A CO_2 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

CO_2 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

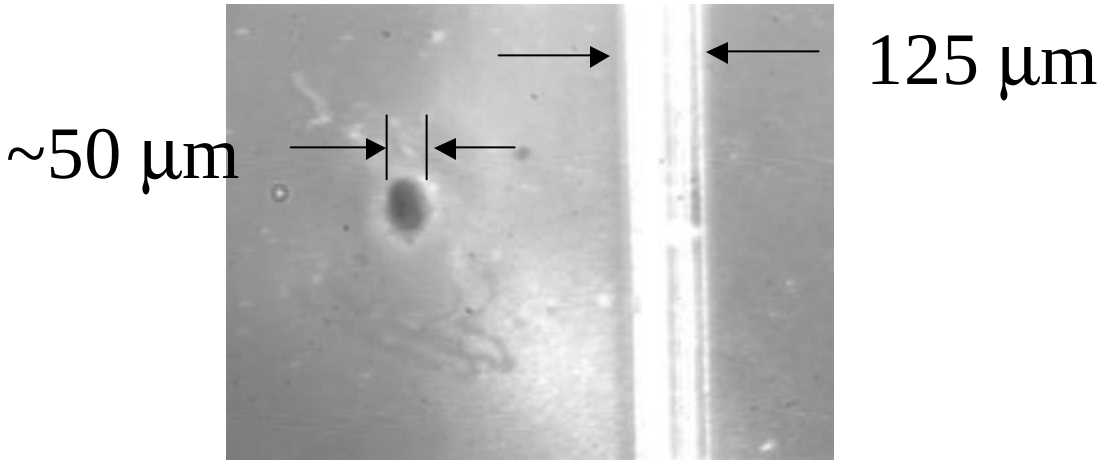
A.C. Chiang et al. Opt. Let. Feb. 1, 2001.

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.

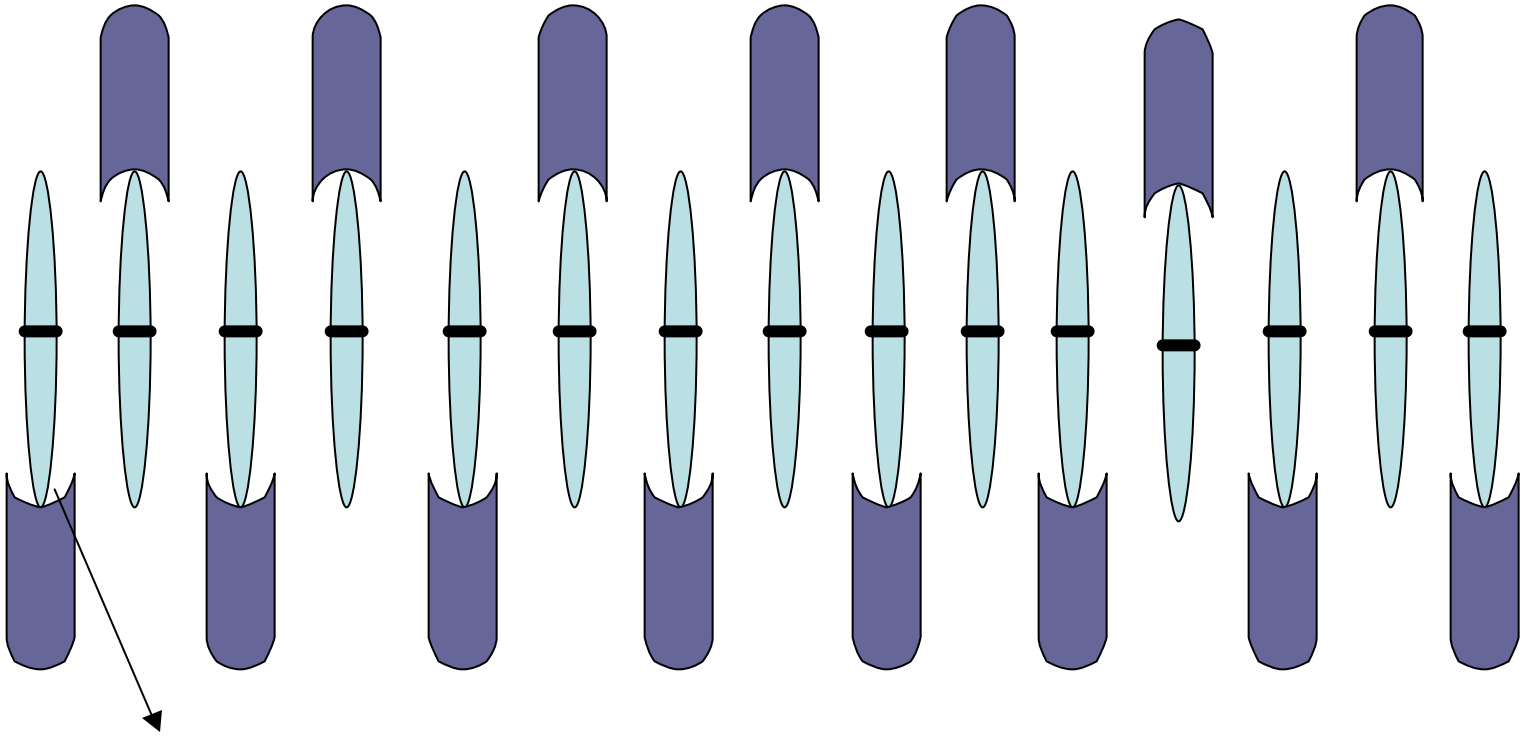
Temporary Solution: Will use ZnSe for the first experiment

acceleration gain ~ 60% of diamond



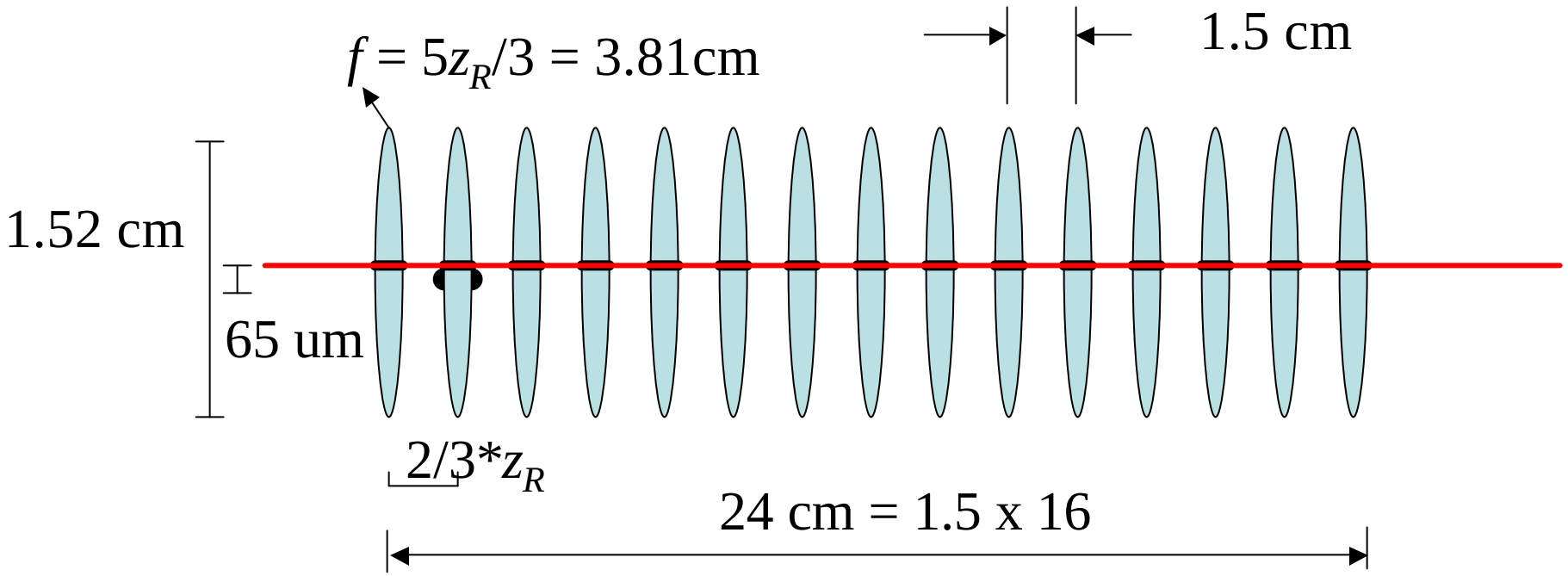
2. Design of the Laser-driven LINAC

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

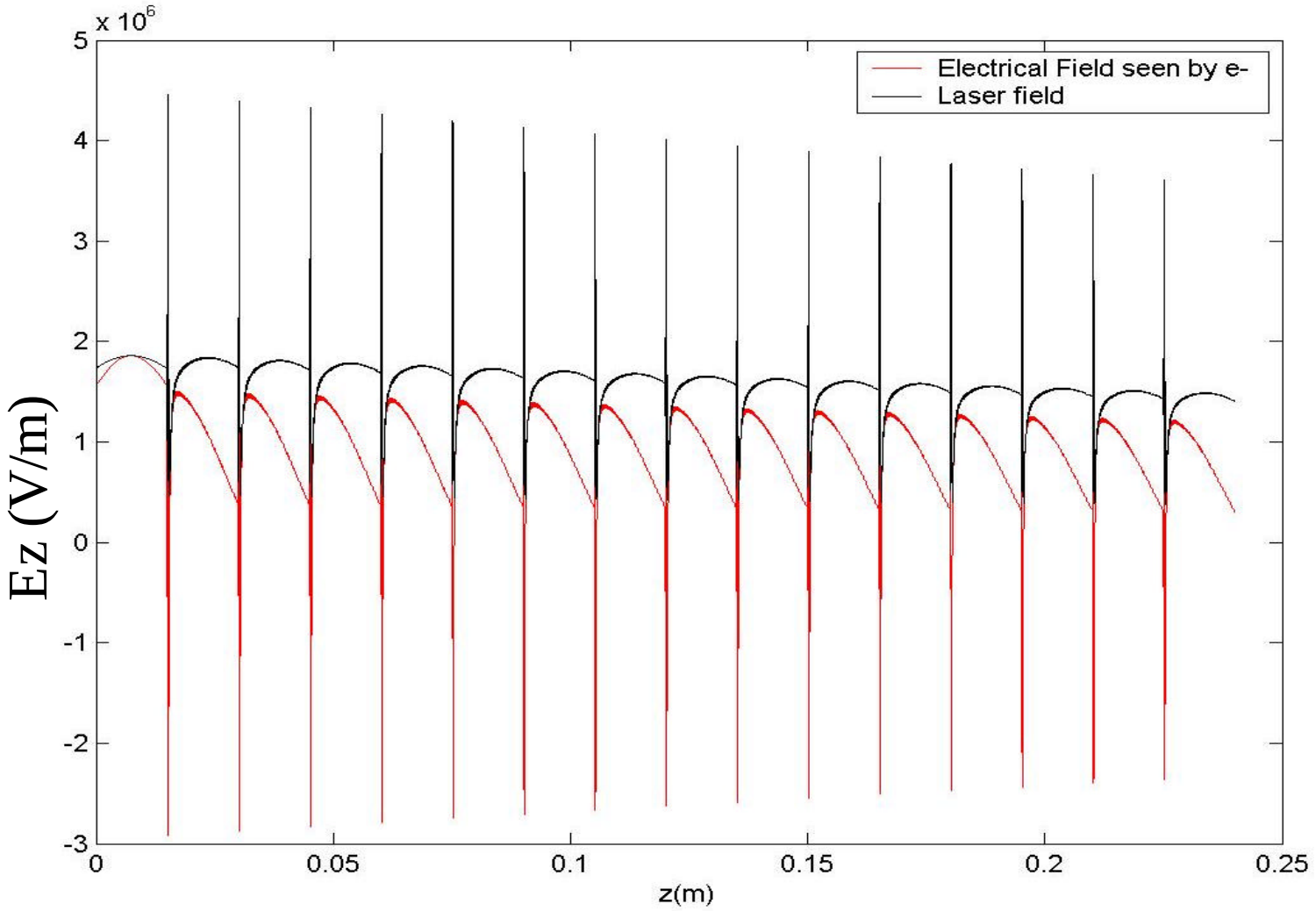


Each lens' temperature is varied independently by a TE cooler/heater

Dimensions of the Accelerating Stages



E_z Along the Axis with 65-mm Holes

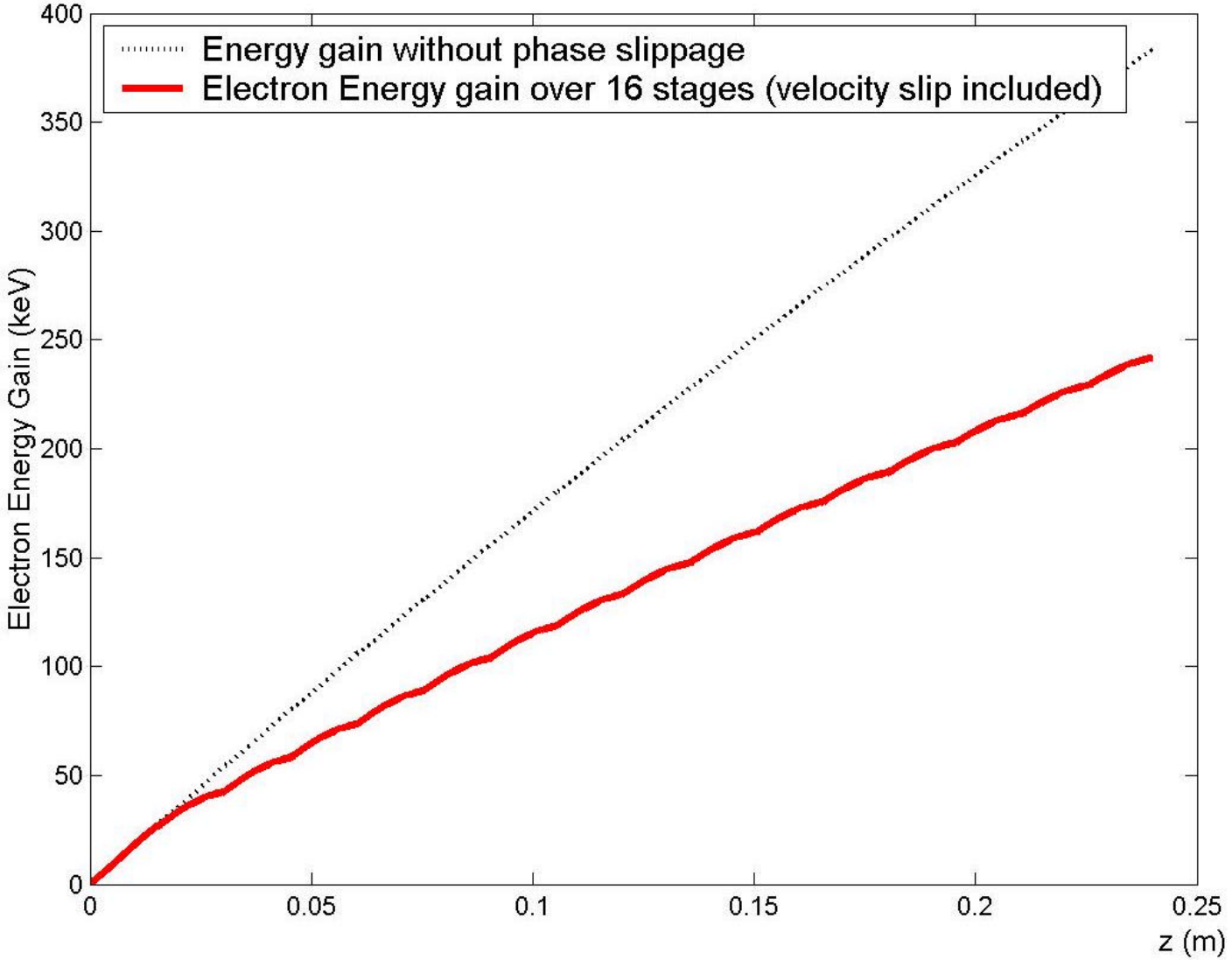


Blue: laser field without slippage

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

Total Energy Gain

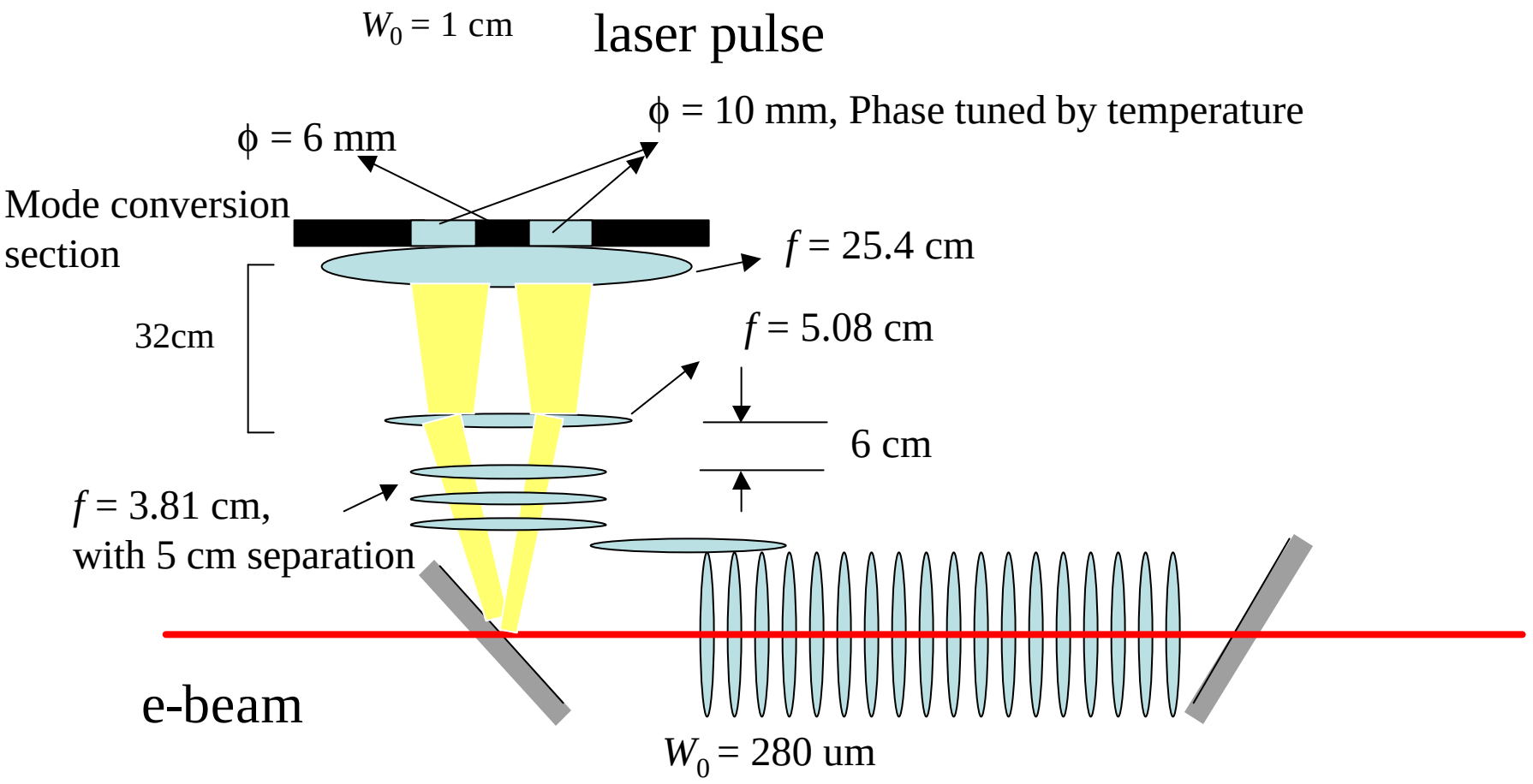
24-cm ZnSe Lens Array, $TEM_{01} \Rightarrow$ 250 keV



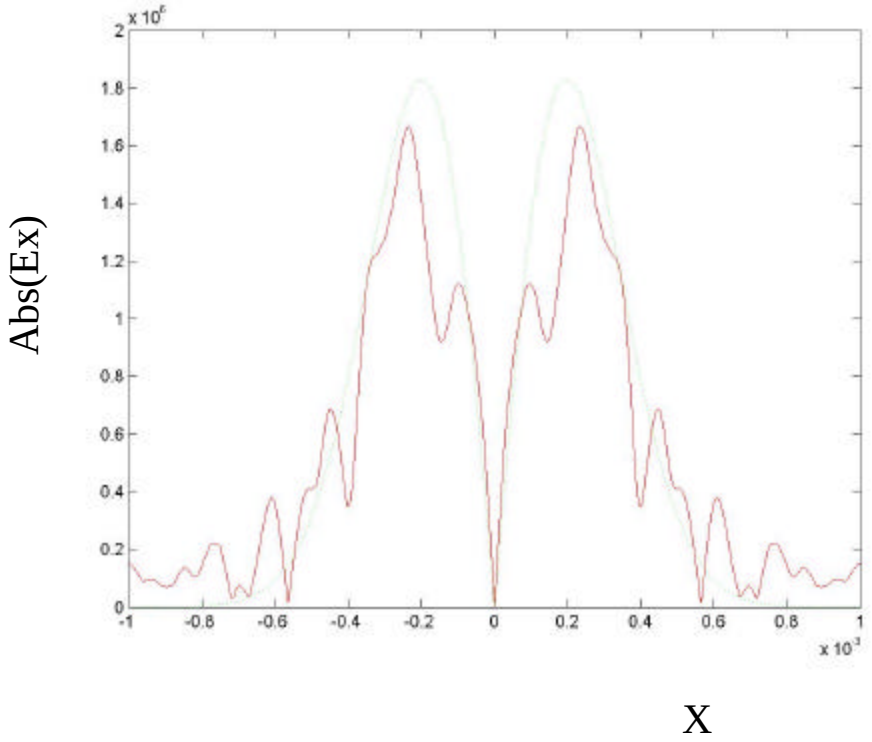
Phase I: ZnSe Laser LINAC Design Parameter

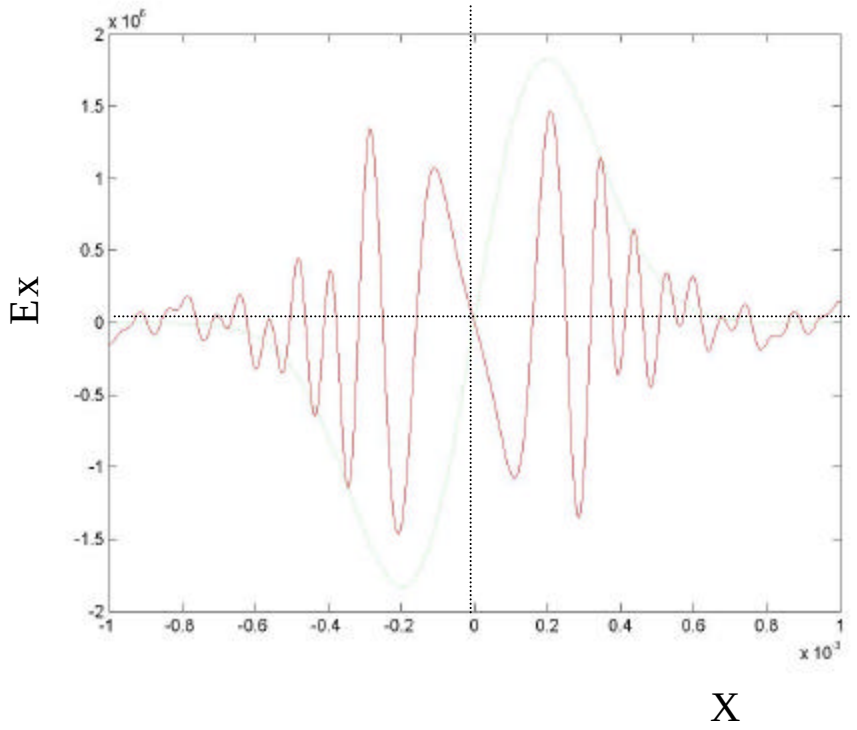
Beam waist	280 μm
Damage threshold Intensity	2.25 GW/cm^2
Laser wavelength	10.6 um
Optical field Mode	TEM_{01}
Phase tuning (by varying lens temperature)	180 ° / 93 Deg. C for ZnSe
Total Gain	250 keV over 24-cm linac

3. TEM_{01} or TEM_{11} Mode-excitation



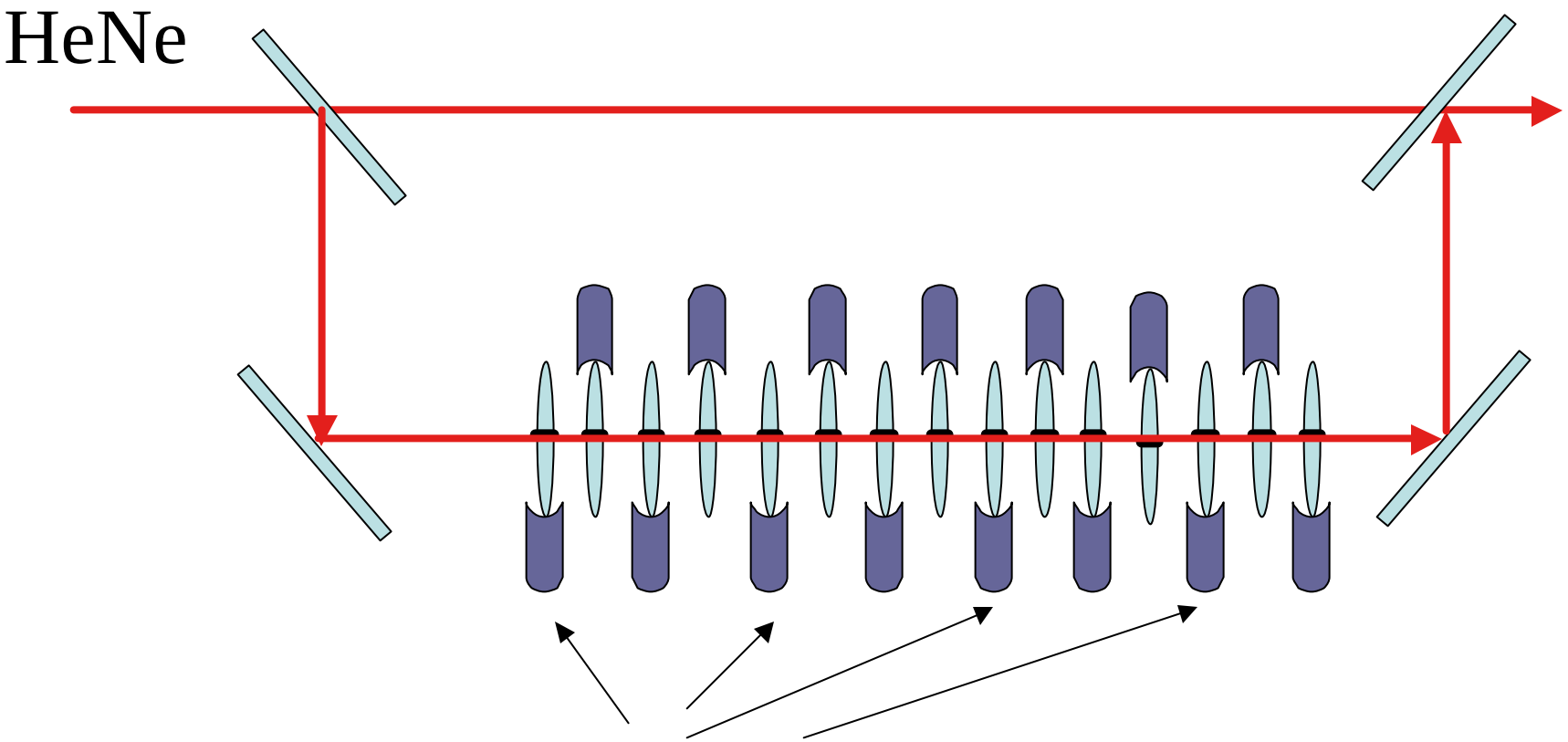
Beam Profile at the End of the Mode Converter





4. Phase Diagnostics

For ZnSe at $\lambda = 10.6\ \mu m$, 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