Need of improved sources for medical fluorescence diagnostics

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Identification or staging of visible lesion

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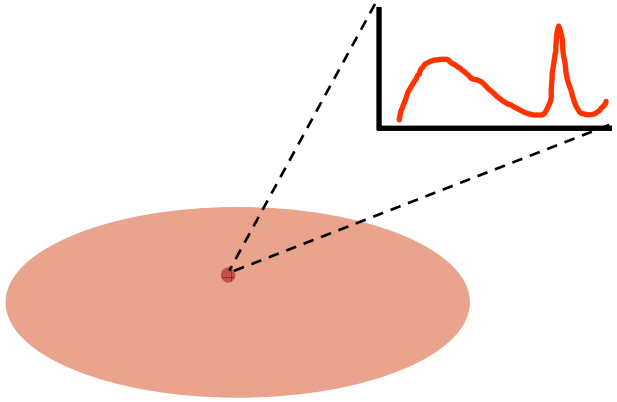
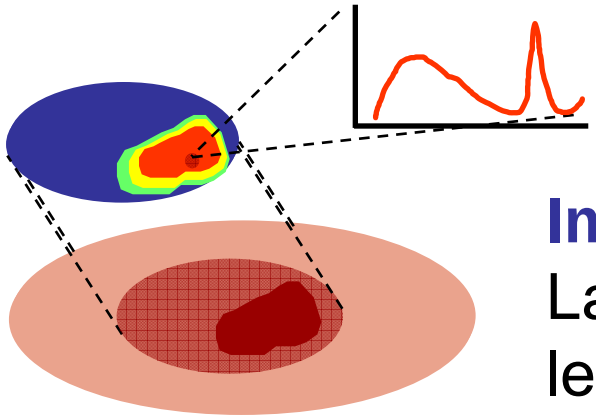
Point monitoring:
Whole spectrum in one small tissue site



Delineating lesion and visualization of tumour border



Multicolour or Hyperspectral imaging

Imaging:
Larger area often implies less spectral information

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Fluorescence

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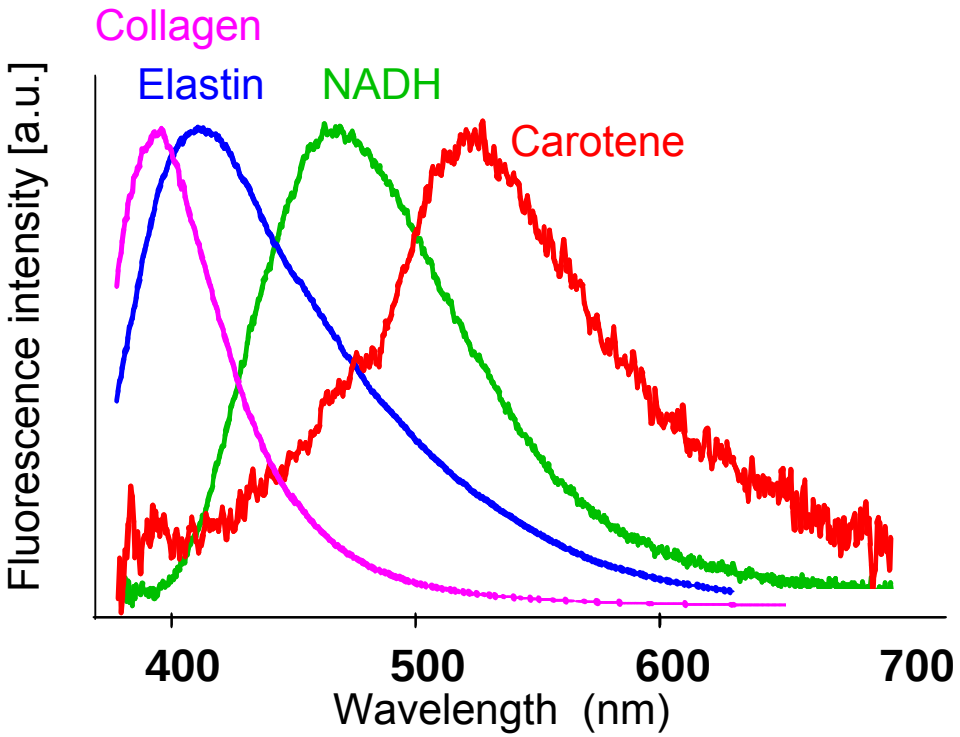
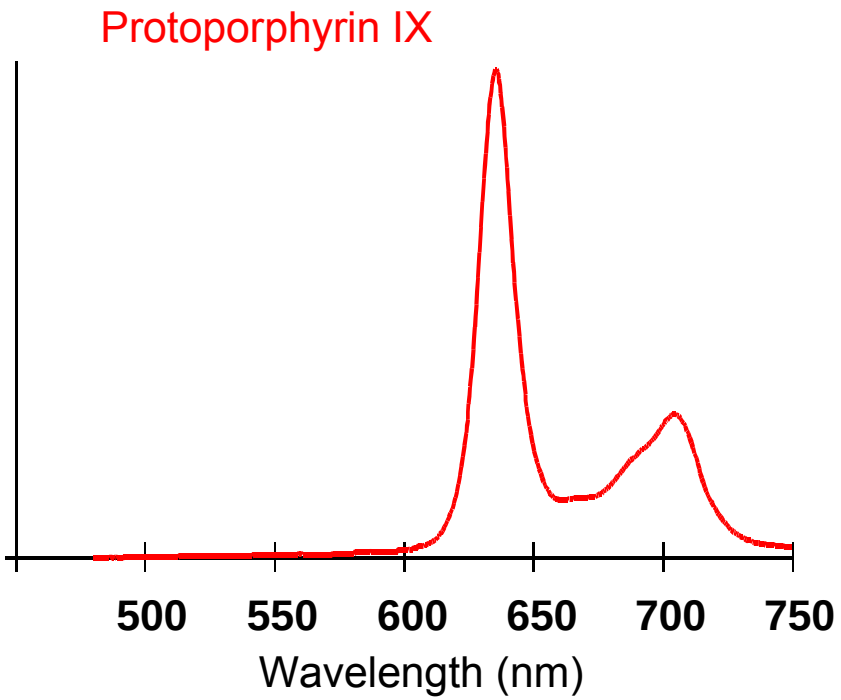
Tissue autofluorescence

337 nm excitation



Protoporphyrin IX

405 nm excitation



J. Johansson, Dissertation thesis, LTH (1993).
af Klinteberg *et al.* (1999)

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Gated Fluorosensor

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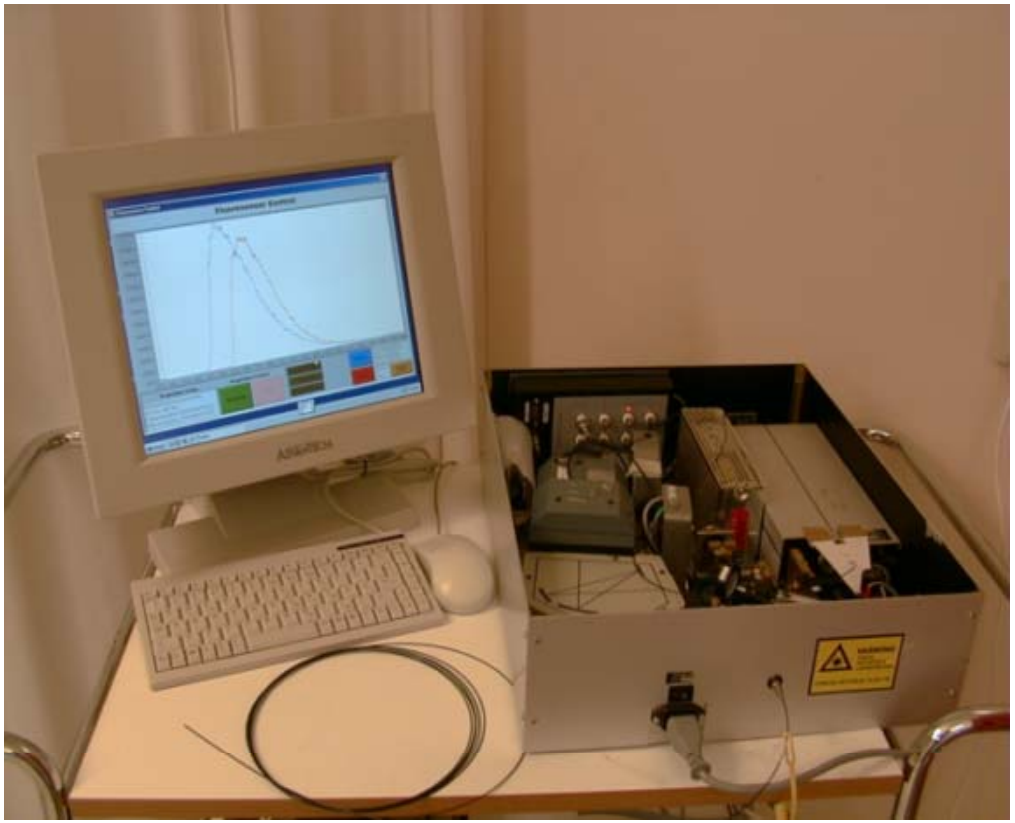

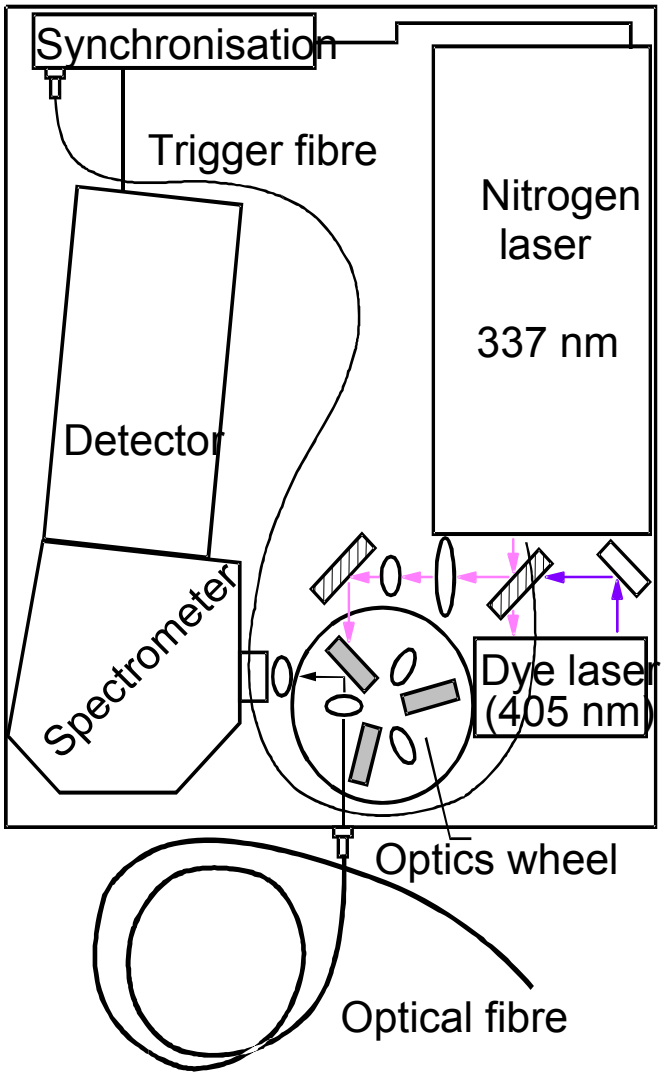

C. Eker *et al.* Gut (1999)
C. Eker *et al.* Lasers Surg Med (2001)
C. af Klinteberg, *et al.* Rev Sci Instrum. (2005)
S. Pålsson et al. JEPTO (2006)

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Clinical measurements

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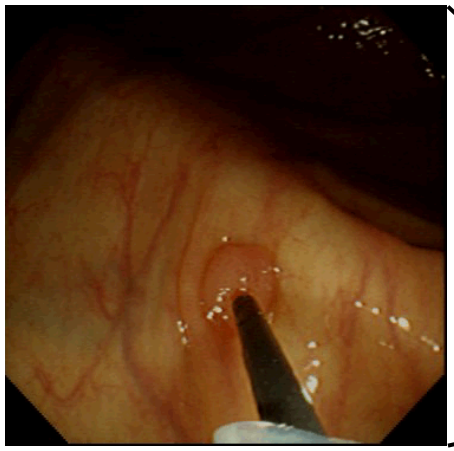

Hyperplastic:

Adenomatous:

C.Eker, et al. *Gut* 44, 511-518 (1999).

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Diode laser fluorosensor

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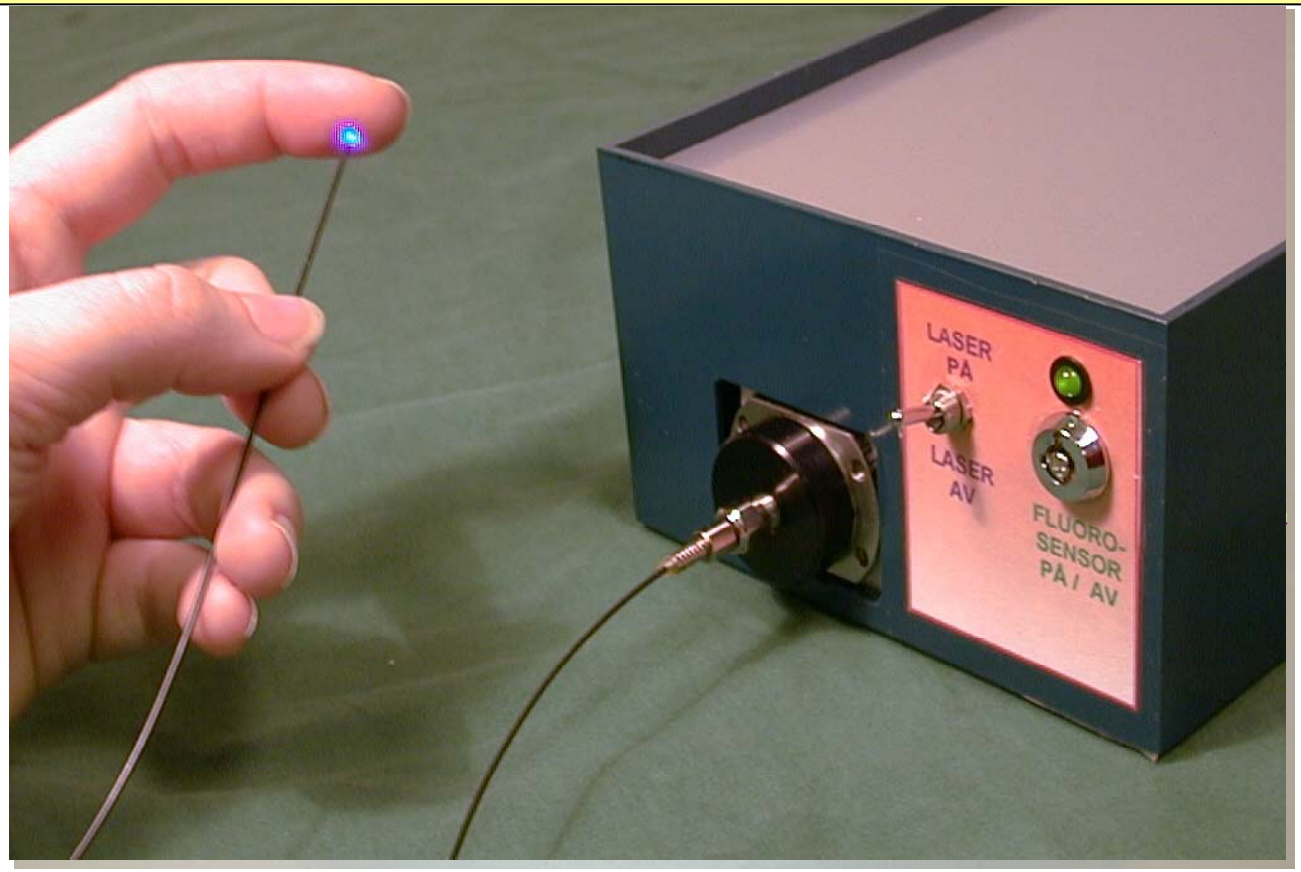
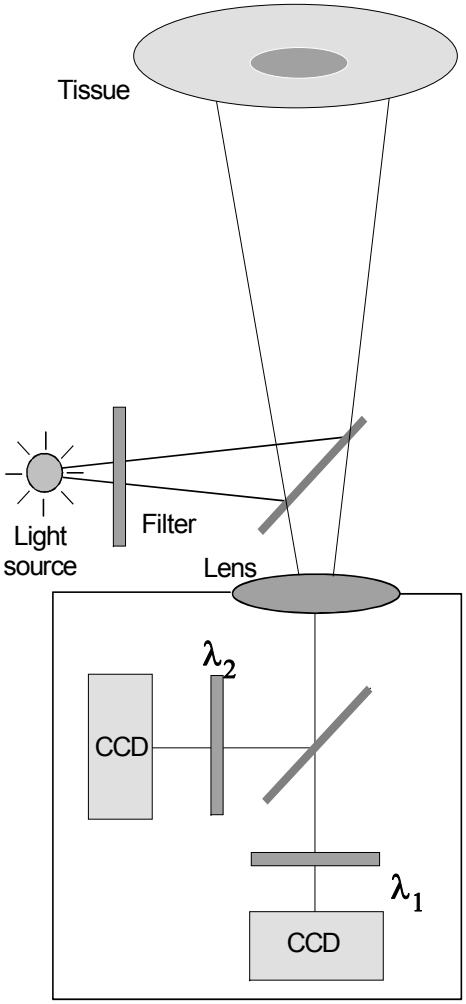


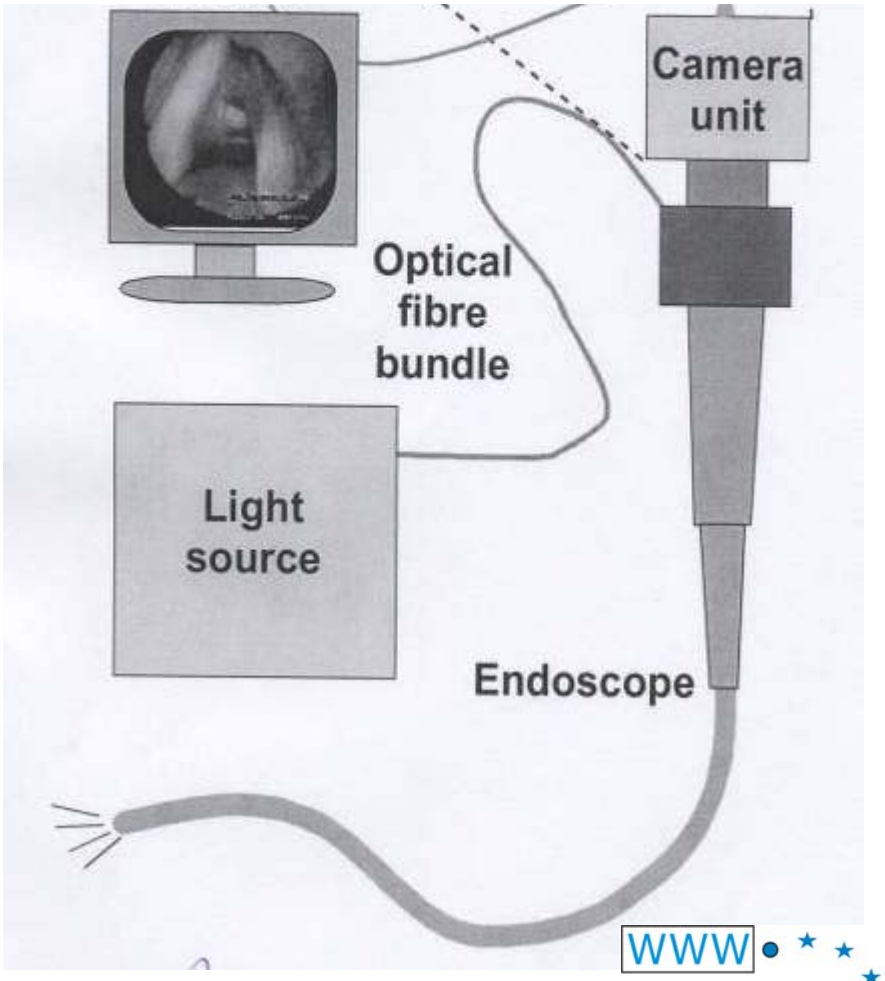
- **Diode laser 396 nm**
- **Beam splitter**
- **Optical fibre**
- **Spectrometer**
- **Shutter**

Lap top controlled

Also constructed LED based fluorosensors
BUT - Need of more power and pulsing!

Multicolour fluorescence imaging





S. Andersson-Engels *et al* Appl Opt (1993)
K. Svanberg *et al* Acta Radiologica (1998)
S. Andersson-Engels *et al.* Lasers Surg Med (2000)
S. Andersson-Engels *et al.* Biomedical Optics (in press)

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Ambient light shielding

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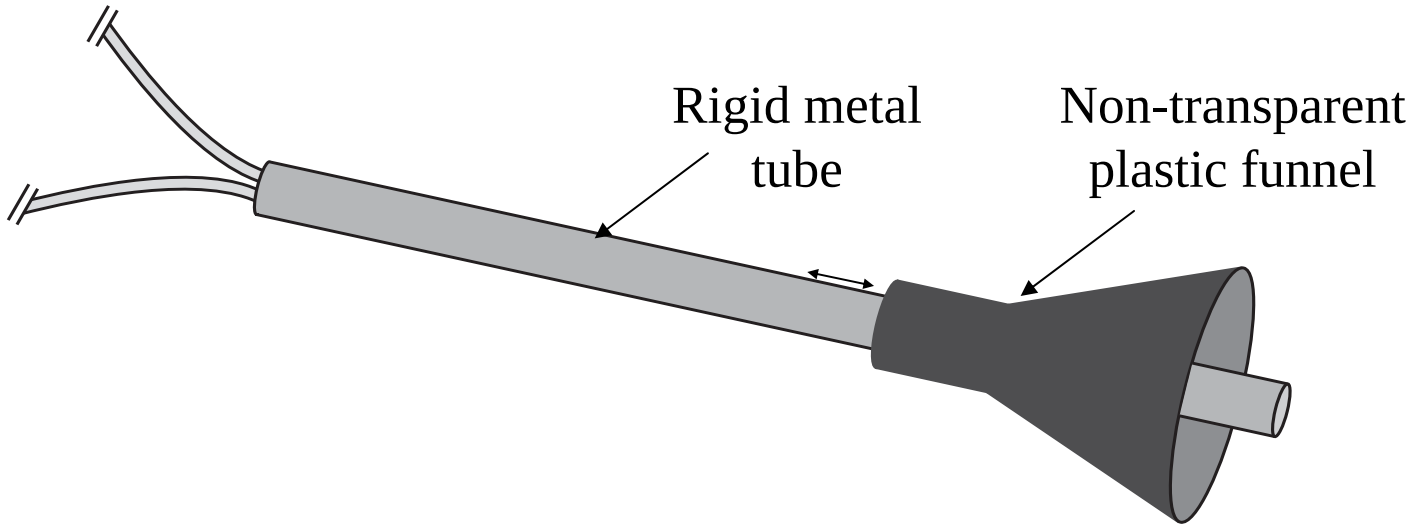

M. Ilias *et al.* Proc SPIE 6631 (in press)

Suppression of ambient light

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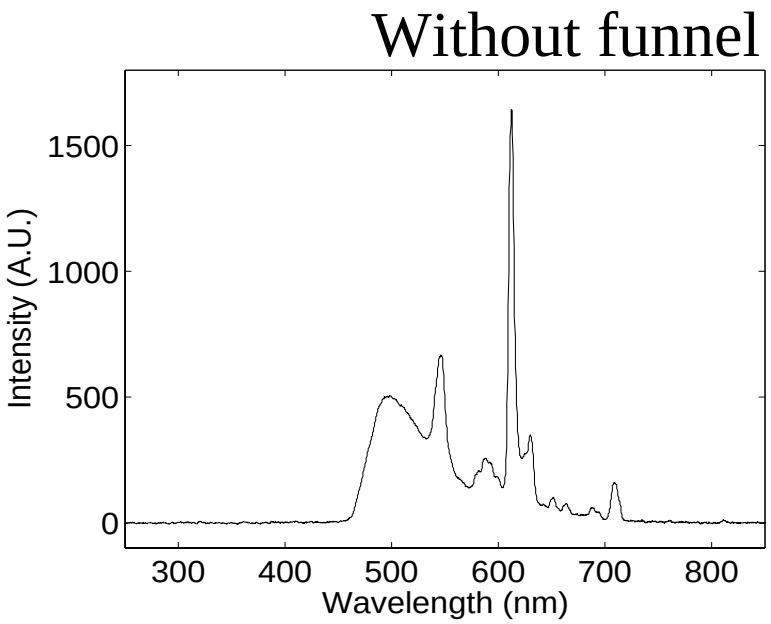

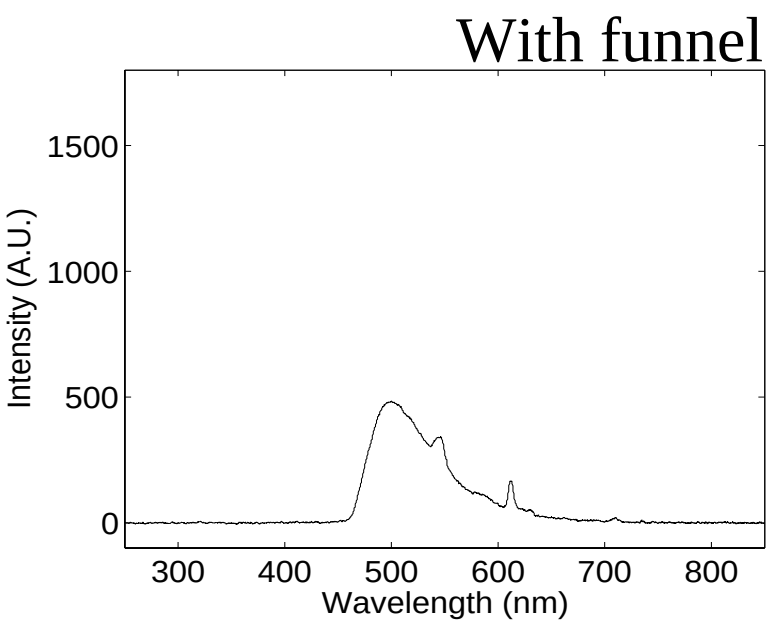

M. Ilias *et al.* Proc SPIE 6631 (in press)

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Skin measurements

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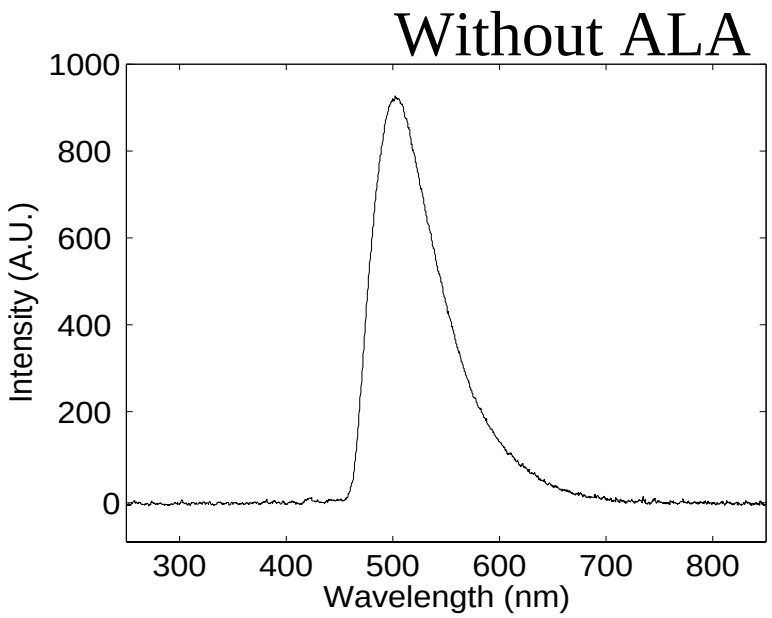

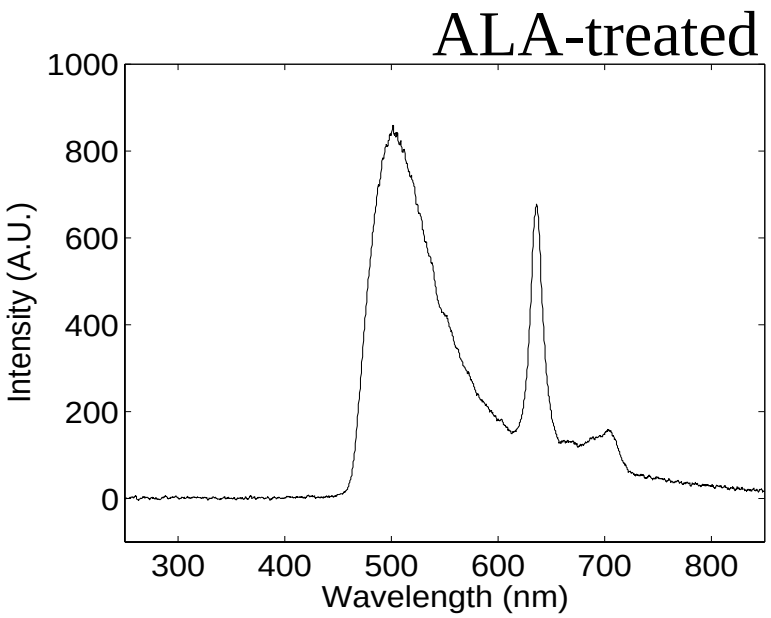

M. Ilias *et al.* Proc SPIE 6631 (in press)

See presentation Michail Ilias ECBO 6631-34 Tuesday 12.00

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Brain measurement

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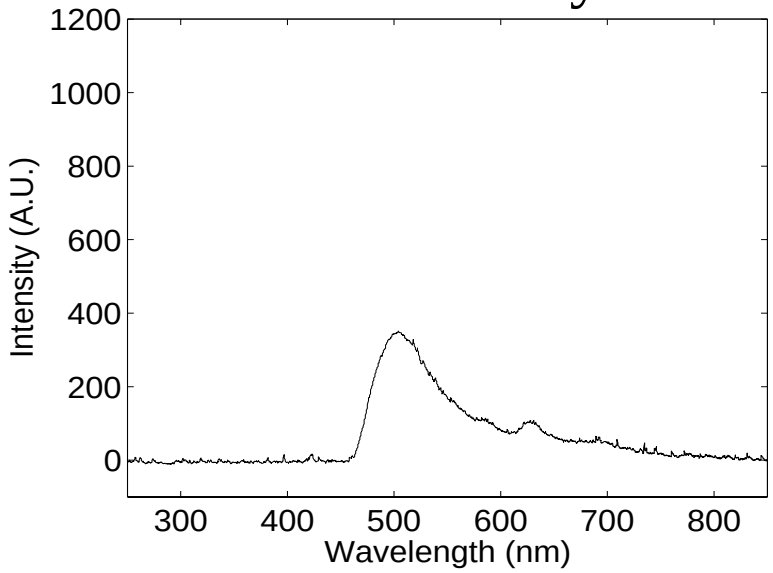
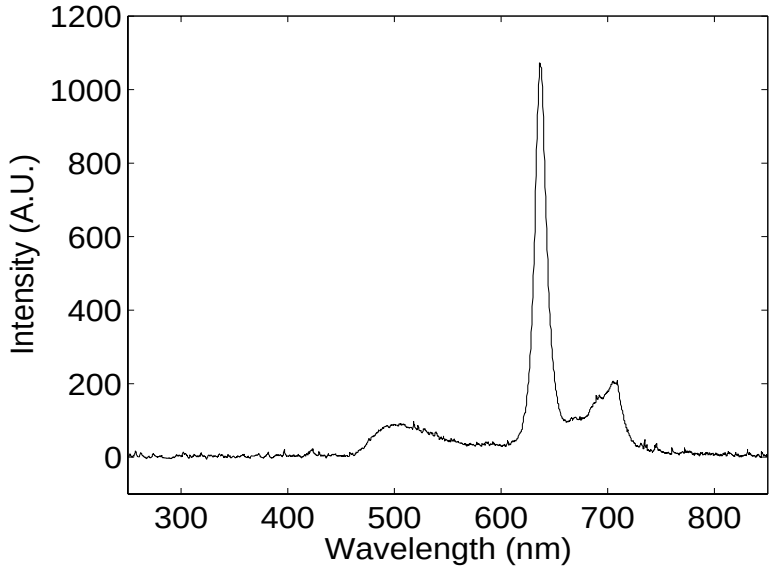
Healthy tissue



Glioblastoma multiforme



M. Ilias *et al.* Proc SPIE 6631 (in press)

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The need

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- Currently, there is lack of suitable, compact sources fulfilling requirements for clinical applications
  - wavelength,
  - output power,
  - pulse duration, repetition rate and duty cycle,
  - beam quality,
  - compactness.
- Semiconductor laser systems fulfilling the above-mentioned requirements are being investigated
- Advantages with semiconductor lasers
  - high wall-plug efficiency,
  - high output power.
- Challenges
  - **Pulsing!**
  - how much output power is needed?
  - beam quality and spectral shape?

Target specifications – the challenge

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	Fluorescence spectroscopy	**Fluorescence imaging**
Average power @ 405 nm (to allow real time recording)	> 1 mW	> 10 mW
Duty cycle (to allow suppression of ambient background light)	< 10^{-4}	< 10^{-4}
Rep. Rate (limited by repetition rates of the image intensifier of available cameras)	< 1 kHz	< 5 kHz
Pulse duration (calculated as the longest pulse possible with the duty cycle given and highest rep. rate.)	≈ 100 ns	≈ 20 ns
Peak power	≈ 10 W	≈ 100 W

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2W tapered laser with external feedback at 800 nm

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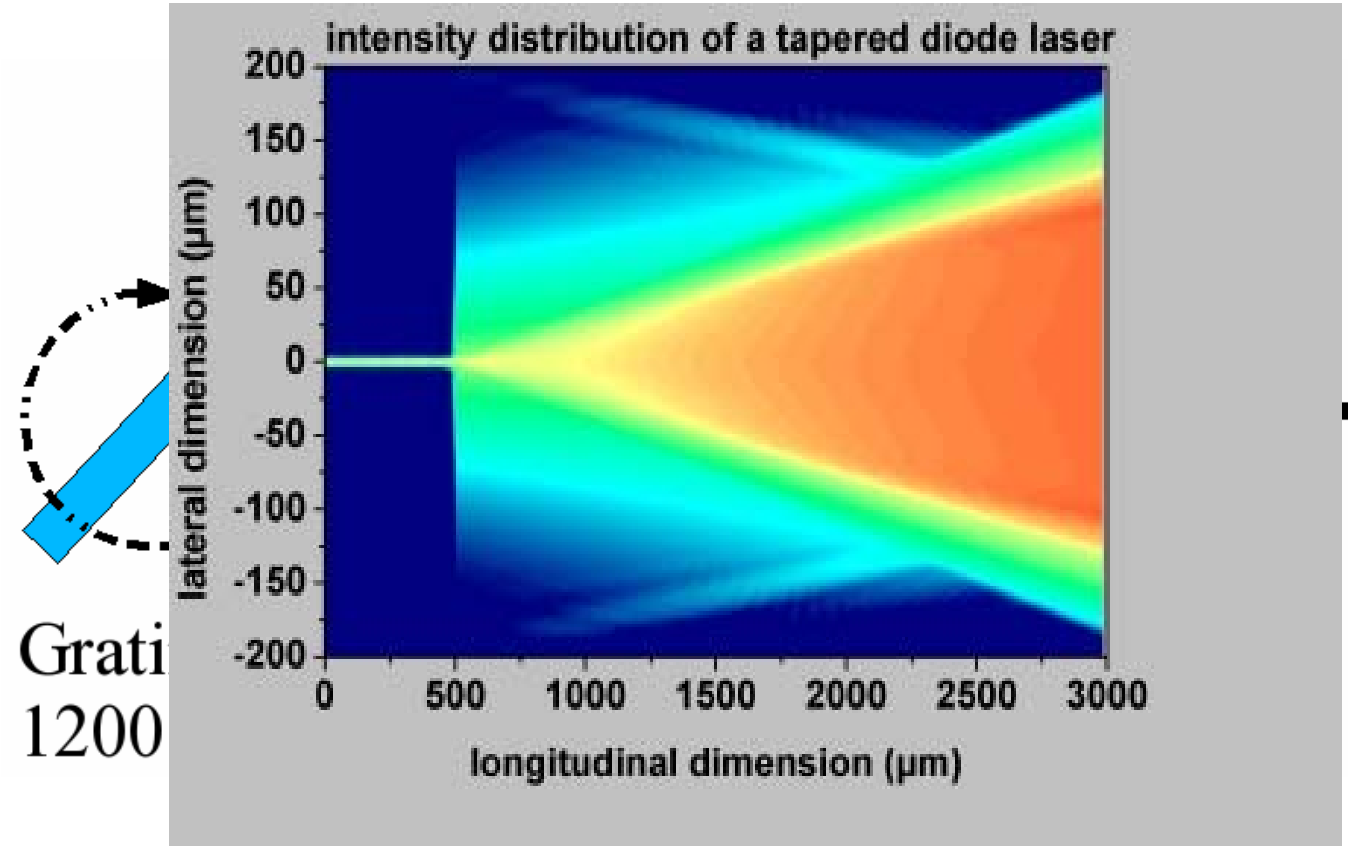

M. Chi, O. B. Jensen, J. Holm, C. Pedersen, P. E. Andersen, G. Erbert, B. Sumpf, and P. M. Petersen, Opt. Express **13**, 10589 (2005)

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405 nm laser adapted to Fluorescence imaging

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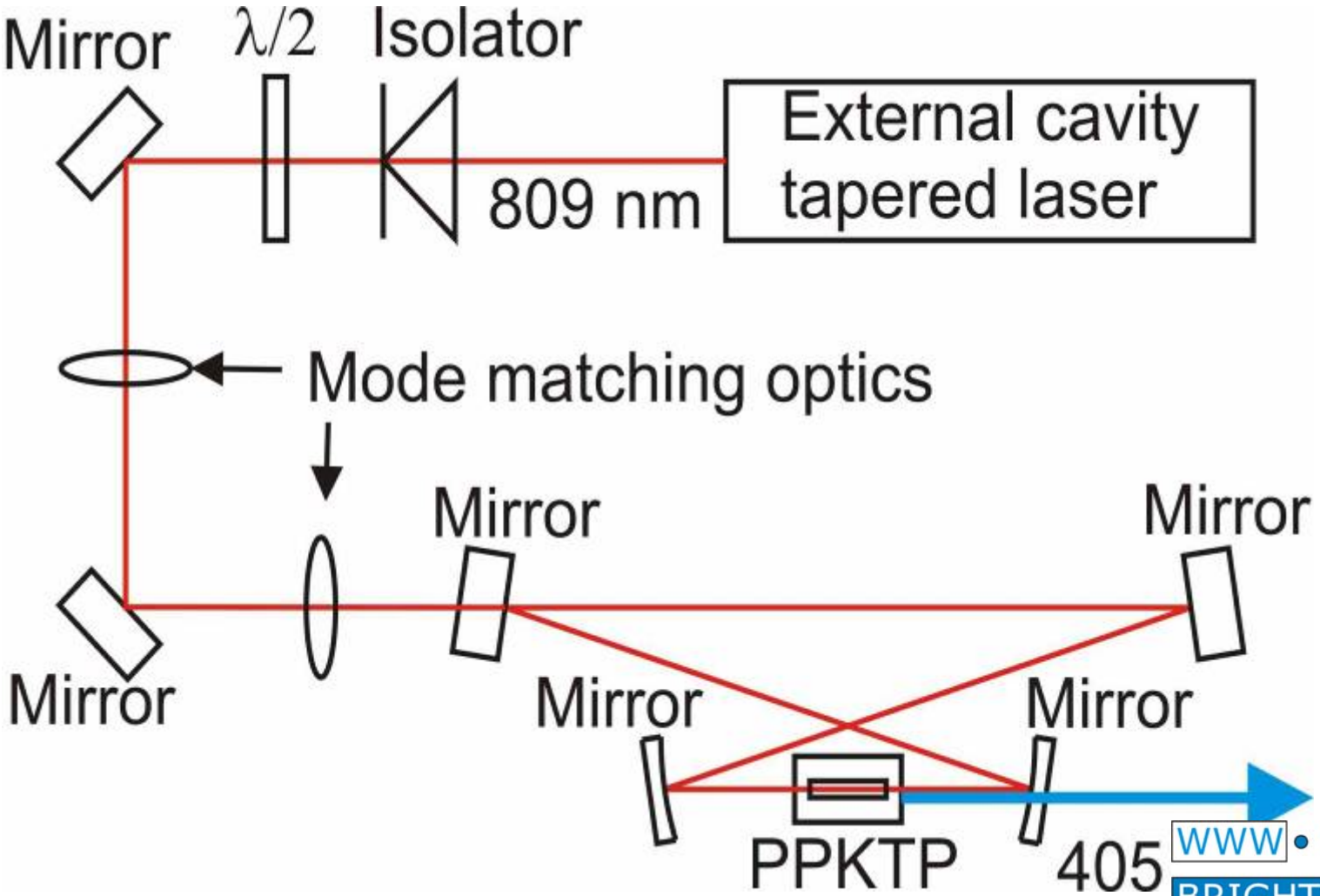

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Bow-tie – in the lab

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