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Characterisation and analysis of supersonic gas jets using interferometric measurement methods

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Supersonic gas jets are useful tools in particle accelerators used in both scientific and medical applications. They can provide real-time, longitudinal and transverse beam profile measurements for charged particle beams in accelerators and are also being used as a plasma source in wakefield accelerators. For gas jets to be used effectively as beam profile monitors, the density profile of the jet must also be well-known. This can be calculated by measuring the phase shift produced by the gas jet inside a laser beam due to the difference in density between the gas and the surrounding vacuum environment from the Lorentz-Lorenz relation.

In this contribution, multiple techniques for measuring gas jet profile and density will be compared and analysed; Mach-Zehnder and Nomarski interferometry. A 532 nm laser will be used for both of these methods, with a gas jet backing pressure of 7 bar. Multi-pass interferometry will also be used to increase the phase shifts by a factor of 4, and therefore sensitivity to lower density gas jets. This method involves retro-reflecting the interferometry beams, passing them through the gas jet multiple times. These techniques will be compared and their suitability for gas jet density characterisation will be assessed.

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Footnotes

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