Laser-Plasma-Accelerator–Driven Electron Radiography on the OMEGA EP Laser

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Summary

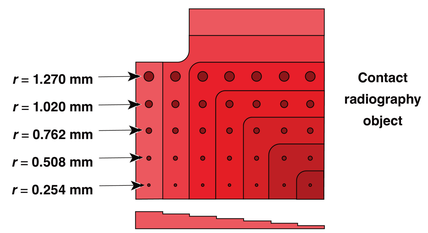
- Laser-plasma-accelerator (LPA) electron radiography is a powerful technique for diagnosing high-energy density (HED) experiments
- Initial results are reported for OMEGA EP-based LPA electron radiography [1]
- Contact, static projection and laser-driven projection radiography were performed
- Resolutions as low as 90 μm were seen on materials ranging from plastic to tungsten

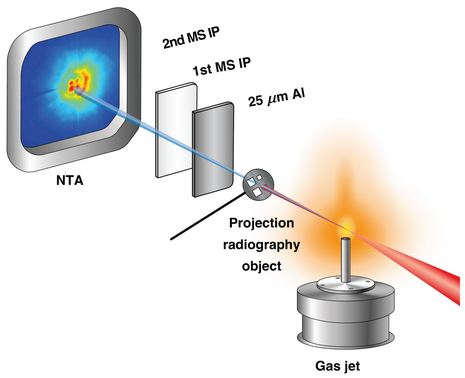
Electron Radiography

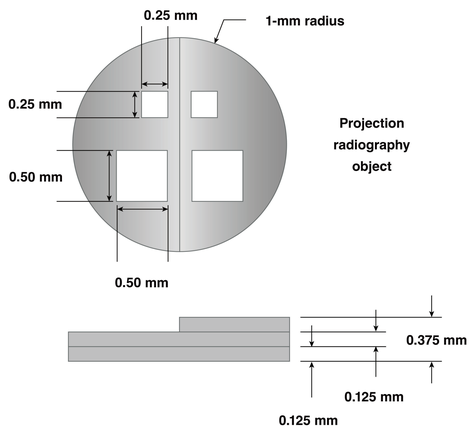
- Relativistic electrons have been used extensively for radiography with traditional rf LINAC's [2]
- Relativistic electrons are highly penetrating and can be used to measure fields in targets [1]
- LPA electron radiography was recently shown on small-scale laser facilities [3]
- Many HED facilities have ps–fs lasers available for generating LPA electron beams for radiography[4]

LPA Electron Radiography with the OMEGA-EP Laser

- 5 LPA electron radiography campaigns have been undertaken on OMEGA EP in the past year
- Contact radiography
  - Al
  - Ti
  - 306 stainless
  - Cu
  - Sn
  - W
- Projection radiography
  - Al
  - Ti
  - Cu
  - W







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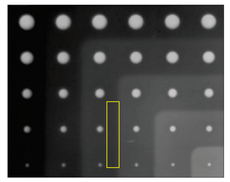
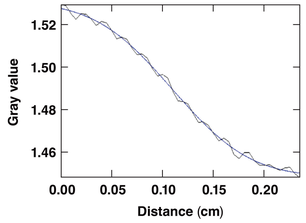
Results





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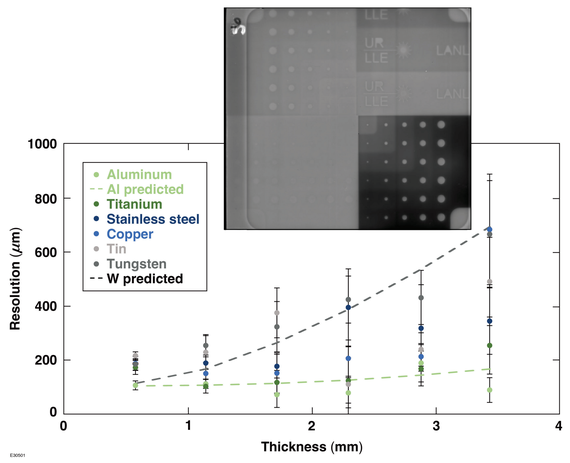
- Resolution was measured on holes and edges and then averaged over many measurements [5]
- Contact radiography showed a strong trend with Z number and thickness as expected



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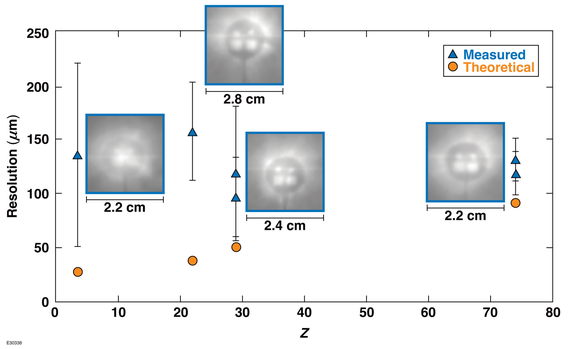
- Projection radiography suffered from drift distance blur and plasma effects



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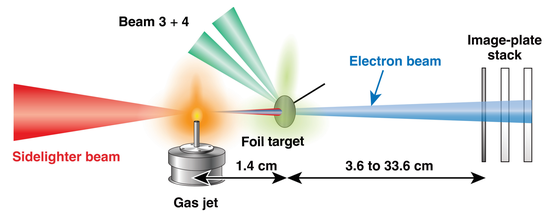
Future Refinements

- Preliminary experiments have been undertaken with laser-driven targets



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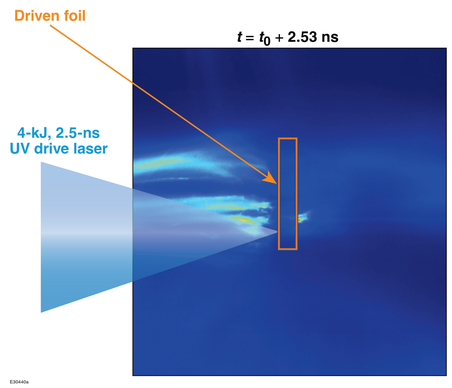
- ~100-T magnetic fields were measured, similar to proton radiography [6]



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- Future experiments will seek to achieve <10-μm resolution with magnetic optics [2]

References

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[6] L. Gao *et al.*, Phys. Rev. Lett. 109, 115001 (2012).

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