MAIN CHARACTERISTICS of TAC IR-FEL

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***For TAC IR FEL Machine Gorup**

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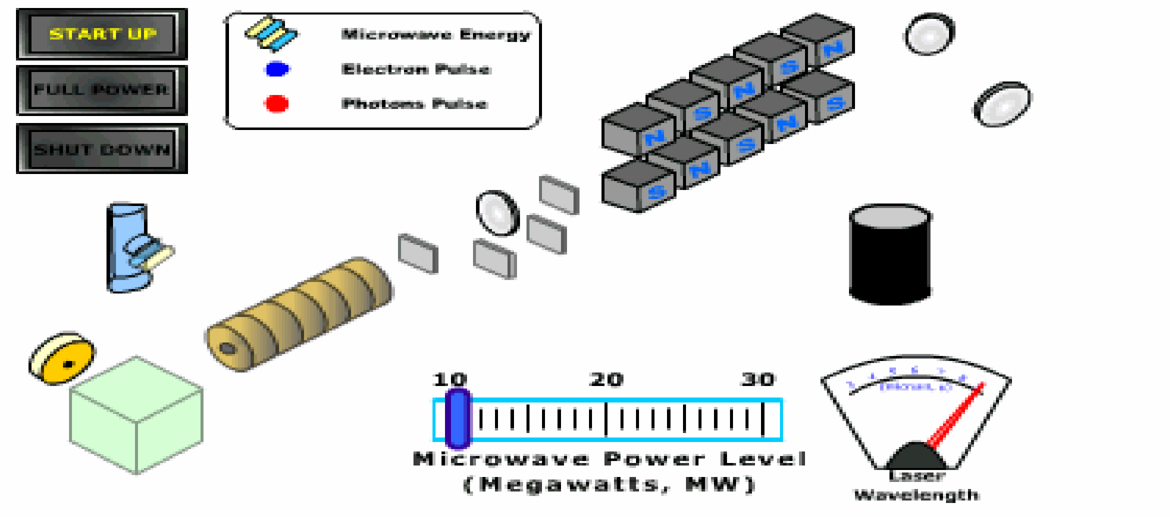
OUTLINE

- **FEL Oscillator**
- **TAC IR-FEL Project**
- **Electron Beam Parameters**
- **Resonator and FEL Parameters**
- **FEL Characteristics**
- **Conclusion**

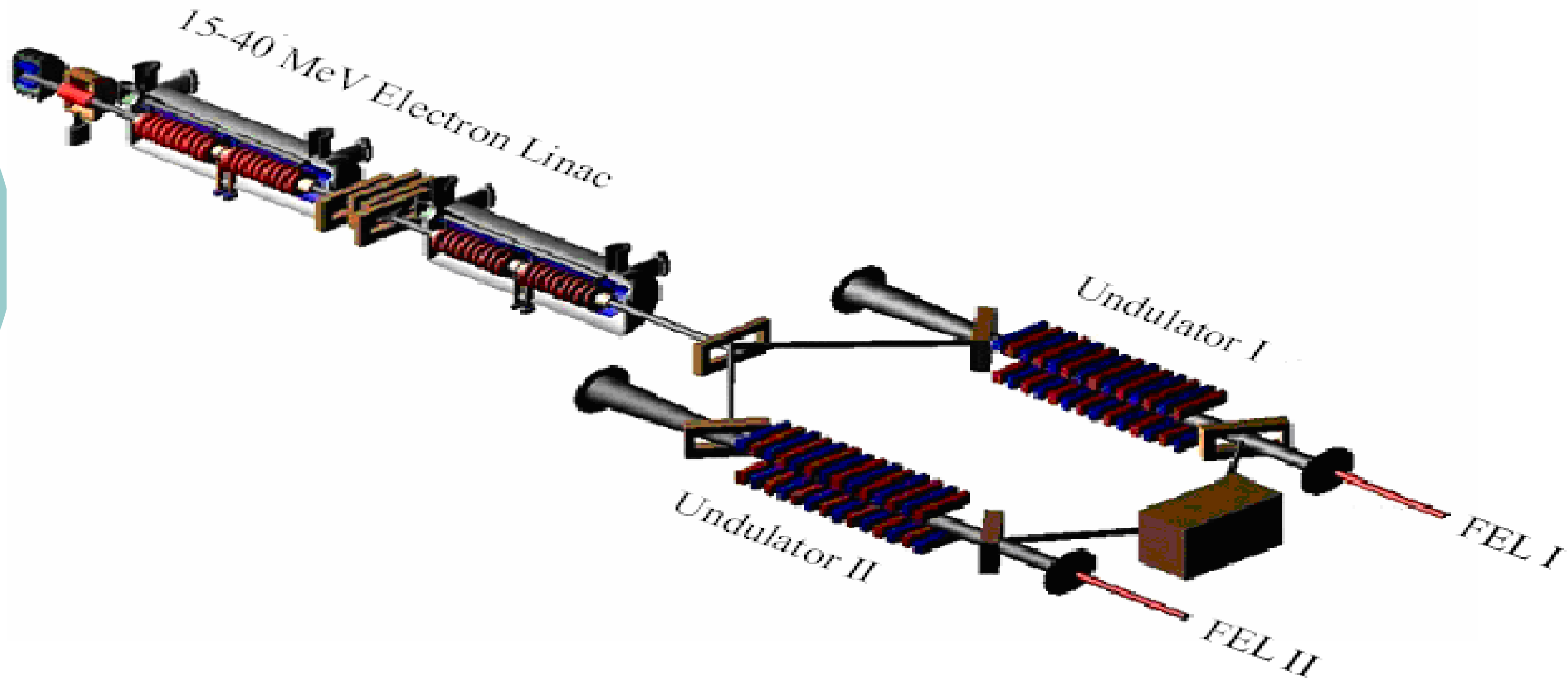
FEL OSCILLATOR



When a relativistic electron beam obtained from a linear accelerator is passed through an undulator magnet, an undulator radiation occurs in a narrow cone.

The emitted radiation is trapped between two mirrors and interacts with the electron bunches in the undulator. The interaction between the electron bunches and the electromagnetic field causes the coherency of the radiation wavelength.

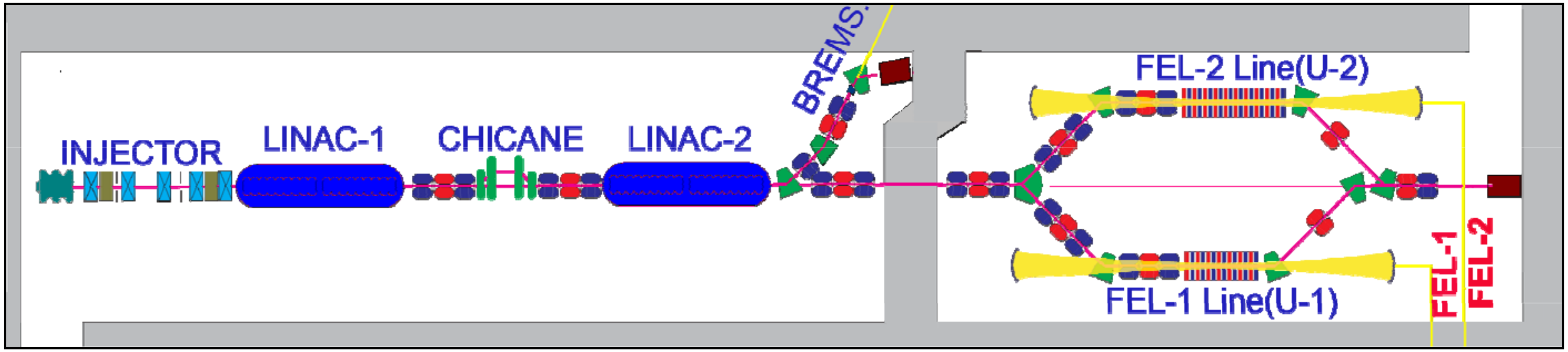
TAC IR FEL PROJECT



Electron beam with a tunable energy of *15-40 MeV* can be injected into two undulators. These two undulators are designed with the period numbers of 3 and 9 cm. The obtained beam will be between *2-185 µm* wavelength range.

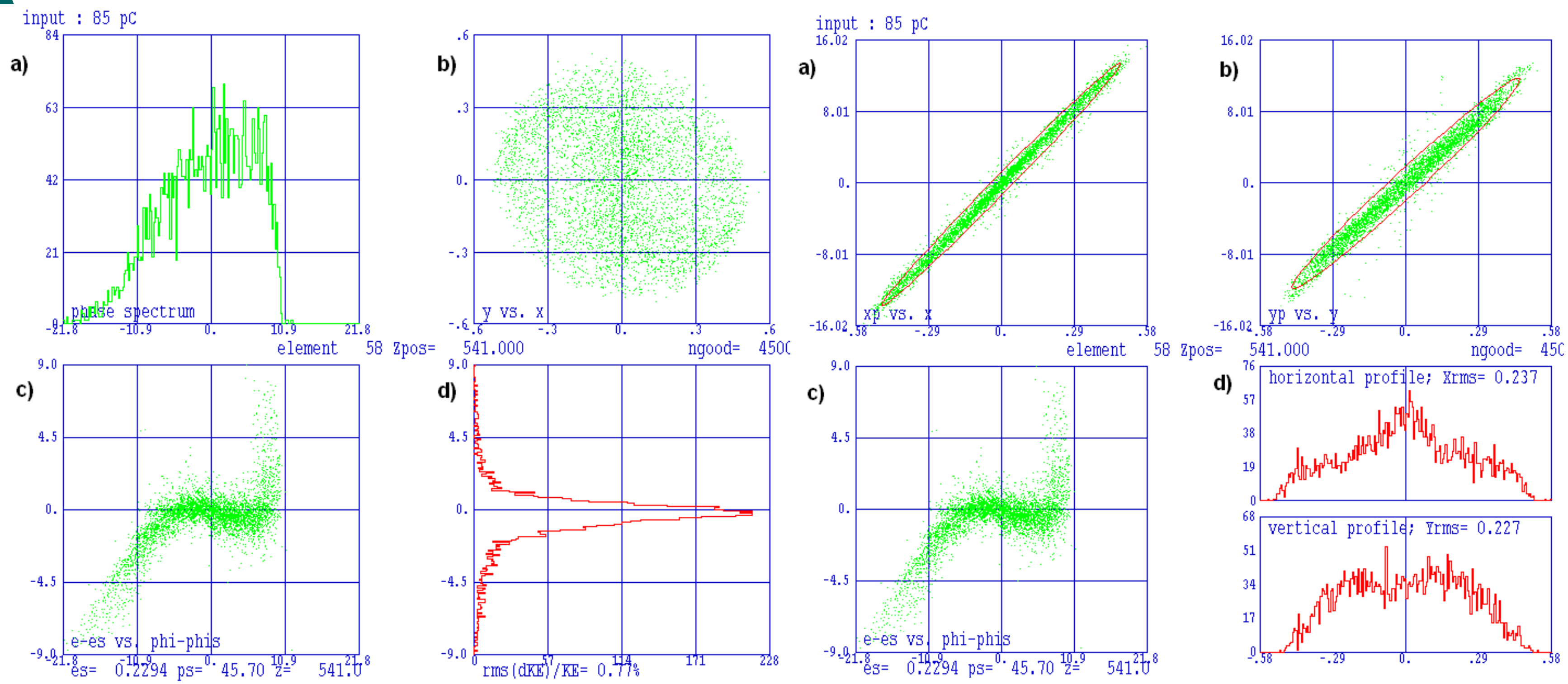
TAC IR FEL PROJECT

Besides the IR FEL experimental stations, a Bremsstrahlung experimental station is also planned using the same electron linac in the 20 MeV electron beam energy range to study nuclear physics.



General Layout of the TAC IR-FEL Facility

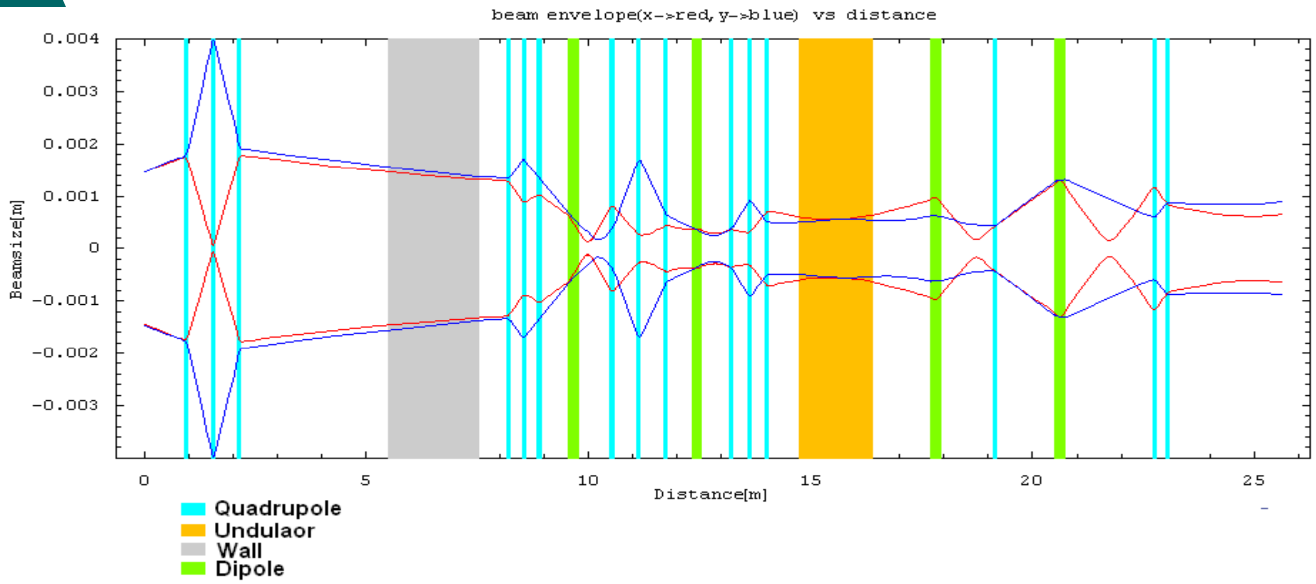
PARMELA Results at the end of Injector



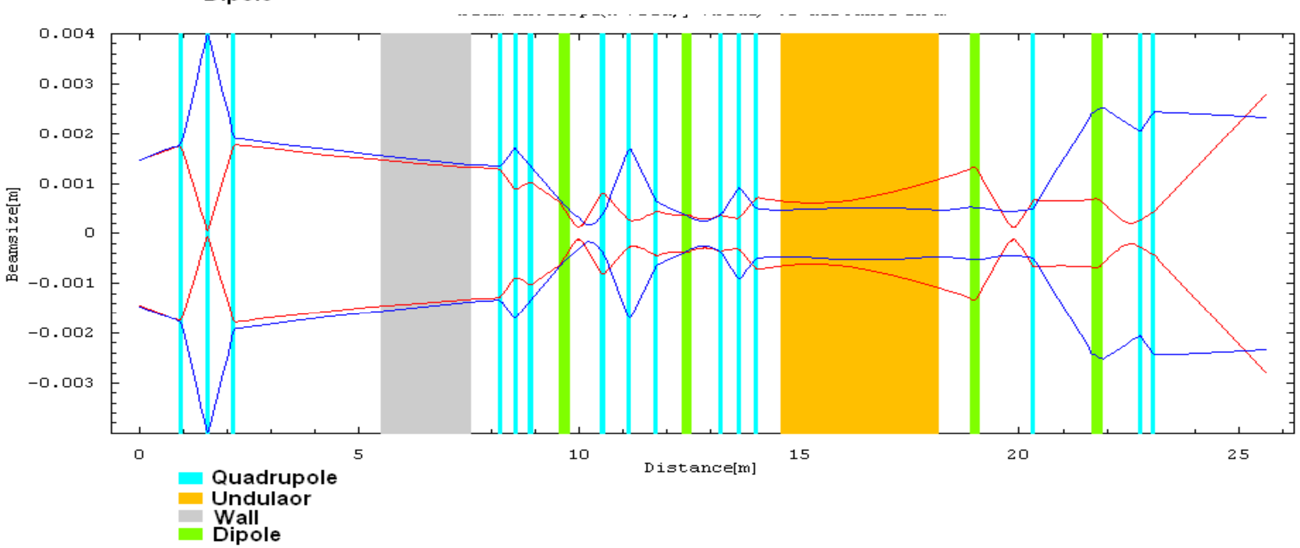
Left : a) horizontal phase space, b) vertical phase space,
c) longitudinal phase space d) transverse beam profiles

Right: a) phase spectrum, b) transverse beam size,
c) longitudinal phase space, d) energy spectrum

Beam line calculations (FEL lines)



Beam envelope variation trough FEL-1 line to the dump.



Beam envelope variation trough FEL-2 line to the dump.

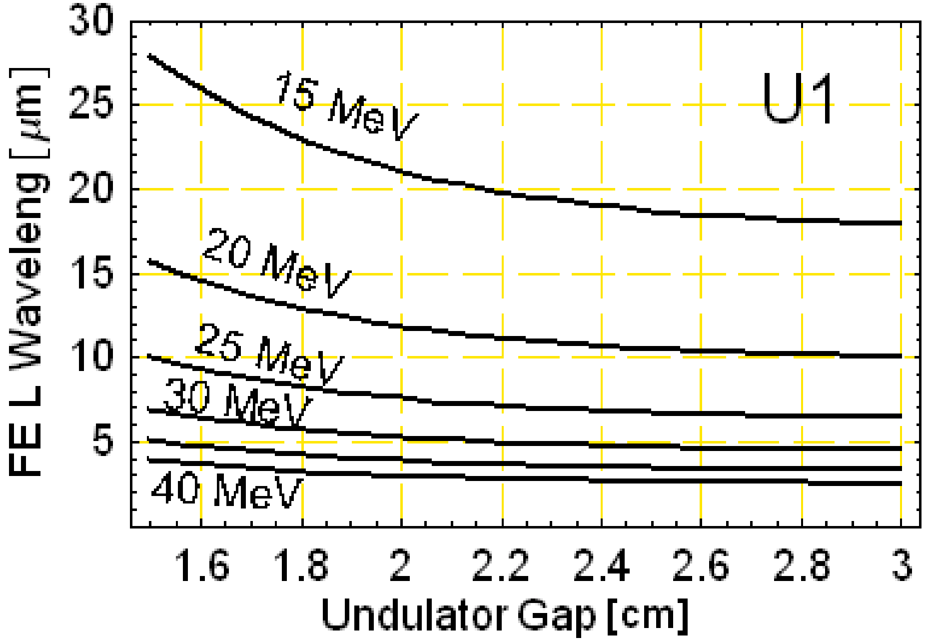
ELECTRON BEAM PARAMETERS

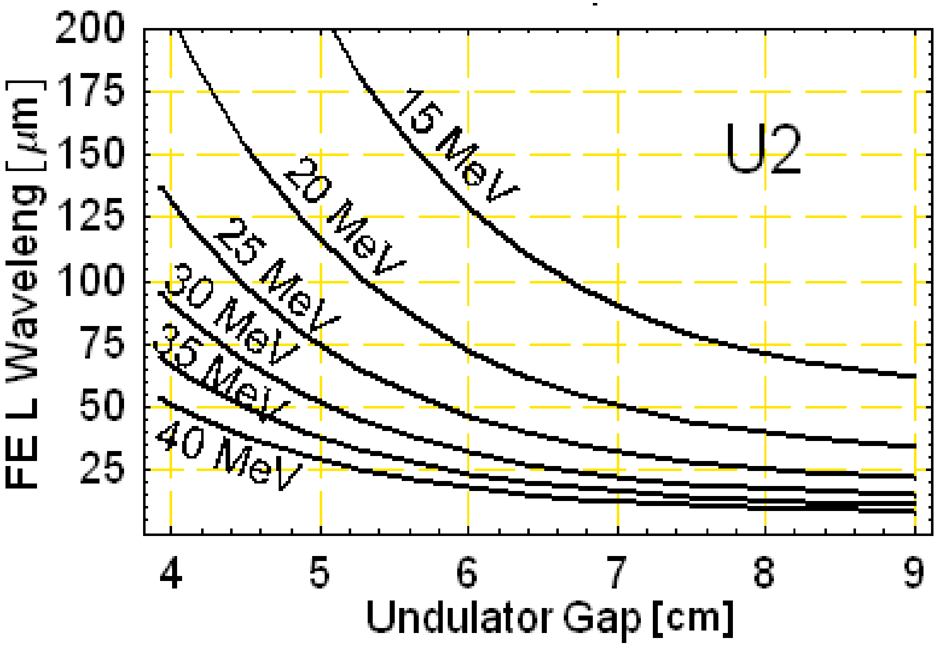
Parameter	10 kW RF	16 kW RF
Max Beam Energy (MeV)	40	40
Bunch Charge (pC)	80	120
Average Current (mA)	1	1.6
Rms Bunch Length (ps)	1-10	1-10
Bunch Separation (ns)	77	77
Nor.rms Trans.emt. (mm.mrad)	<15	<15
Nor.rms Long.emt. (mm.mrad)	<35	<38
Rms Energy Spread (%)	0.05	0.05

RESONATOR AND FEL PARAMETERS

Parameter	U1	U2
Undulator material	Sm_2Co_{17}	Sm_2Co_{17}
Undulator period (cm)	3	9
Undulator gap (cm)	1.5-3	4-9
Rms undulator strength	0.2-0.8	0.4-2.5
Number of period	56	40
Parameter	FEL-1	FEL-2
Wavelength (μm)	2.7-30	10-190
Pulse energy @ 80pC(μJ)	2	4
Pulse energy @ 120pC(μJ)	4	10
Max. peak Pow.@80pC(MW)	8	10
Max. peak Pow.@120pC(MW)	12	15
Pulse length (ps)	1-10	1-10

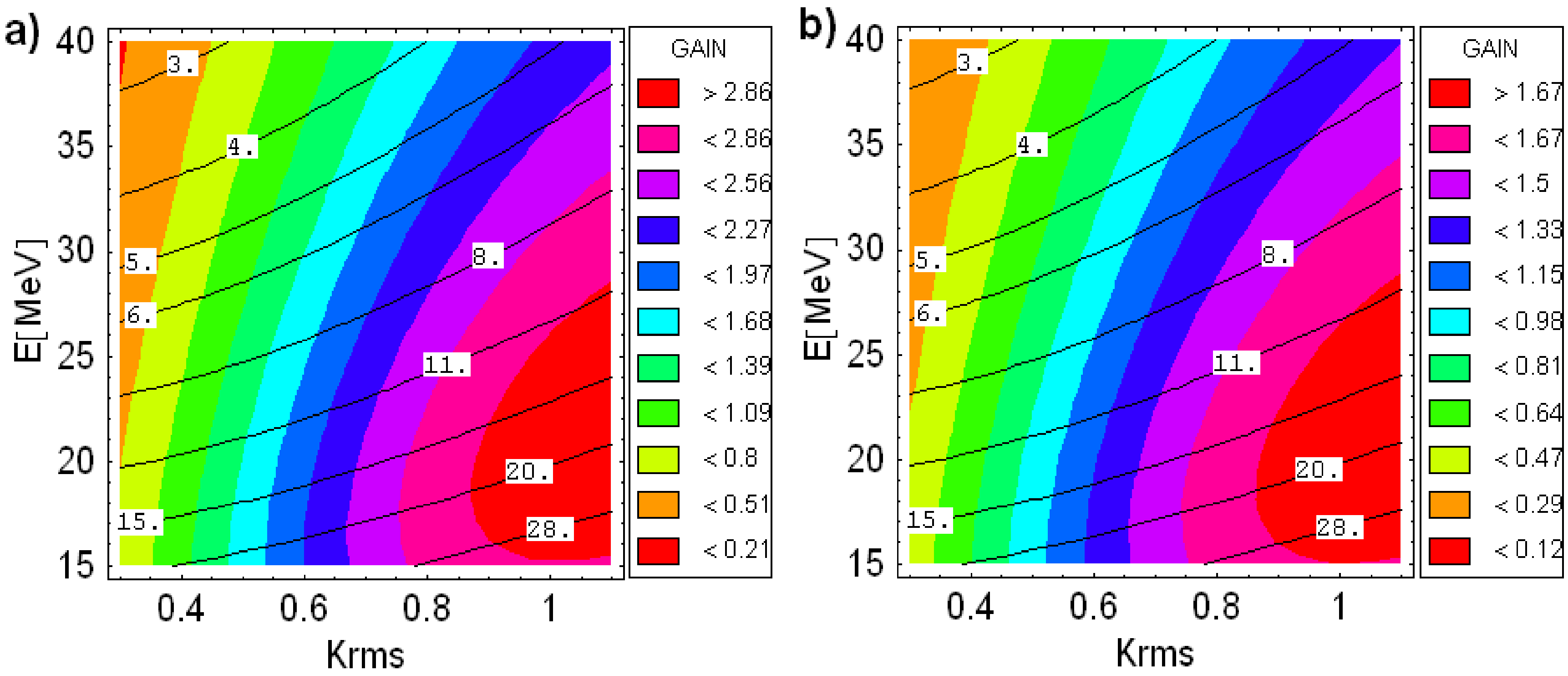
FEL CHARACTERISTICS





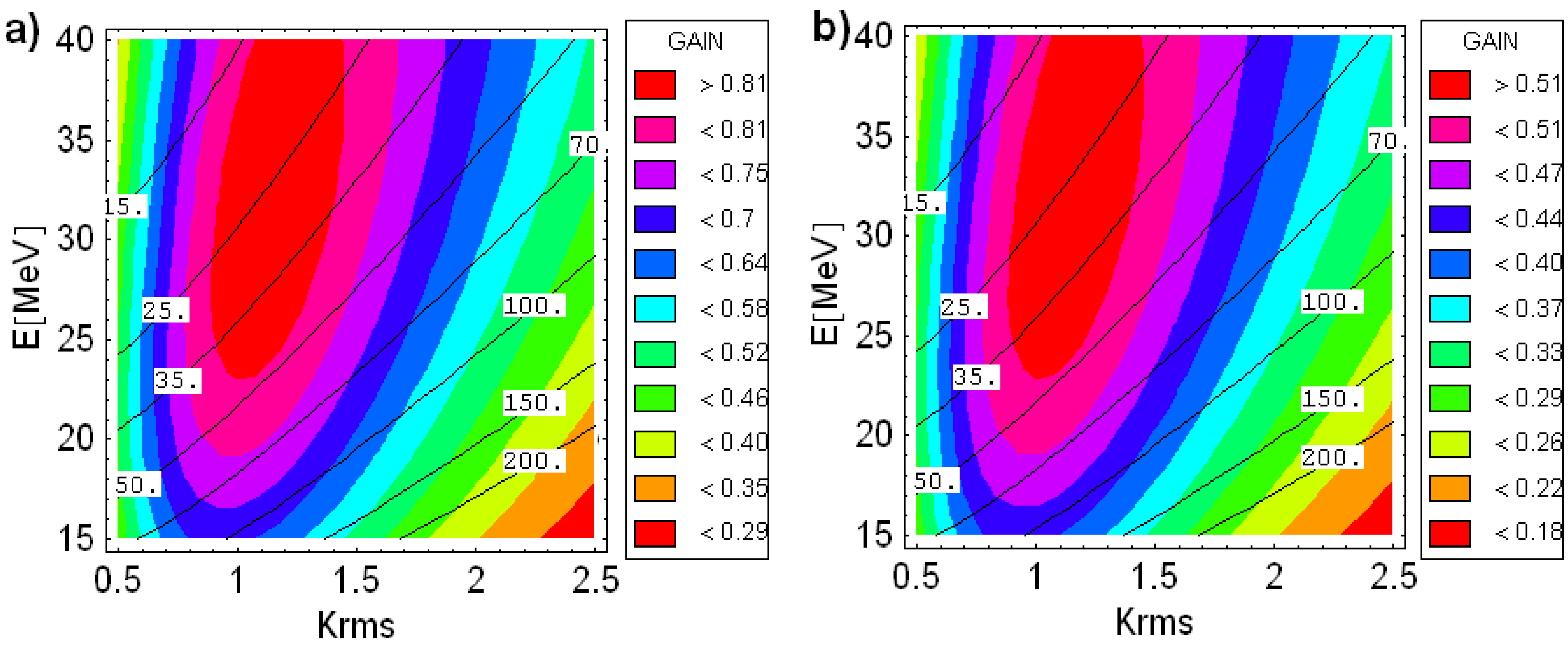
FEL wavelength tunability vs the undulators' gaps with respect to beam energy. a) U1 b) U2

FEL CHARACTERISTICS



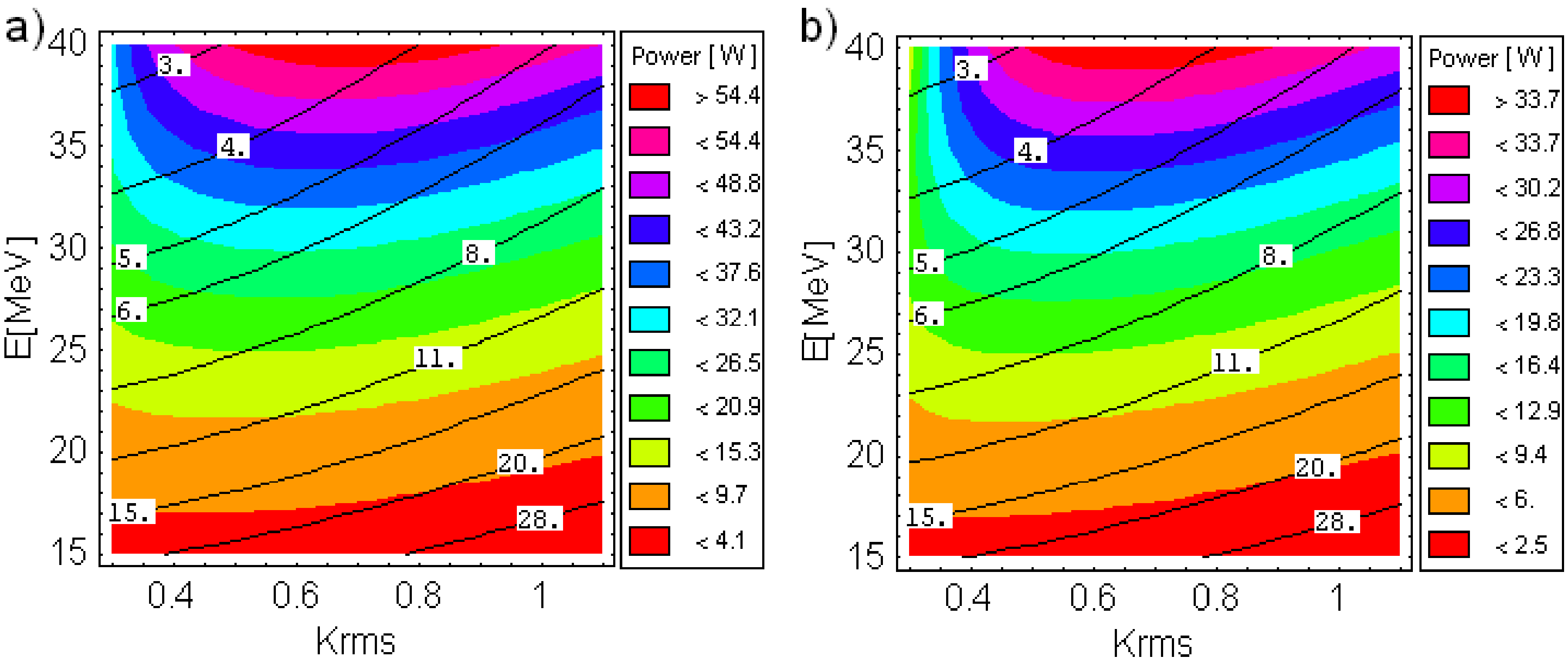
Single pass gain respect to E and Krms for λ_{U1}=3cm
a) i = 1.6 mA, b) i = 1 mA.

FEL CHARACTERISTICS



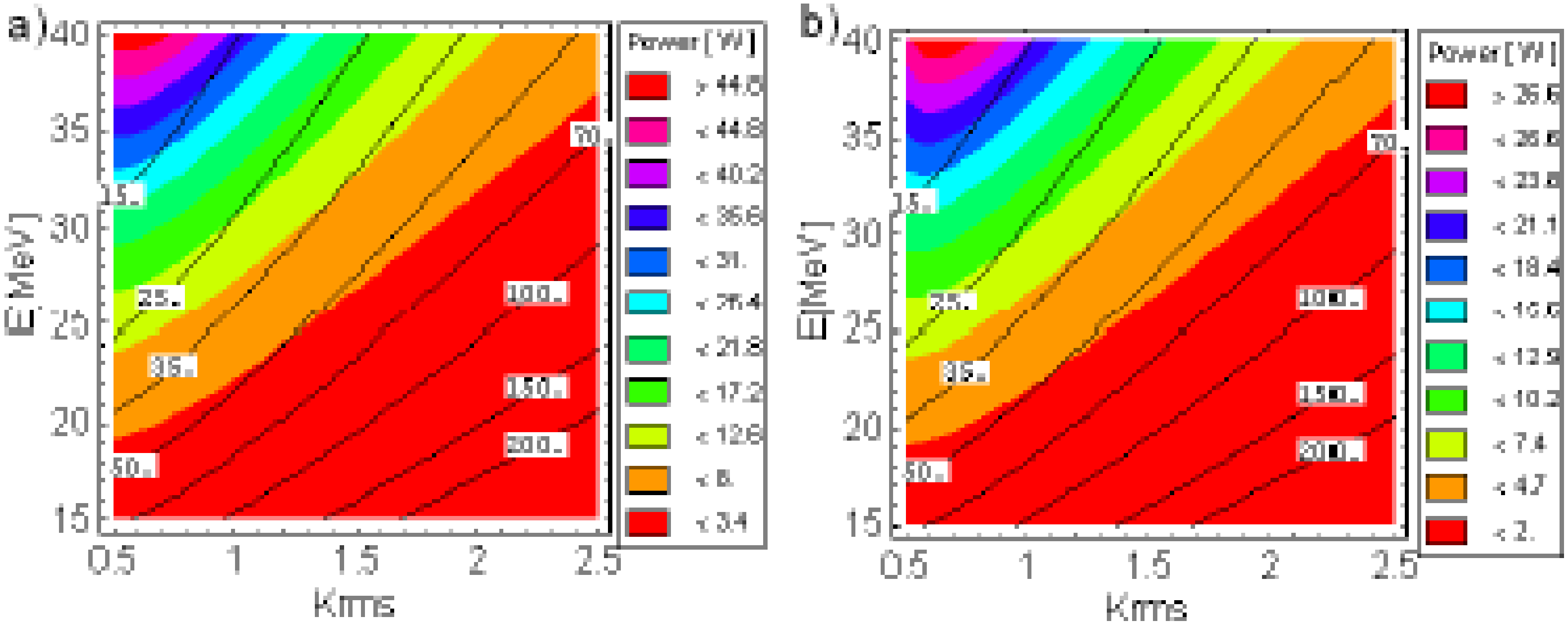
Single pass gain respect to E and Krms for λ_{U2}=9cm
a) i = 1.6 mA, b) i = 1 mA

FEL CHARACTERISTICS



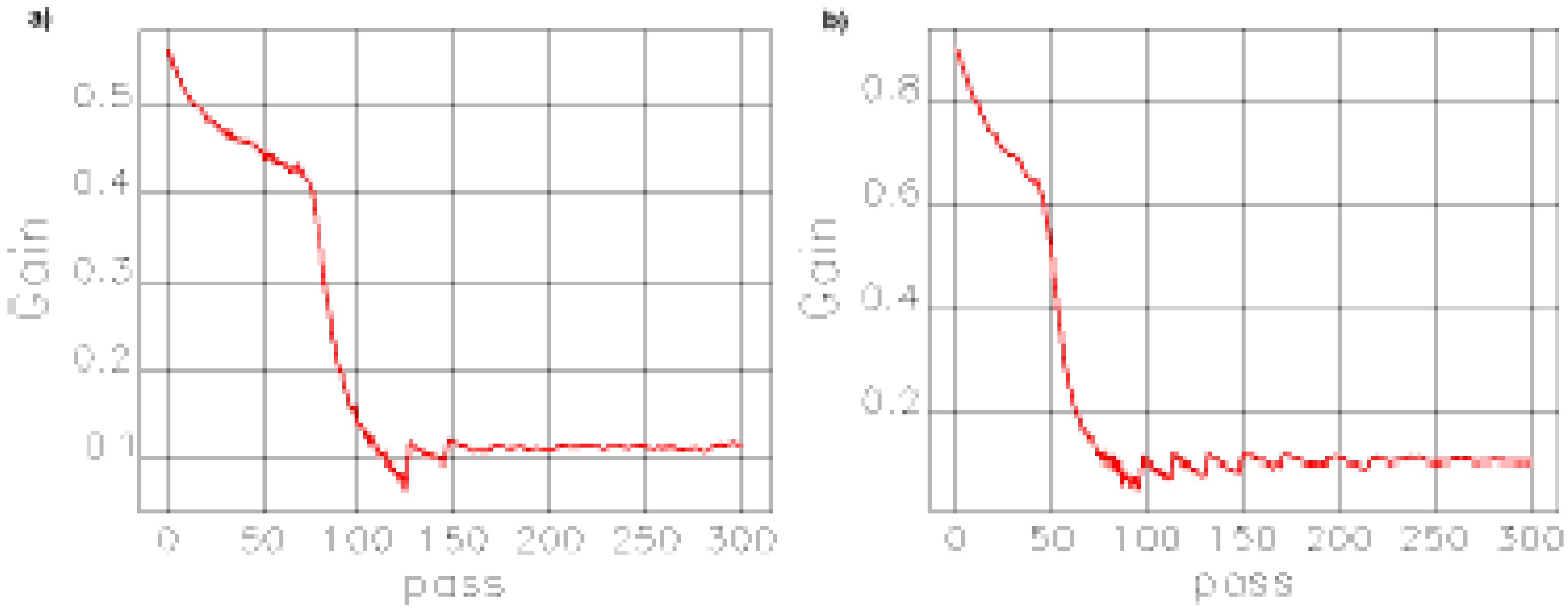
FEL expected output power respect to E and K_{rms} for λ_{U1}=3 cm
a) i = 1.6 mA, b) i = 1 mA

FEL CHARACTERISTICS



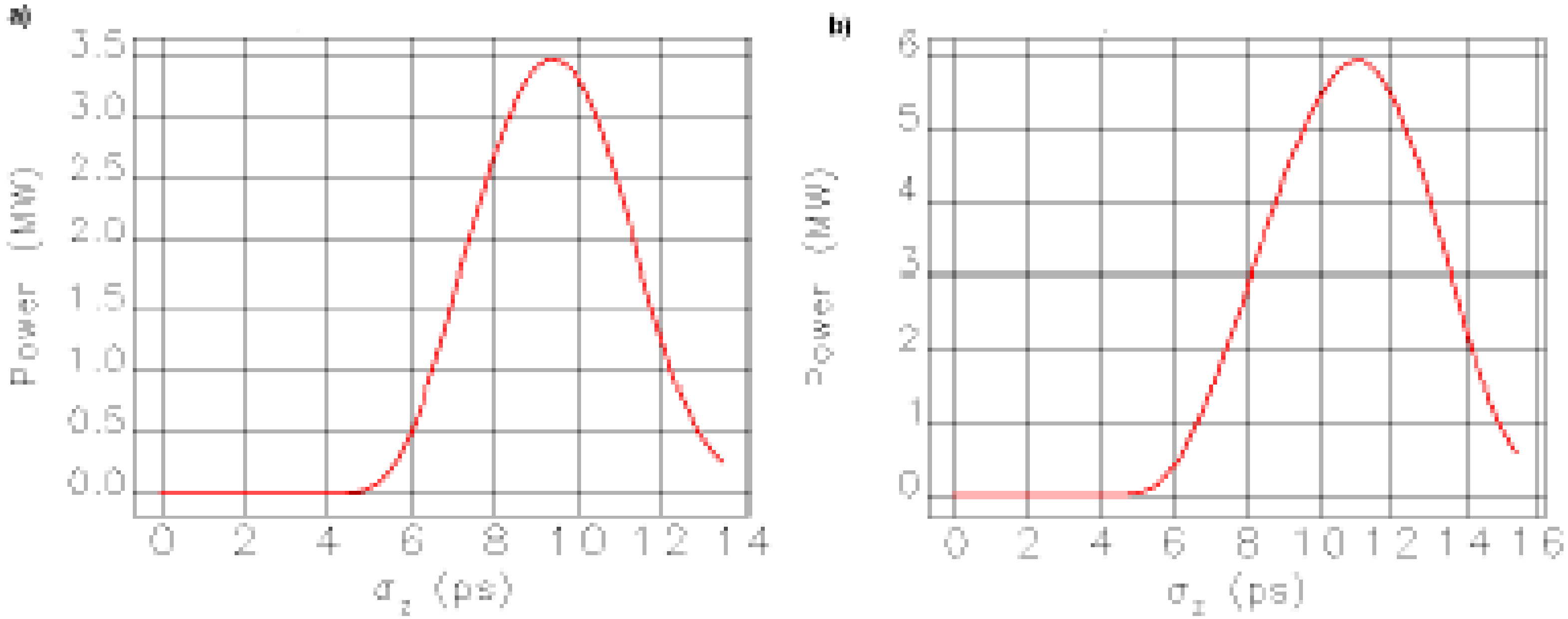
FEL expected output power respect to E and K_{rms} for λ_{U2}=9 cm
a) i = 1.6 mA, b) i = 1 mA

FEL CHARACTERISTICS



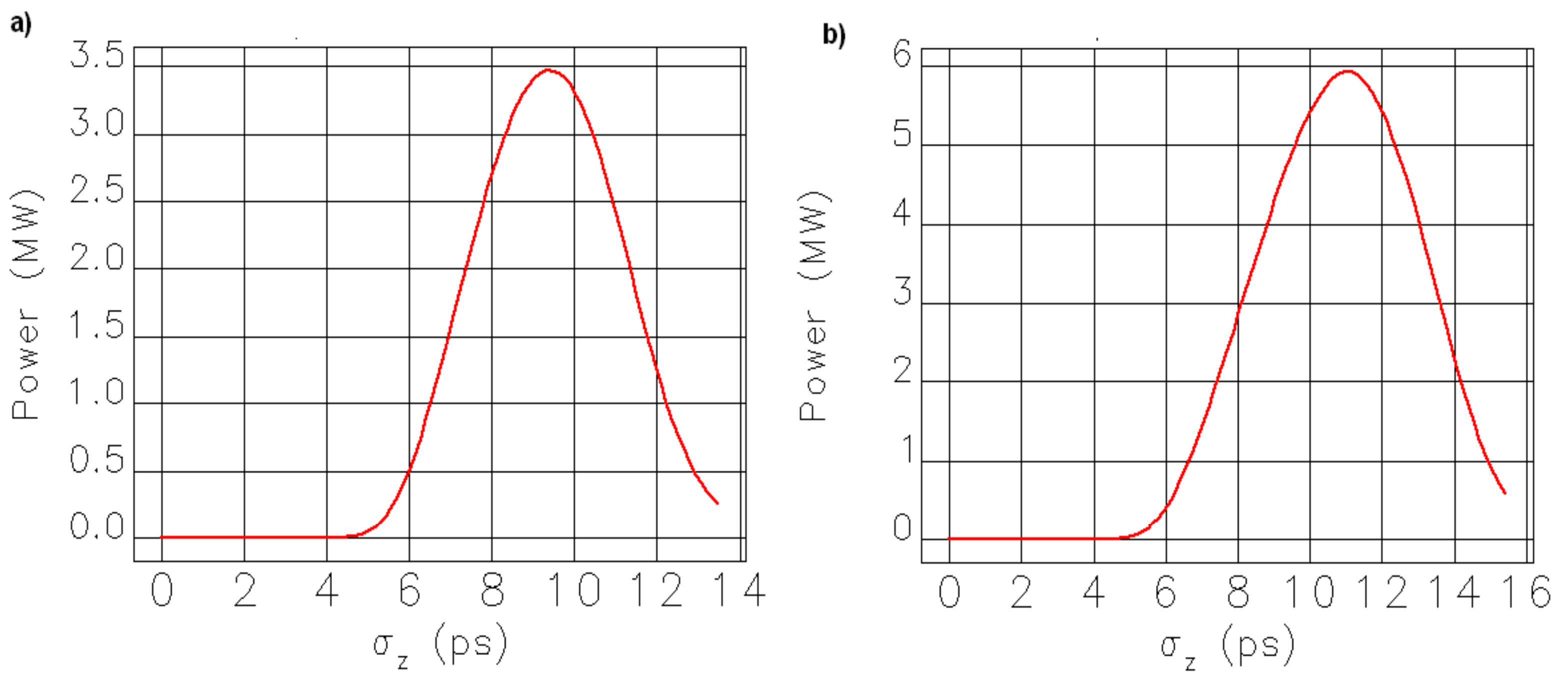
Gain vs passes for 3 μm obtained with U1
a) i = 1mA   b) i = 1.6 mA.

FEL CHARACTERISTICS



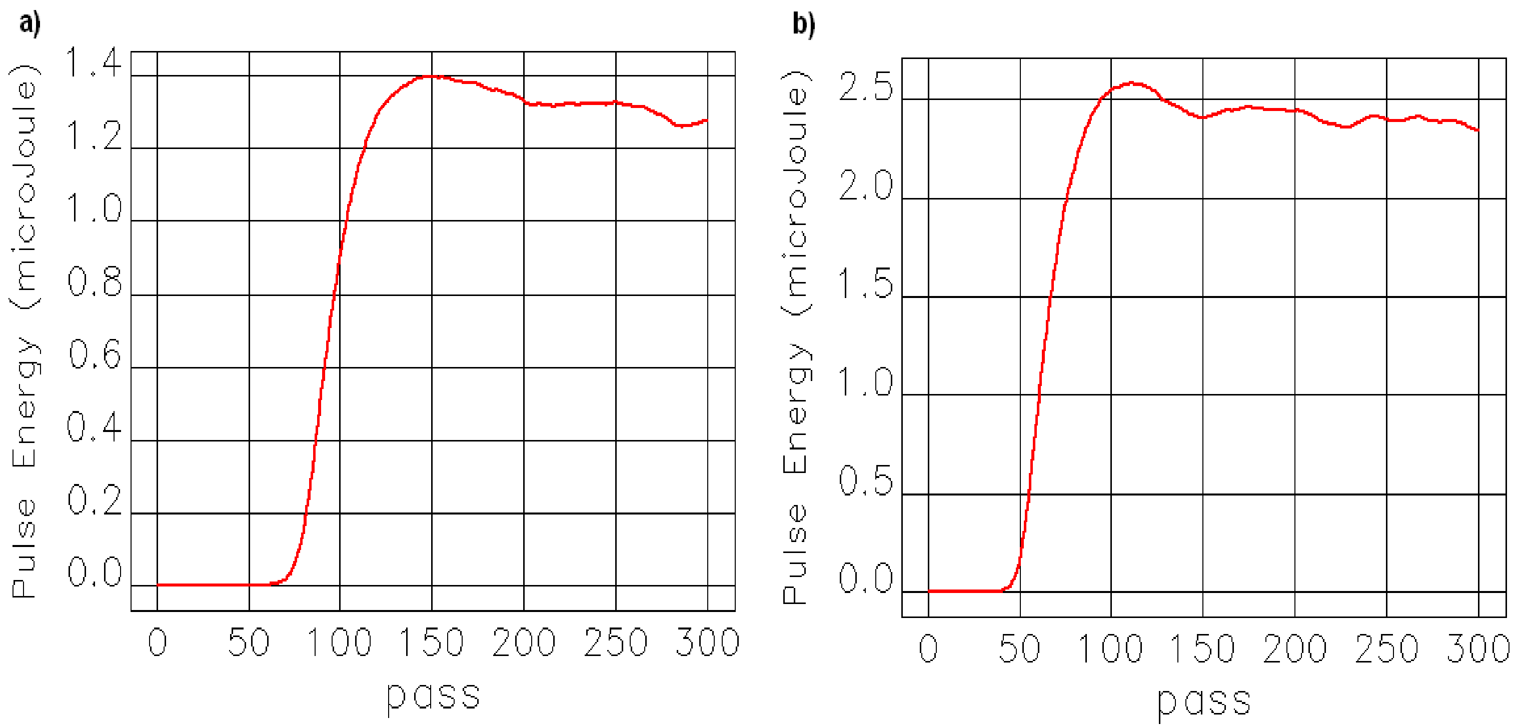
Power vs bunch length for 3 μm obtained with U1
a) i = 1mA b) i = 1.6 mA.

FEL CHARACTERISTICS



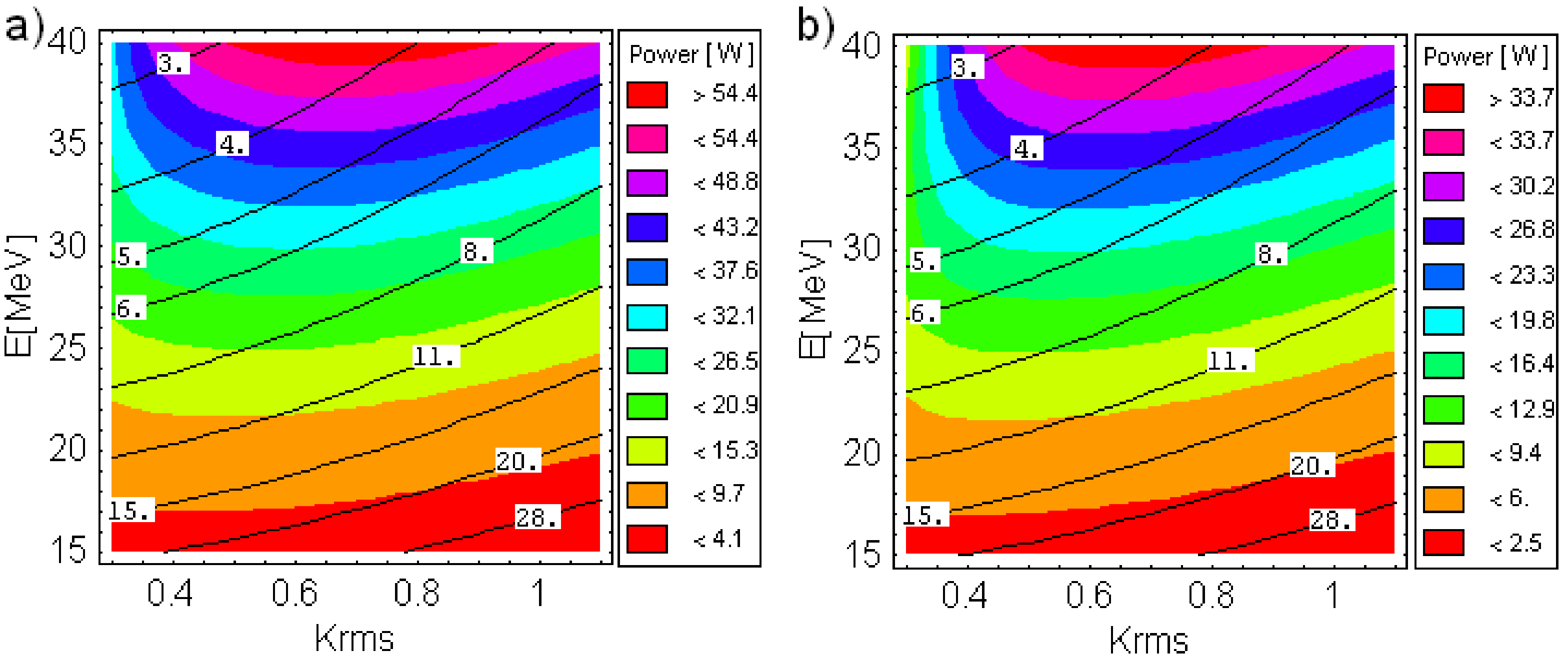
Power vs bunch length for 3 μm obtained with U1
a) i = 1 mA b) i = 1.6 mA.

FEL CHARACTERISTICS



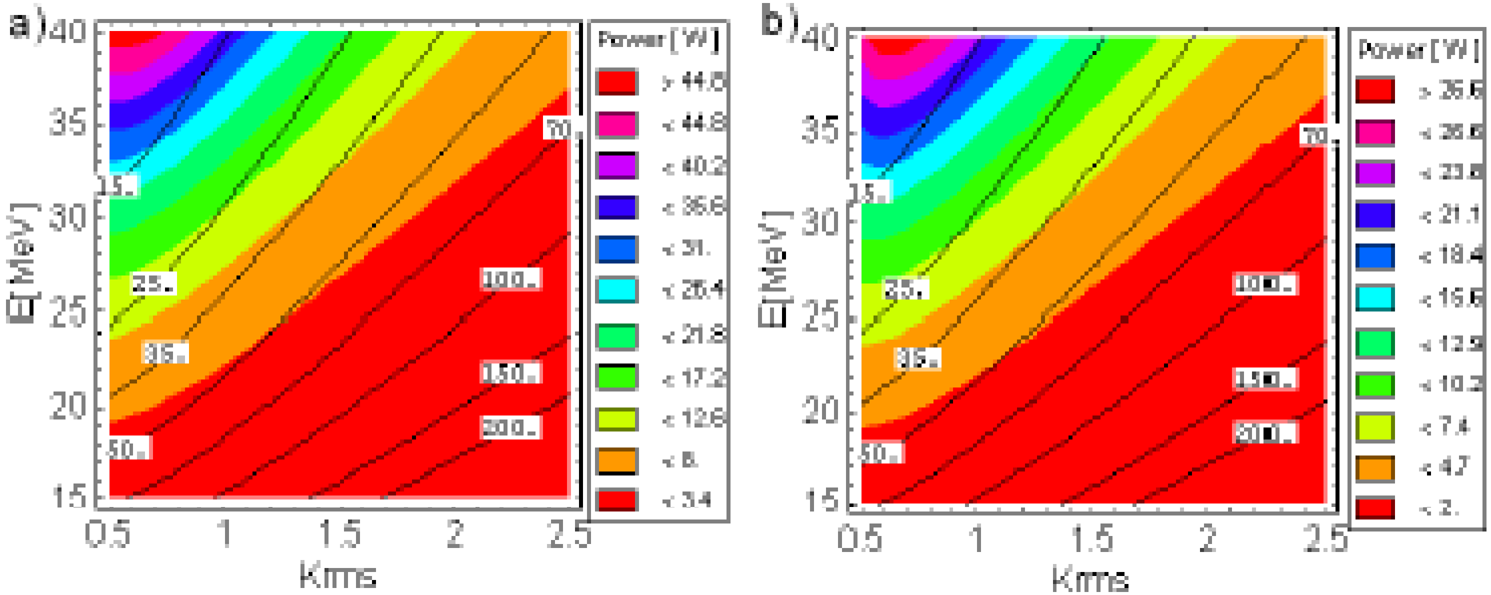
Pulse energy propagation vs passes for 3 µm obtained with U1
a) i = 1 mA b) i = 1.6 mA

FEL CHARACTERISTICS



FEL expected output power respect to E and Krms for λ_{U1}=3 cm
a) i =1.6 mA, b) i =1 mA

FEL CHARACTERISTICS



FEL expected output power respect to E and K*rms* for U_2=9 cm
a) i =1.6 mA, b) i =1 mA

CONCLUSION

- It is planned that TAC IR FEL Facility will be commissioned 2011. It will be the pioneer for the national center.

- TAC project will give a lot of opportunities for researches with its accelerator based light sources:

  Oscillator IR FEL

  3rd Generation Synchrotron Radiation and

  4th Generation SASE FEL

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http://thm.ankara.edu.tr

Announcement:

Sixth TAC Workshop

December, 2-5, 2008

Ankara University

Ankara, Turkey

Thank you for your attention...