L-Egant Solutions

Second-Harmonic Dispersion-Interferometer

A Second-Harmonic Dispersion-Interferometer (SHDI) is a diagnostic used to precisely measure density. The SHDI uses two co-linear beams, unlike a conventional, dual-arm interferometer and is characterized by high sensitivity, immunity to mechanical vibrations, reduced maintenance, and low cost. The SHDI is available for 1-dimensional line-of-sight measurements, and for 2-dimensional, time-resolved imaging. The SHDI's primary characteristics are as follows:

- The SHDI instrument is stable and beam re-alignment is rarely needed, since the probe- and reference-beams are co-linear, suppressing common-mode noise.
- The SHDI is comprised of two compact optical units that may be mounted directly on the experiment/test chamber. Vibration isolation systems are typically not needed.
- The SHDI instrument may be used to measure large, and small sample sizes. SHDIs have been used to study object sizes 0.1- 10 mm, and in a multi-path, 12-m long instrument.
- The characteristics of the laser source (power, CW/pulsed, line width, software, etc.) are tailored to the requirements of the application, in order to keep cost low.
- The SHDI can measure line-integrated density with a high time- and phase-sensitivity, $\Delta t \sim 1$ ns and $\Delta\Phi \sim 10^{-3} - 10^{-2}$ radians, as a single-chord, multi-cord, or 2D instrument.
- The SHDI's time resolution is determined by the detector system used. Bandwidth and sensitivity can be customized to accommodate specific requirements.
- As a 2-D instrument, the SHDI can provide $mm^2 - cm^2$ mapping, and larger. The rate at which images are recorded depends on the components used and can approach 1 kHz.
- The minimum sensitivity for the SHDI depends on the details of the investigation. Large gradients, beam deflections, and fringe jumps may limit the resolution.
- User-friendly software provides for quick-image visualization and data analysis, enhancing workflow and decreasing the timescale for discovery.

General specifications for the 1-D, and 2-D instruments are listed on the next page.

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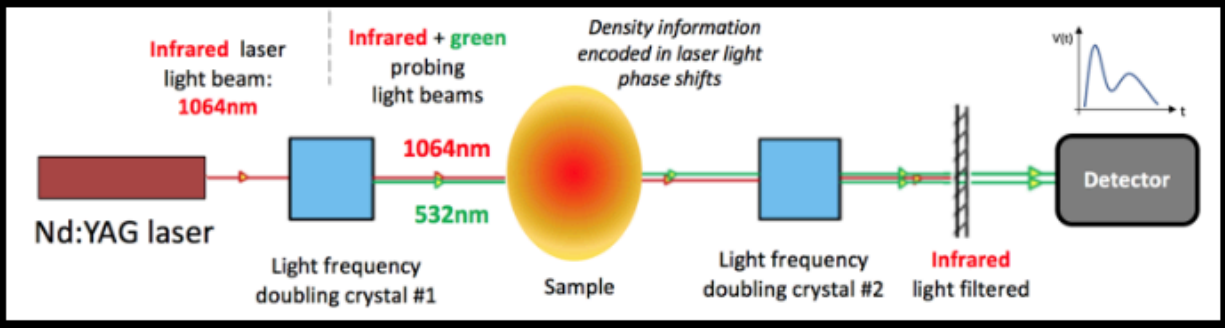
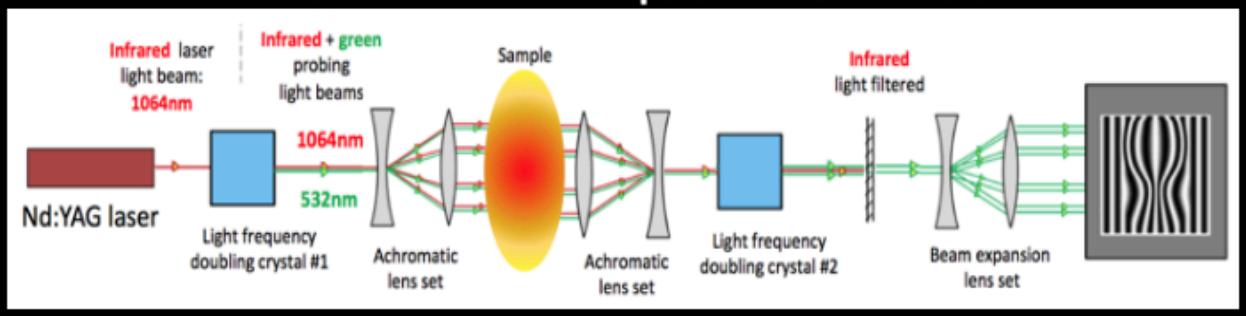
1-D Second-Harmonic Dispersion-Interferometer



- An infrared-laser (IR) beam is (partially) converted to visible light in doubling crystal #1. The IR and visible beams are collinear. Beam alignment/re-alignment requirements are minimal.
- After the sample, the residual IR (primary) beam is converted in crystal #2 and then filtered.
- The sample encodes a phase difference between two visible (532 nm) beams and a fast detector measures the (interference) fringe shift.
- The 2-D instrument is similar to the above 1-D instrument, except with expanded beams, to probe a sample with a much larger cross-section, thereby providing a 2-D profile.

2-D Second-Harmonic Dispersion-Interferometer



	1D SHDI	2D-SHDI
Nd: YAG laser	CW	Pulsed
Time resolution (ns)	200	1
Spatial resolution (mm)	1	0.2
Beam diameter (mm)	< 1	>10
Phase-equivalent noise (rad)	0.005	0.01
Minimum line density (m^{-2})	> $1x10^{18}$	$1x10^{18}$
Maximum line density (m^{-2})	< 10^{22}	<10^{22}

Photographic illustrations of the instrument components are provided on the next pages.

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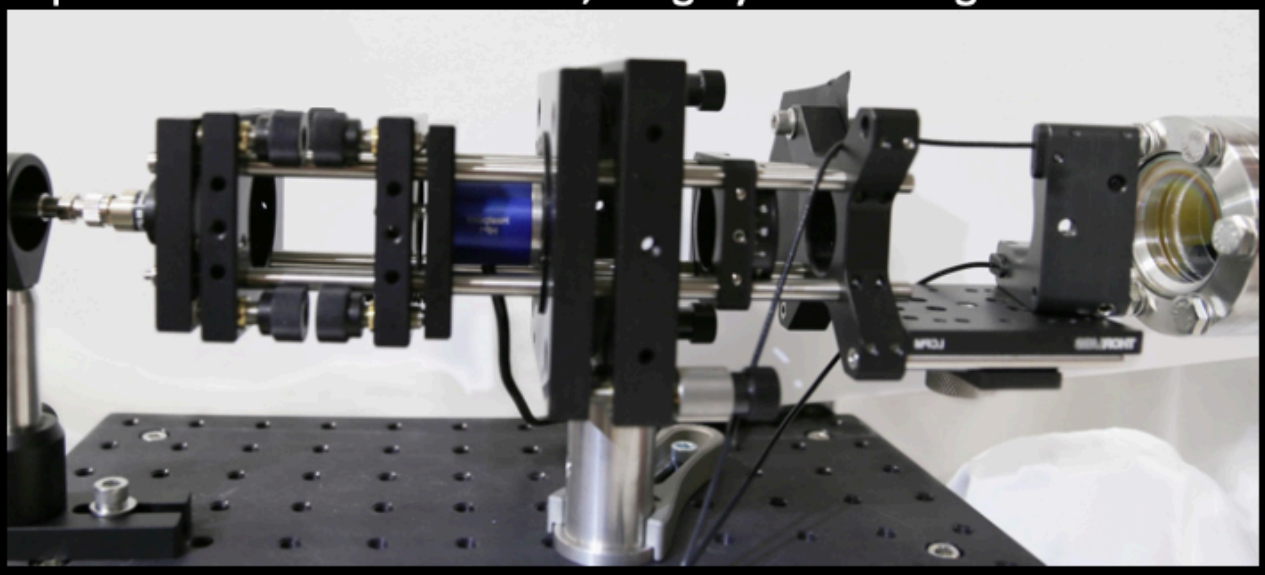
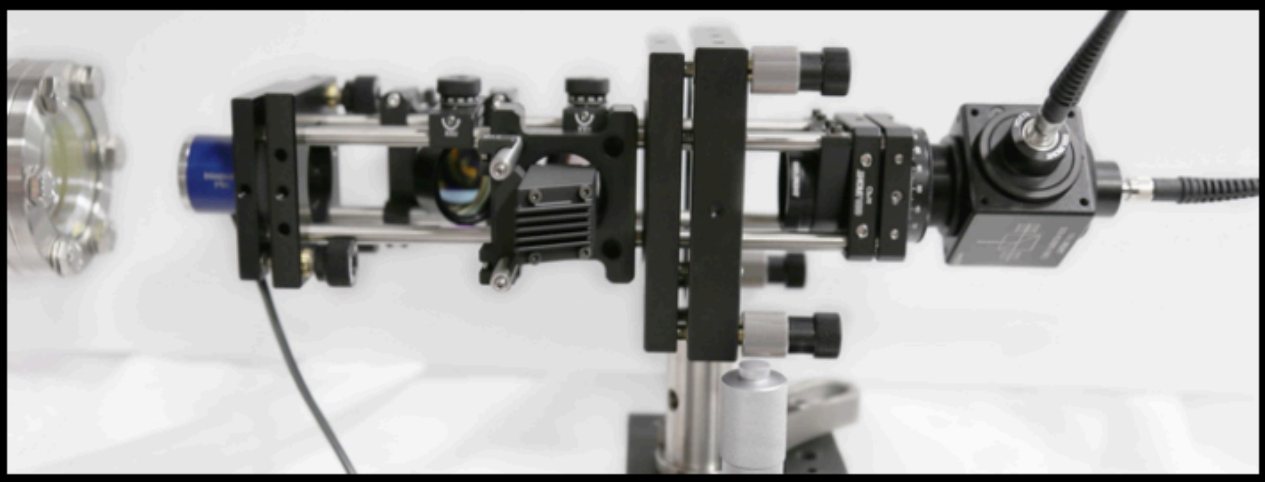
Two compact optical units are used in the 1D-SHDI.

Optical Unit 1 in the 1D-SHDI, roughly 20 cm long x 10 cm wide



Optical Unit 2 in the 1D-SHDI, roughly 20 cm long x 10 cm wide



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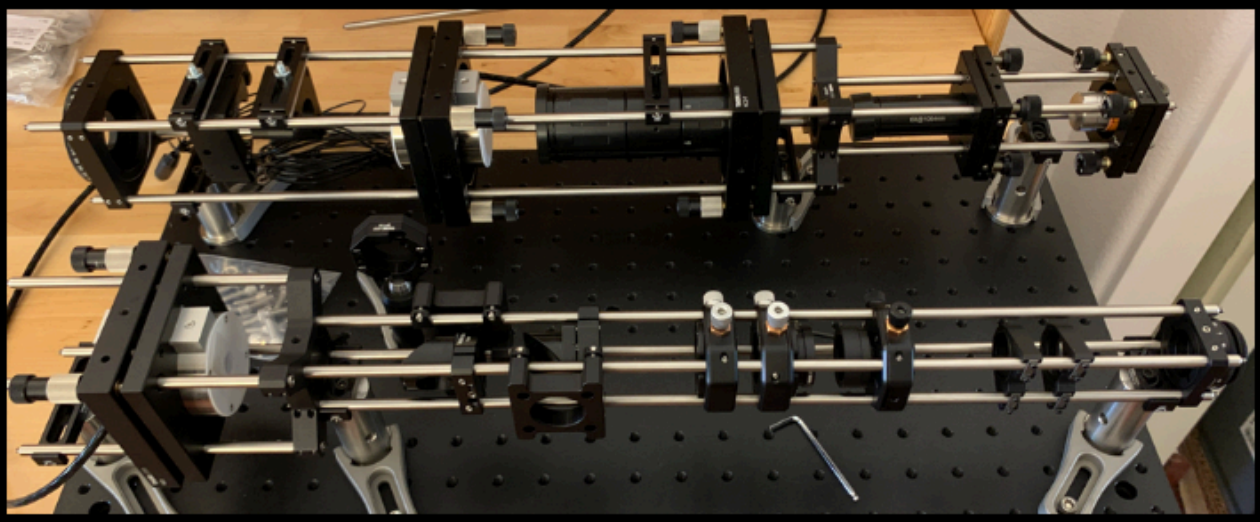
Two compact optical units are used in the 2D-SHDI.

Optical Unit 1 in the 2D-SHDI, roughly 50 cm long x 15 cm wide



Optical Unit 2 in the 2D-SHDI, roughly 50 cm long x 15 cm wide

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