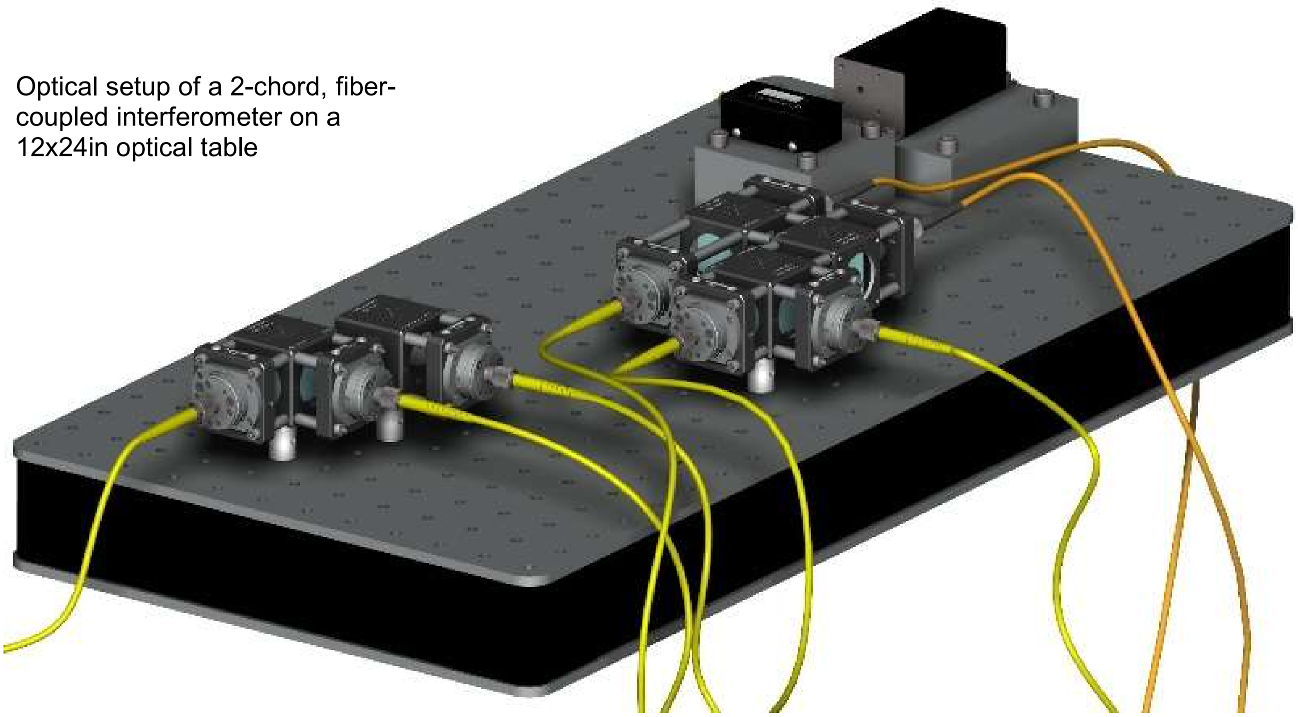
	Woodruff Scientific Inc 4000 Aurora Ave N, Suites 5 & 6, Seattle, WA 98103 (206) 905 9477 8am to 5pm Pacific sales@woodruffscientific.com **http://www.woodruffscientific.com**

Model number(s): R1-F
Descriptive name: Fiber-Coupled Interferometer

Optical setup of a 2-chord, fiber-coupled interferometer on a 12x24in optical table



Features:

- Measures chord-averaged electron density
- Fiber-based design allows line of sight to be changed without realignment of optics
- High-coherence laser allows for single reference beam and large path length discrepancies
- Heterodyne configuration for extended measurement range
- I-Q mixer for robustness against attenuation from changes in plasma
- High-frequency laser provides high temporal resolution
- Extendable to multiple chords
- Laser sources in 532nm – 5µm wavelengths
- Uses FC/PC fiber optic connections for high quality beam launching

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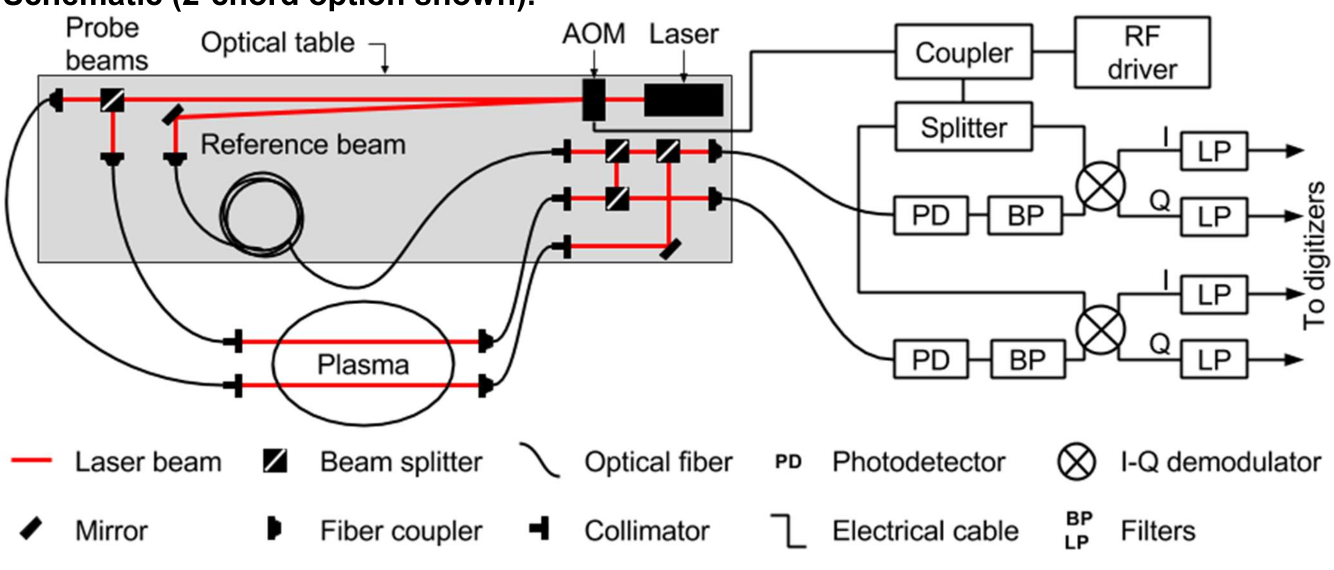
Operational ratings:

Electron density (n_e):	$< 10^{27}$ m^{-3}
Line-integrated density ($<n_eL>$):	$> 10^{16}$ m^{-2}, corresponding to 0.3° phase resolution
Temporal resolution ($d<n_eL>/dt$):	$< 10^{29}$ m^{-2}s^{-1}, depending on data acquisition
Path length mismatch:	up to 2m between reference beam and probe beam(s)

Options:

- Laser wavelength in the range 532 - 5μm
  Higher frequencies allow greater density before reaching cutoff, faster temporal response, and better spatial resolution. Lower frequencies are less sensitive to mechanical motion and can be more economical in many applications.
- Number of chords
  Having multiple chords allows for the spatial reconstruction of the electron density profile or analysis of plasma propagation, but increases the cost and complexity of the system.

Schematic (2-chord option shown):



Shown above are the optical (left) and electrical (right) schematics for a 2-chord R1-F interferometer. The laser is sent through a standard AOM and split into the reference beam

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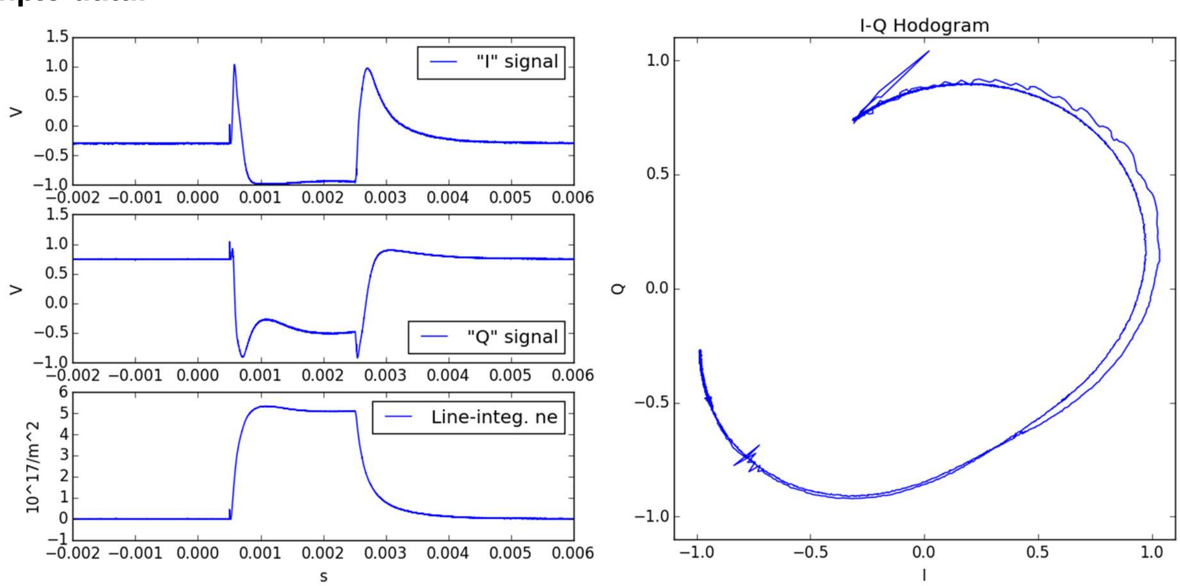
(now at different frequency) and the probe beam. The probe beam is then split into the desired number of chords. All beams are attenuated to the same power and coupled into fiber-optic cables. The cables are run to the desired viewing locations on the chamber, where a collimator is used to launch the probe beams into the plasma. The probe beams are collected on the other side, coupled back into fiber optic cables, and returned to the optics assembly. The reference beam is split and recombined with the probe beams. The recombined beams are converted to an electrical signal, filtered, and mixed with a local oscillator signal. The I and Q for each probe beam are output to coaxial cables for connection to the experiment DAQ system.

Example data:



At left is example data from an interferometer. The I and Q signals represent the cosine and sine of the phase shift, respectively. The right-side plot of Q vs. I demonstrates this relationship; ideal signals would trace a constant-radius arc or circle, the real-world plasma distorts the radius of the arc on the hodogram without changing the polar angle. The line-integrated electron density is shown bottom left.

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