Using Negative Muons for Elemental Analysis

Beth Hampshire

RIKEN
ISIS
WARWICK
THE UNIVERSITY OF WARWICK

Dr. Adrian Hillier

Prof. Don Paul

Katsu Ishida – RIKEN

Kevin Butcher – University of Warwick

George Green – University of Warwick / Ashmolean museum

RIKEN

ISIS

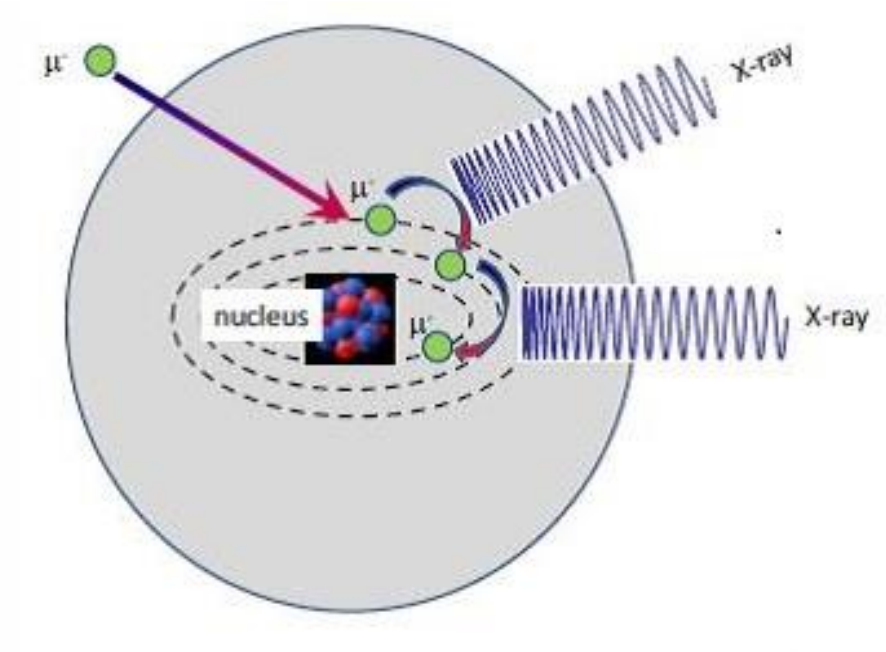
WARWICK
THE UNIVERSITY OF WARWICK

How does it work?

Muon mass = 105.66 MeV/c^2

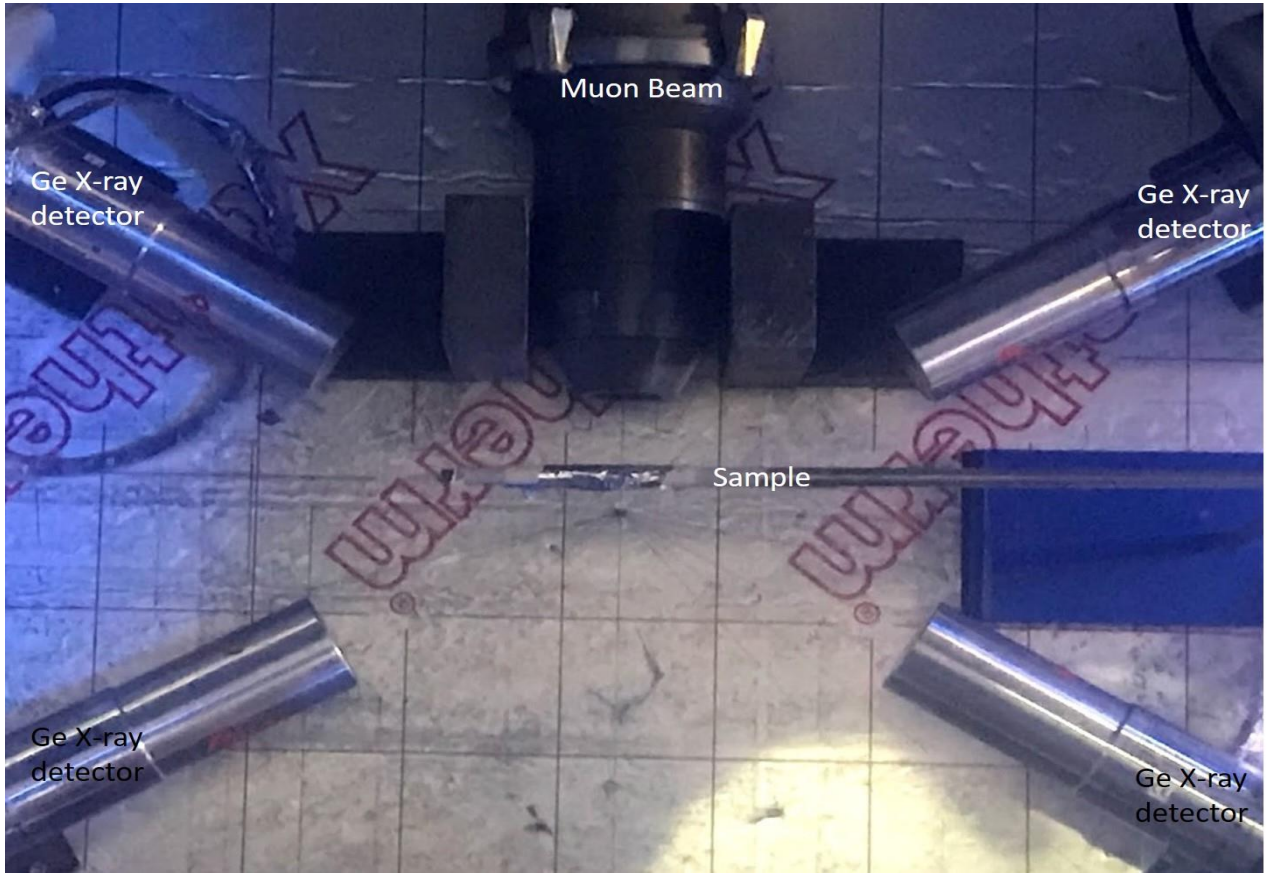
Emitted X-ray range: 2 KeV – 10 MeV

Allows bulk analysis of samples without absorption of X-rays



Julia Domna – AD300

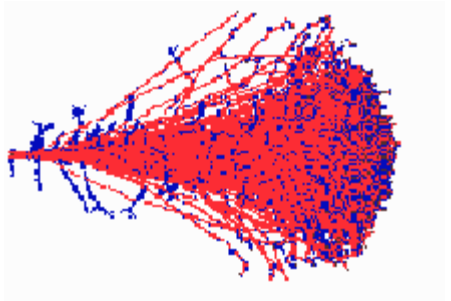
WARWICK
THE UNIVERSITY OF WARWICK



Julia Domna – AD300

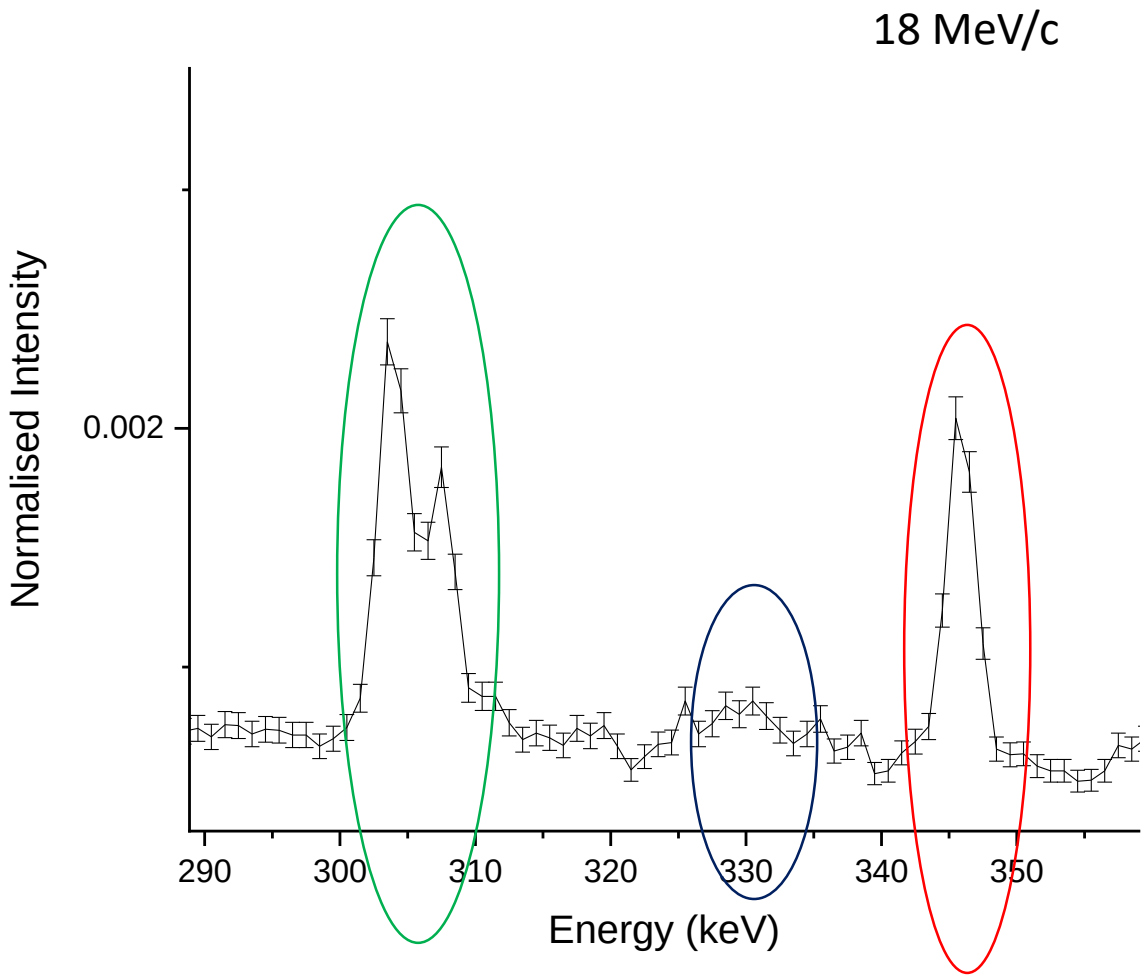
WARWICK
THE UNIVERSITY OF WARWICK

Momentum (MeV/c)	Depth (μm)
17	59.5
18	67.4
19	86.8
20	141
22	223
35	450



Julia Domna – AD300

WARWICK
THE UNIVERSITY OF WARWICK



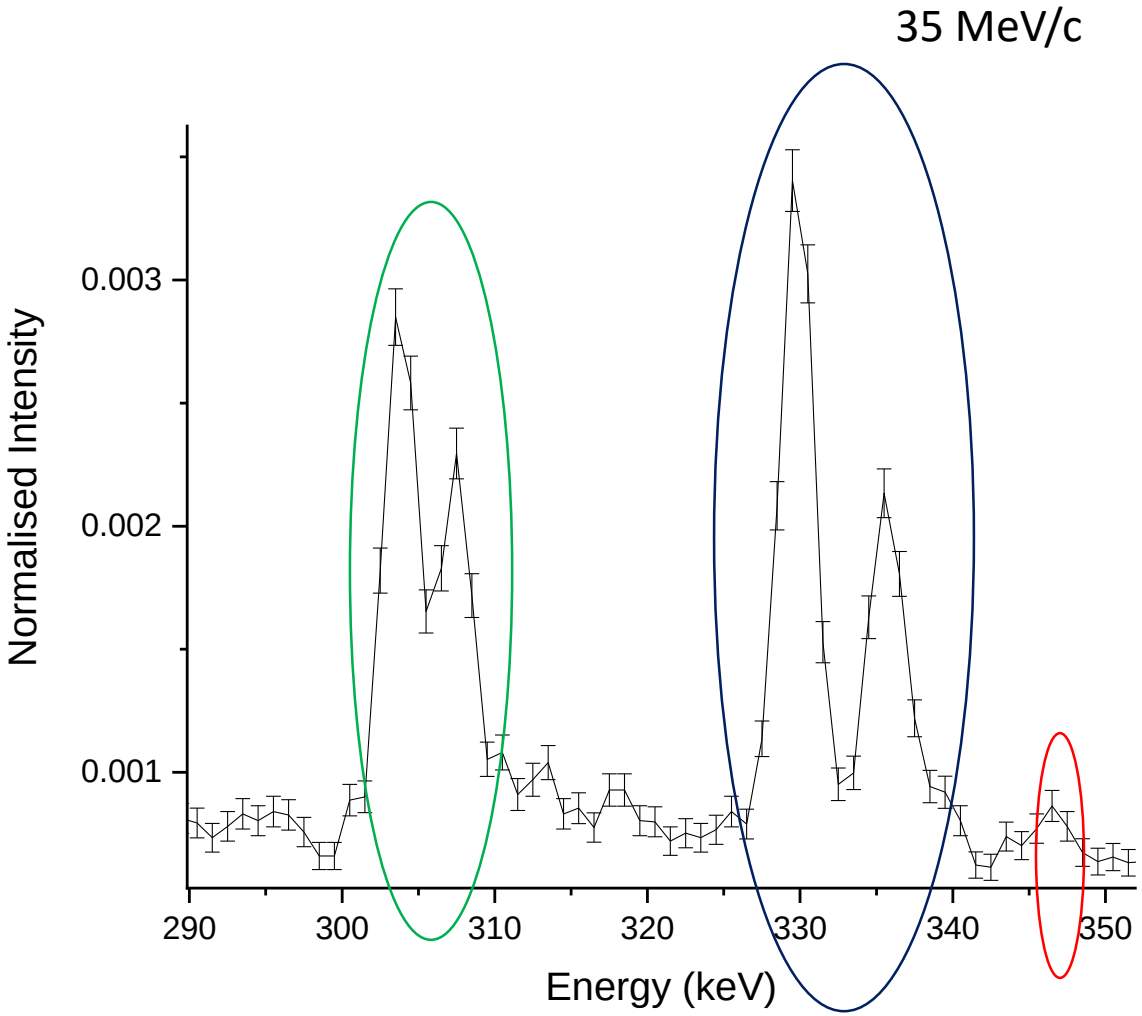
304.7 and 308.3 Silver

330.6 and 336.6 Copper

346 Aluminium

Julia Domna – AD300

WARWICK
THE UNIVERSITY OF WARWICK



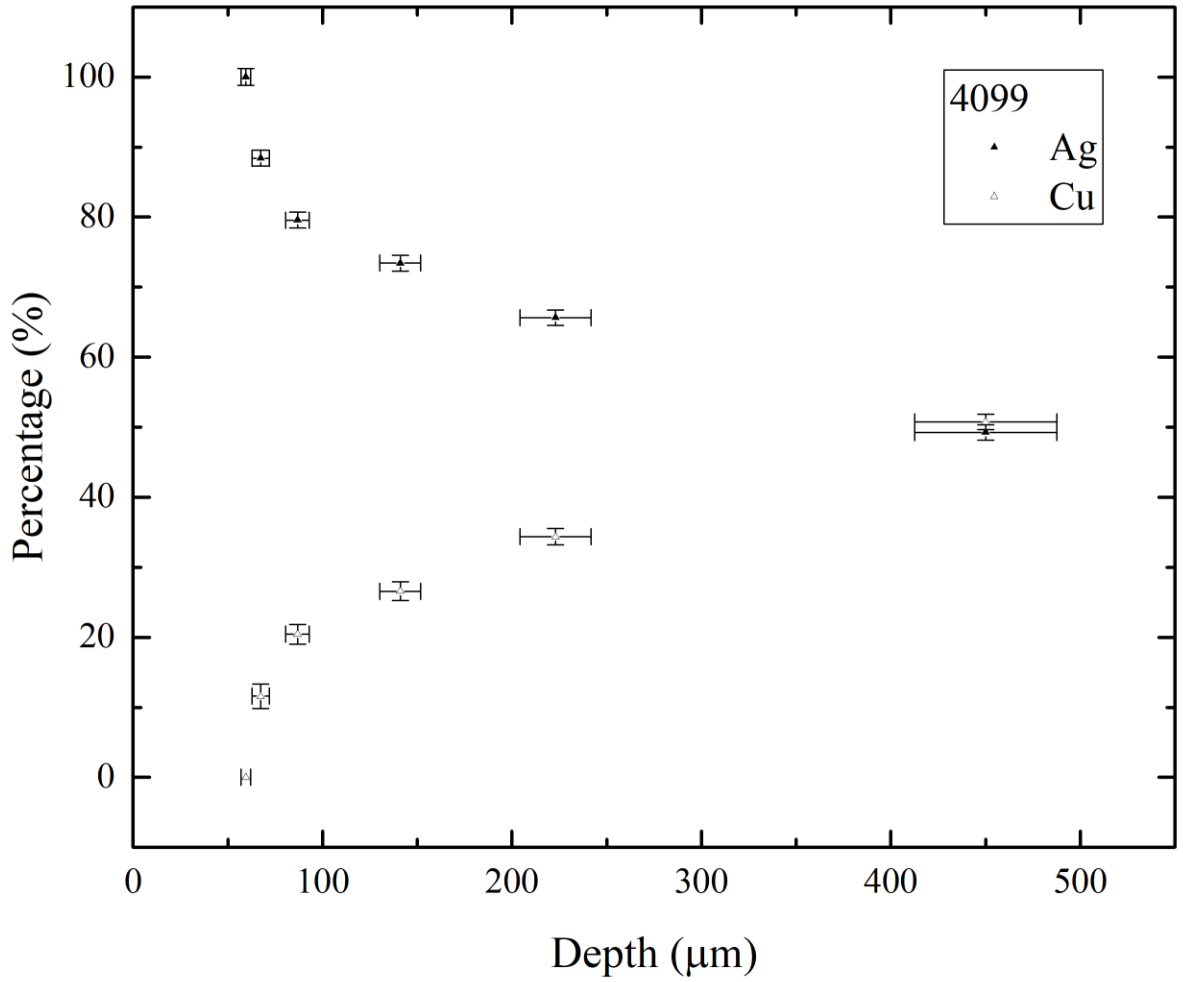
304.7 and 308.3 Silver

330.6 and 336.6 Copper

346 No aluminium – now probing bulk of sample

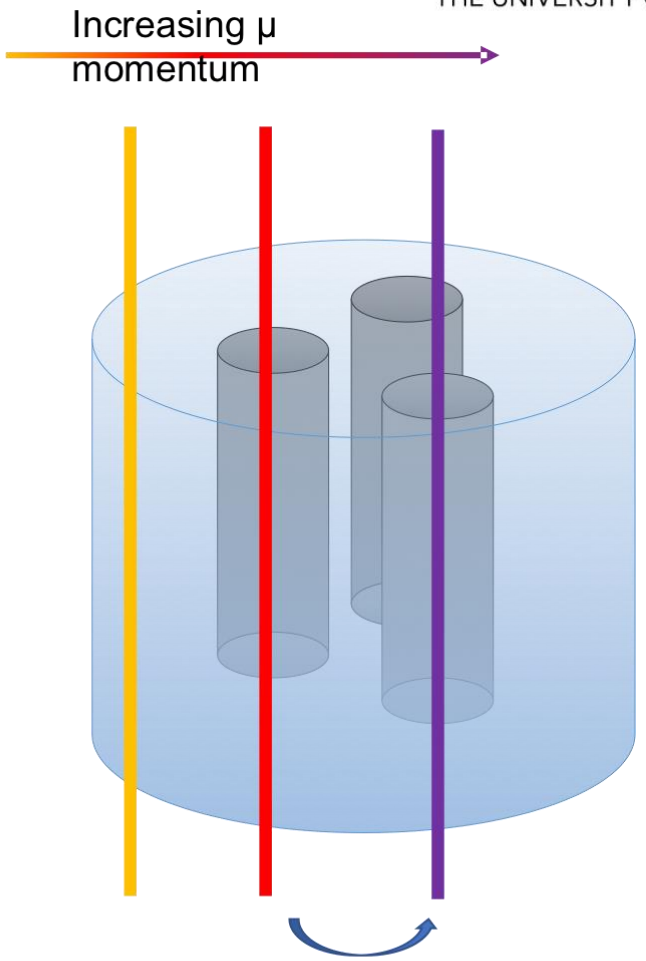
Julia Domna – AD300

WARWICK
THE UNIVERSITY OF WARWICK

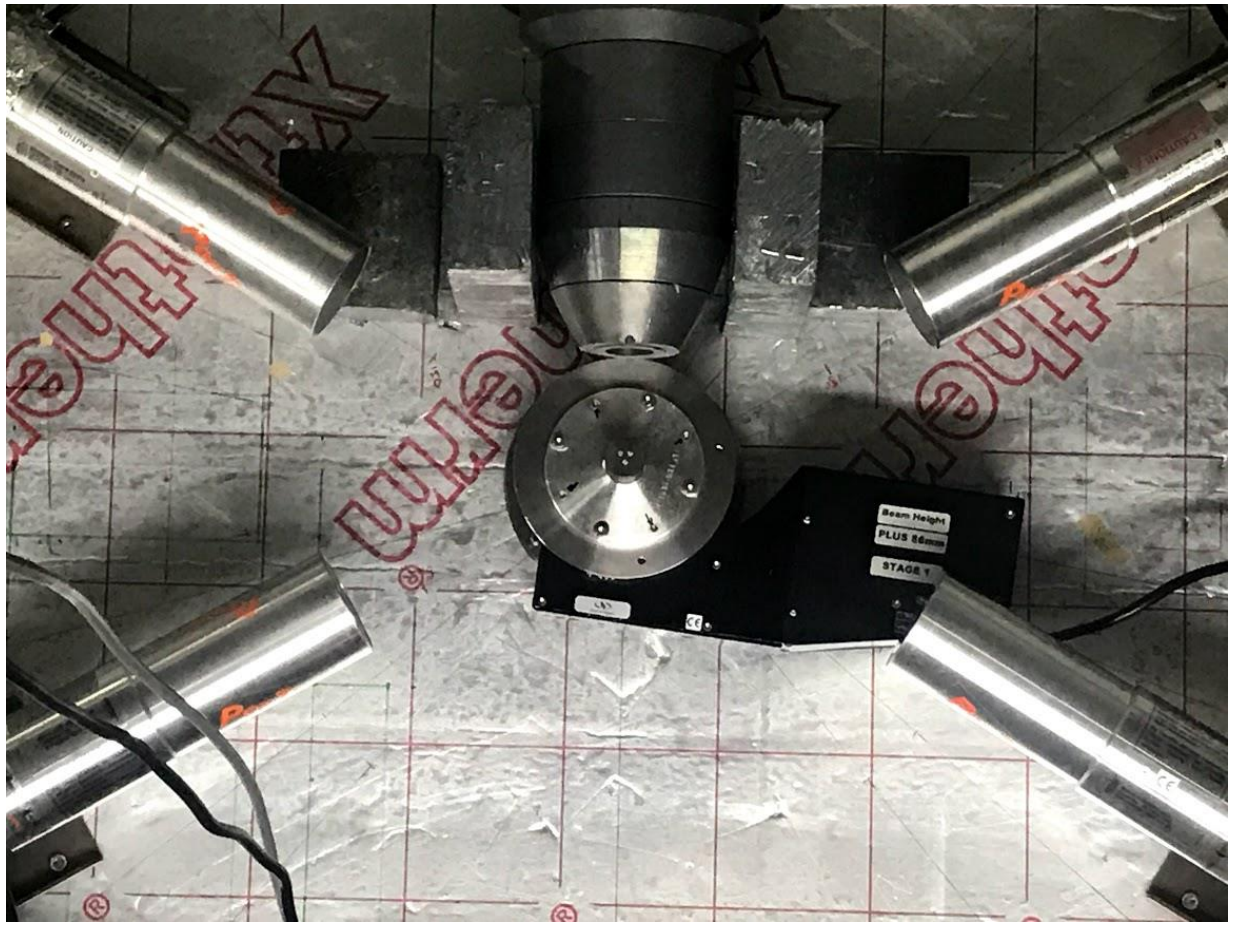


Imaging

- 20 mm carbon tube
- 3 x 5 mm aluminium tubes
- Rotational symmetry of 3
- 20 slices



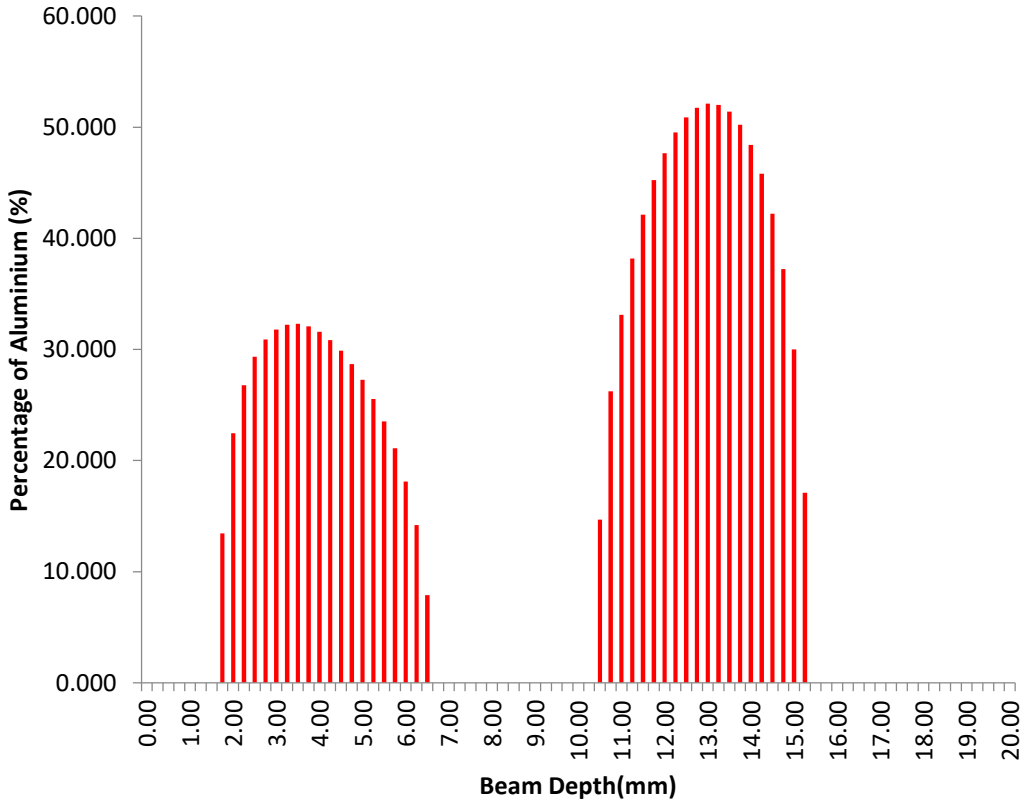
Imaging



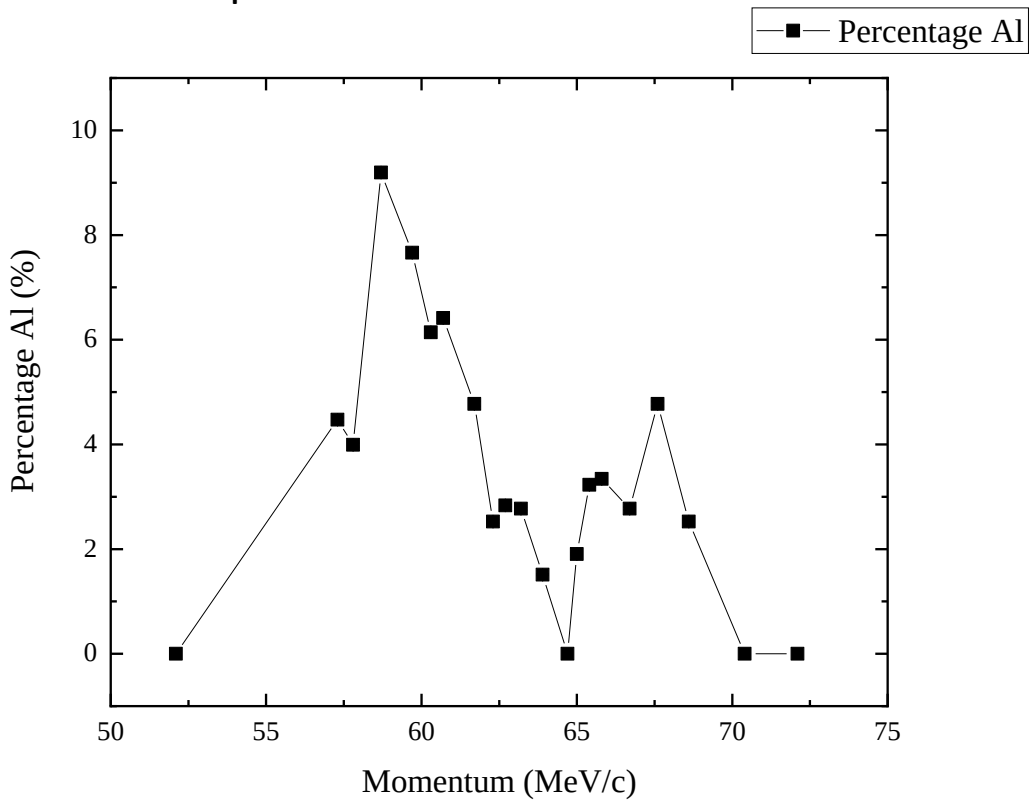
Imaging – Percentage Al

WARWICK
THE UNIVERSITY OF WARWICK

Simulation



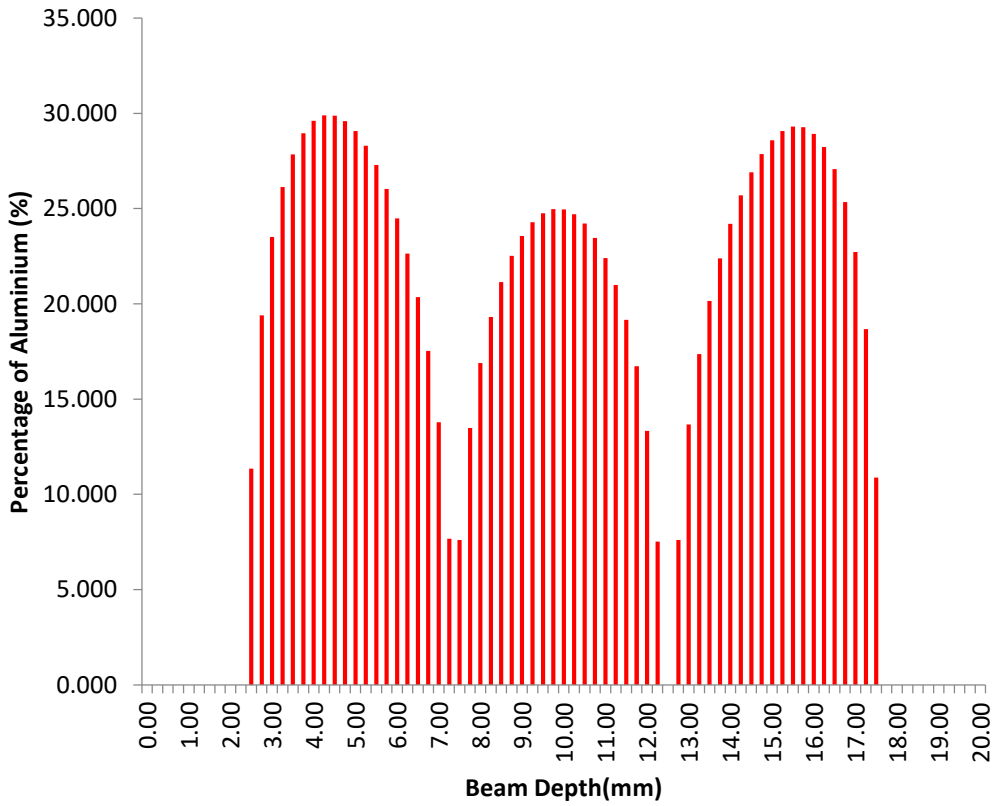
Experiment



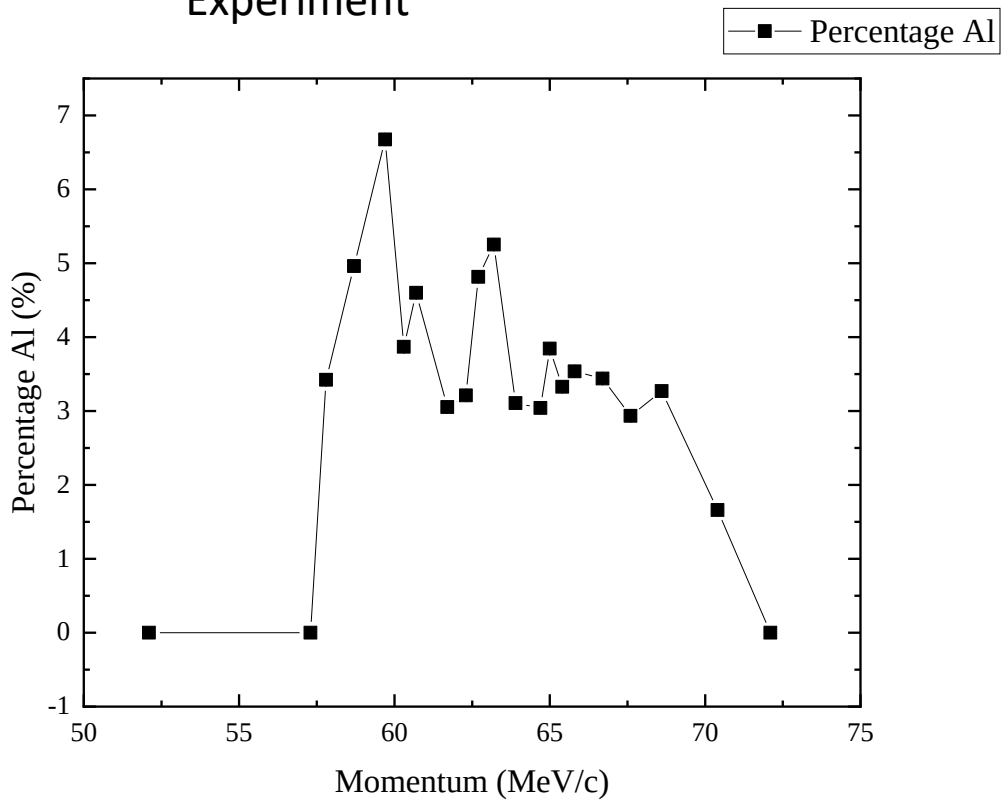
Imaging – Percentage Al

WARWICK
THE UNIVERSITY OF WARWICK

Simulation



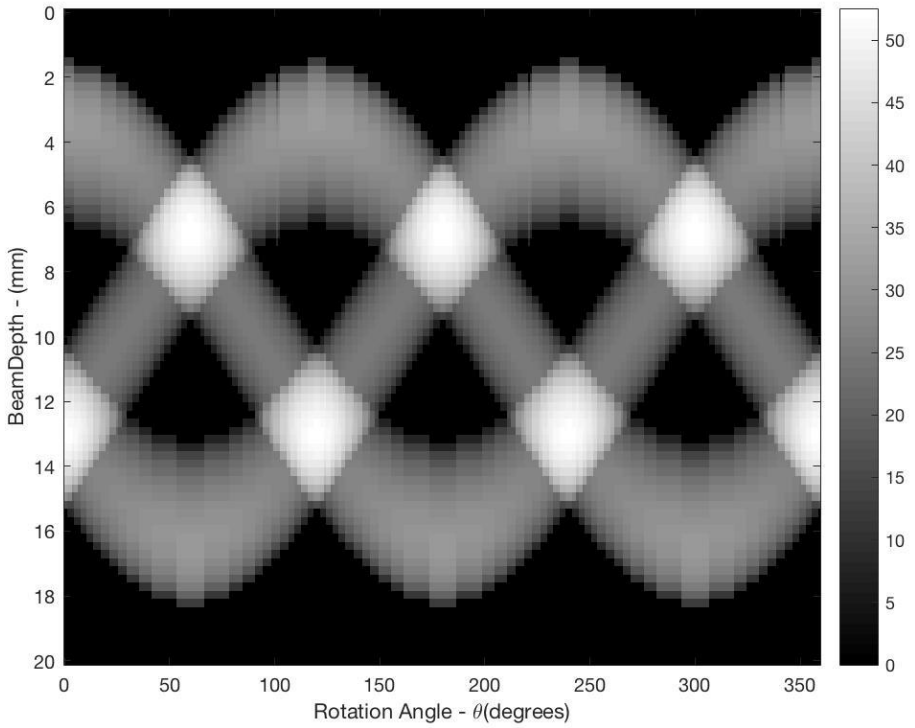
Experiment



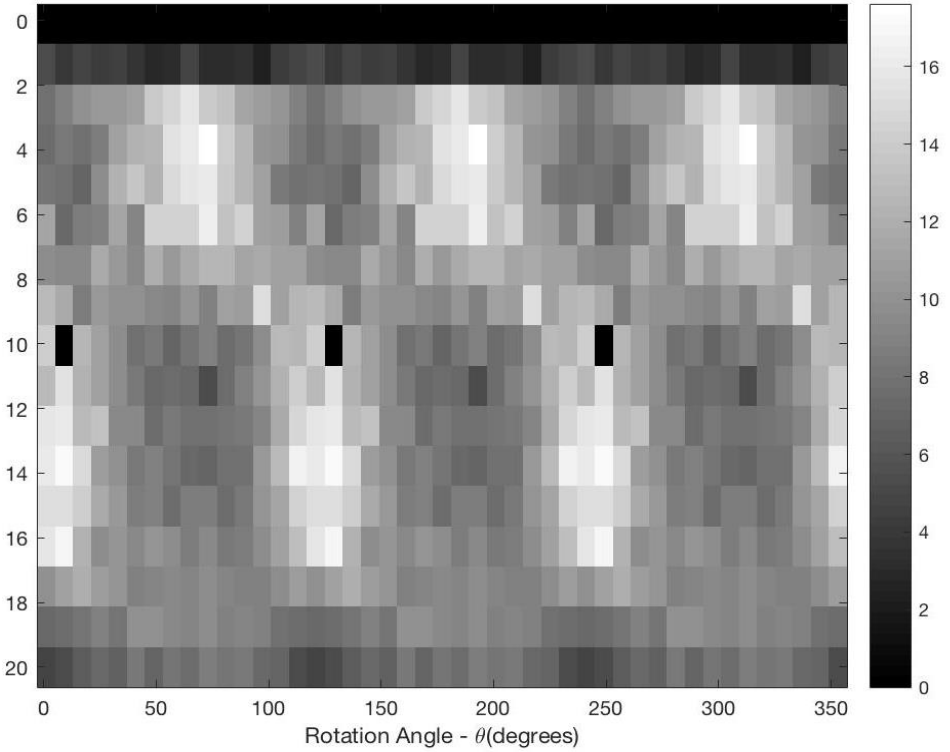
Imaging – Radon Transform

WARWICK
THE UNIVERSITY OF WARWICK

Simulation



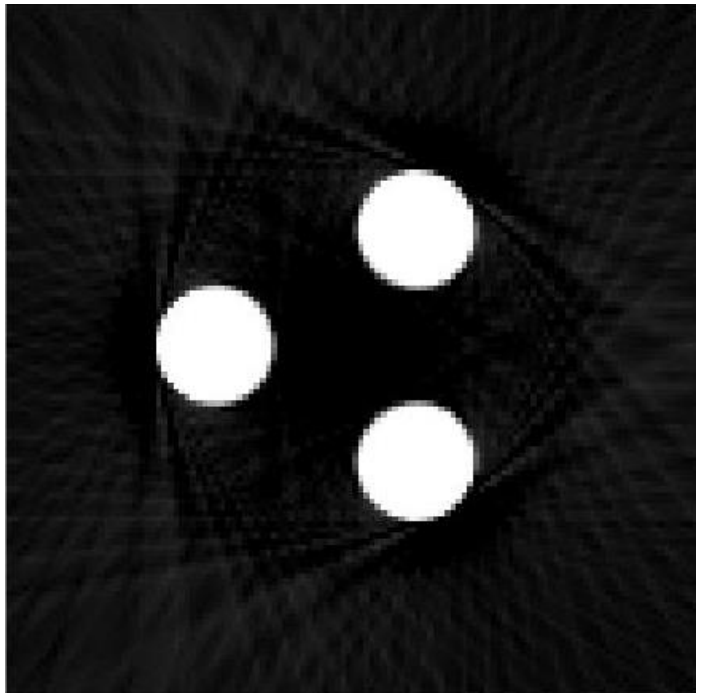
Experiment



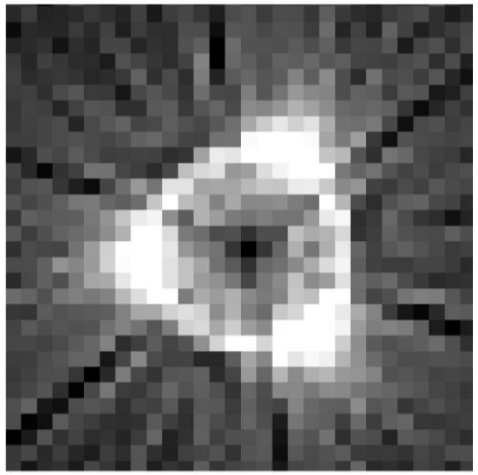
Imaging – Inverse Radon Transform

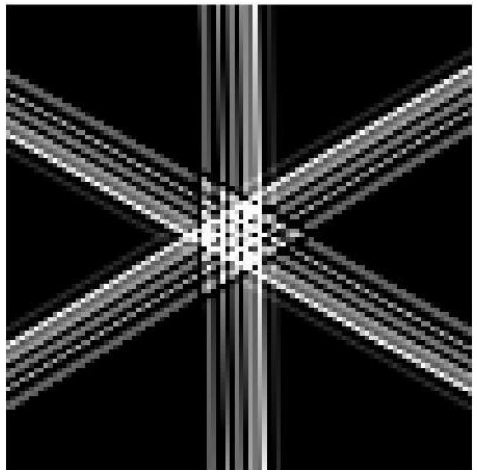
WARWICK
THE UNIVERSITY OF WARWICK

Simulation



Experiment





Future work

WARWICK
THE UNIVERSITY OF WARWICK

- Deconvolution of the image
- Software that identifies and fits peaks
- Determine resolution – 2 mm and 1 mm
- Measure standards