Rayleigh Scattering Mapping System

School of Physics, University of Western Australia

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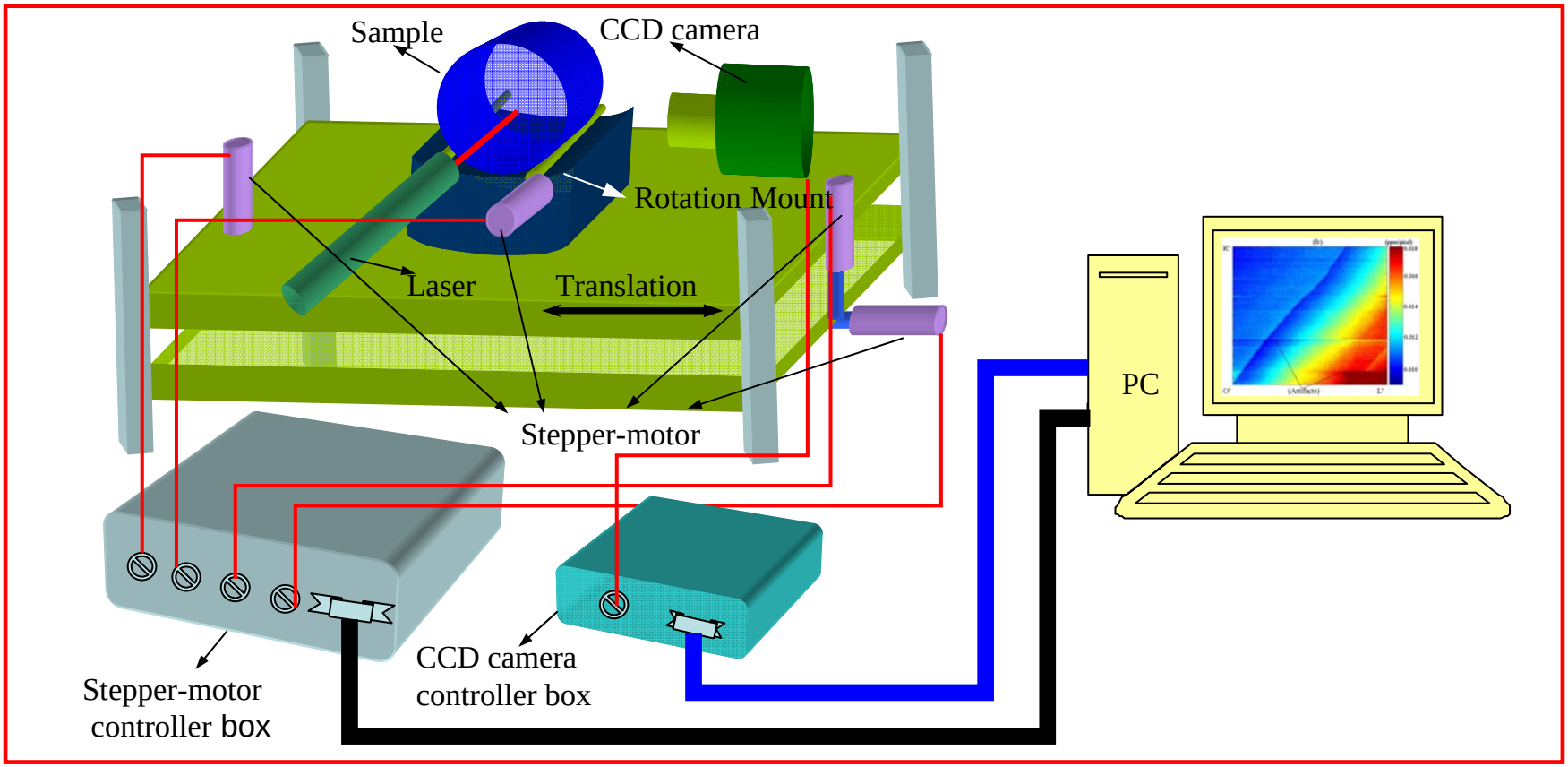
Contents:

Experimental Set-up



The ARSMS contains two subsystems:

- Optical imaging subsystem
- Mechanical motion control subsystem

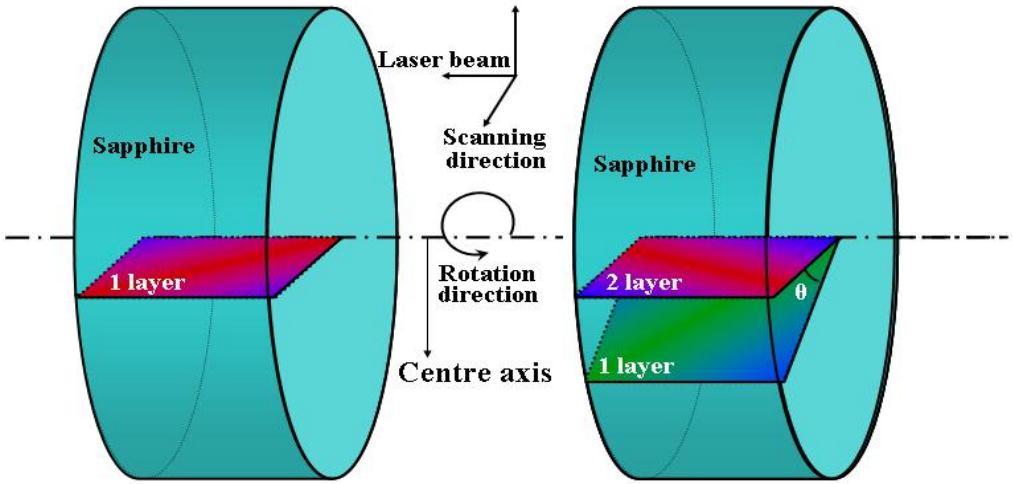
Technique Parameters

- **Translation:**
  Resolution: 0.05 mm
- **Rotation:**
  Resolution: 0.3 degree (the diameter of sample is 150 mm)
- **Scattering sensitivity:**
  0.5 ppm/cm (the laser power is 10 mw)

Advantages

- High resolution
- 3D images
- Rayleigh scattering intensity
- Mapping large-size test masses

Measurement and Data Processing



1 **Single beam images**

2 **2D images**

3 **3D image**

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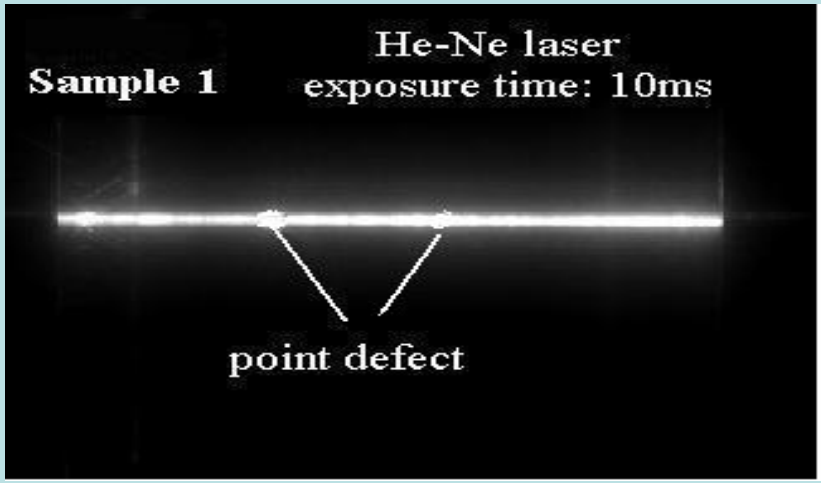
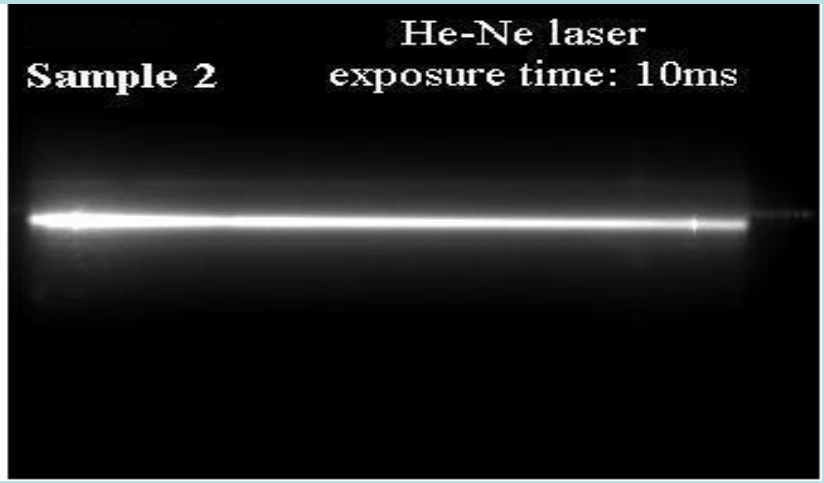
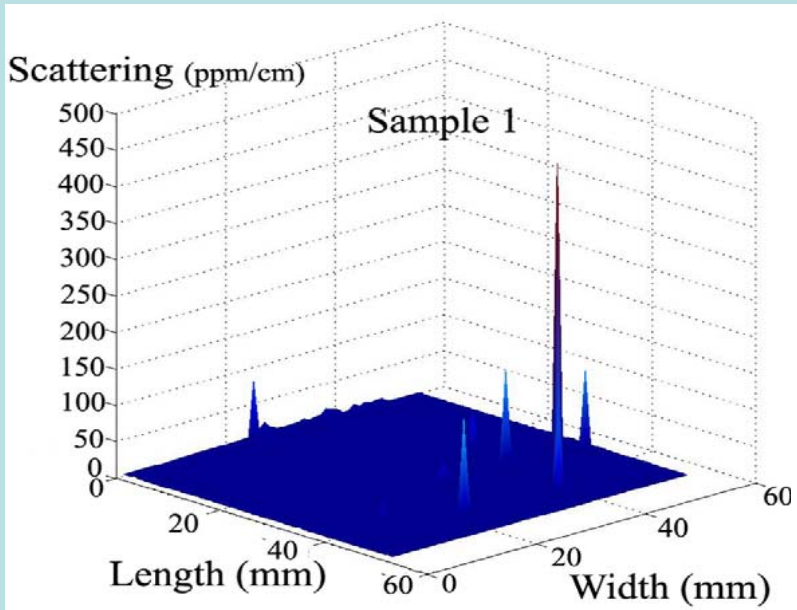
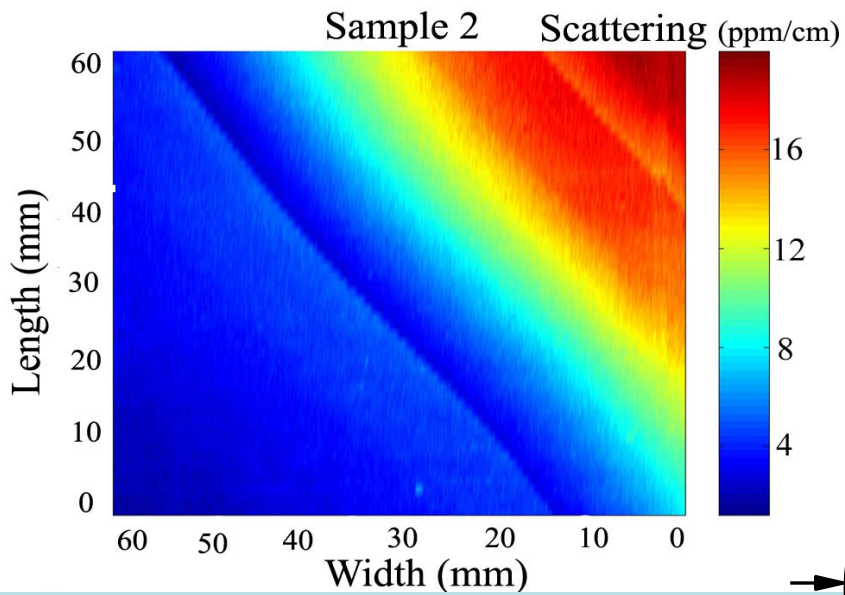
Examples:

Single images and 2D images



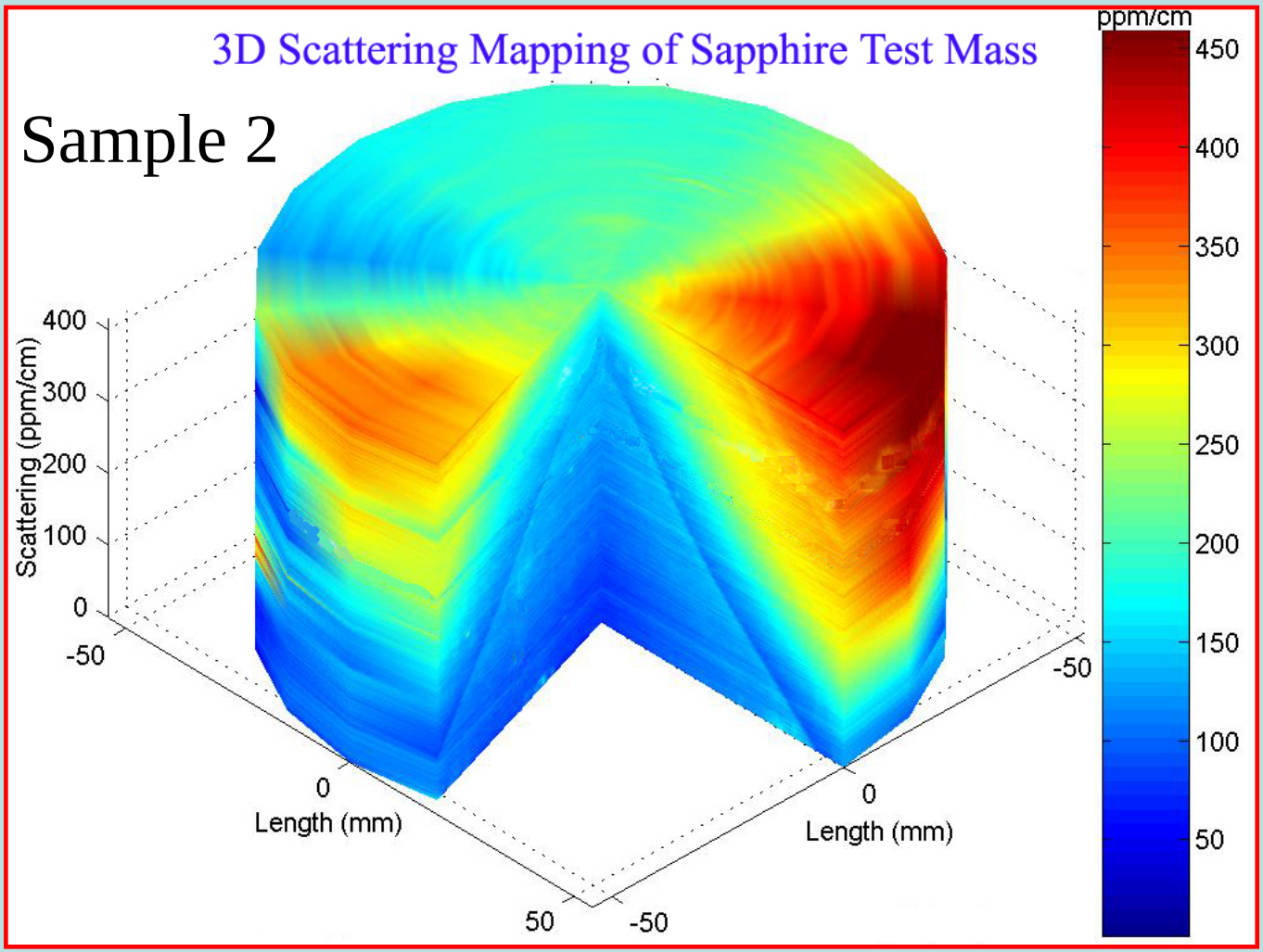






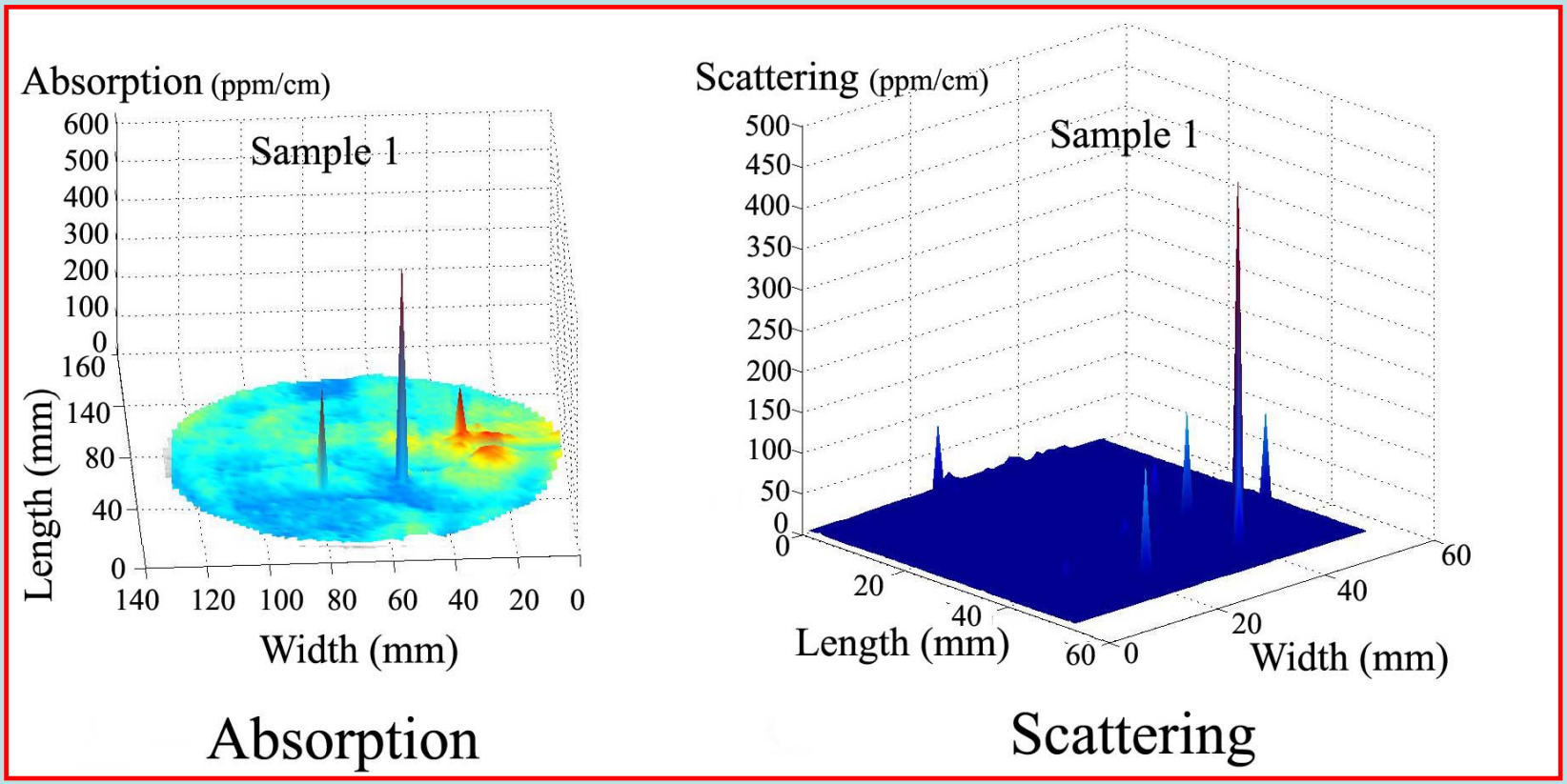
Examples:

Reconstructed 3D image



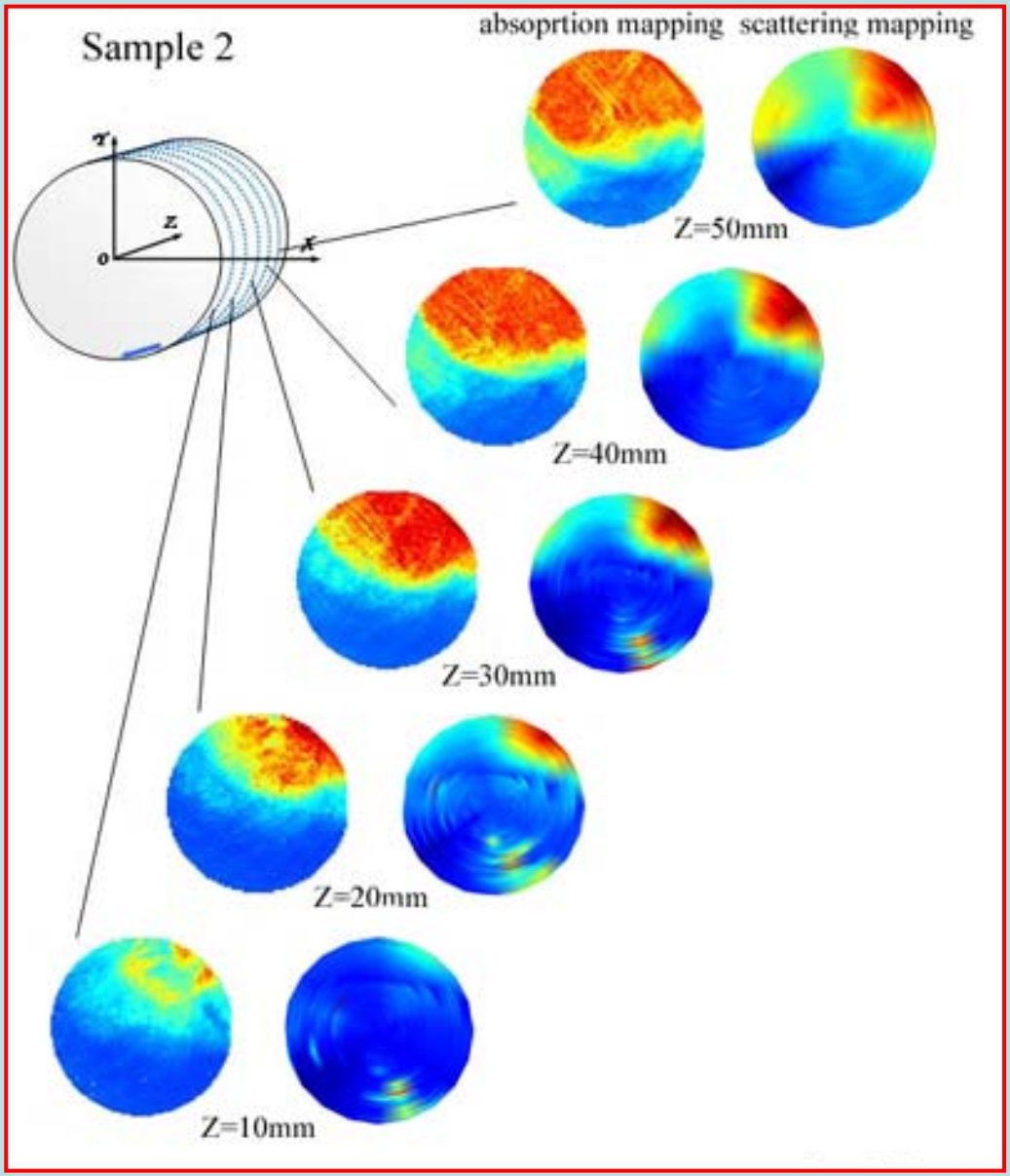
Comparisons between scattering and absorption

Typical scattering and absorption[1] maps



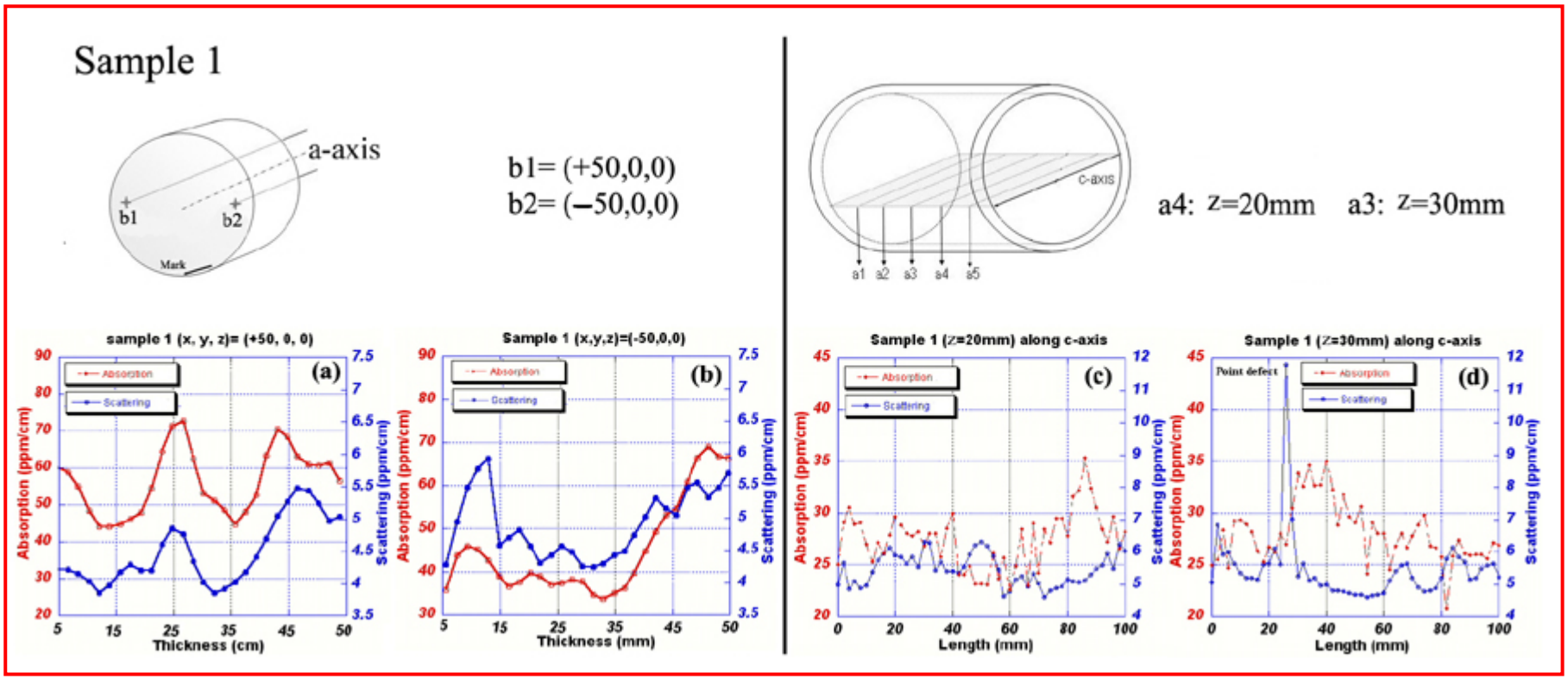
1.The optical absorption is measured using the photothermal deflection technique at Laboratoire des Matériaux Avancés, Lyon.

Comparisons between scattering and absorption



- **High scattering correlates with higher absorption.**
- ***Scattering structure is spatially displaced from a similar absorption structure.***

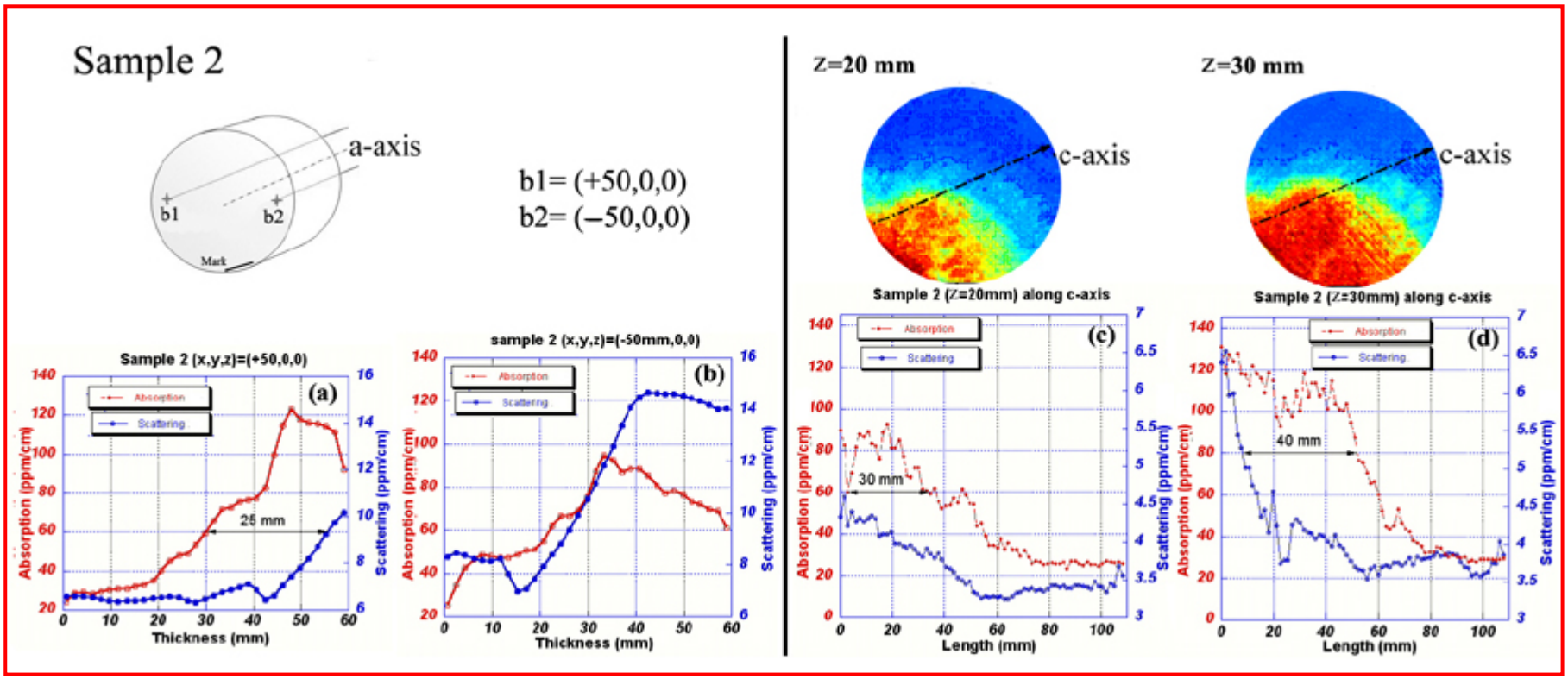
Correlations between scattering and absorption



Absorption and scattering in sample 1:

In detail there is not a clear point to point correlation between scattering and absorption.

Correlations between scattering and absorption



Absorption and scattering in sample 2:

The spatial displacements indicate that absorption centres and scattering centres are laid down during crystal growth at different distances from the solid liquid interface.

Conclusions:

- 2D and 3D scattering mappings reveal different features—the inhomogeneities and the point defects.

- Scattering and Absorption seem to be coming from different origins

- The ARSMS can ensure that an adequate low level of scattering is achieved for gravitational wave detectors and other precision applications.

- The ARSMS may provide data that can be utilized to improve the quality control of both single crystal and glass optical materials.

Acknowledgement

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