Characterisation of gas-jet targets for laser-plasma electron acceleration

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**Motivation: Laser Wakefield Acceleration**

- In laser-plasma electron acceleration a high intensity ultrashort laser pulse drives plasma waves, inducing a high field gradient (~GV/m) which can accelerate electrons to high energies within a very short distance.
- For applications, e.g., ultra-fast pump-probe X-ray spectroscopy as a preparation stage for XFEL 2015, important issues are tunability, stability and scalability.
- To address these issues we carefully analyse the acceleration targets, enabling:
  - PIC-on-GPU simulations using real-life experimental parameters.
  - Precise control and adjustment of experimental parameters.

**LWFA target characterisation: Mach-Zehnder interferometric tomography**

- Tomographic reconstruction:
  - no assumption of centro-symmetry as is the case with Abel reconstruction.
- Non-centrosymmetric targets can be analysed.

**Facility**

- Combined facility with access to both high intensity laser & conventional electron accelerator:
  - Thomson backscattering experiments as stepping stone towards fully laser driven Thomson backscattering x-ray source.

**Outlook**

A stable compact laser-driven electron accelerator can be used as a driver for unique x-ray sources via:
- electron/laser Thomson scattering
- betatron radiation

X-ray characteristics:
- finite bandwidth
- tuneable
- ultra-fast (~fs)

Such a source enables new experiments such as ultra-fast pump-probe X-ray spectroscopy.