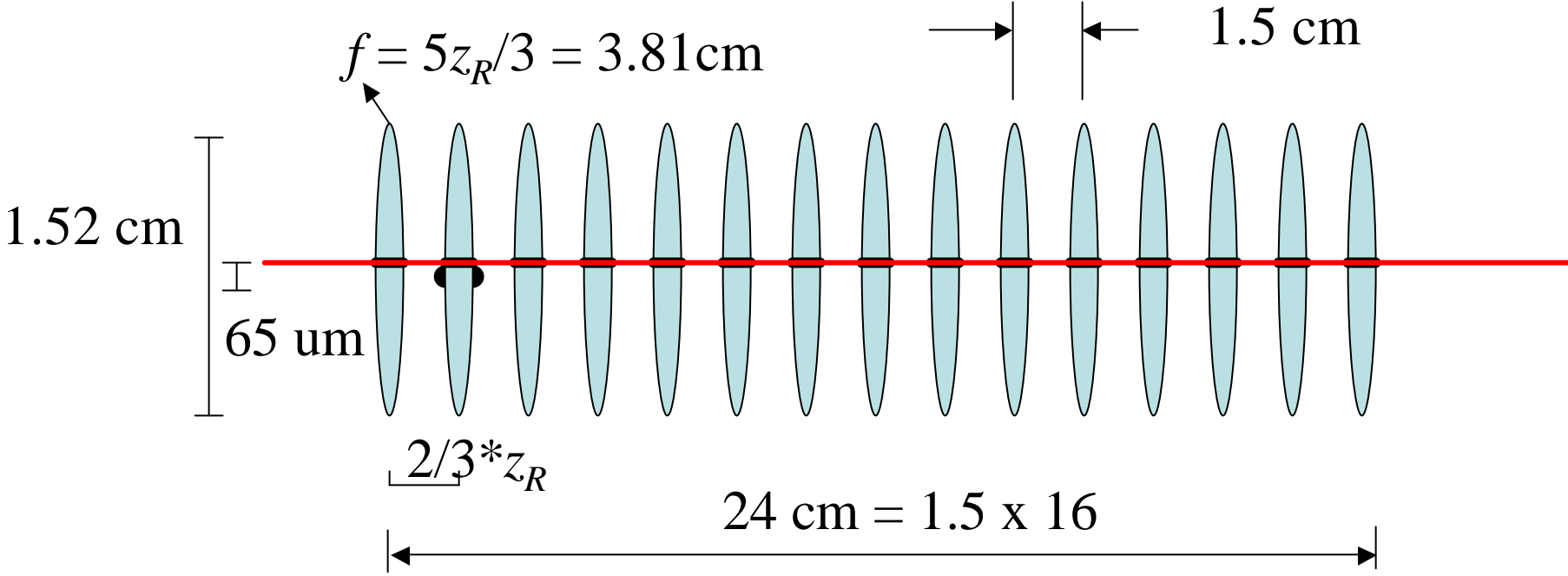
2. Design of the Laser-driven LINAC

A Staggered lens-array Structure with TEM_{01} or TEM_{11} Acceleration Mode

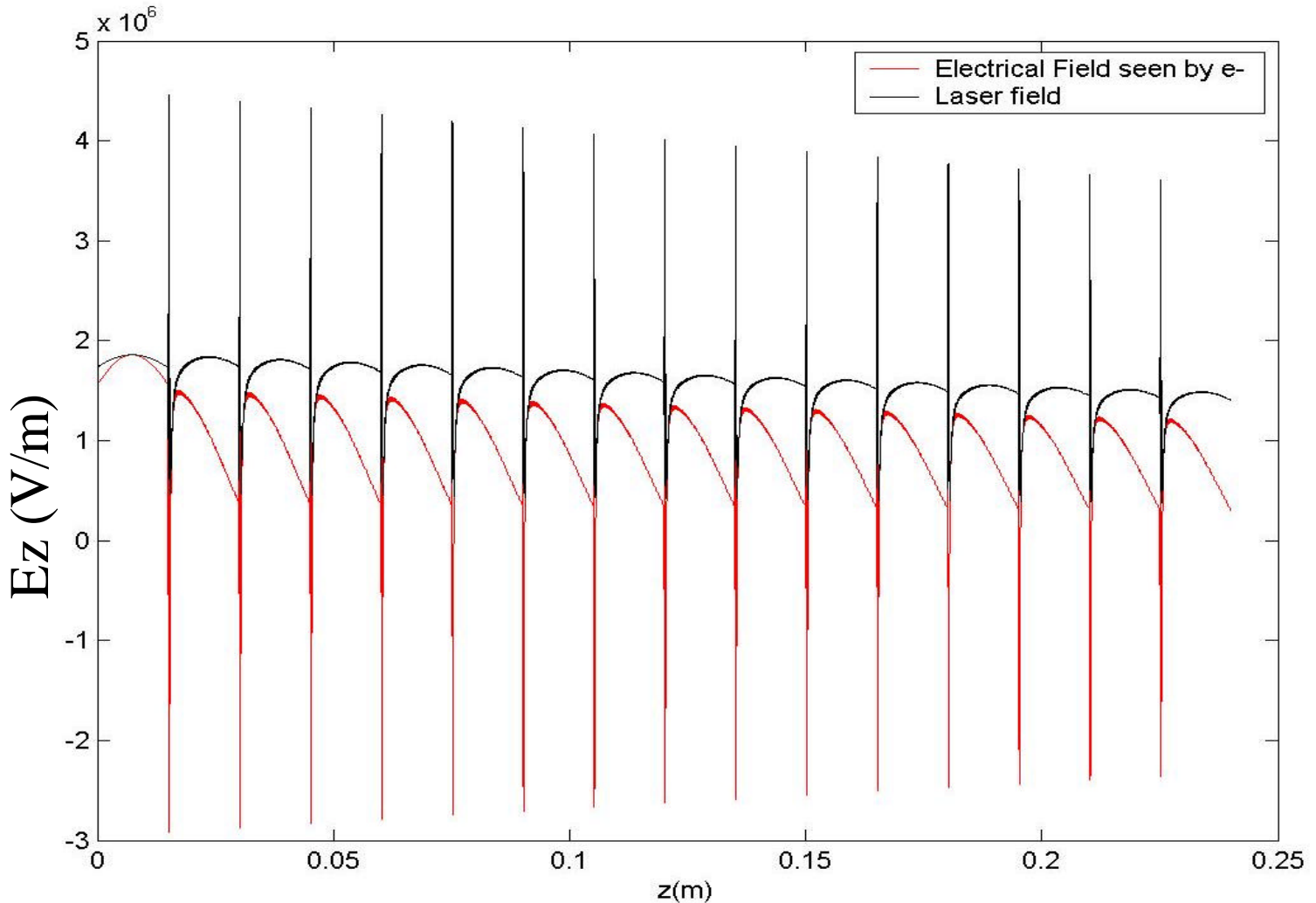


Each lens' temperature is varied independently by a TE cooler/heater

Dimensions of the Accelerating Stages



E_z Along the Axis with 65-mm Holes

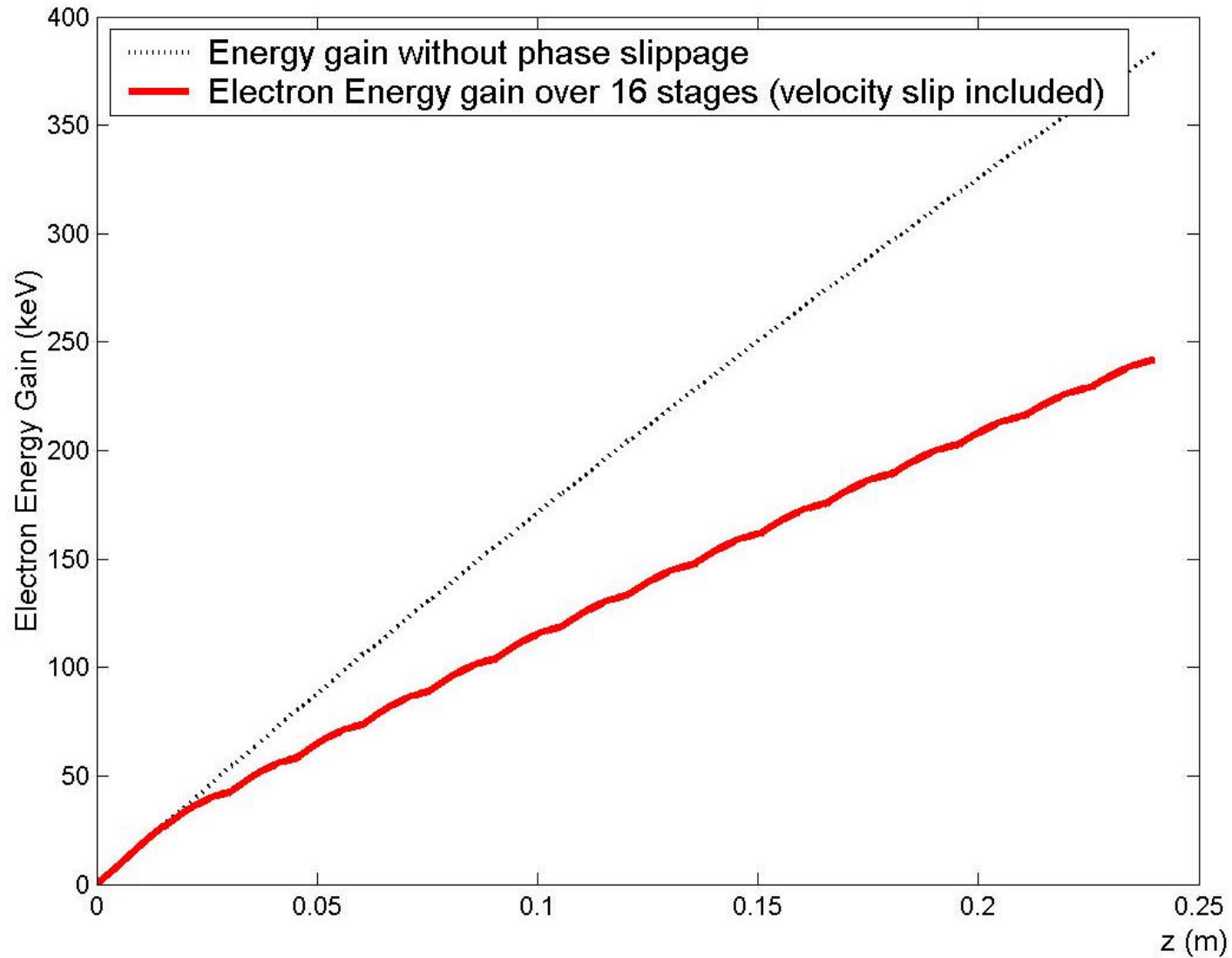


Blue: laser field without slippage

Red: field seen by the electron (with velocity slip)

Total Energy Gain

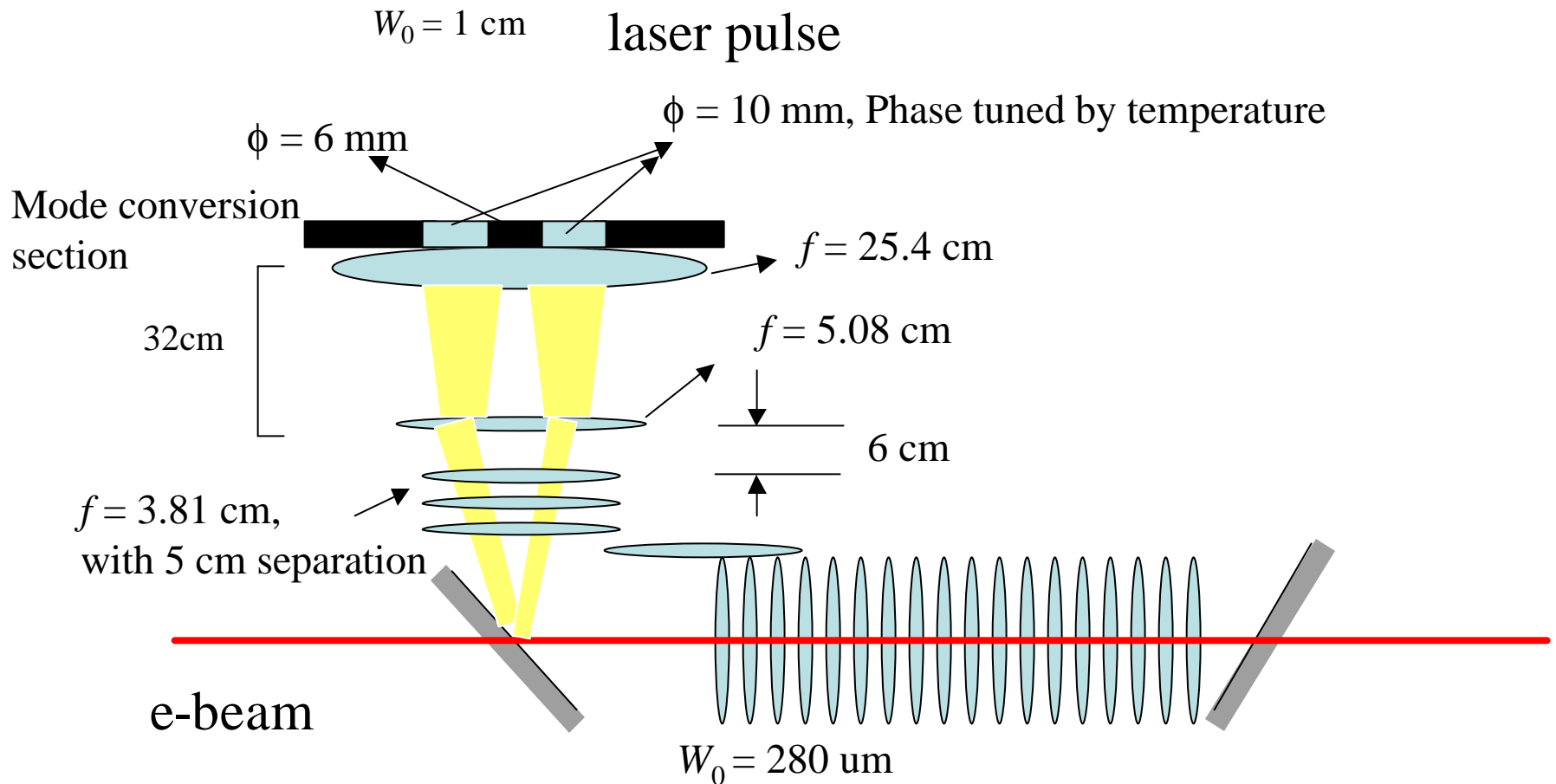
24-cm ZnSe Lens Array, $TEM_{01} \Rightarrow 250$ keV



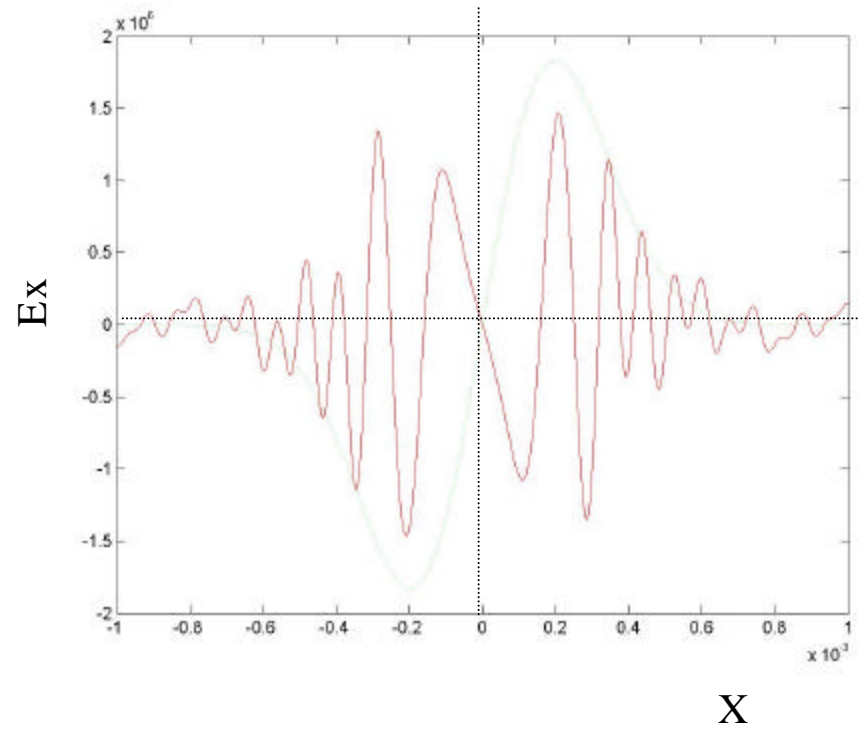
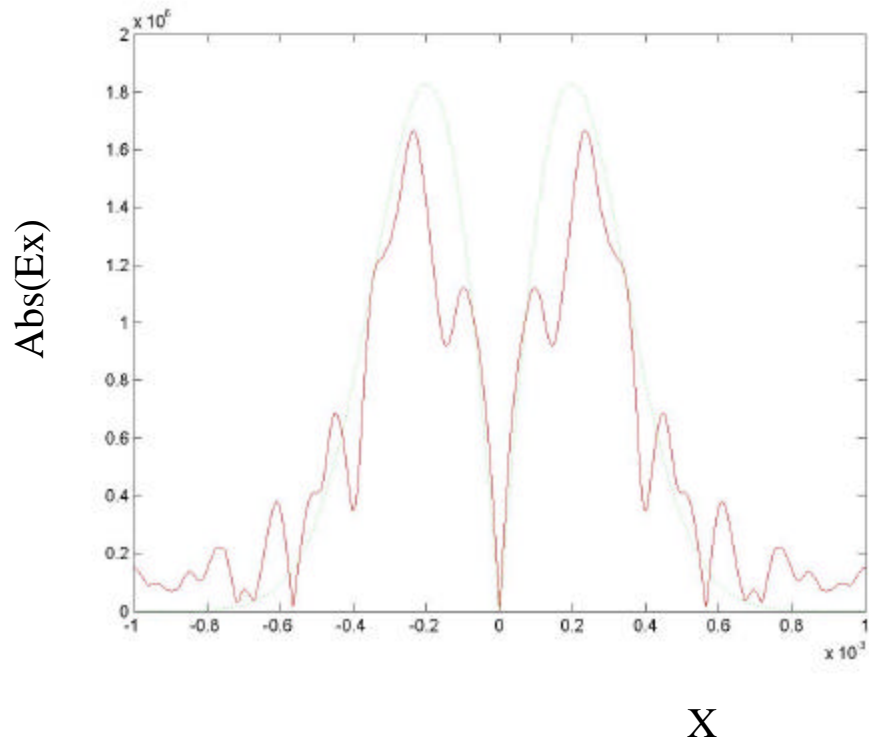
Phase I: ZnSe Laser LINAC Design Parameter

Beam waist	280 μm
Damage threshold Intensity	2.25 GW/cm^2
Laser wavelength	10.6 μm
Optical field Mode	TEM_{01}
Phase tuning (by varying lens temperature)	180 $^\circ$ / 93 Deg. C for ZnSe
Total Gain	250 keV over 24-cm linac

3. TEM₀₁ or TEM₁₁ Mode-excitation

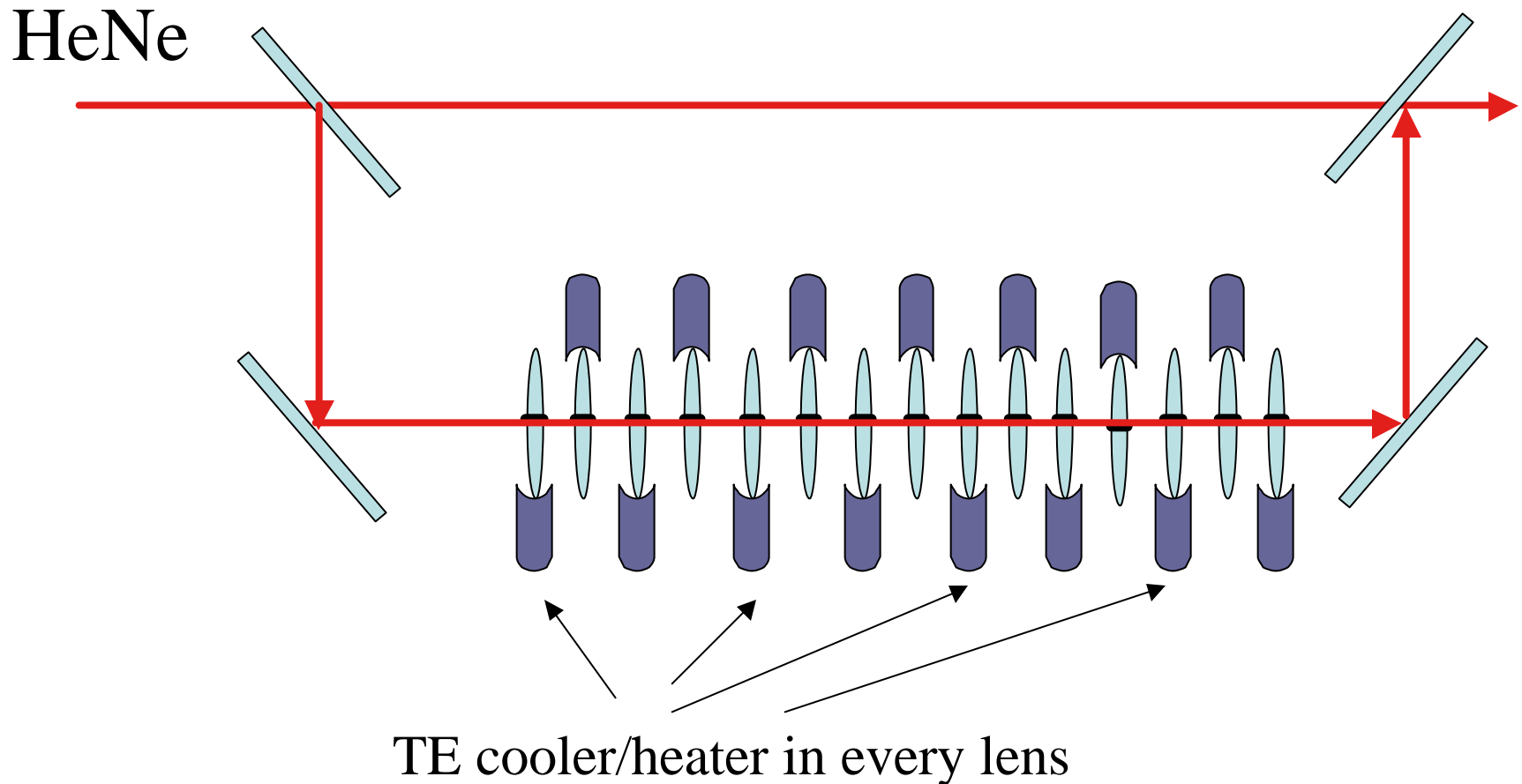


Beam Profile at the End of the Mode Converter



4. Phase Diagnostics

For ZnSe at $\lambda = 10.6 \mu\text{m}$, the adjustment is 2-/Deg. C.



5. Experiment Schedule for this year

Jan. ~ Feb.: ATF visit

vacuum test, optical test, finalizing design,
operator training.....

Feb. ~ Apr.: NTHU, Taiwan

laser machining, mode conversion, phase
control experiment.....

May: ATF visit for the first experiment

August: further experiment for improvement