High-speed imaging of the powder-bed and shield gas during metal PBF additive manufacture

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CIM-Laser

- EPSRC's Centre for Innovative Manufacturing in Laser-based Production Processes

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High-speed imaging: Process understanding

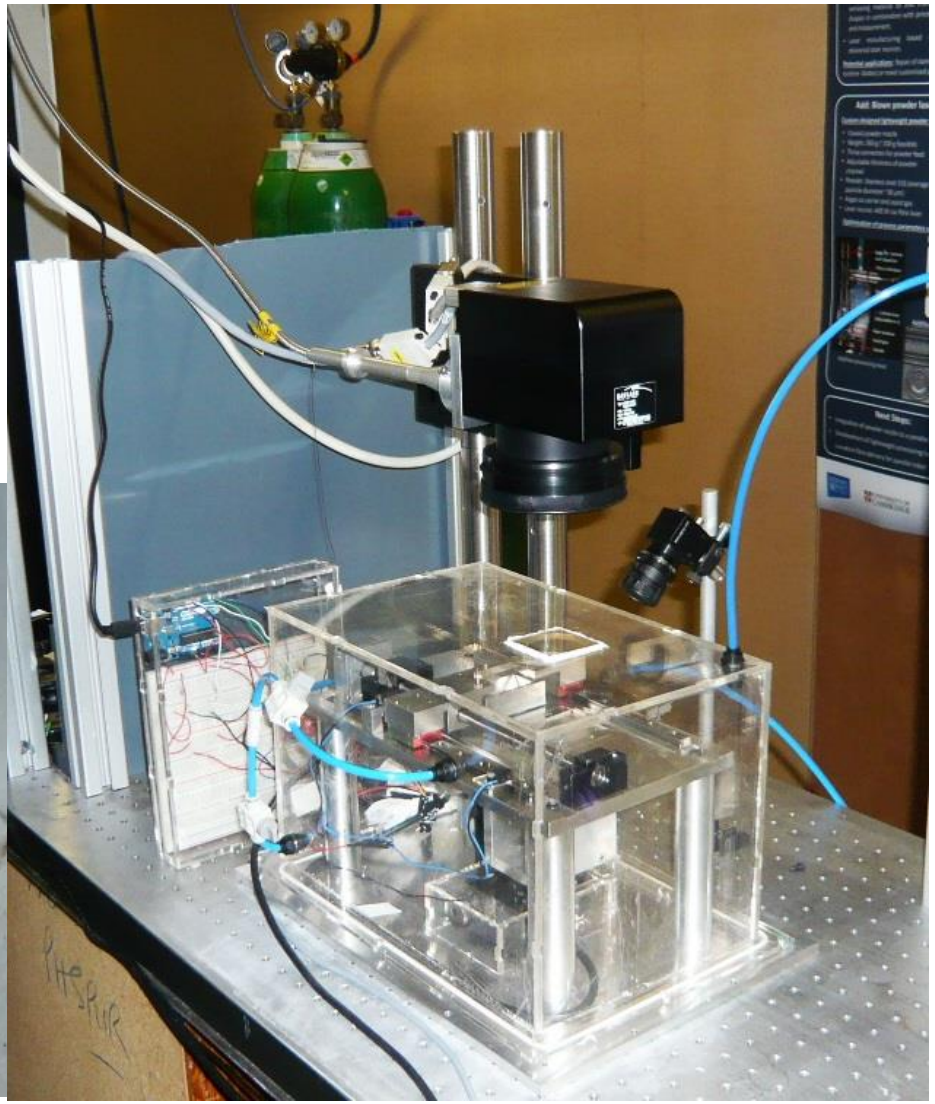
Power 200 W, Speed 0.5 m/s, Diameter 50 µm

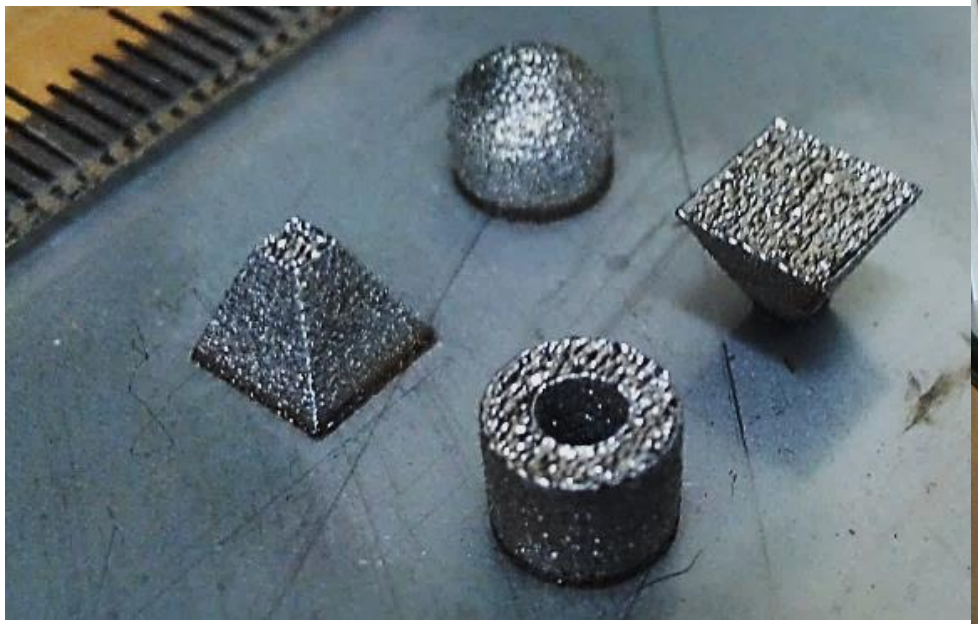
Overview

- Open-architecture PBF system
- High-speed imaging
  - Single track scans
  - Area scans
  - Multiple layer builds
- FE model of laser plasma and shield gas flow
  - High-speed schlieren imaging
- Discussion

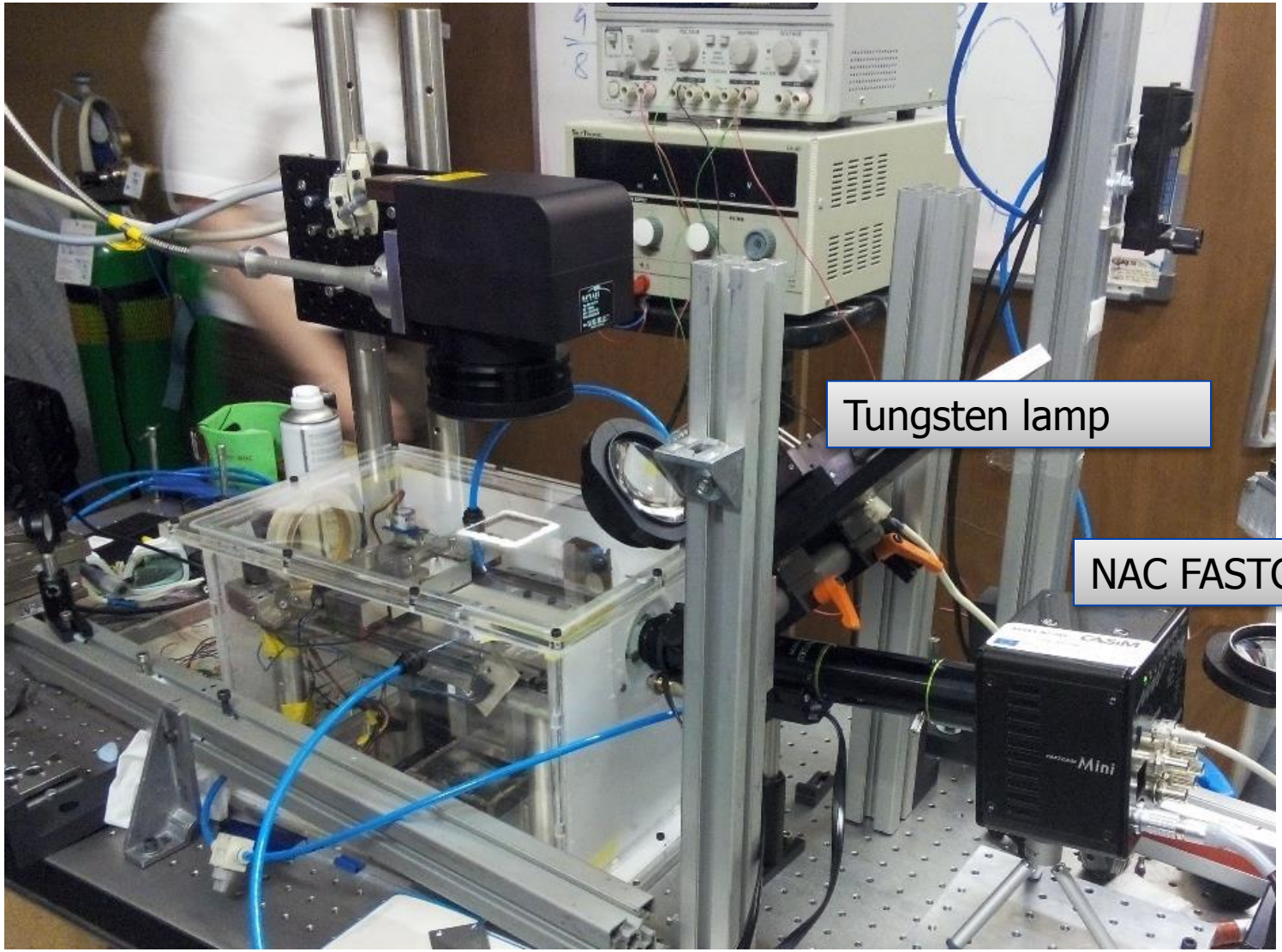
Open-architecture PBF system

- Designed for x-ray measurements
- Builds fully dense parts

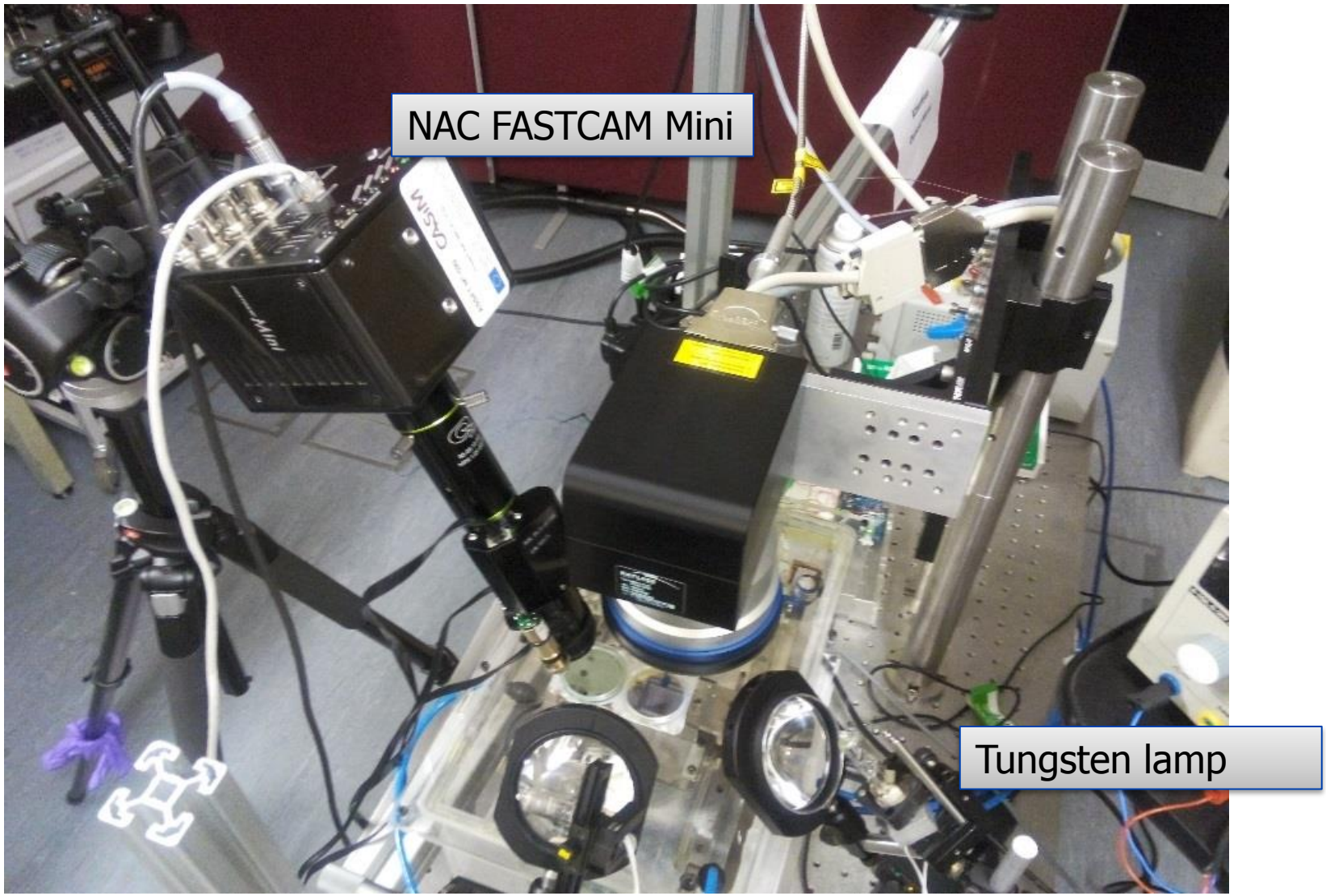




High-speed imaging: Side view (~10° to horizontal)



High-speed imaging: Top view (~20° to vertical)



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Conclusions

- High-quality imaging of powder bed
  - Single tracks, Area scans and Multiple layer builds
  - First layer vs 'steady-state' build condition
- Importance of laser plume
  - Particle level models
  - Characterisation of properties of powder layer
- Model of laser plume in PBF (+ schlieren)
  - Explains particle motion in powder bed
  - Predicts metal vapour concentration