

Characterisation of Gas Targets for Laser-Plasma Electron Acceleration

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Outline

- I. Density Measurement Setup
- II. Measurements with Different Gases
- **III.** Tailored Density Profile



I. Density Measurement Setup



Density Measurement Setup





Measured Phase at 9 bar Backing Pressure



$$\mu_{\rm H_2} - 1 = 1.389 \times 10^{-4}$$

$$\Delta arphi = 2\pi d imes \Delta \mu / \lambda$$

$$\mu_{\rm He} - 1 = 3.488 \times 10^{-5}$$

$$(\mu - 1) = K \times n_{\text{neutral}}$$



II. Measurements with Different Gases



Laser Wakefield Acceleration Setup

- Laser parameters:
 - 800 nm
 - 35 fs
 - 650 mJ on target
 - 19 µm spot size





Different Gases at 10 bar Backing Pressure





Pressure Scan





Converging-Diverging Nozzle



See also: Schmid, K., & Veisz, L. Rev. Sci. Instrum. 83, 053304 (2012).



Calibration of Gases





Calibration of Gases





III. Tailored Density Profile



Tailored Density Profile

- Double nozzle setup
 - 2 mm main nozzle
 - 400 µm tube
- Hydrogen





Tailored Density Profile





Control of Electron Peak Energy

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Control of Beam Charge





Summary

- Robust tool for measuring gas density
- Gas density of jets
 - Depends linearly on backing pressure
 - Depends on heat capacity ratio
- Tailored and adjustable density profile
 - Tuning peak electron energy
 - Tuning beam charge



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