

Progress on AE85

A Multiatmosphere CO₂ Amplifier Optically Pumped by a 4.3 μm Fe:ZnSe Laser

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Electron Beam Requirements

Parameter	Units	Typical Values	Comments	Requested Values
Beam Energy	MeV	50-65	<i>Full range is ~15-75 MeV with highest beam quality at nominal values</i>	NA
Bunch Charge	nC	0.1-2.0	<i>Bunch length & emittance vary with charge</i>	
Compression	fs	Down to 100 fs (up to 1 kA peak current)	<i>A magnetic bunch compressor available to compress bunch down to ~100 fs. Beam quality is variable depending on charge and amount of compression required.</i> <i>NOTE: Further compression options are being developed to provide bunch lengths down to the ~10 fs level</i>	
Transverse size at IP (s)	mm	30 – 100 (dependent on IP position)	<i>It is possible to achieve transverse sizes below 10 um with special permanent magnet optics.</i>	
Normalized Emittance	mm	1 (at 0.3 nC)	<i>Variable with bunch charge</i>	
Rep. Rate (Hz)	Hz	1.5	<i>3 Hz also available if needed</i>	
Trains mode	---	Single bunch	<i>Multi-bunch mode available. Trains of 24 or 48 ns spaced bunches.</i>	

CO₂ Laser Requirements

Configuration	Parameter	Units	Typical Values	Comments	Requested Values
CO₂ Regenerative Amplifier Beam	Wavelength	mm	9.2	<i>Wavelength determined by mixed isotope gain media</i>	<i>NA</i>
	Peak Power	GW	~3		
	Pulse Mode	---	Single		
	Pulse Length	ps	2		
	Pulse Energy	mJ	6		
	M ²	---	~1.5		
	Repetition Rate	Hz	1.5	<i>3 Hz also available if needed</i>	
	Polarization	---	Linear	<i>Circular polarization available at slightly reduced power</i>	
CO₂ CPA Beam	Wavelength	mm	9.2	<i>Wavelength determined by mixed isotope gain media</i>	<i>NA</i>
<i>Note that delivery of full power pulses to the Experimental Hall is presently limited to Beamline #1 only.</i>	Peak Power	TW	2	<i>~5 TW operation is planned for FY21 (requires further in-vacuum transport upgrade). A 3-year development effort to achieve >10 TW and deliver to users is in progress.</i>	
	Pulse Mode	---	Single		
	Pulse Length	ps	2		
	Pulse Energy	J	~5	<i>Maximum pulse energies of >10 J will become available in FY20</i>	
	M ²	---	~2		
	Repetition Rate	Hz	0.05		
	Polarization		Linear	<i>Adjustable linear polarization along with circular polarization will become available in FY20</i>	

Other Experimental Laser Requirements

Ti:Sapphire Laser System	Units	Stage I Values	Stage II Values	Comments	Requested Values
Central Wavelength	nm	800	800	<i>Stage I parameters should be achieved by mid-2020, while Stage II parameters are planned for late-2020.</i>	NA
FWHM Bandwidth	nm	20	13		
Compressed FWHM Pulse Width	fs	<50	<75	<i>Transport of compressed pulses will initially include a very limited number of experimental interaction points. Please consult with the ATF Team if you need this capability.</i>	
Chirped FWHM Pulse Width	ps	☐50	☐50		
Chirped Energy	mJ	10	200		
Compressed Energy	mJ	7	100		
Energy to Experiments	mJ	>4.9	>80		
Power to Experiments	GW	>98	>1067		

Nd:YAG Laser System	Units	Typical Values	Comments	Requested Values
Wavelength	nm	1064	<i>Single pulse</i>	NA
Energy	mJ	5		
Pulse Width	ps	14		
Wavelength	nm	532	<i>Frequency doubled</i>	
Energy	mJ	0.5		
Pulse Width	ps	10		

Special Equipment Requirements and Hazards

- Electron Beam
 - Please indicate any special equipment that you expect to need, including (but not limited to) the transverse deflecting cavity, shaped bunch using mask technique, plasma capillary discharge system, bolometer/interferometer setup etc.:
- CO₂ Laser
 - Please note any specialty laser configurations required here:
- Ti:Sapphire and Nd:YAG Lasers
 - Please note any specialty non-CO₂ laser configurations required here:
- Hazards & Special Installation Requirements
 - Large installation (chamber, insertion device, etc.):
 - Cryogenics: **Liquid nitrogen for Fe:ZnSe**
 - Introducing new magnetic elements:
 - Introducing new materials into the beam path:
 - Any other foreseeable beam line modifications:

Experimental Time Request

CY2020 Time Request

Capability	Setup Hours	Running Hours
Electron Beam Only		
Laser* Only (in FEL Room)		
Laser* + Electron Beam		

Time Estimate for Remaining Years of Experiment (including CY2020)

Capability	Setup Hours	Running Hours
Electron Beam Only		
Laser* Only (in FEL Room)		
Laser* + Electron Beam		

* Laser = Near-IR or LWIR (CO₂) Laser