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MESA+
Institute for Nanotechnology

Department of Science and Technology

Laser Physics and Non-Linear Optics Group

Lasing of a compact Cerenkov Free Electron Laser

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- Setup
- Results
- Conclusions

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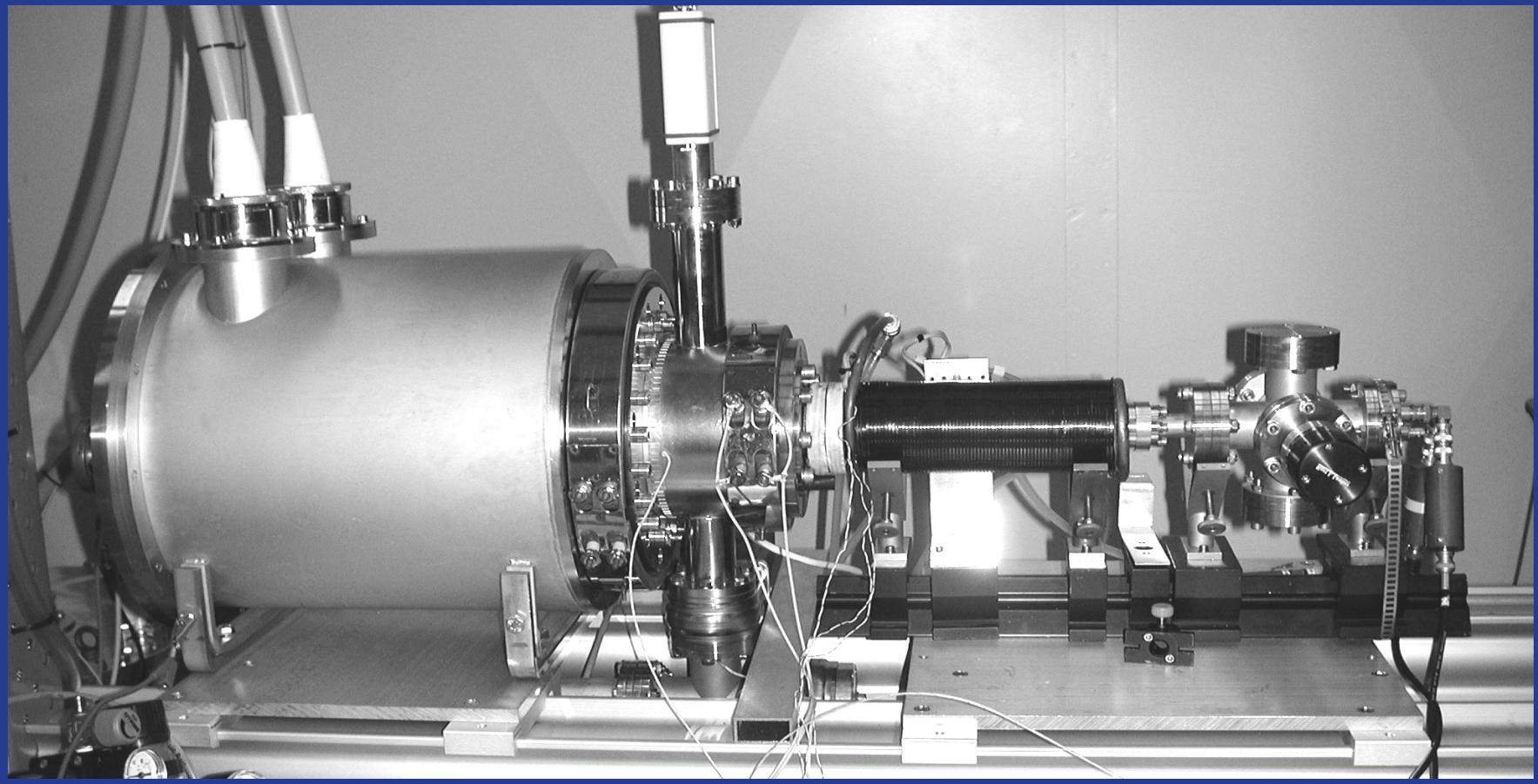
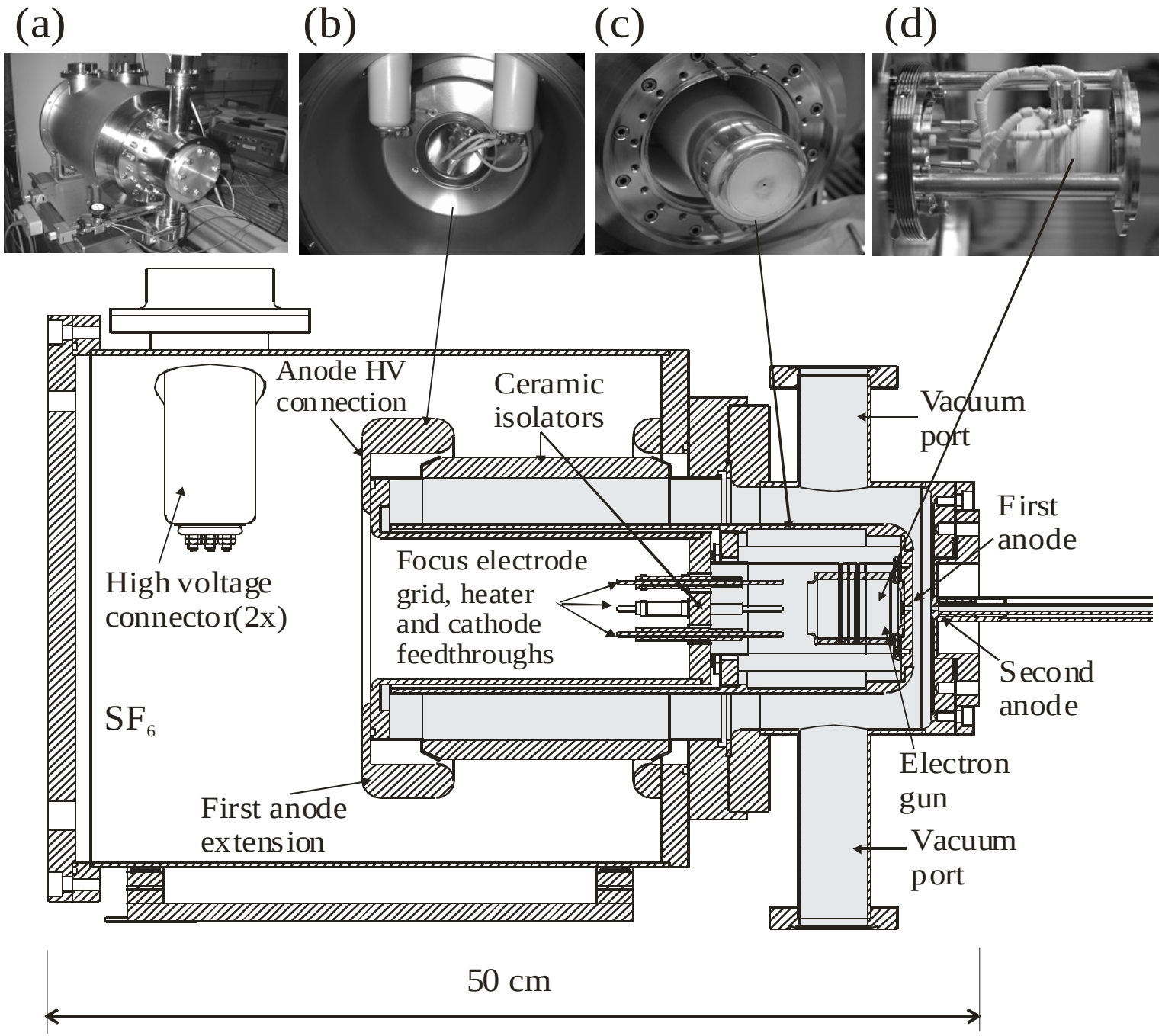
Overview Experimental Setup




(a)
(b)
(c)
(d)
Anode HV connection
Ceramic isolators
Vacuum port
First anode
Focus electrode grid, heater and cathode feedthroughs
High voltage connector (2x)
Second anode
SF_6
Electron gun
First anode extension
Vacuum port
50 cm

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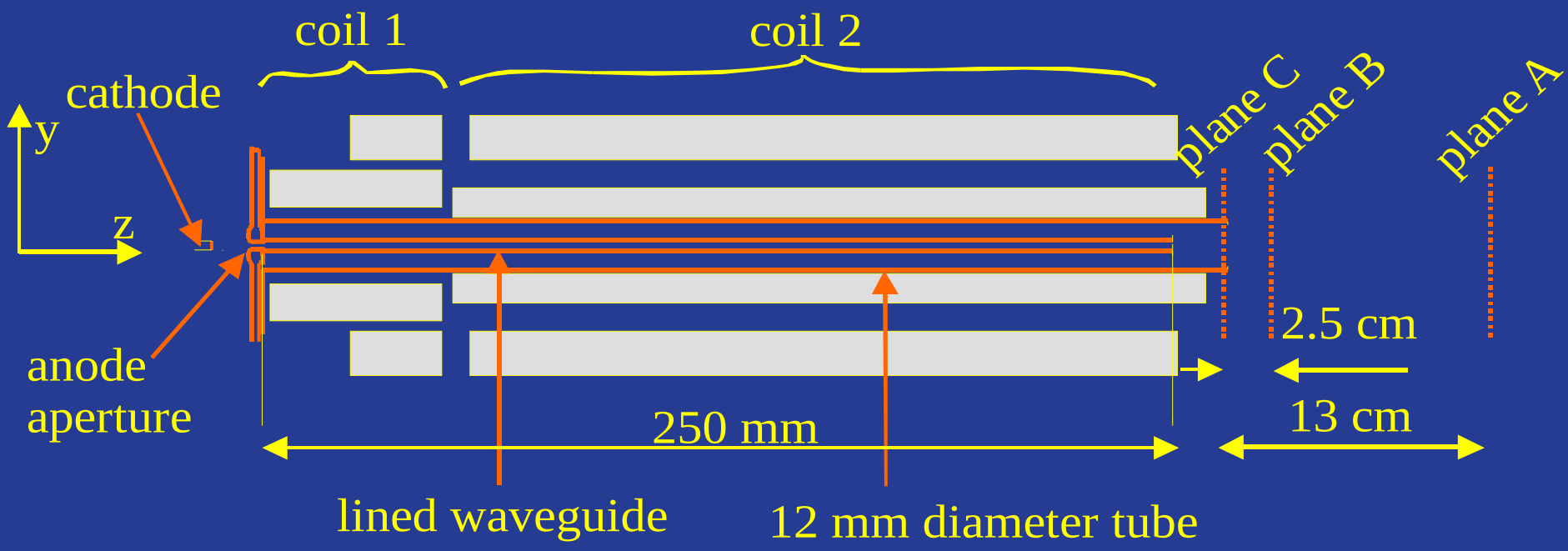
Solenoids



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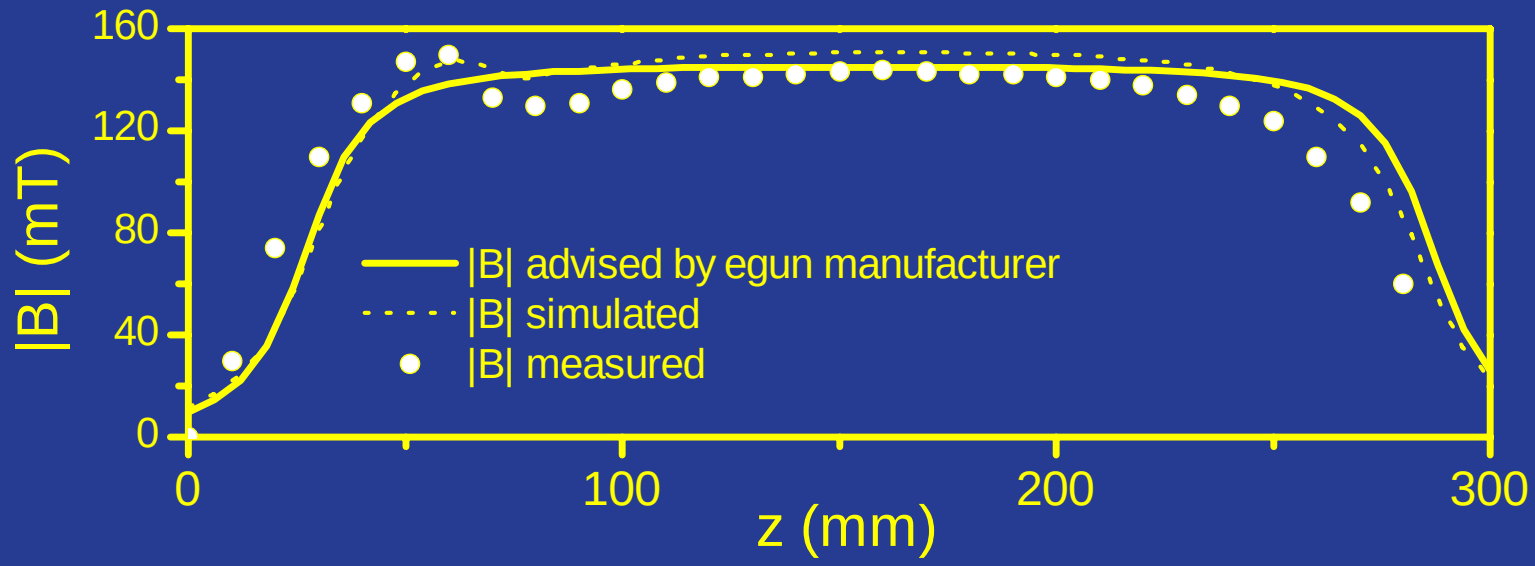
Magnetic field of two solenoids



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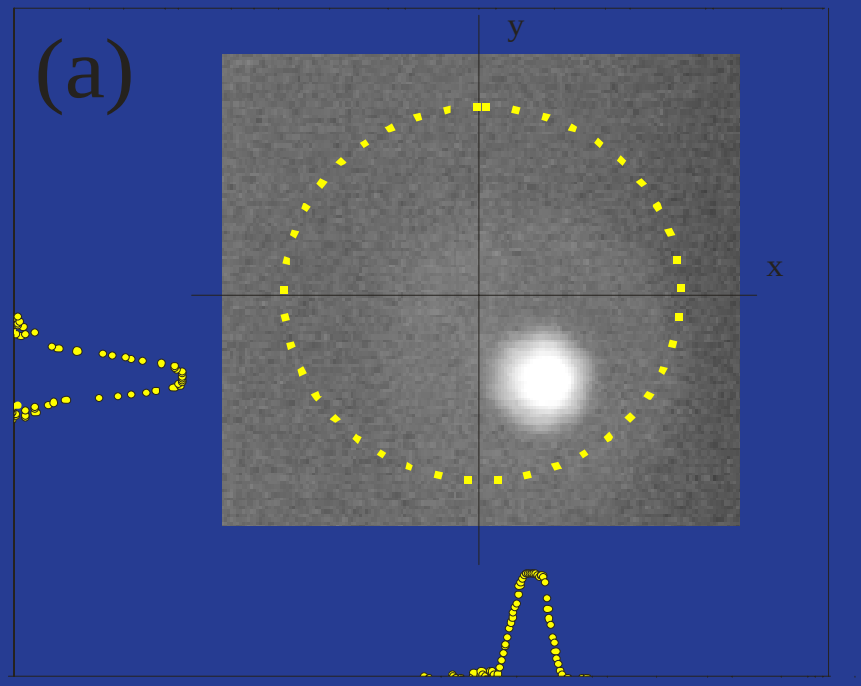
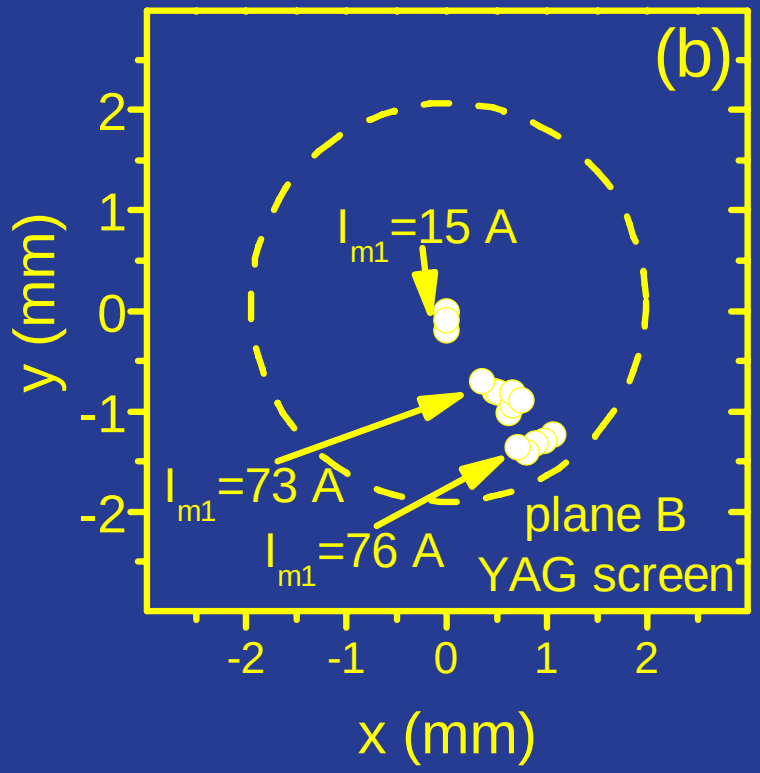
Electron beam transport





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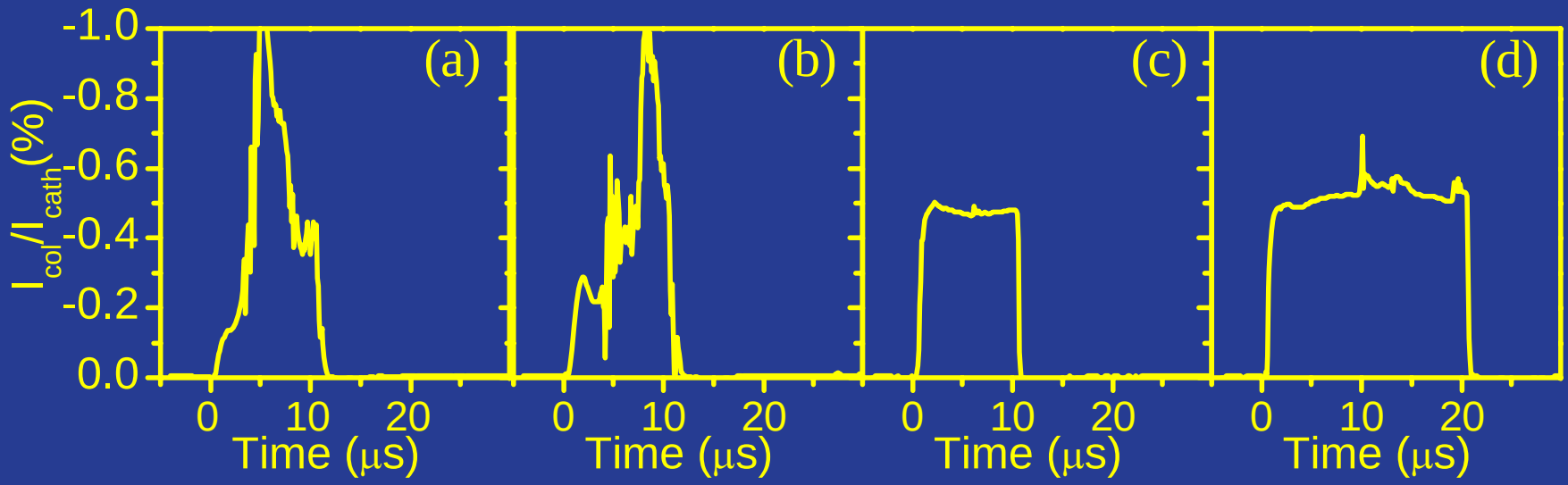
Electron beam transport



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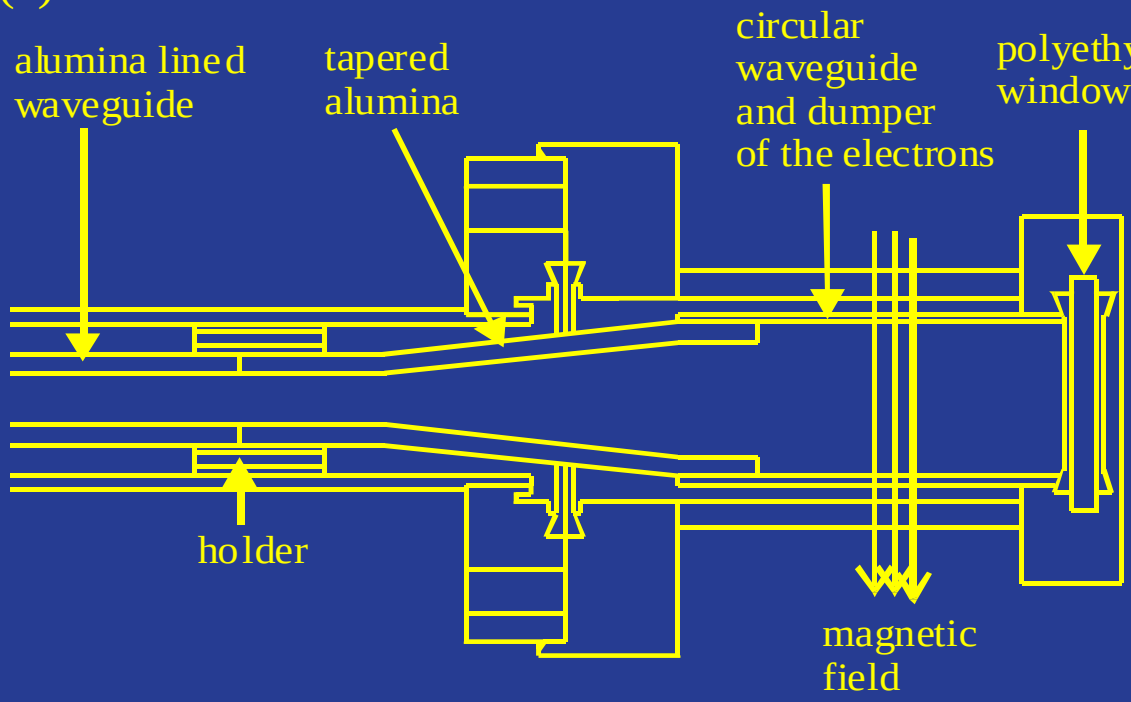
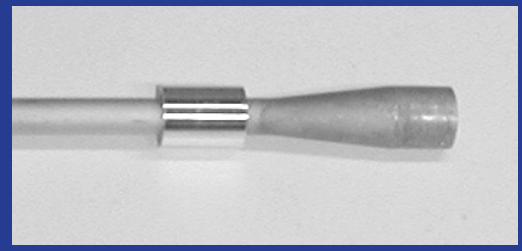
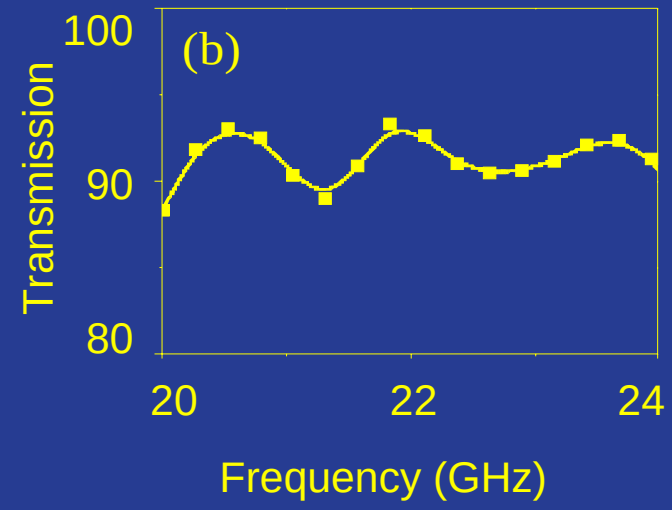
Outcoupling for ‘amplifier’ setup

(a)







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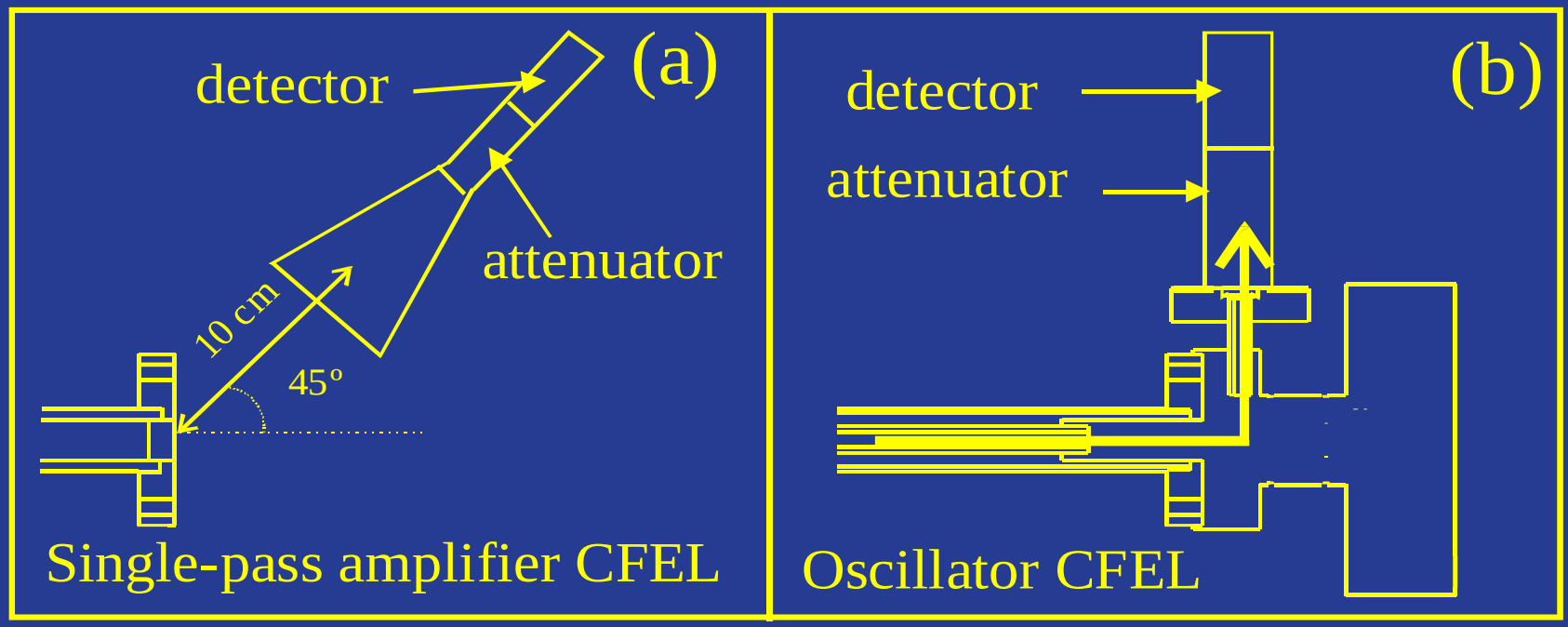

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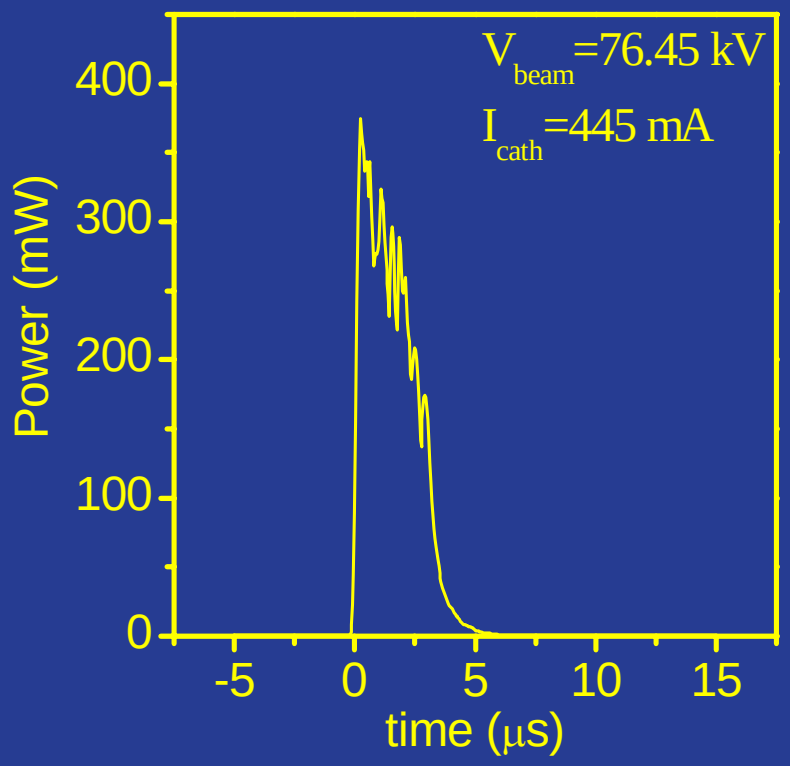
Typical Output Power



Power in finite solid angle of detector

Integrated over all angles $\Rightarrow$ ~ 3 W

Theory predicts ~ 0.1 W assuming $\delta\gamma/\gamma \cong 5$ %, I_b=250 mA, 60 μm rms liner fluctuations, R=10 % and $\tan\delta = 10^{-3}$

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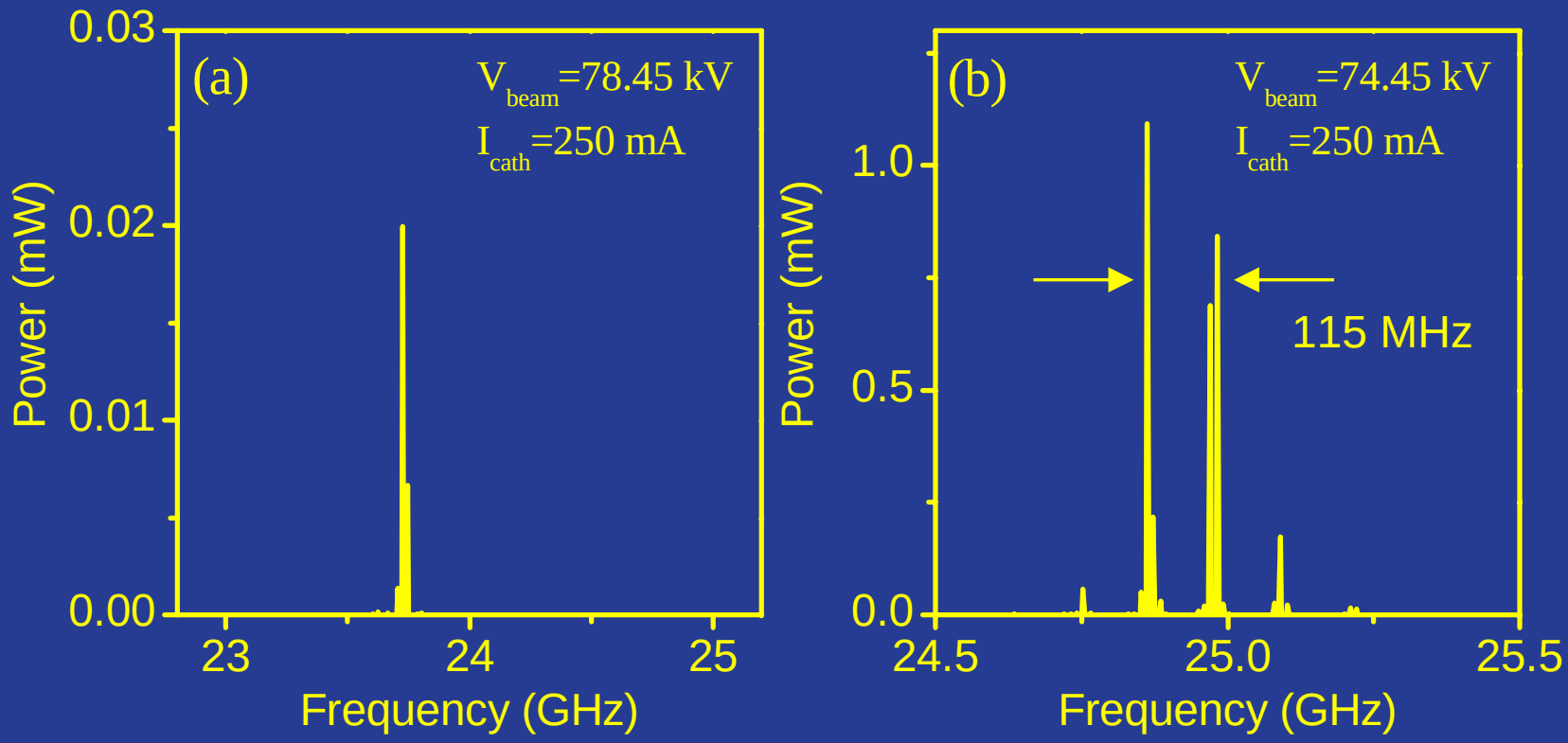
Typical Spectra



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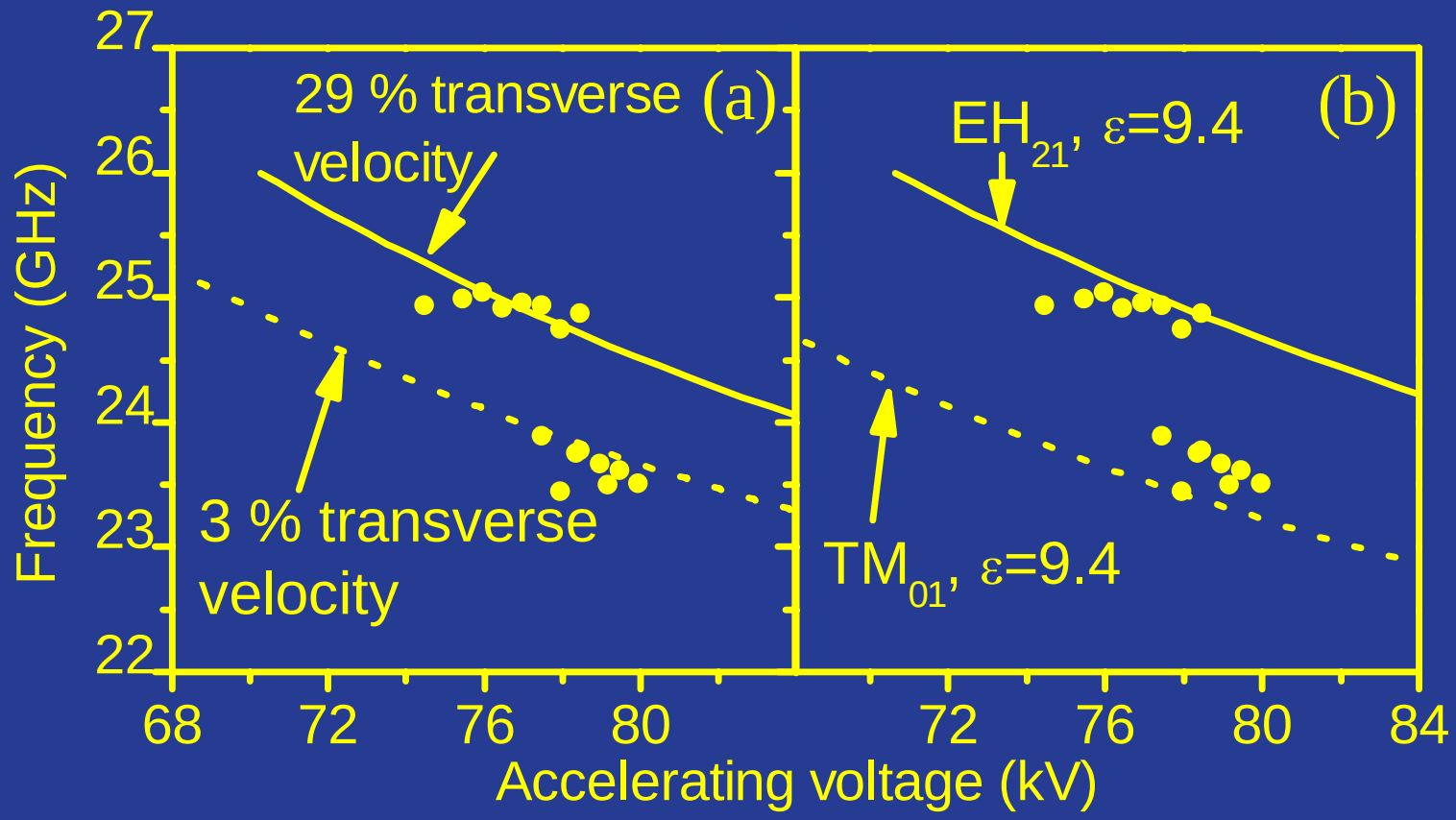
Tuning



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Conclusions

- Mode spacing agrees with resonator operation.
- Tuning rate -0.15 GHz/kV
- Operation at two different modes, one being a hybrid mode.
- Output power is low due to poor electron beam transport.
- Output power agrees reasonably well with theory
- Lasing observed for a collected current as low as ~ 100 mA.

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Outlook

- Reasonable agreement between theory and experiment for best estimates for liner fluctuations and energy spread.

- Performance can be significantly improved (kW level) with better beam transport $\Rightarrow$ redesign magnet + second anode.