Time resolved photocurrent measurements of terahertz QCLs

Richard Green, Alessandro Tredicucci, Lukas Mahler

(SNS Pisa)

NQ Vinh, Ben Murdin, Carl Pidgeon

(FELIX, Surrey, Heriot-Watt)

Harvey Beere, Dave Ritchie

(MBE growth- Cambridge)

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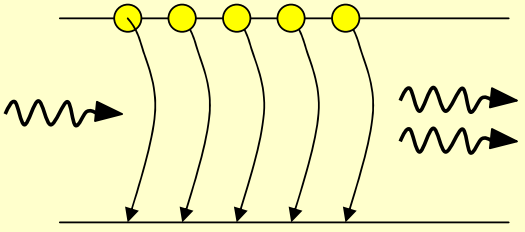
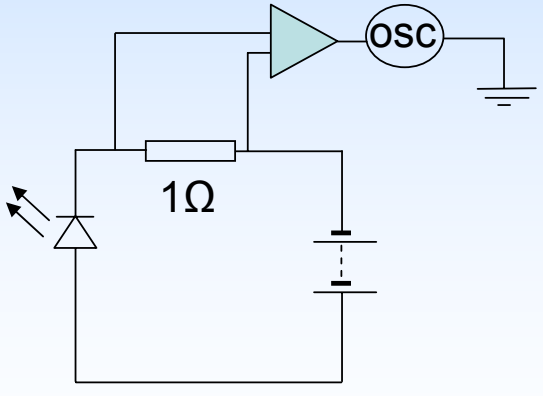
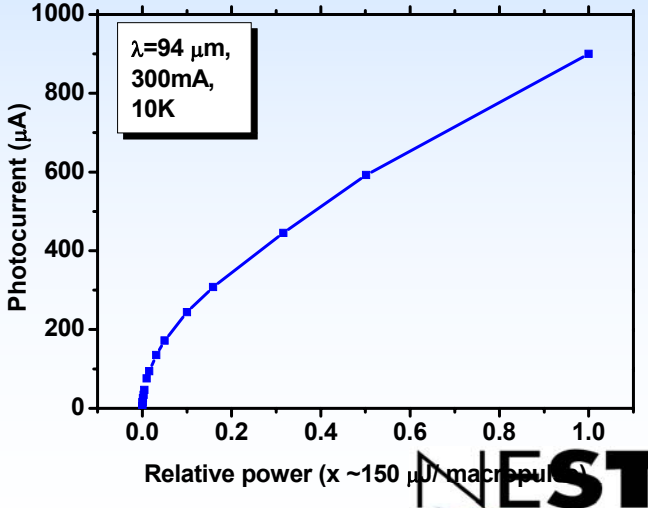
Photocurrent measurements

- Use free electron laser source.
- Tunable short pulses (~10ps)
- High power
- Laser biased cw



FEL pulse stimulates emission- get current pulse.





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Photocurrent measurements

- Use free electron laser source.
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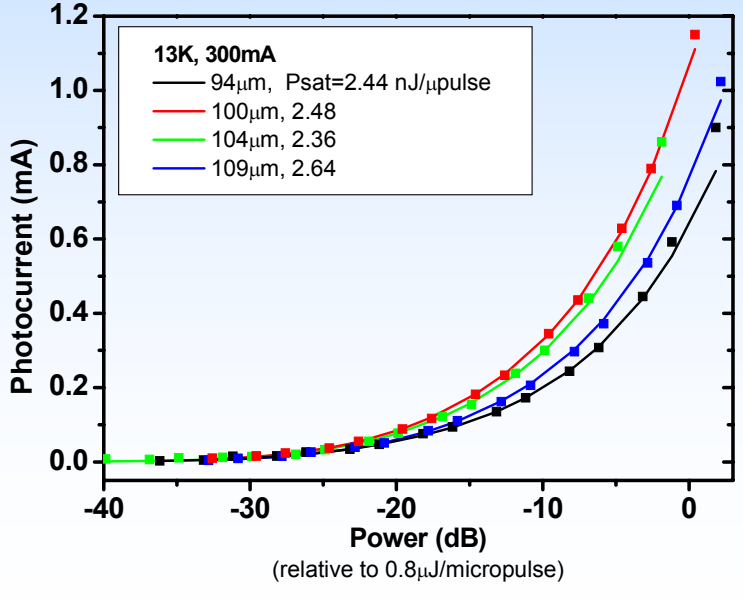
Transition saturation:

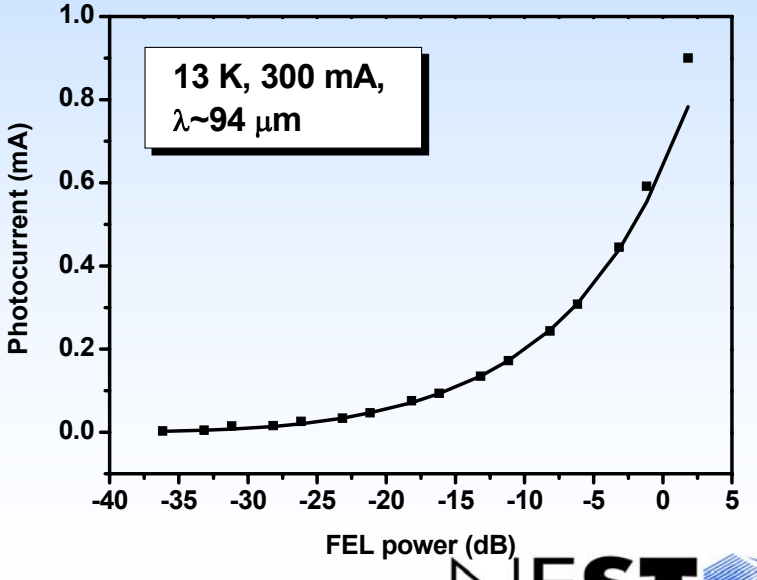
Homogeneous broadening

$$\Delta I = \frac{\alpha_0 P}{1 + \frac{P}{P_{sat}}}$$

Inhomogeneous broadening

$$\Delta I = \frac{\alpha_0 P}{\sqrt{1 + \frac{P}{P_{sat}}}}$$





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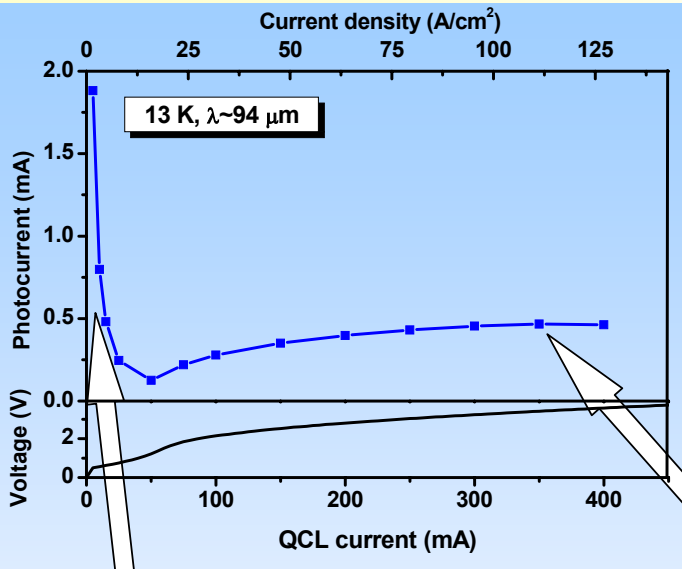
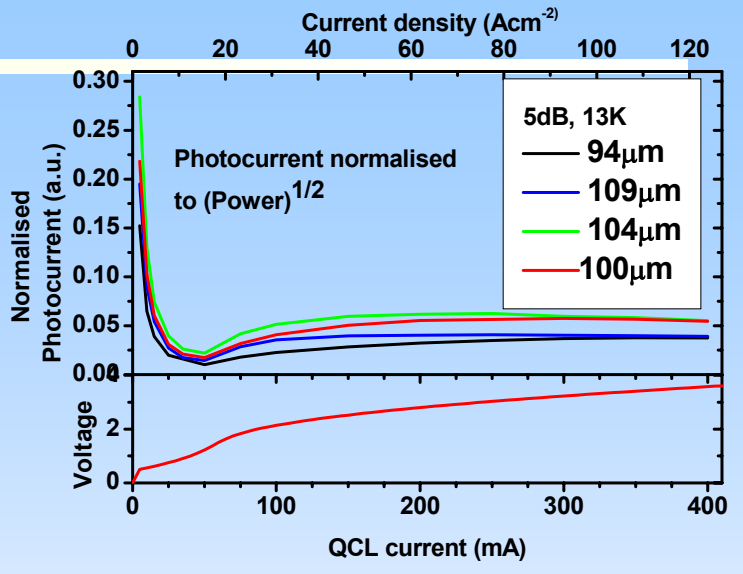
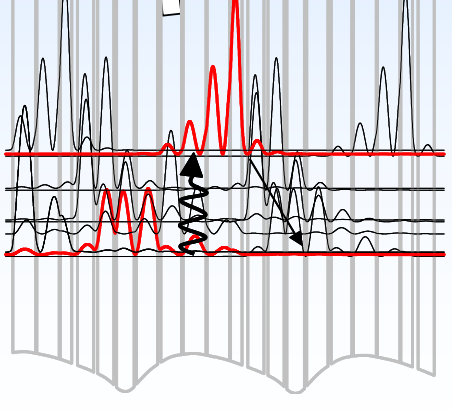
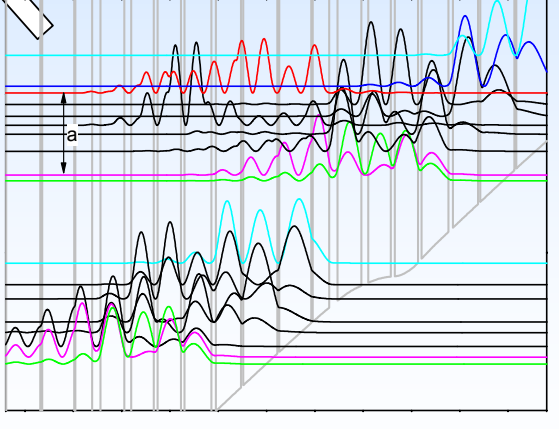
Current dependence









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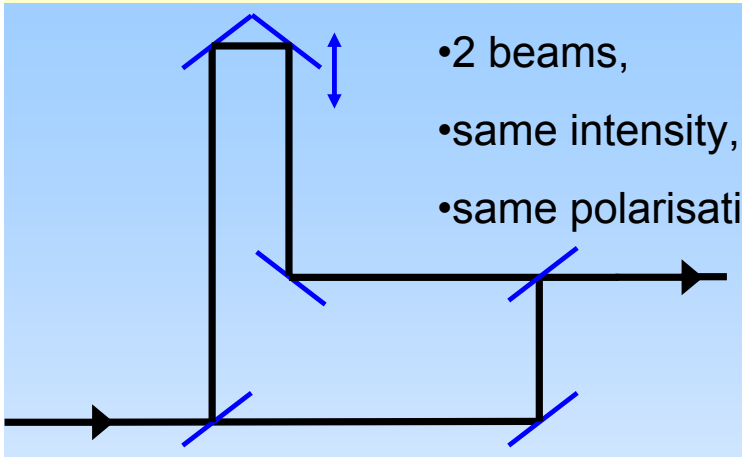
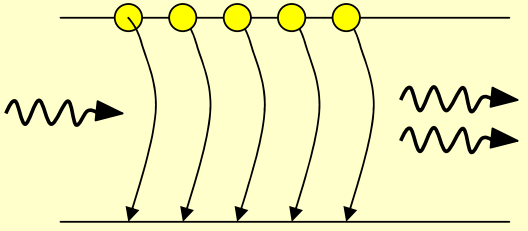
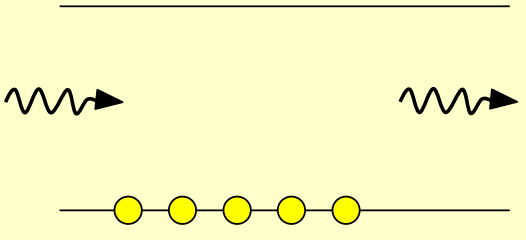
Time resolved photocurrent



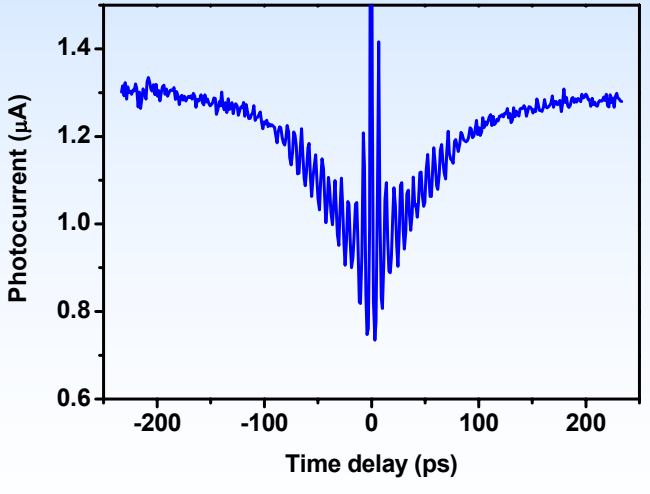
- 2 beams,
- same intensity,
- same polarisation



FEL pulse stimulates emission- get current pulse.



Short delay times- no electrons in ull ï no current pulse



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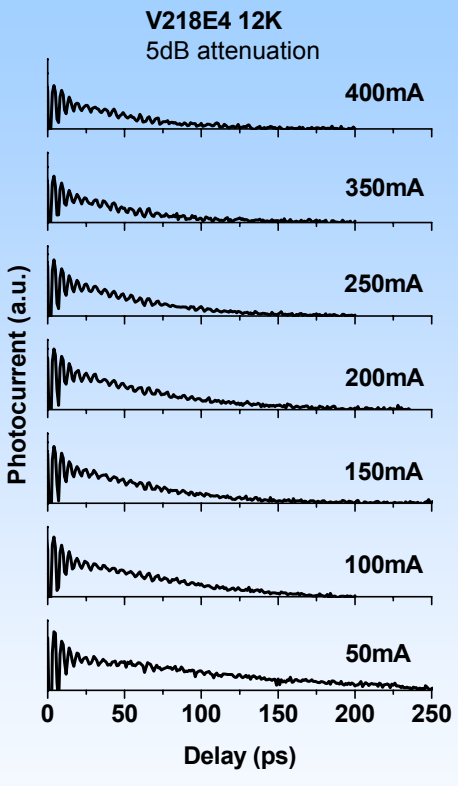
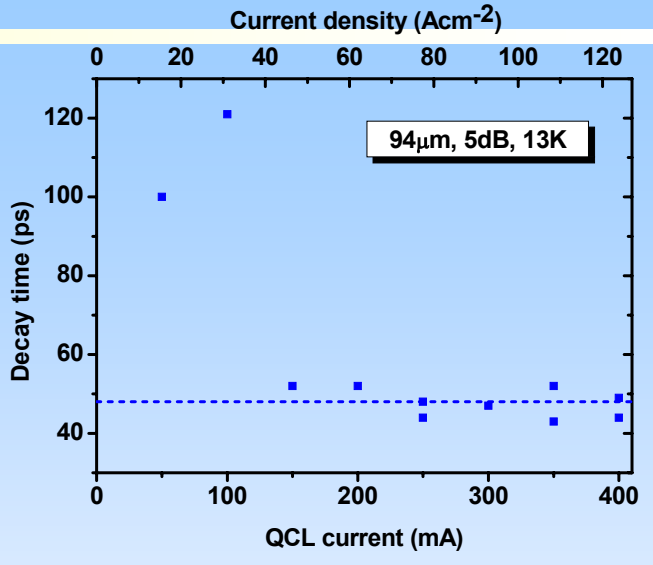
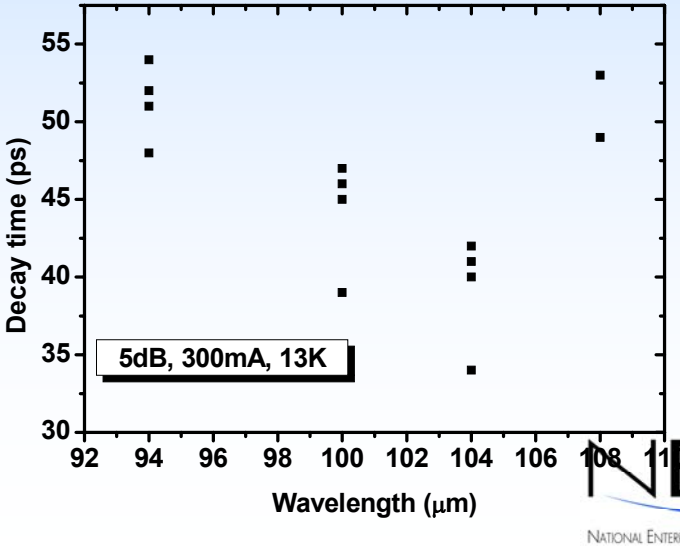
Time resolved photocurrent







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Conclusions

- ✓Time resolved photocurrent used to measure QCL dynamics
- ✓Laser transition inhomogeneously broadened
- ✓Gain recovery time 40-50 ps

r.green@sns.it

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Conclusions

- ✓Measure LEF of a THz QCL
- ✓LEF~0.5
- ✓Due to cross- absorption effects
- ✓Time resolved photocurrent used to measure QCL dynamics
- ✓Laser transition inhomogeneously broadened
- ✓Gain recovery time ~50 ps

r.green@sns.it

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Contents

- Terahertz QCLs
- Linewidth Enhancement factor
- Time resolved photocurrent & gain recovery time

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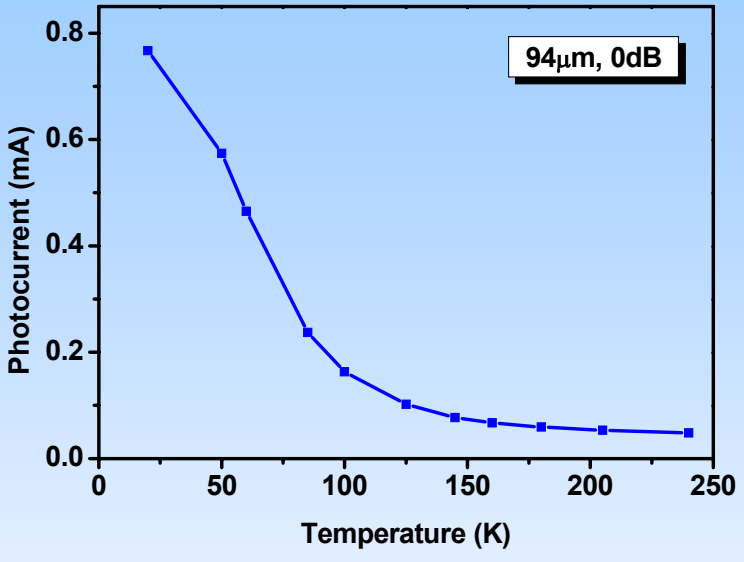
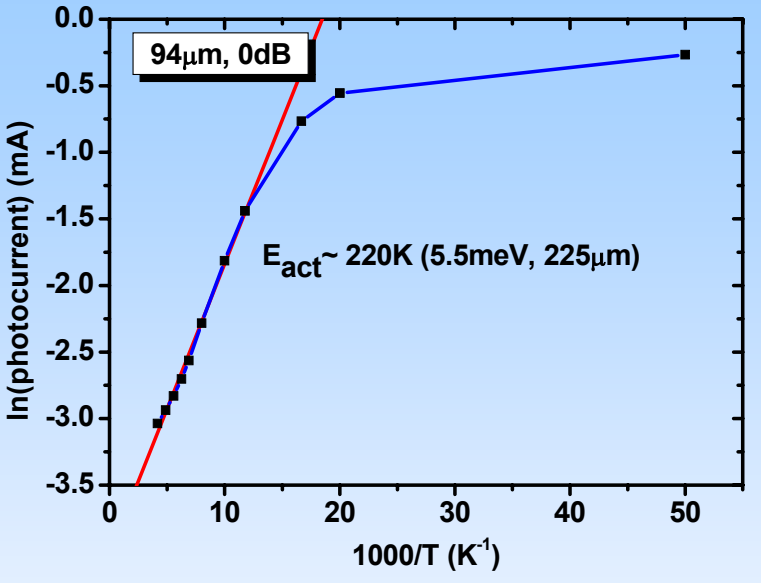
Temp dependence





Decay times reduce very quickly with temperature

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