# Respirable Fibre Detection from Light Scattering Patterns

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#### Motivation

*Health Concerns* – Asbestos and other fibres:

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Causes [1]: Lung cancer, mesothelioma, pulmonary fibrosis, asbestosis.  $\succ$  Fairly common exposure.

Toxicity is linked to aspect ratio [2] along with composition [3]. *Current Detection Methods* – Asbestos and other fibres:

> Phase Contrast Microscopy (PCM), can be automated [4].  $\blacktriangleright$  ALERT [5] asbestos detection system.



 $\triangleright$  Raman spectroscopy [6] and fluorescent tagging [7].

Distinction between fibres and other aerosol can be made but little is known of their morphology or composition.

Electron microscope images of asbestos fibres [8]

### Aims

To develop a relationship between the light scattering patterns of single respirable fibres and their morphological and optical properties that can lead to a more efficient method of detection, characterisation, and counting.

## Modelling

*First Order Approximation* – Simplest approximation for predicting patterns.

Diffraction alone provides inadequate results!

*Improved Approximation* – Increasing accuracy

Mie theory – Infinitely long cylinders.

DDA – Improved freedom of particle shape.

Identifying Features- Reverse scattering problem

#### Measurement

Focusing Optics -

*Instrumentation* – Possible adaptations of devices currently used – Including Particle Phase Discriminator (**PPD**). Current bench-top experiment for stationary light scattering analysis.

For comparison with models and insights into instrumentation design.

> X Translation Alignment Laser-

#### Refractive index effects resulting patterns!



## Challenges



*Test Fibres* – Acquisition or synthesis. Testing Fibres - Appropriate and safe aerosolization methods (acoustic, pneumatic, etc.).



Current bench-top experiment set-up

*Fibres* – Of known size and refractive index to be used in future aerosolization experiments Fibres of known sizes will make for easier analysis!

### Innovation

*Relationship* – Between fibre properties and scattering pattern.

*Facilitation* – Of future instrumentation design and improvement guided by research.



*Fibre Analysis* – Filter collection and bulk analysis or suspension of a single fibre for data comparison.

**Properties** – Compensating for fibre properties such as refractive index and orientation.

*Prevention* – Of exposure leading to illness and death.

*Counting Methods* – Of regulatory bodies streamlined.

> PPD2 instrument with scattering patterns.

#### References

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