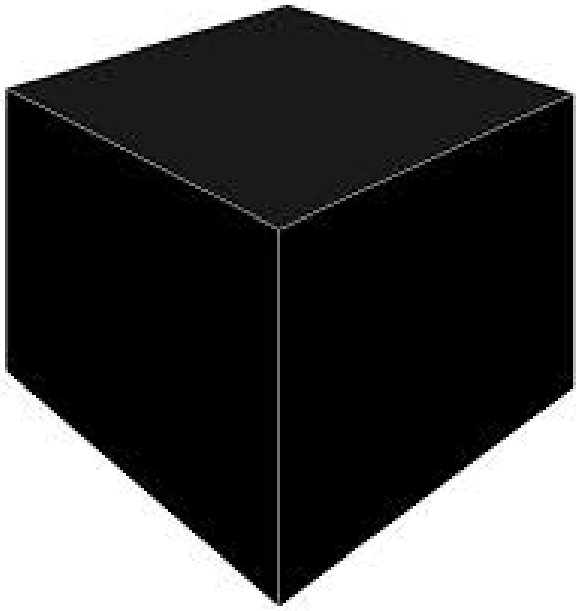


BLADDER CANCER DIAGNOSTICS WITH RAMAN CYTOLOGY

Bryan Hennelly, Laura Kerr, Shu Yu Wu, Ivor Cullen, Katarina Domijan, Sinead Barton, Fan Xin

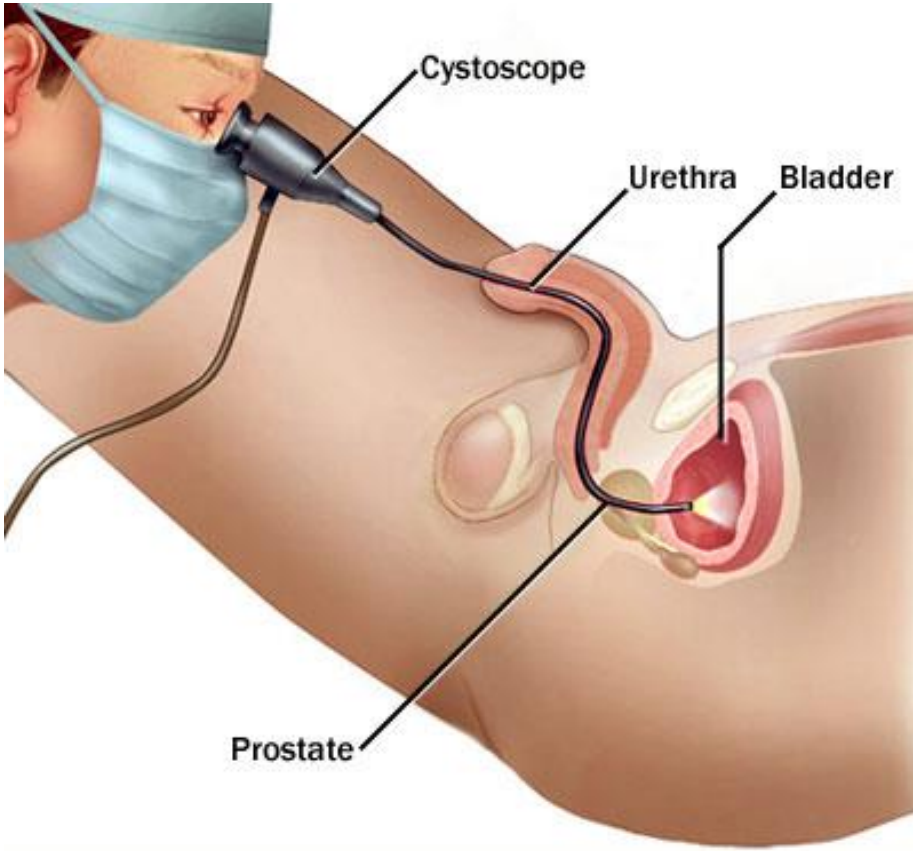
BINI 17th Jan 2015

sfi Science Foundation Ireland

Biophotonics Research Lab
Biomedical Engineering Group
NUIM

Gold standard in diagnostics for bladder cancer

- Patient presents with frank painless haematuria
- Cystoscopy
  - Fluorescence 5-ALA
- Urine cytology
  - Not used independently



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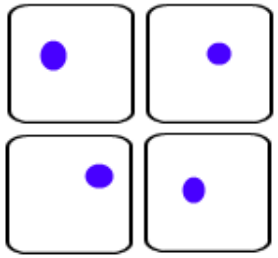
Bladder Cancer

Cystoscopic Imaging

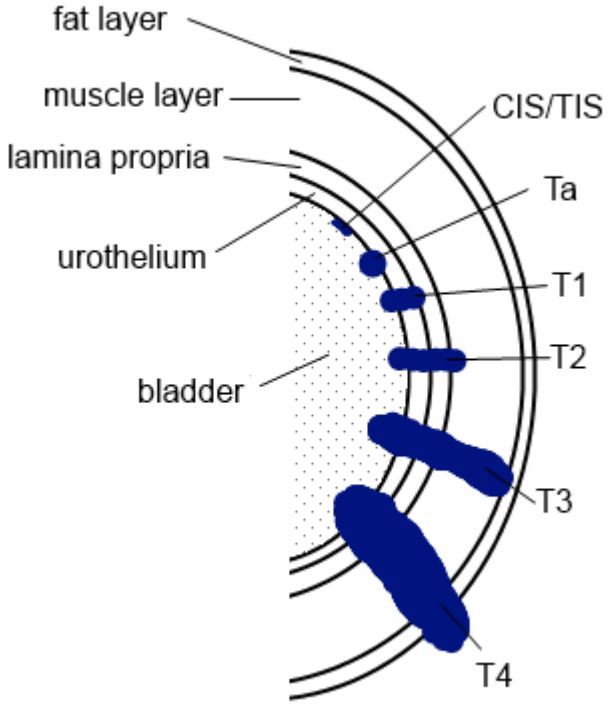
Histological Grade



Normal cells

Poorly differentiated cancer cells

Pathological Staging



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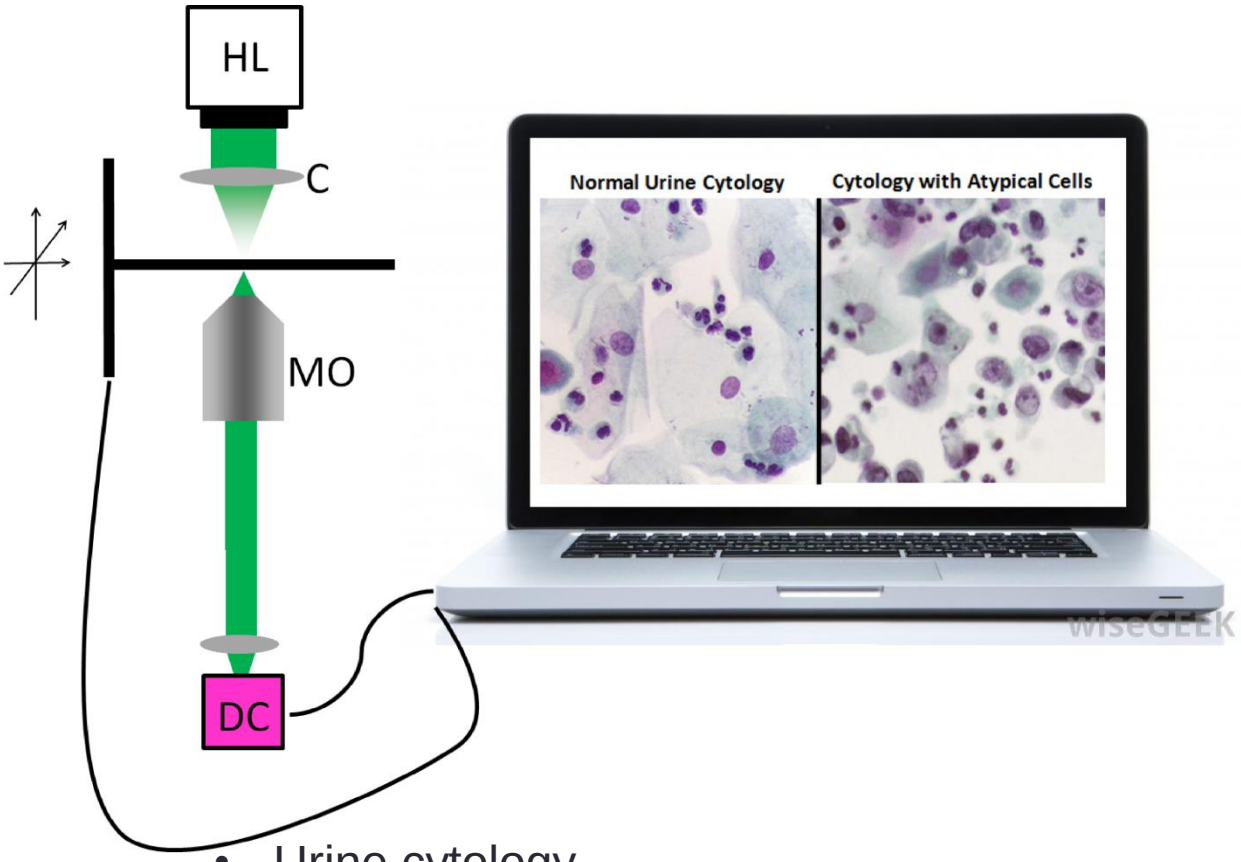
Inside the black box: urine cytology



- Urine cytology
  - 100% sensitive for high grade
  - 20% sensitive for low grade (75% of all cases!)

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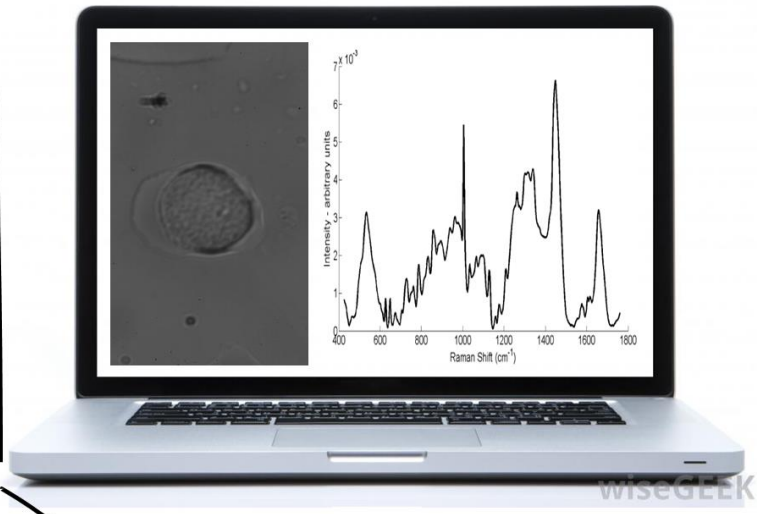
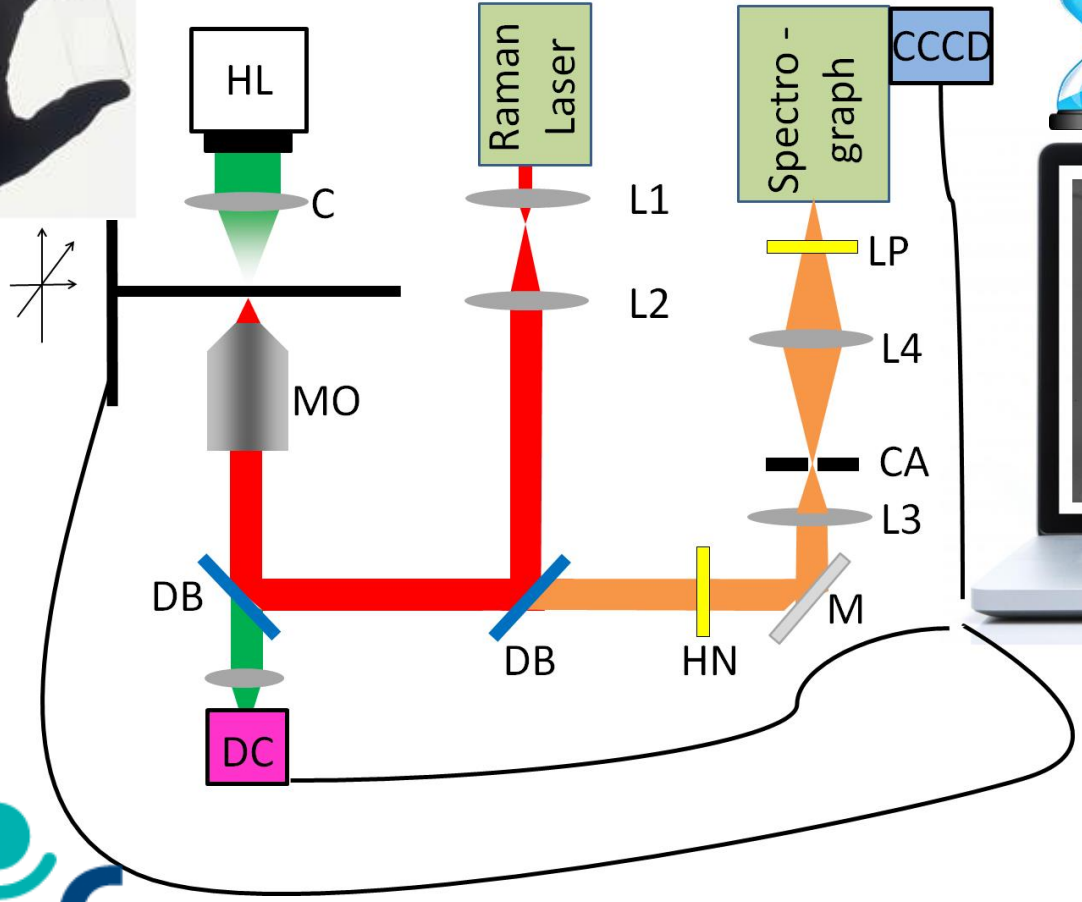
Inside the black box: Raman cytology





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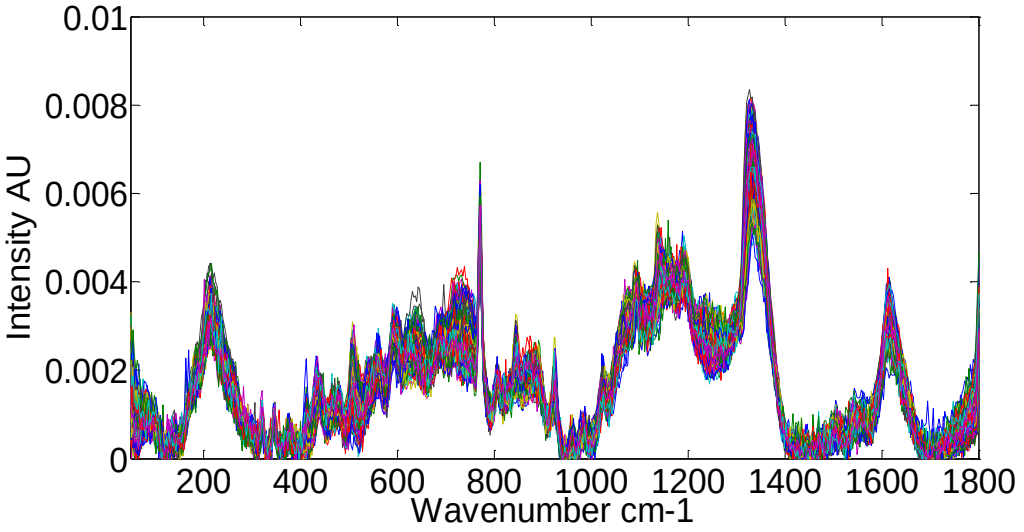
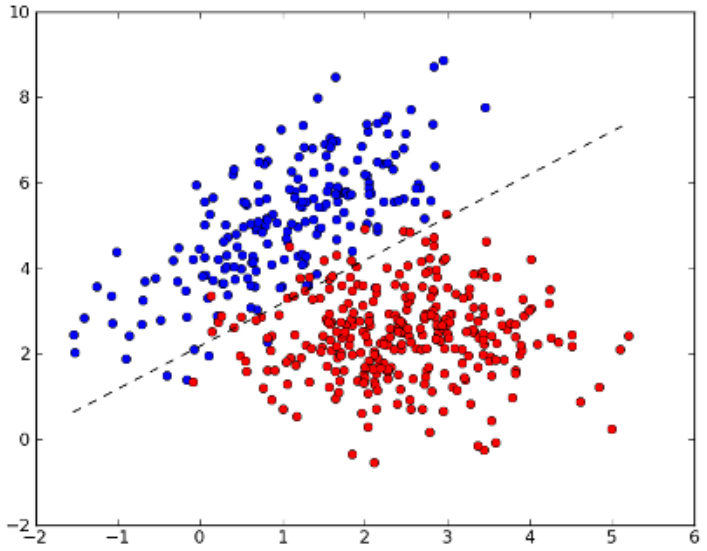
Chemometrics

- Multivariate Statistical Algorithms can detect subtle variations across datasets
  - Classify blind sample
- PCA/LDA allows us to quantify the separation between two groups
- Build up database
  - Healthy cells
  - Low grade
  - High Grade

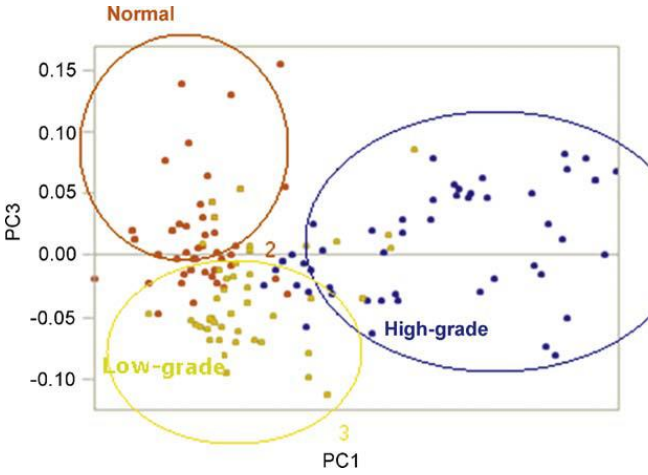




Previous work

- We conducted a large review of over 70 papers
- Only patient study to date: *Shapiro et. al. Journal of European Urology 59 (2011)*

	No. of cases	Detects cancer, n (%)	Correct grade, n (%)
No tumour	116	11 (9.5)	All classified low grade
Low grade	92	79 (95.8)	68 (73.9)
High grade	132	132 (100)	130 (95.8)



- Can we improve on this?
  - Better sensitivity/specificty
  - Suitable for the clinic??
  - Screening??? time taken

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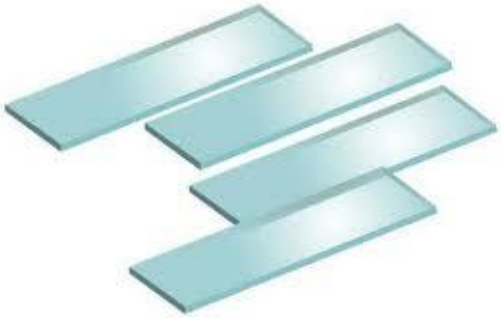
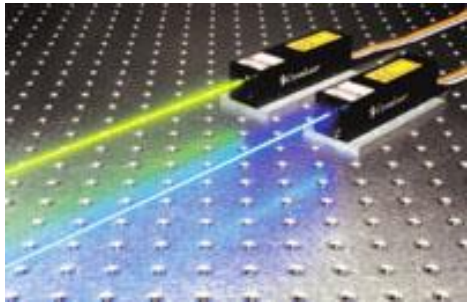
Wavelength/Substrates/Stats

- Exhaustive search for the best:

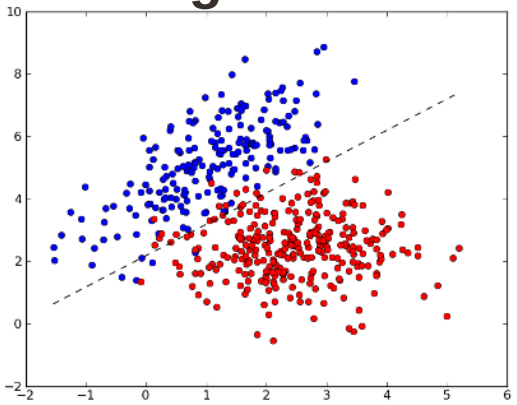
Slide Material



Laser wavelength



Statistical Method/ Algorithm



- Also completed considerable work on pre-processing of spectra to improve results
  - Noise removal
  - Wavelength Calibration
  - Background subtraction

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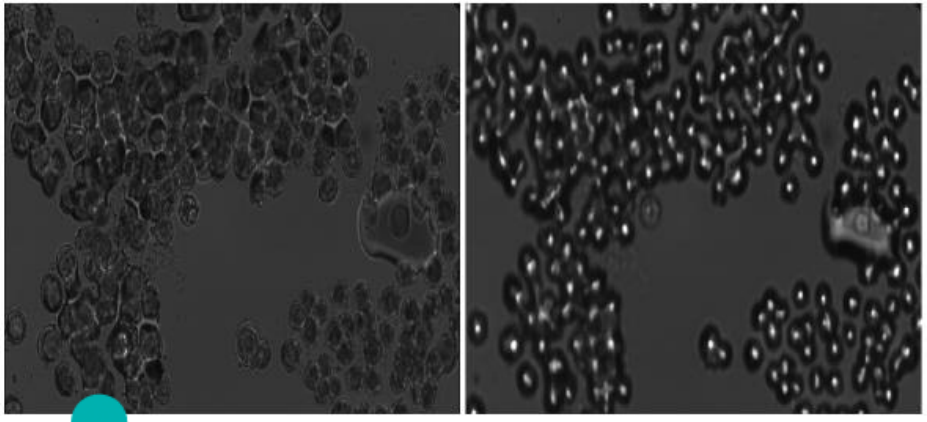
Automated Raman Cytology

- Basic system designed/patented
  - Image processing used to scan slide, identify and align cell nuclei with source laser



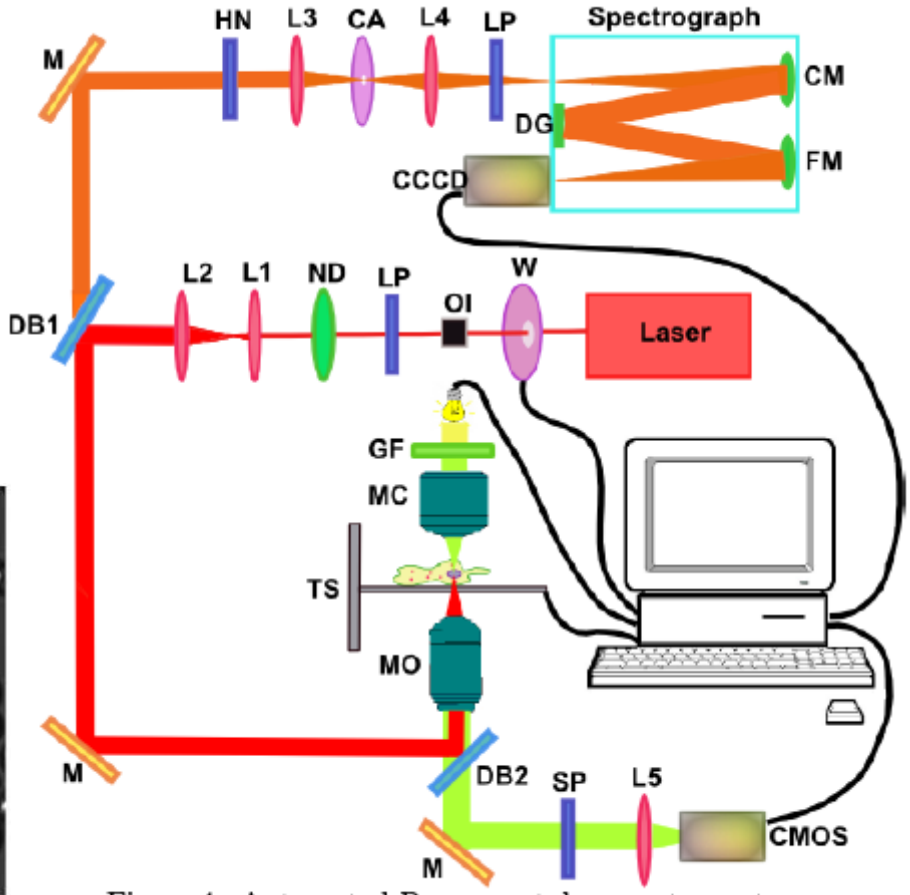


Figure 1: Automated Raman cytology system set-up

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Next step: Medical Trial

- Fixing study
  - Vial with 50% ethanol
  - ICA to separate ethanol spectrum
  - Test using 5 cell lines and using automated Raman
- Ethical Approval and medical trial 2015-2016 Beaumont Hospital

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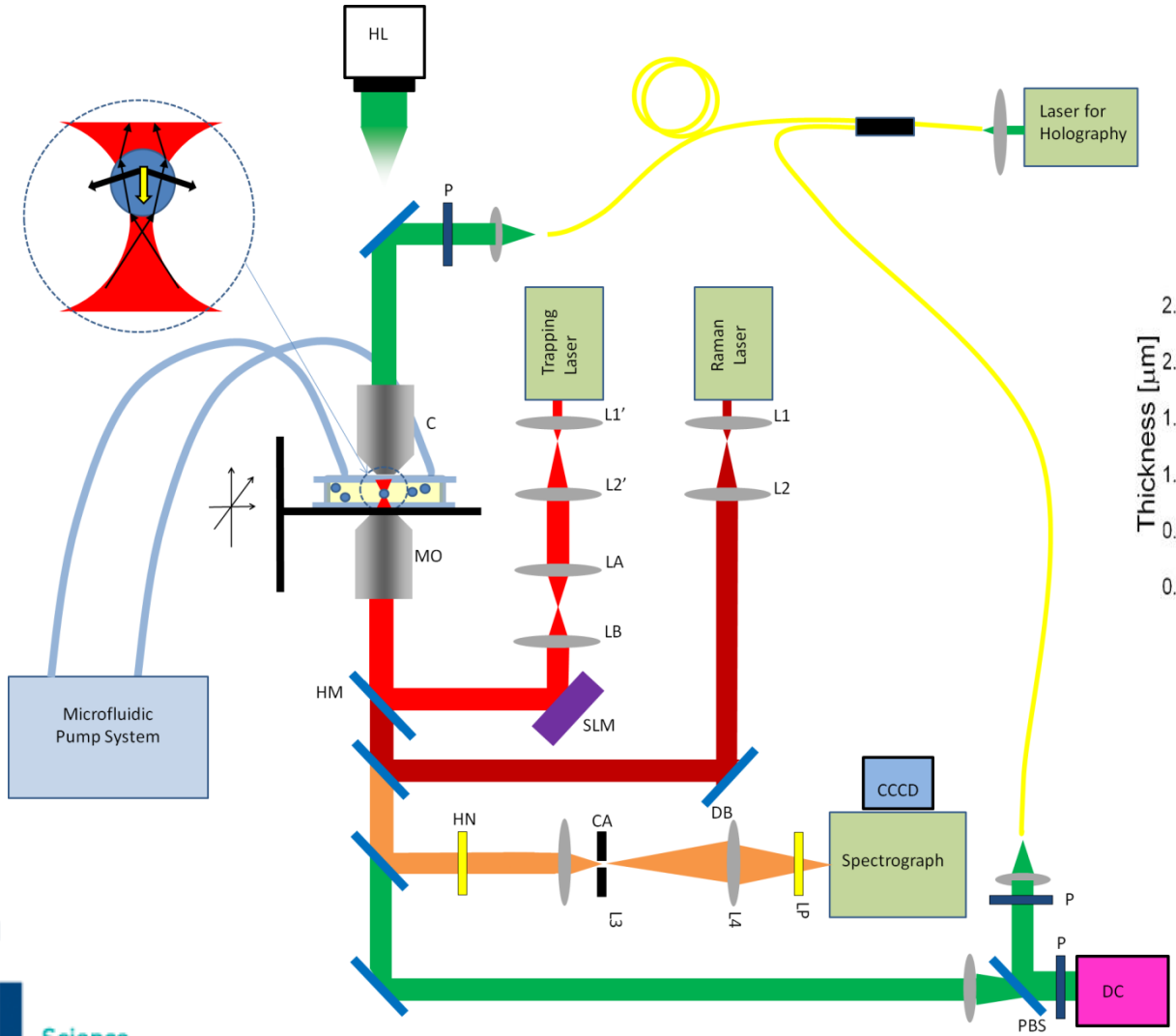
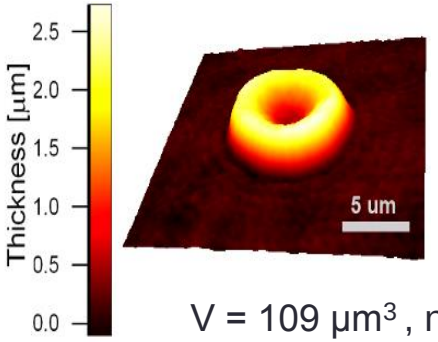
Future Work





V = 109 µm³ , r

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