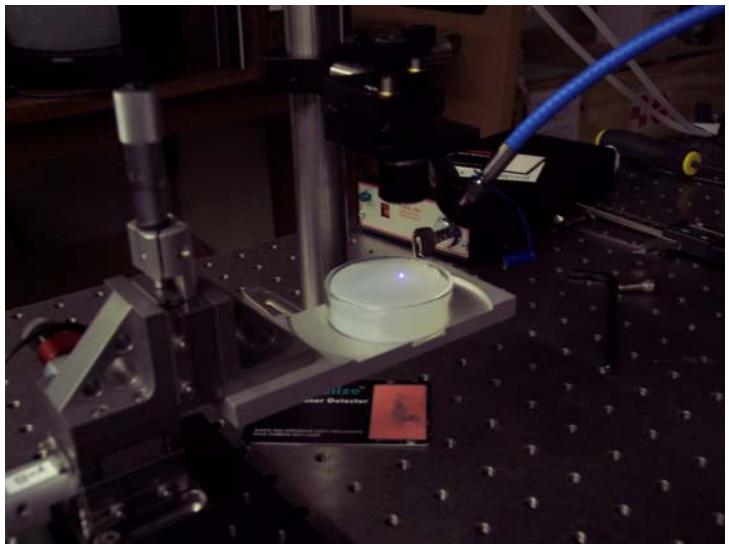
Laser
Induced
Breakdown
Spectroscopy



Detection of Trace Metal Contaminants in Model Biological Tissue

By Marian Adamson

What is my project?

The Problem

Retinal implants are possibly leaching aluminum contaminants into tissue.

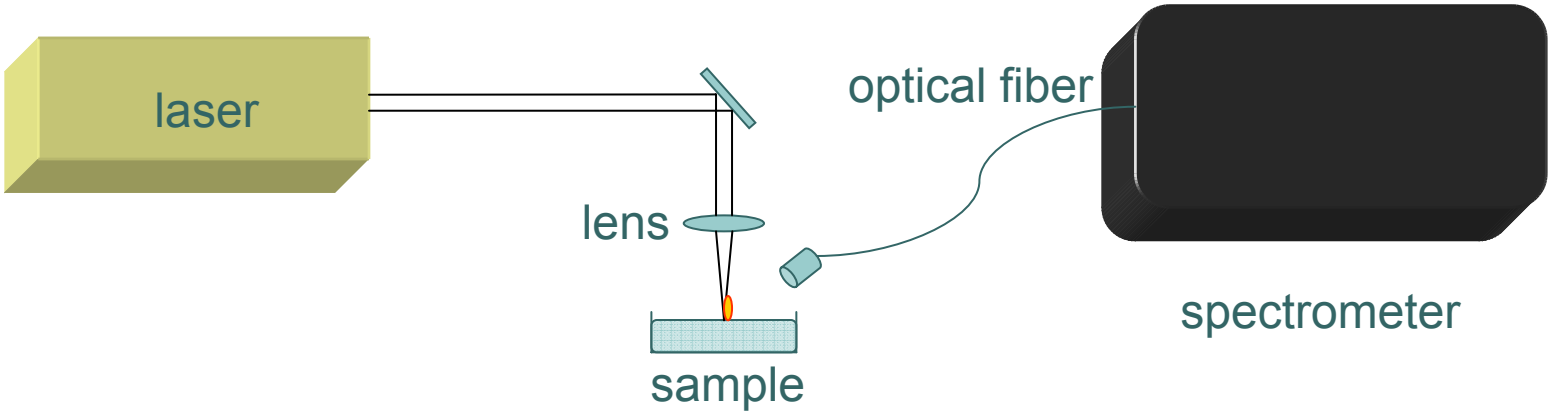
Our Solution

Use LIBS on tissue to determine if and how much aluminum is there.

What is LIBS?

(Laser-Induced Breakdown Spectroscopy)

- An optical spectroscopic technique
- Pulsed infrared laser focused at the surface.
- A microplasma forms, and all atoms and molecules give off light by spontaneous emission.
- The light is analyzed by a spectrometer.



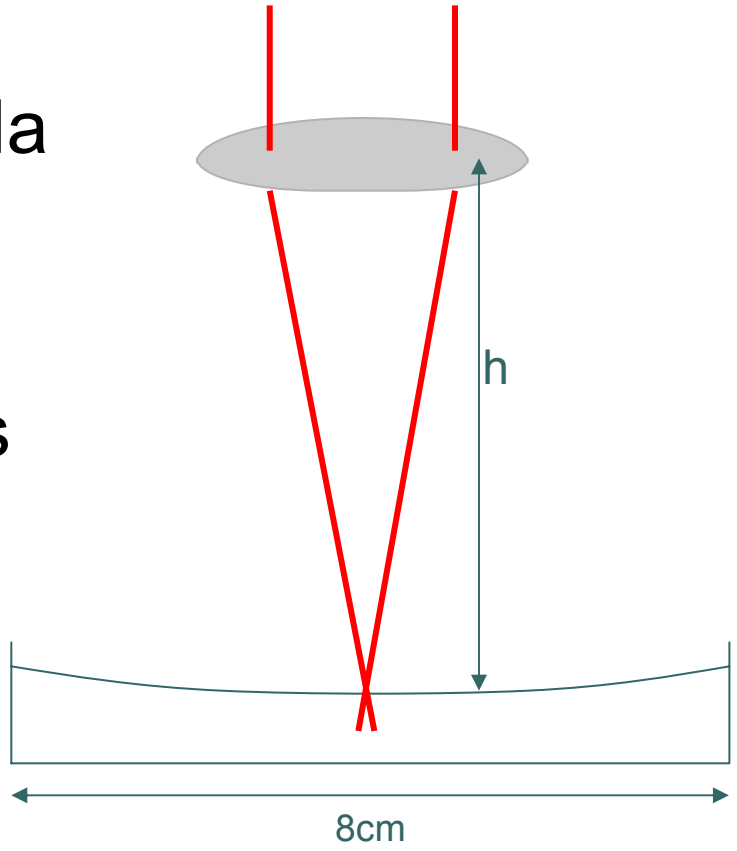
What has been done?

1. Model tissue samples
2. Determine reproducibility
3. Calibration Curves
4. Limit of Detection
5. Testing the Limit of Detection

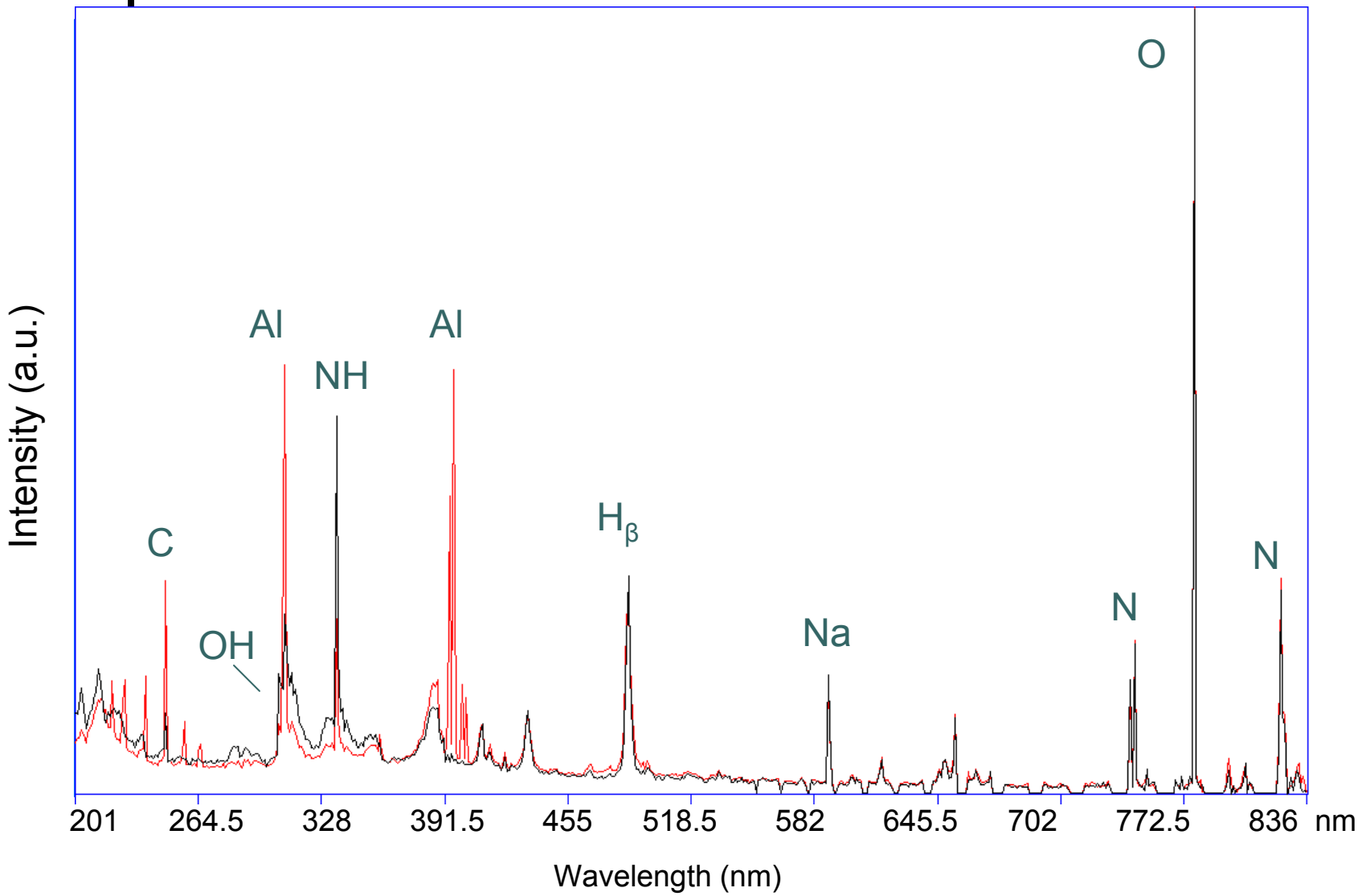
(using practical methodology)

Sample Preparation

- Human tissue—not an option!
- Agarose
  - C, H, O, Ca, and Na
  - 98% water gel
- Aluminum doping
  - Al_20_3 nanoparticles
- Large flat dish
  - Flip over for smoothness

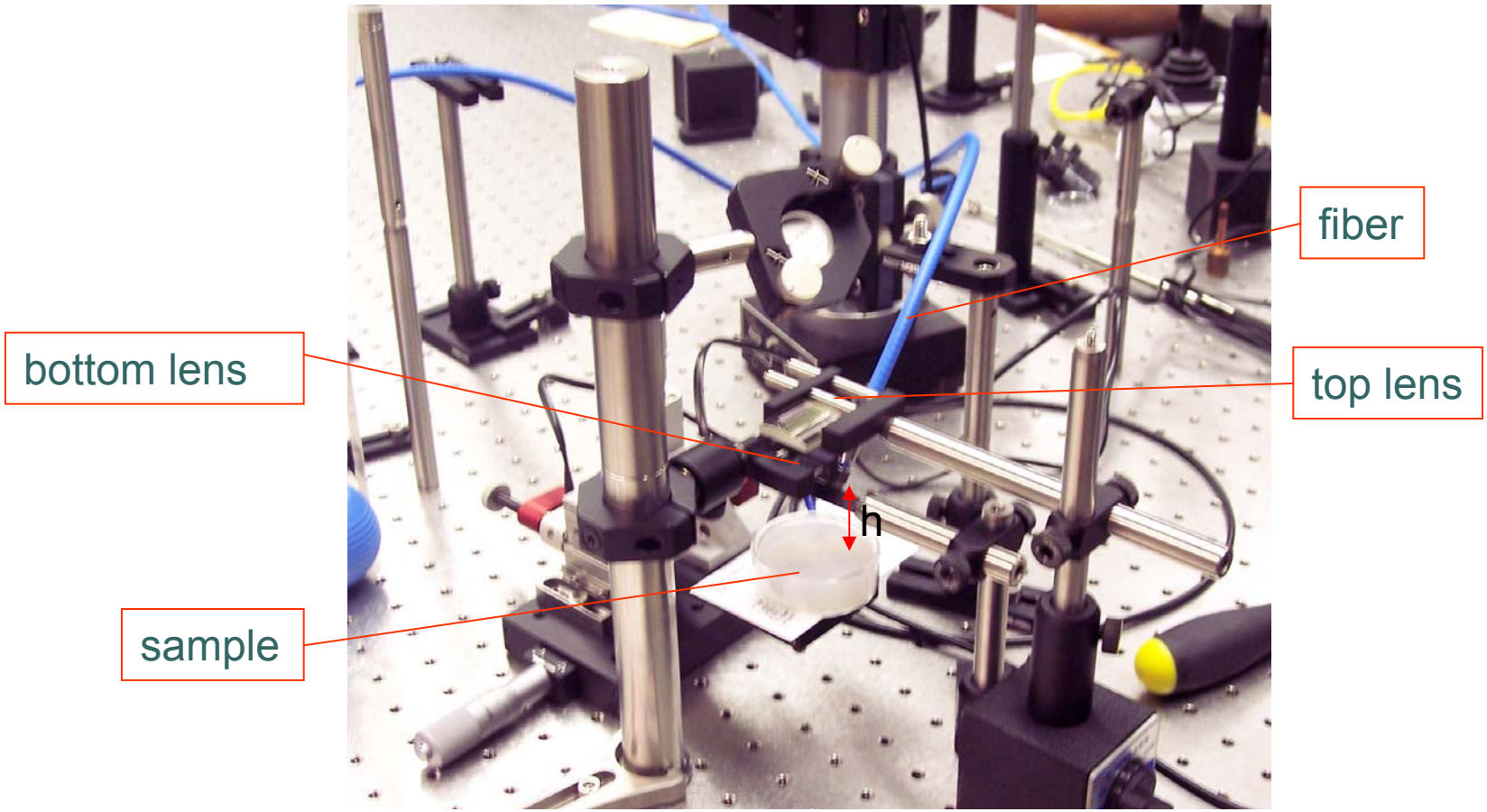


A sample spectrum

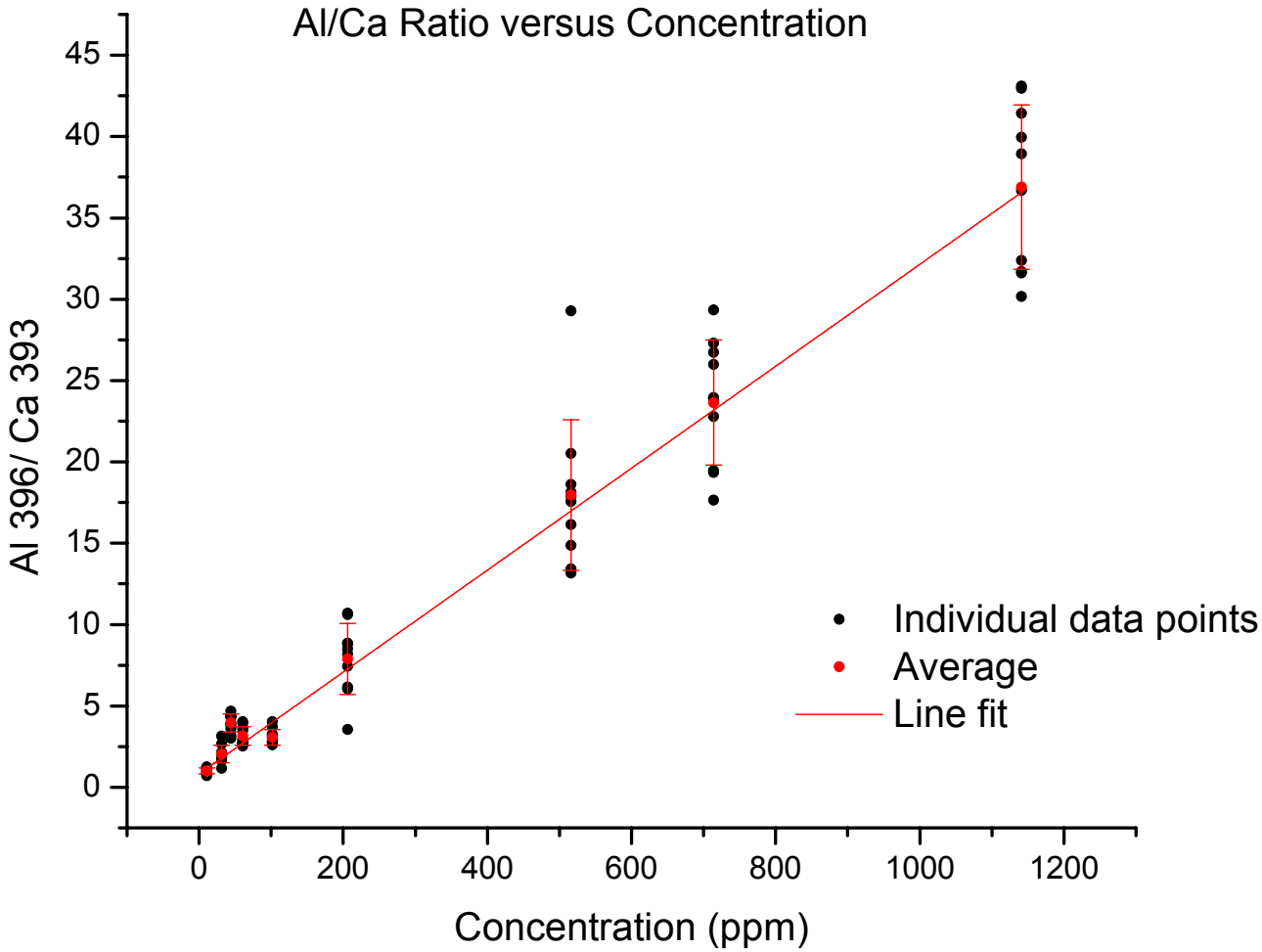


Reproducibility

Cylindrical lenses = Sample more area



Concentration Curves



$R^2 = 0.89$

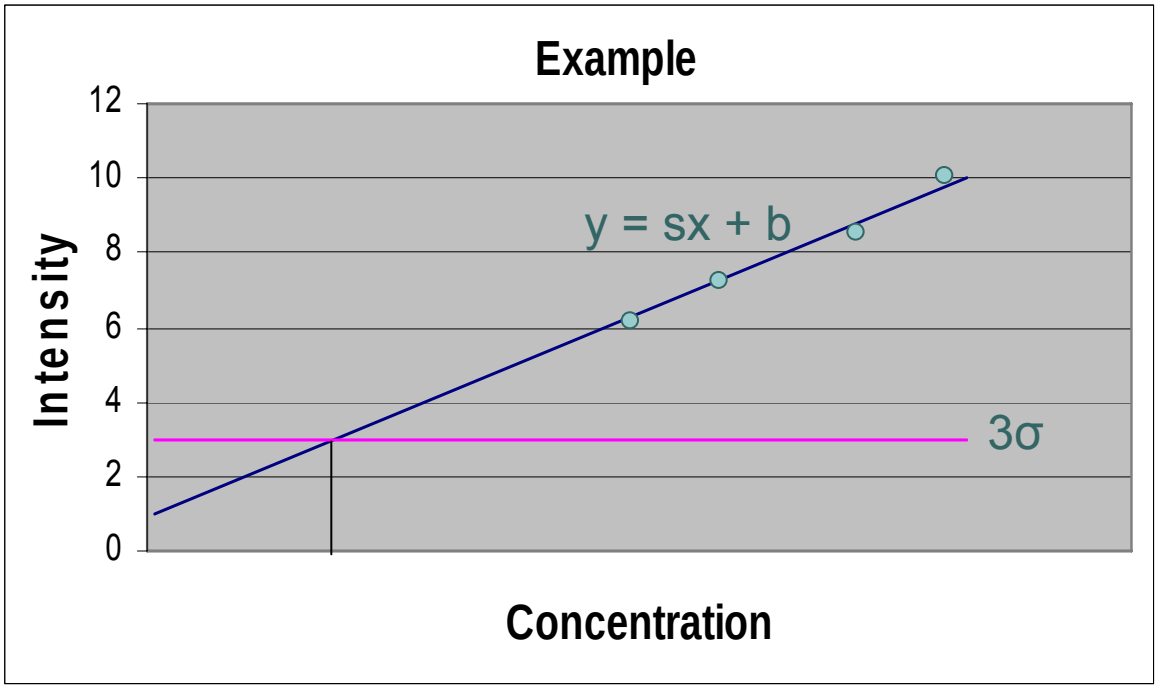
s = 0.0313

Limit of Detection

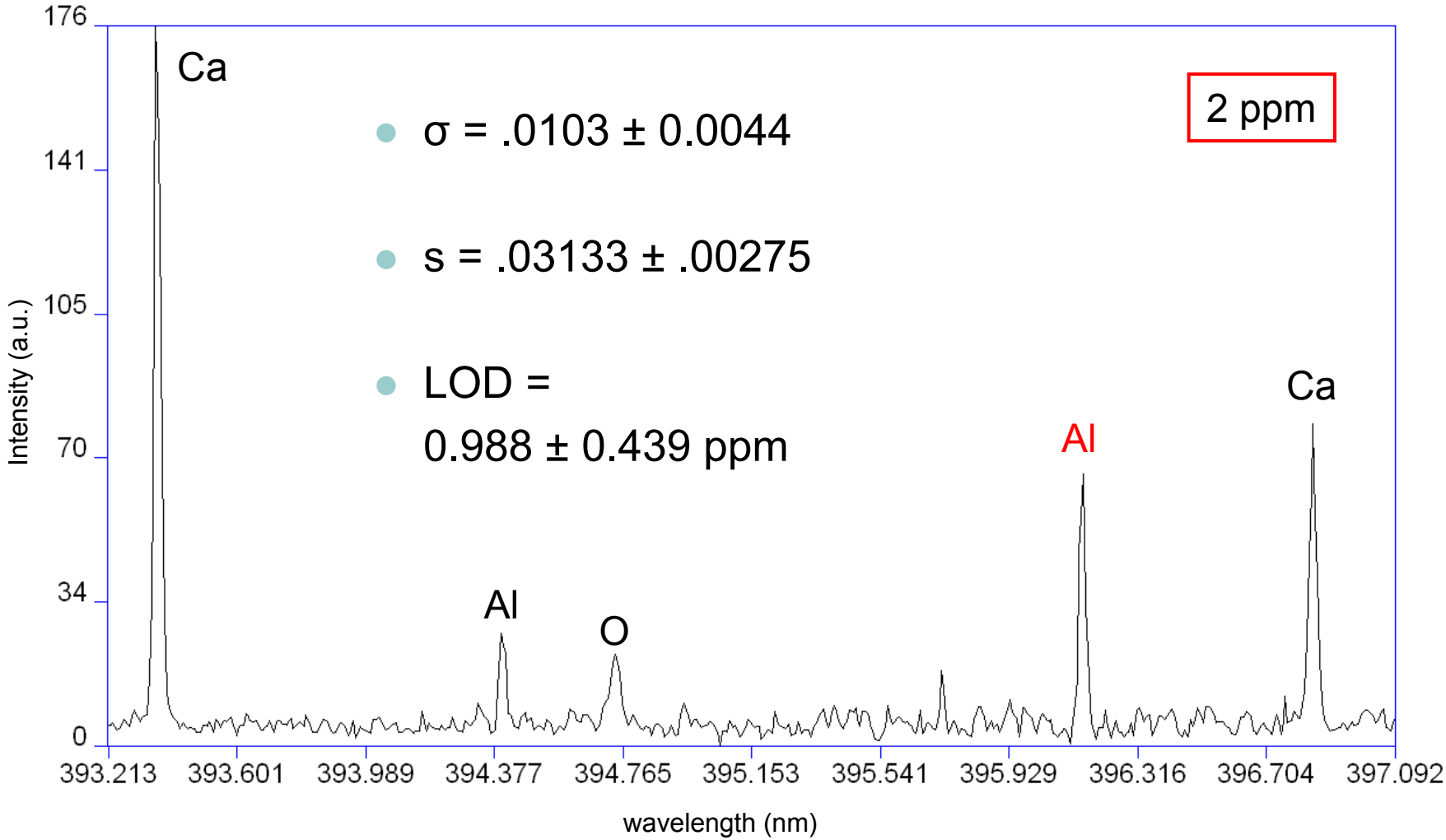
- $LOD = 3\sigma/s$ rule

σ – standard deviation of background

s – slope of calibration curve

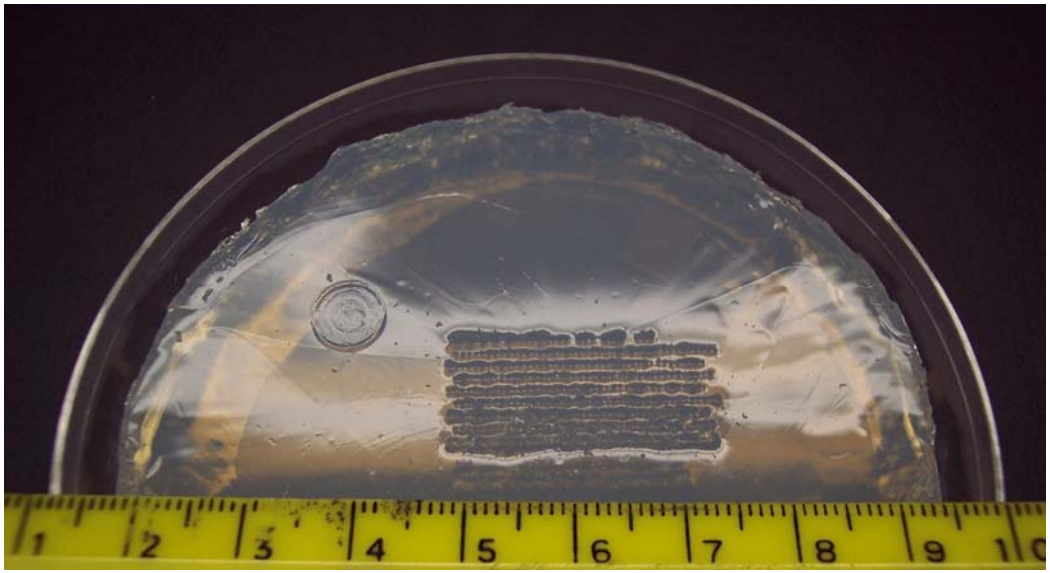


Limit of Detection



Testing the LOD

- Test using a more practical sampling methodology

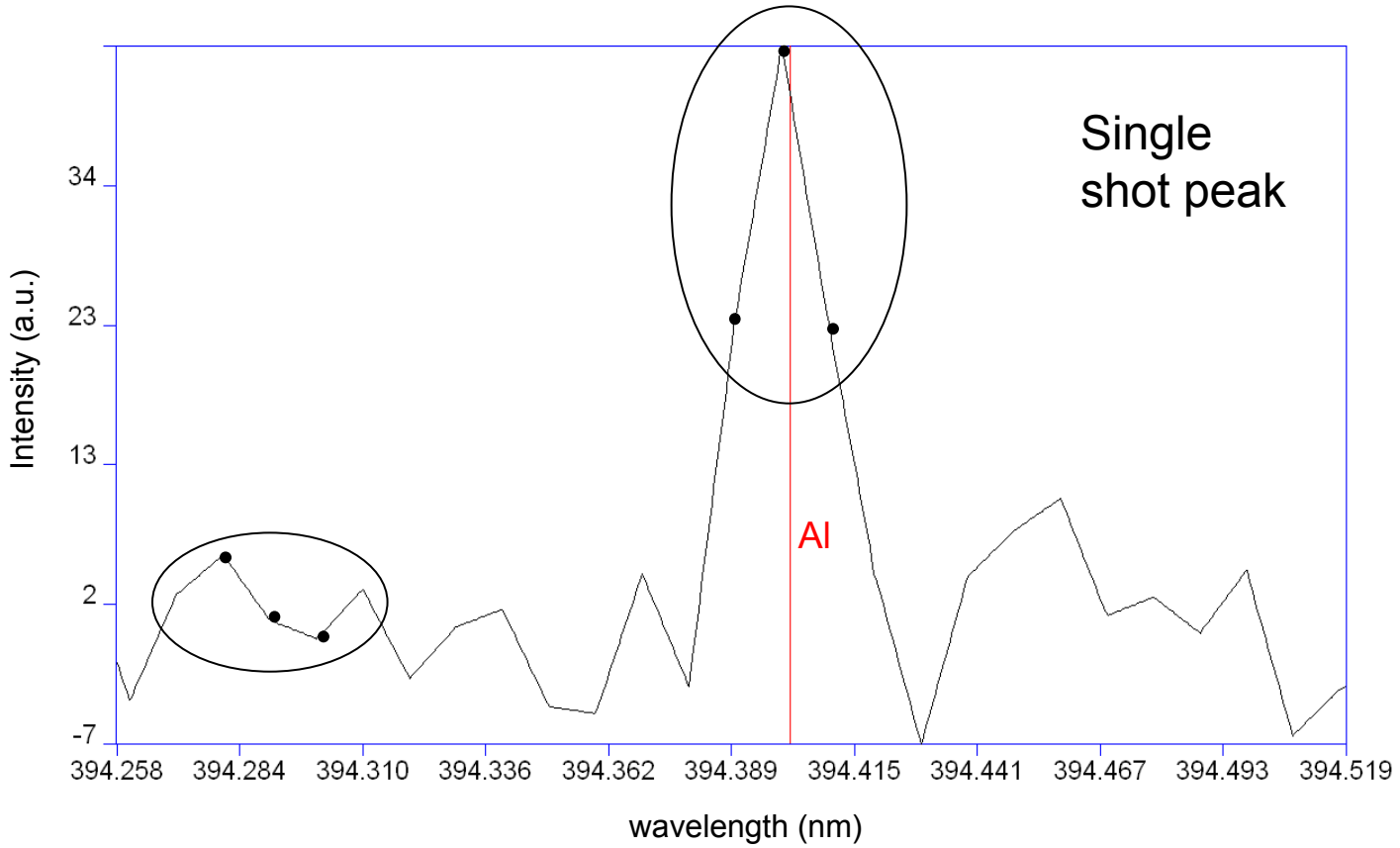


- “Single shots” are more realistic
- What % of time do we see Al in a one shot spectra?

Shot #	1	2	3	4	5	6	7	8	…
See Al?	yes	yes	no	yes	no	yes	yes	yes	…

Testing the LOD

- Criteria for seeing Aluminum:



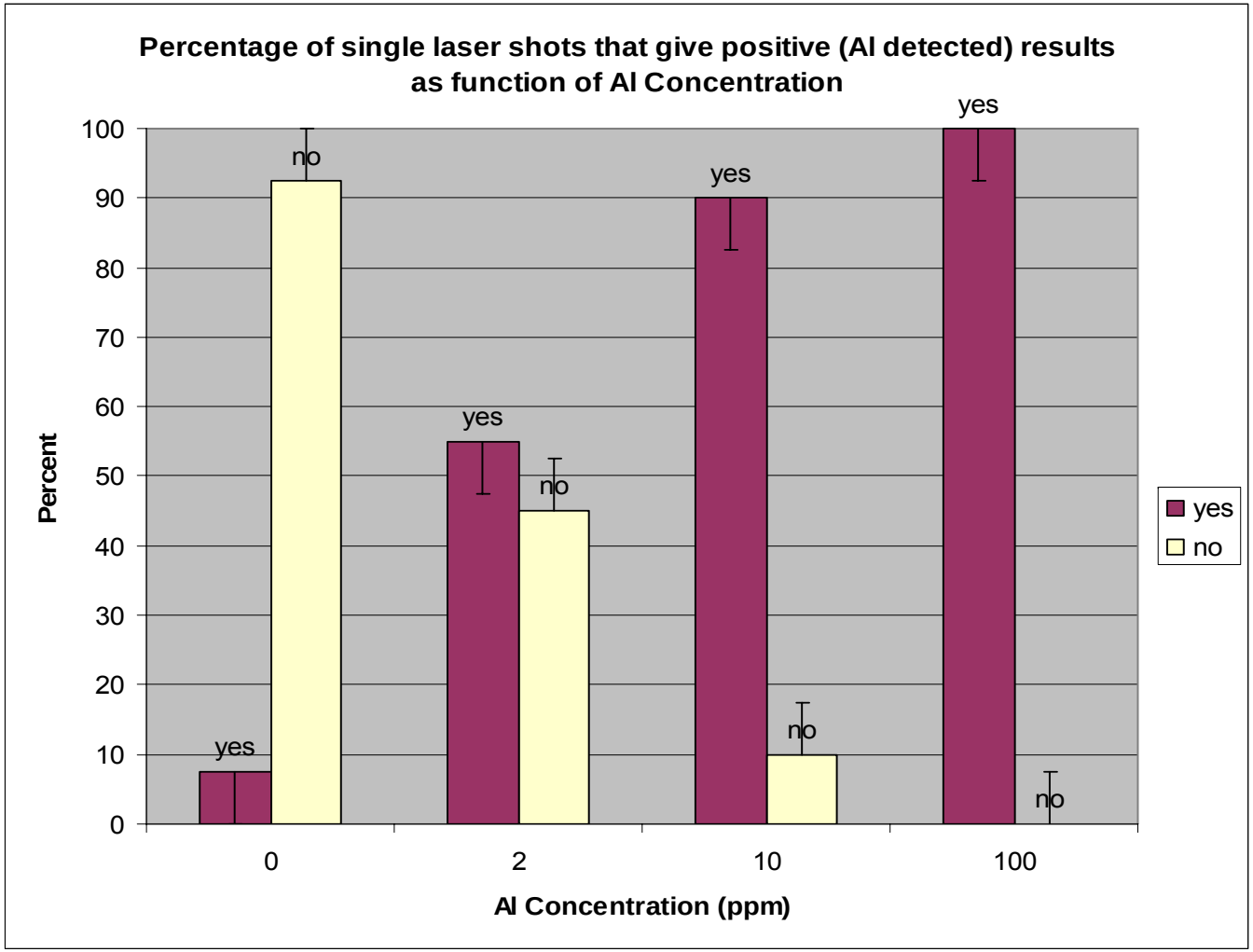
Testing the LOD-results

Criteria :

Al over 3σ

Laser energy:

80 mJ/pulse



Accumulation of more than one spectrum

Concentration:

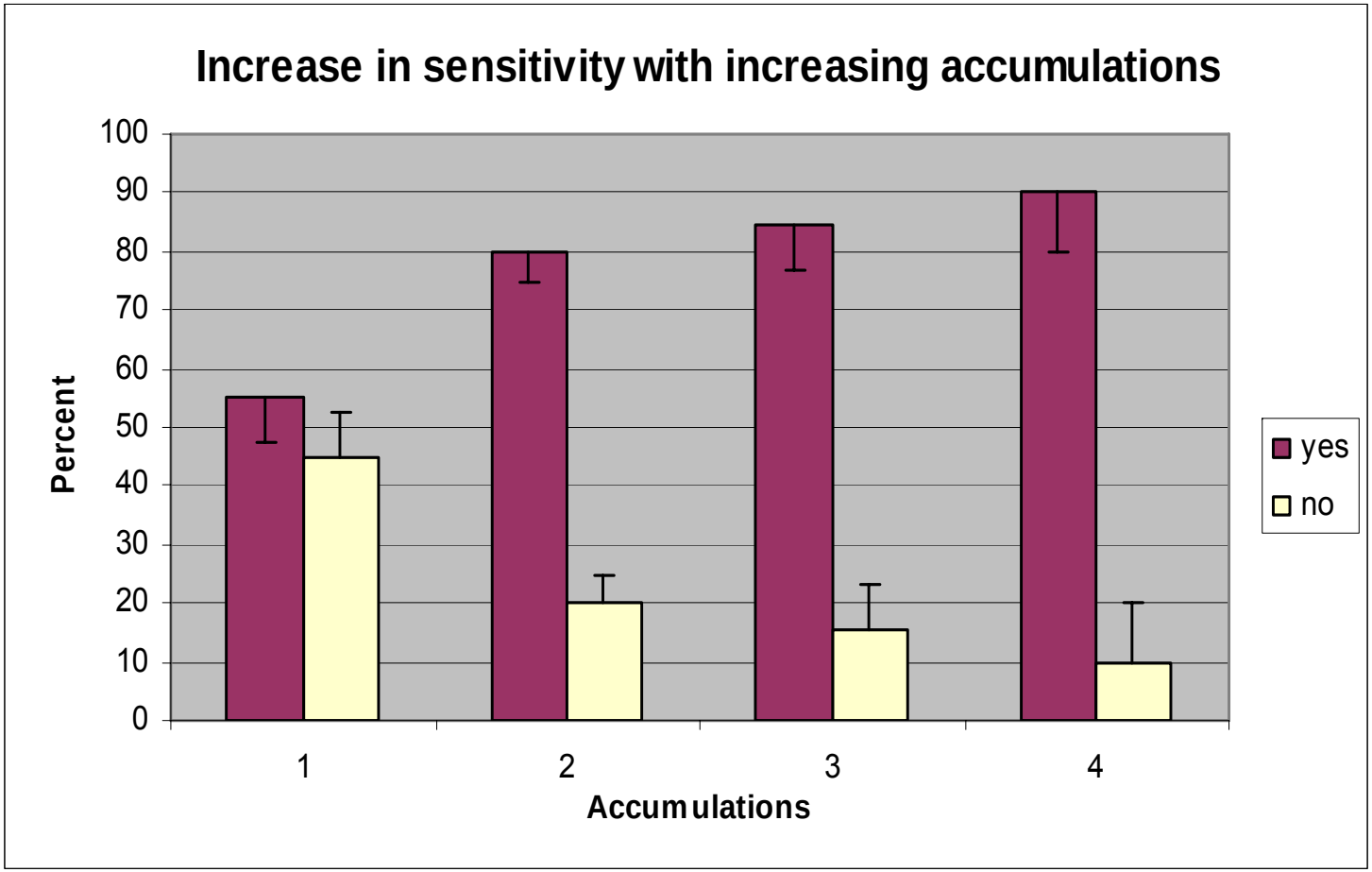
2 ppm Al

Criteria :

Al over 3σ

Laser energy:

80 mJ/pulse

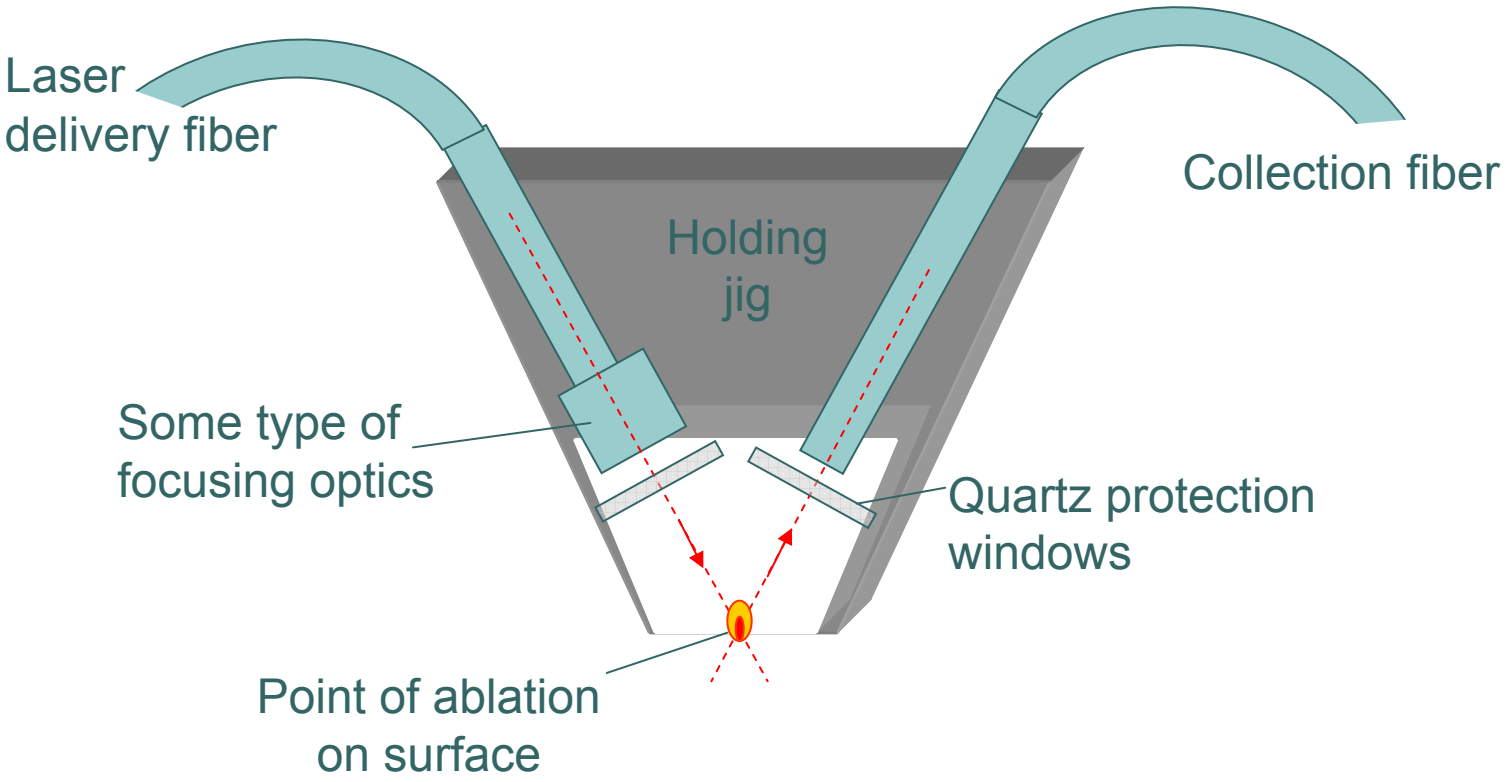


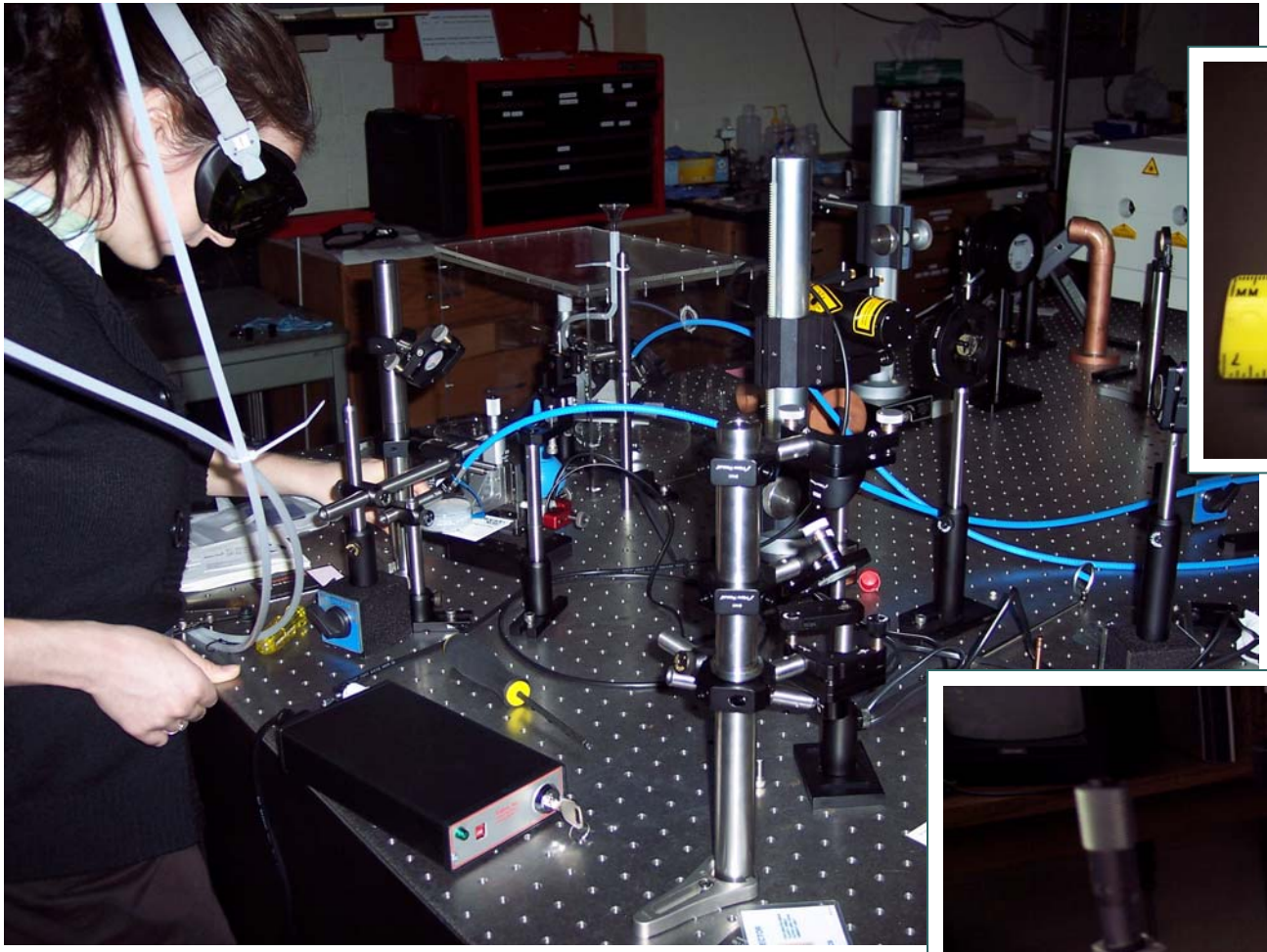
Future Work

- Realistic laser delivery and sample preparation:
  - Fiber optic probe
  - Thin slice sample

Future Work

- Fiber Delivery



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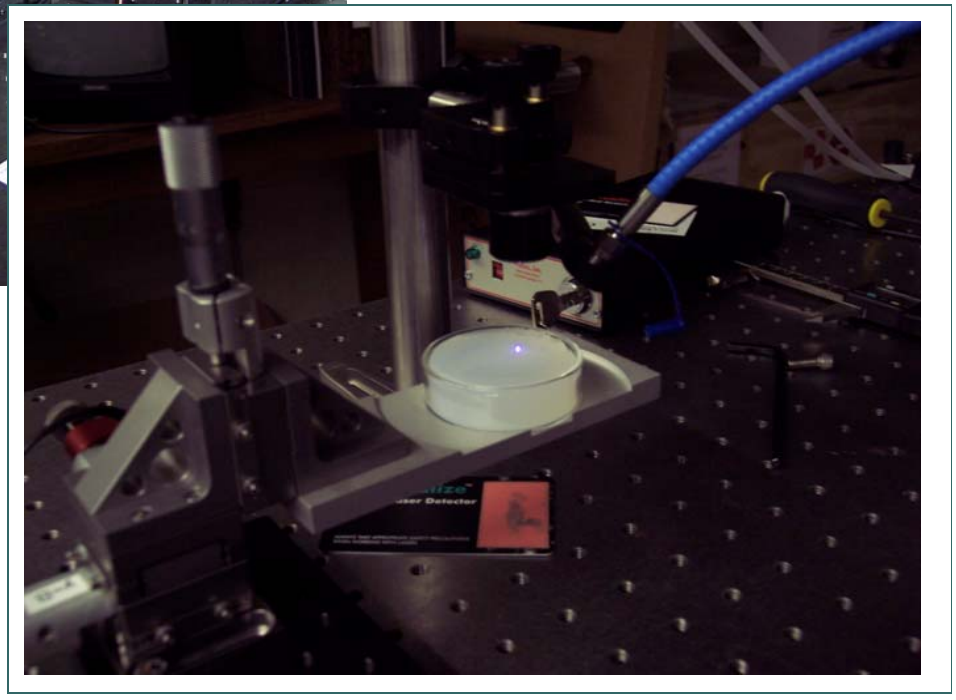
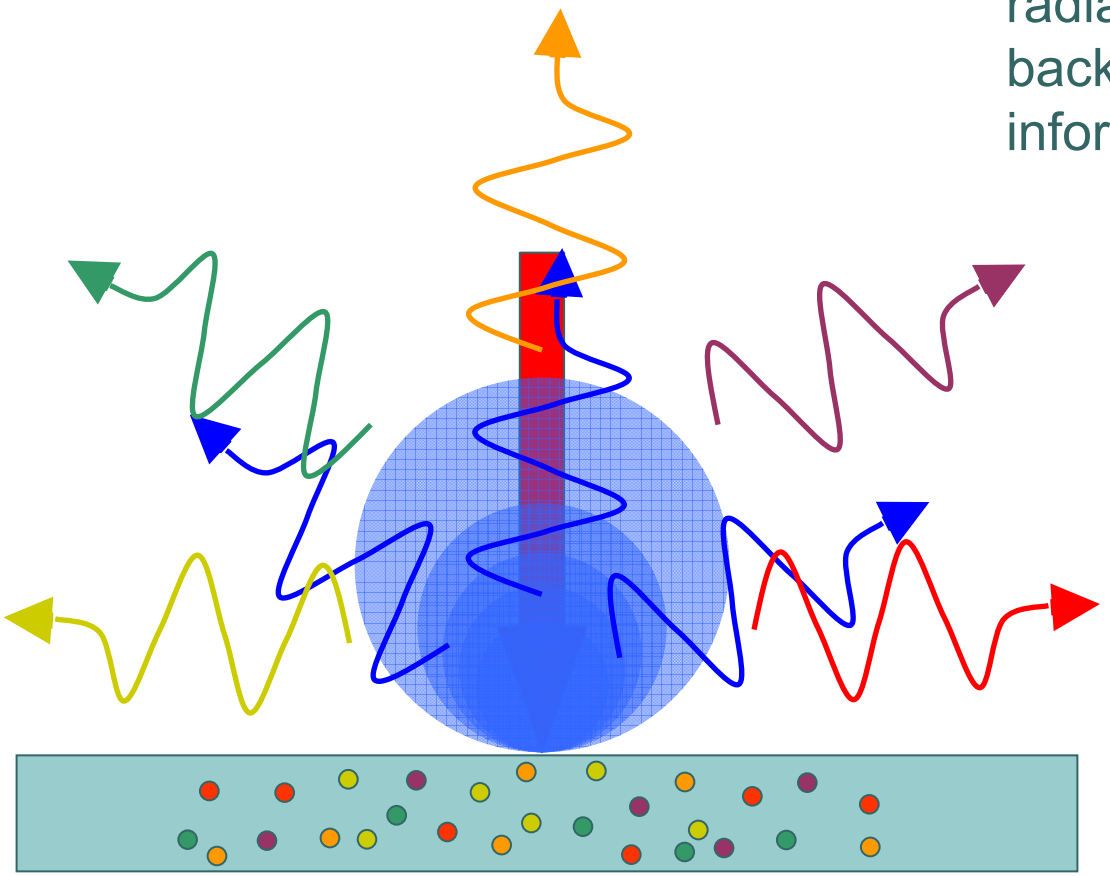


Thank you

What is LIBS?

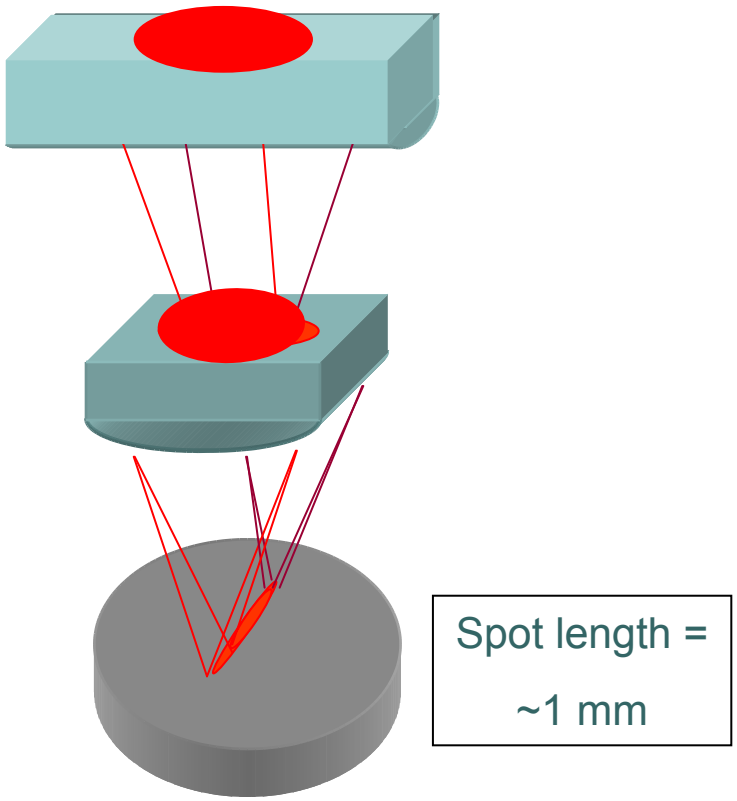
Early parts of process dominated by continuum radiation (broadband background) – little useful information.



Latter parts of process dominated by discrete emission from target specific neutral atoms, molecules, and ions.

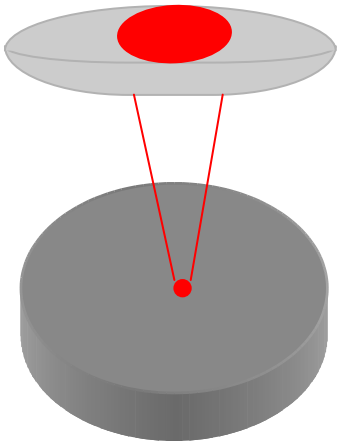
Reproducibility

Dual cylindrical lenses = Sample more area



Spot length =
~1 mm

Cylindrical lens

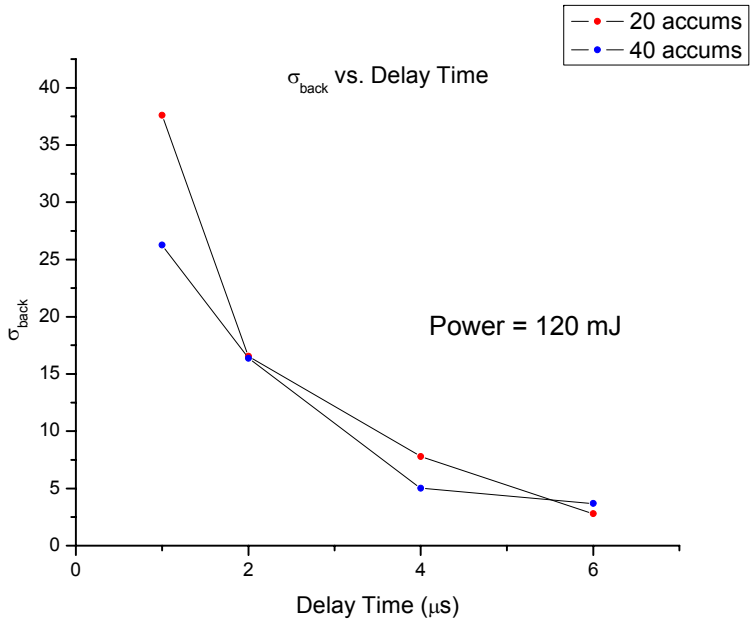


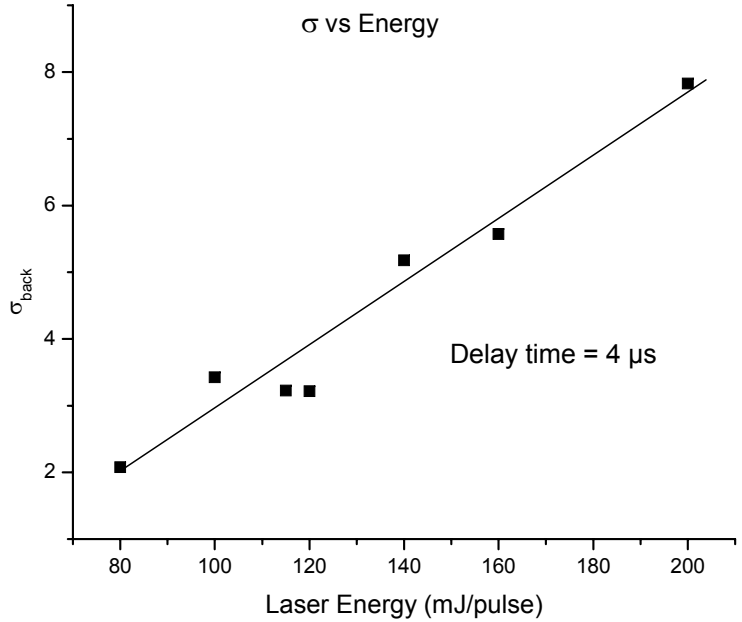
Spot diameter =
~10 µm

Spherical lens

Limit of Detection

- Decrease sigma by optimizing delay time and laser energy





Changes for UG conference

- Conclusion page
- Take out AI single shot peak page
- Rename the Reproducibility Page
- Change the Future Work page