17TH ADVANCED BEAM DYNAMICS WORKSHOP ON

FUTURE LIGHT SOURCES

The TJNAF FEL

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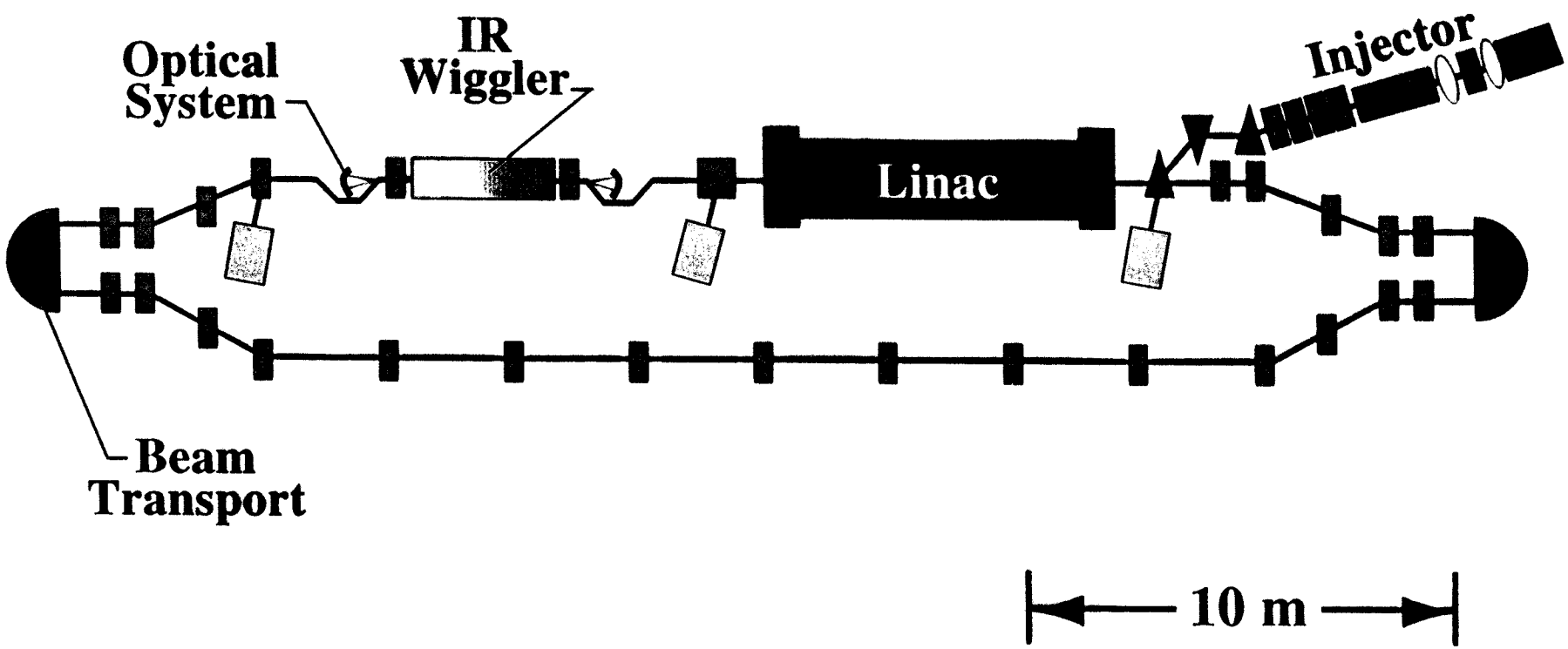
ARGONNE NATIONAL LABORATORY, ARGONNE, IL U.S.A.

IR DEMO LAYOUT



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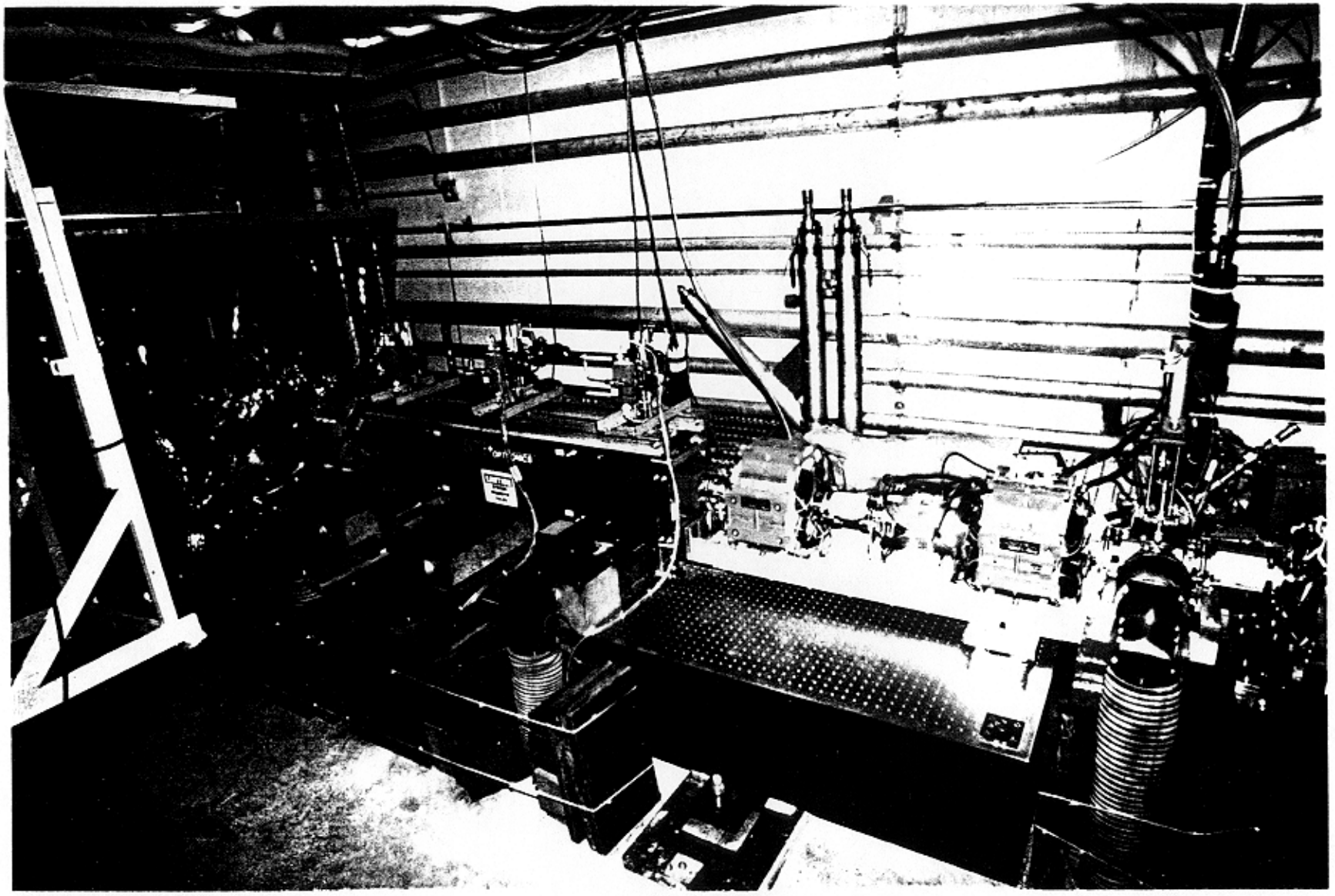
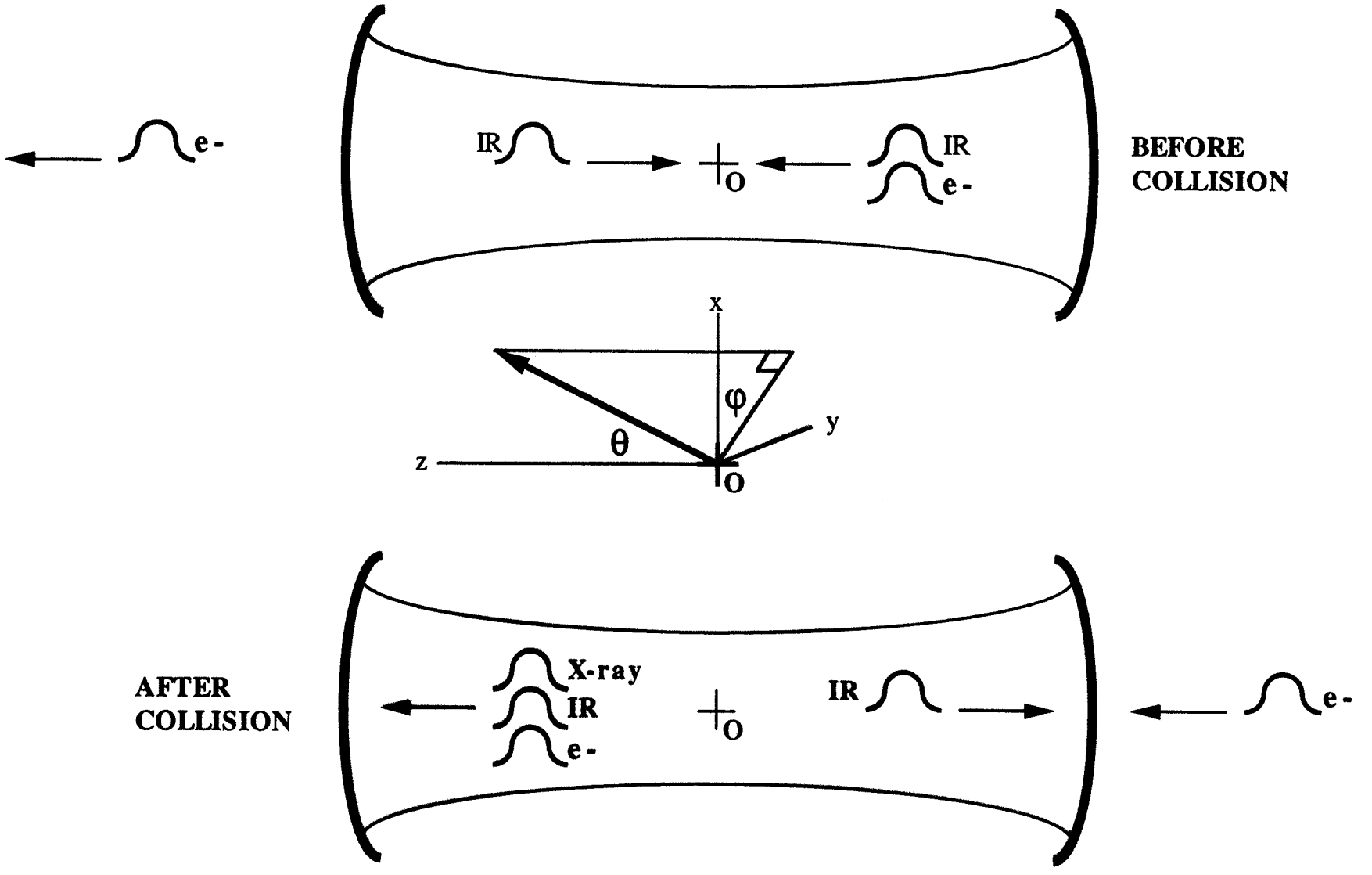
FEL PARAMETERS

	DESIGN	ACHIEVED
Q	135 pC	80 pC
f_B	37.5 MHz	75 MHz
ε	5 mm mrad	6 mm mrad
ℓ_B	500 fsec	110 μm (370 fsec)
ε_L	1 keV °	1.1 keV °
LIGHT POWER	1.1 kW	710 W



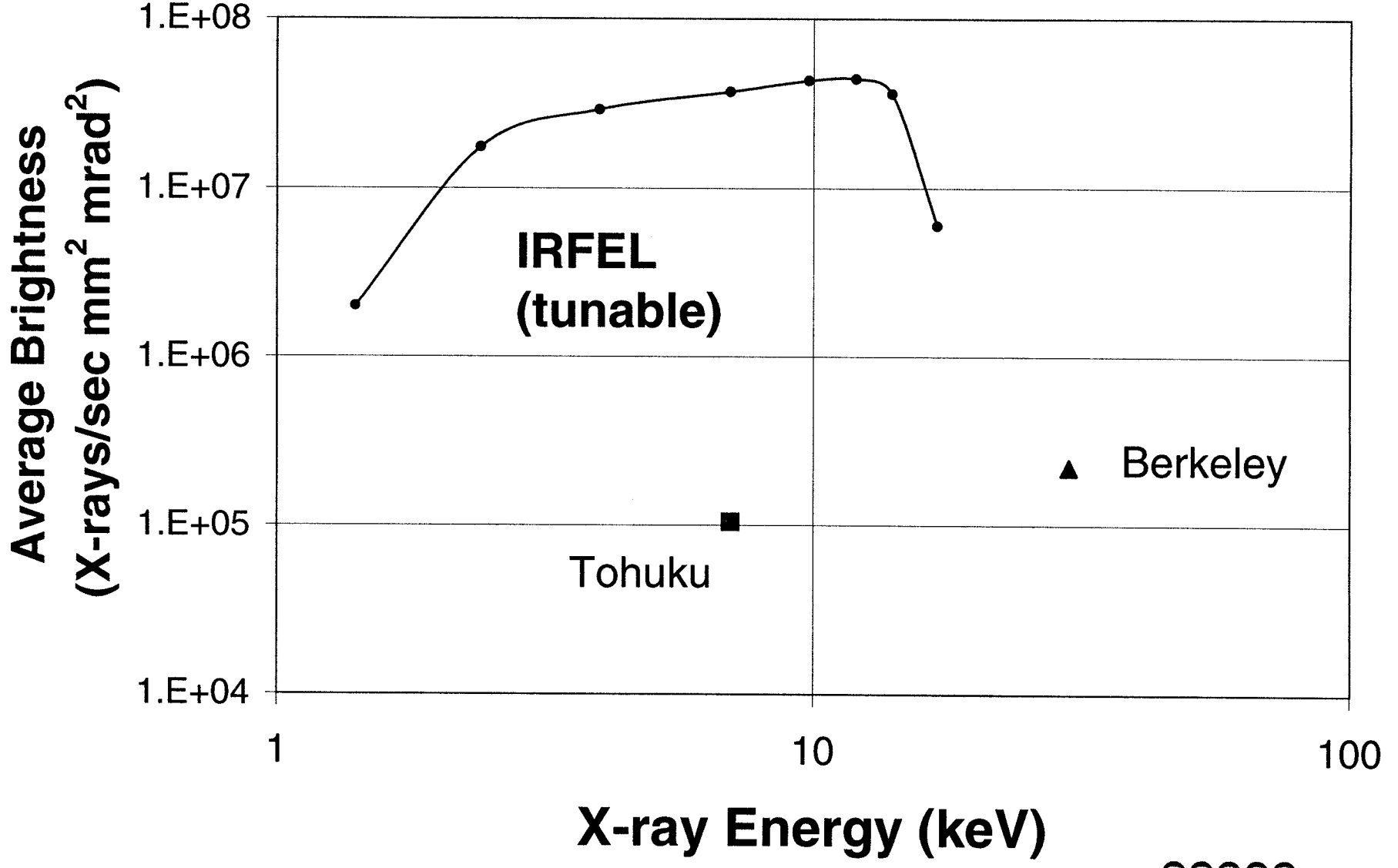
FEL WIGGLER WITH UPSTREAM OPTICAL CAVITY

CONVERSION OF ELECTRON BEAM INTO COHERENT PHOTON ENERGY (~1%)

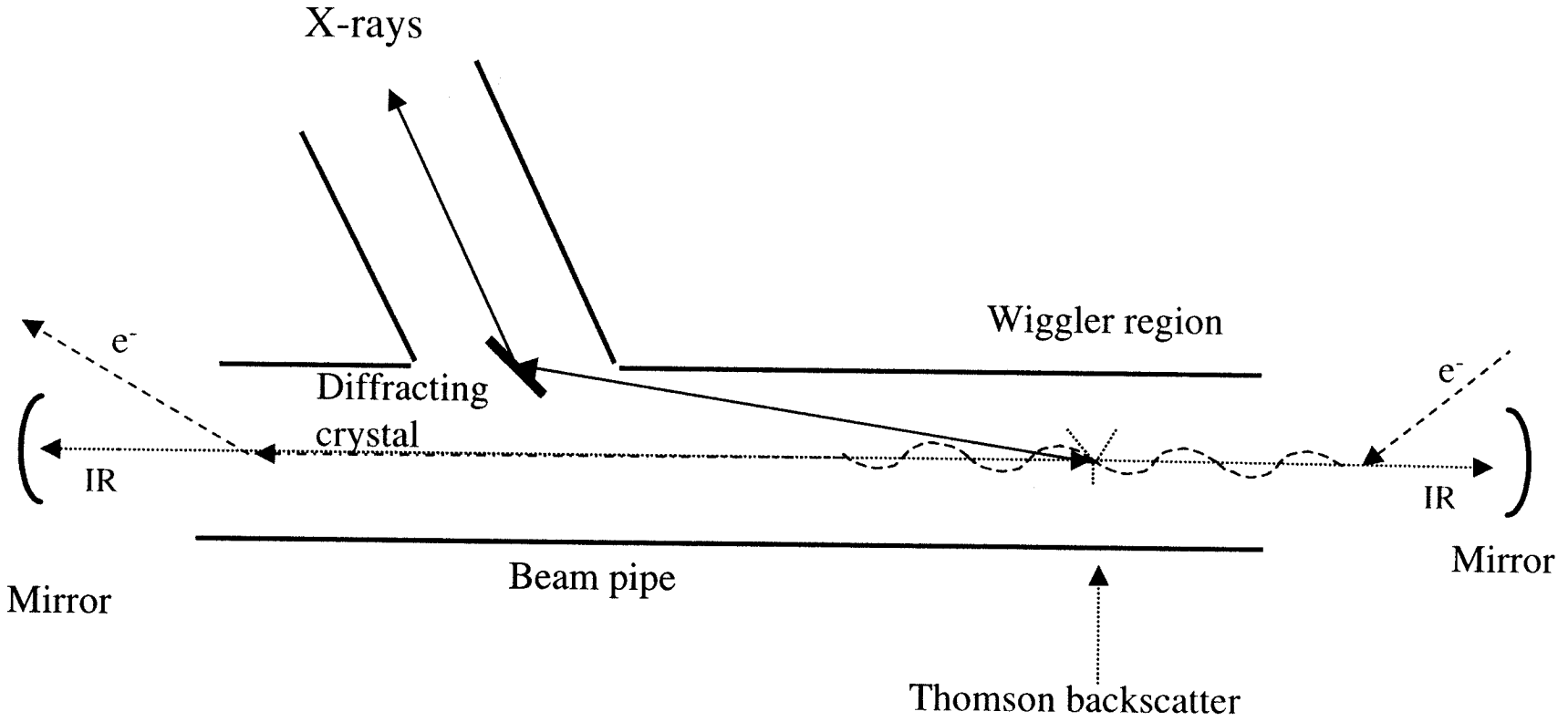


SCATTERING GEOMETRY

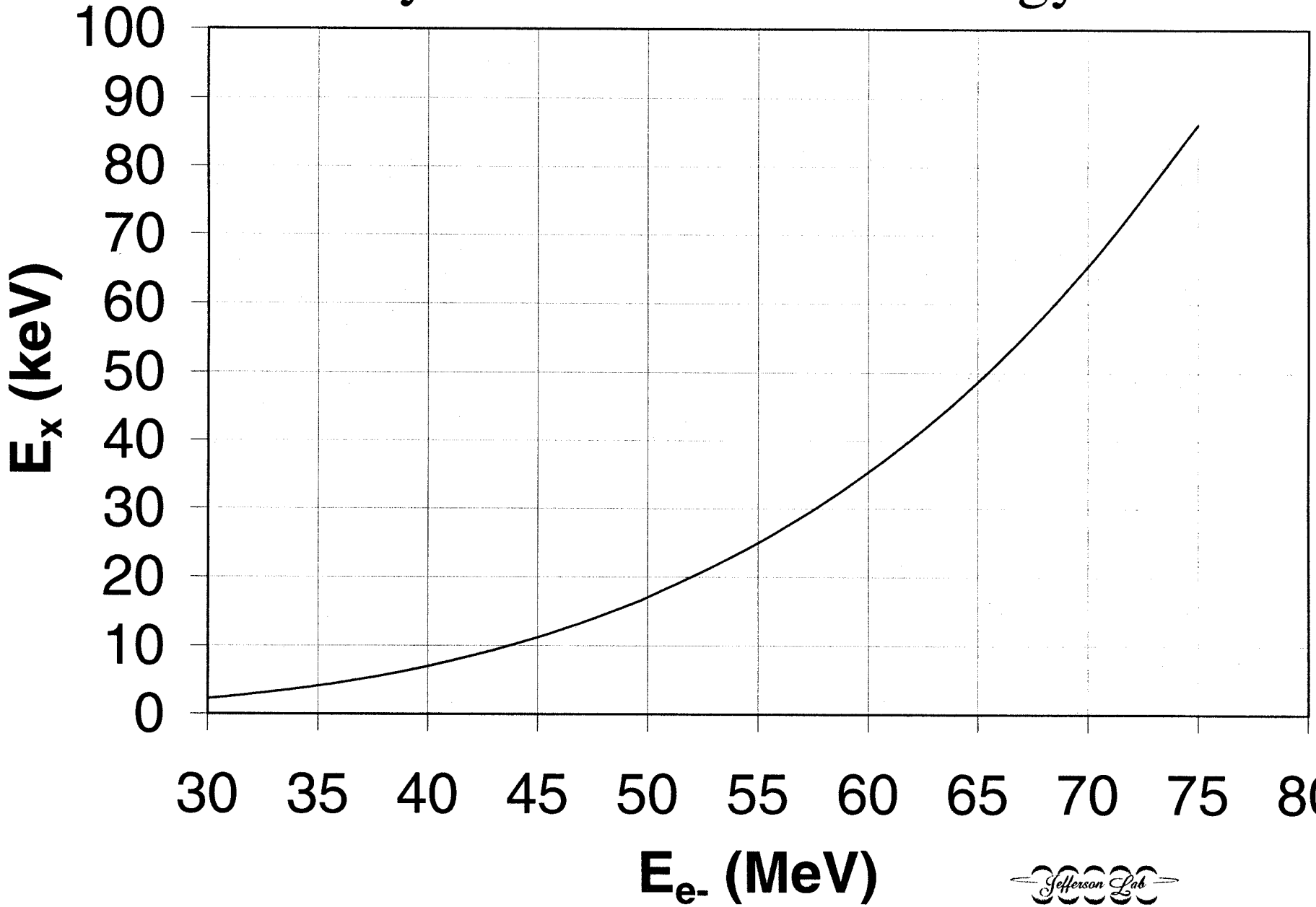
Average Brightness vs. X-ray Energy



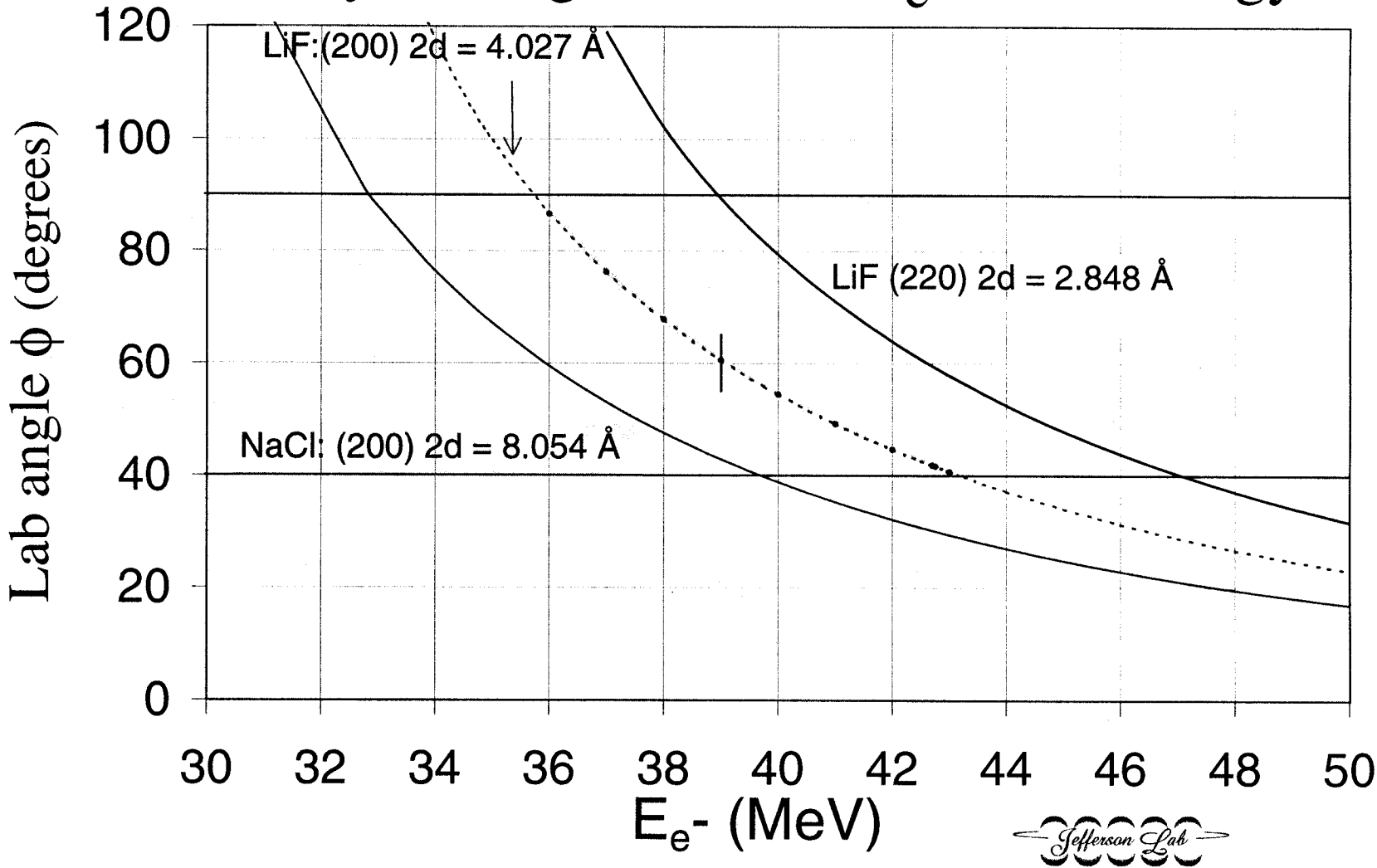
Basic laboratory geometry



X-rays vs FEL e- beam energy



X-ray lab angle vs. FEL E_e- beam energy



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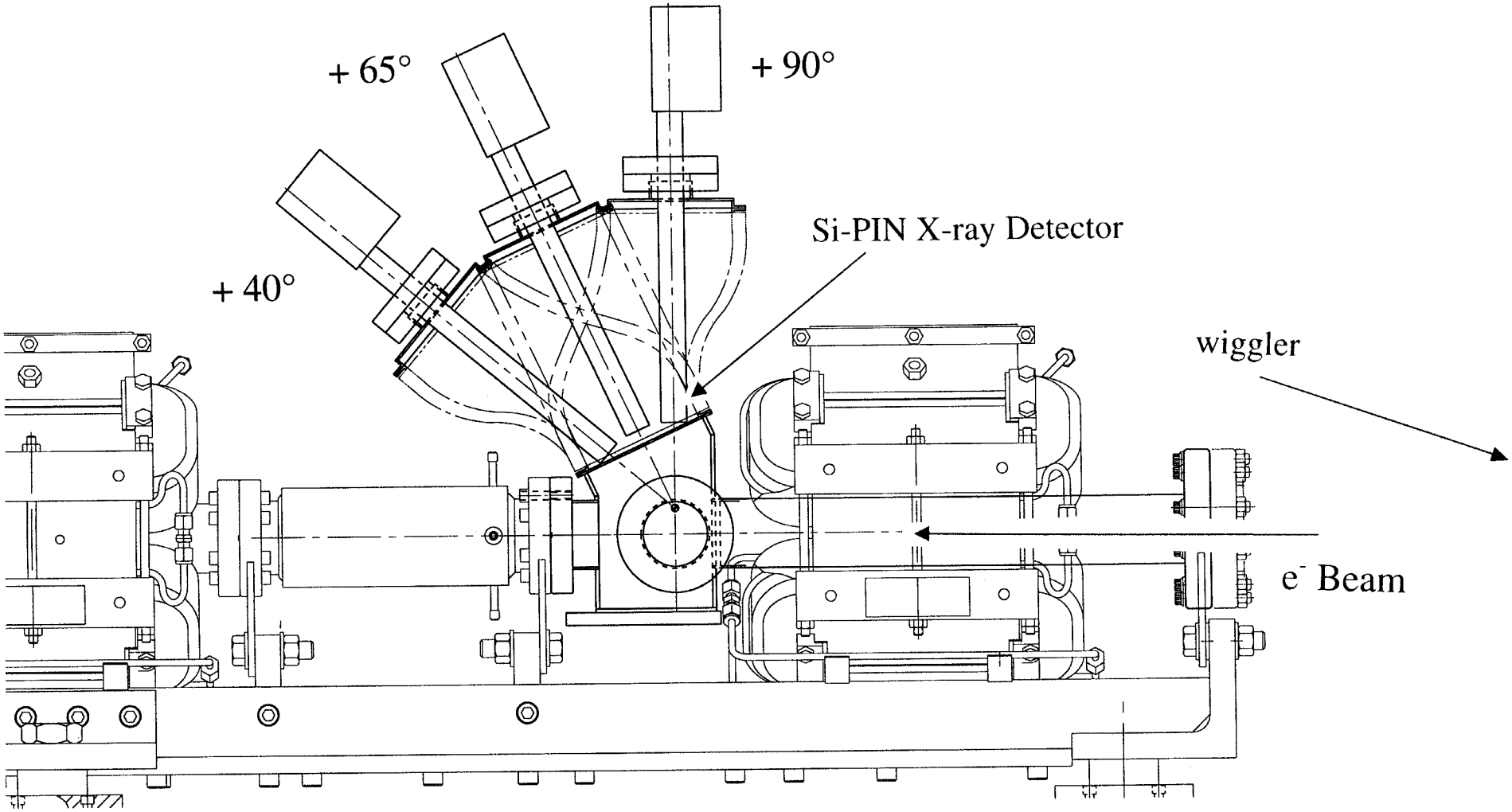
BEAM LINE X-RAY DETECTION CHAMBER



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X-Ray Source Parameters

	Mid-IR*	Near-IR**	UV**	Berkeley	NRL	APS	Units
E_b	42	75	200	50	50	6000	MeV
E_p	6	70	3800	30 (90°)	47	10-100	keV
E_{op}	0.21	0.8	6.2	1.5	1.2	NA	eV
f	37.5M	37.5M	37.5M	2	1k	0.1-1G	Hz
σ_x	500	400	200	50	50	300x90	μm
σ_t	1000	1000	1000	100	1000	40,000	fsec
q	135	135	135	(0.05) 1300	1000	NA	pC
N_p	$8x10^{15}$	$3.4x10^{15}$	$5.4x10^{14}$	$2.4x10^{17}$	$1.0x10^{19}$	NA	
L	$8.1x10^{37}$	$5.3x10^{37}$	$2.1x10^{37}$	$6.2x10^{33}$	$2.0x10^{39}$	NA	m^{-2} sec^{-1}
B	$2.2x10^{7}$	$7.2x10^{7}$	$5.2x10^{8}$	$2.4x10^{5}$	$7.8x10^{10}$	$5x10^{19}$	sec^{-1} mm^{-2} $mrad^{-2}$

* Under Construction
** Proposed Upgrade

Conclusions

- Jefferson Lab's high average power FEL should produce copious, time correlated with the IR, Thomson scattered X-rays.
- A means to characterize these X-rays has been designed and will be installed soon.
- Since the FEL can be tuned to yield specific energy X-rays, we anticipate using variety of diffracting crystals to extract and use these time correlated, energy specific, X-rays for research.