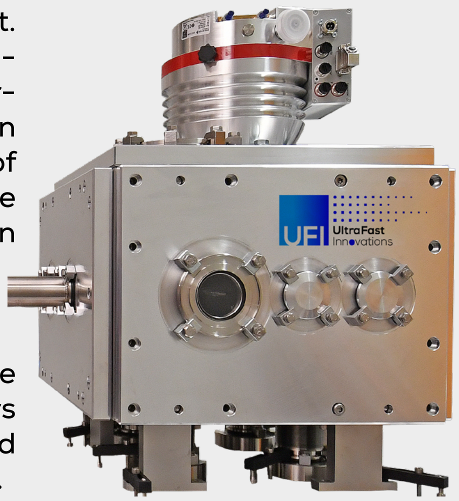
UltraFast Innovations

YOUR KEY to innovation and success

Coherent ultrabroadband XUV light source
NEPAL

Our High-Harmonic-Generation (HHG) setup consists of a vacuum chamber, all necessary KF vacuum components (incl. pump) and a fully motorized gas jet target. It generates XUV/Soft X-ray pulses through HHG when a (short) femtosecond laser is focused into the gas target. Moreover, single attosecond pulses can be isolated when NEPAL is combined with SAVANNA and our multilayer mirrors.
A flexible access allows quick and easy exchange of the gas jet target. The breadboard inside the chamber is isolated from environment vibrations to improve the temporal and pointing stability of your experiment. A feedthrough for noble gas inlet is included to supply e.g. argon, neon or helium for HHG in the spectral photon range of interest. For example, few-cycle (4-5 fs) 800 nm pulses in neon can generate high harmonics up to 150 eV (8.3 nm). The final generated high-harmonic spectrum depends on the focused laser pulse parameters and the used noble gas based on phase-matching conditions.



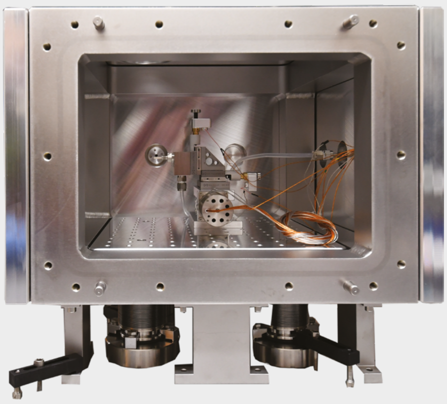
Key Product Features:

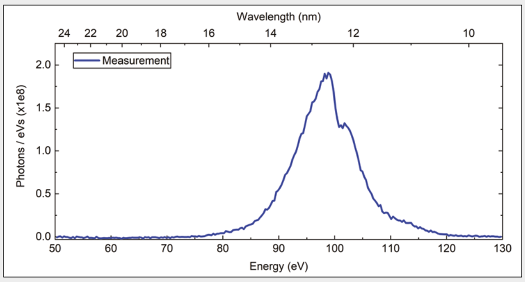
- **High-quality vacuum chamber** in KF technology
- **Up to 360 µW @ 3 kHz** high-harmonic power
- **Oil-free turbo-molecular** pumping system
- **Typical operating pressure: few mbar down to ‹10-3 mbar. Base pressure ‹10-7 mbar.**
- **Backing pressure in target:** 100s mbar up to few bar
- **Breadboard setup isolated** from environment vibrations for improved temporal and pointing stability
- **1-50 kHz** driver compatible
- **ISO and KF access ports and viewports**
- **Thin Brewster window** for minimal chirp and polarization cleaning.
- **Gas jet setup for HHG** (e.g. attosecond pulse generation). **Quick and easy exchange of the gas target.** Replacement gas jet targets can be requested.
- Gas jet mounted on a motorized XYZ translation stage
- **Gas flow control by a locking valve**
- **Footprint** 45 x 45 cm^2
- **Ceramic targets** for better performance and durability
- **Gas recycling** possible

UltraFast Innovations GmbH
Dieselstr. 5
85748 Garching
Germany

phone: +49 89 36039 - 437
fax: +49 89 36039 - 453
info@ultrafast-innovations.com
www.ultrafast-innovations.com

UltraFast Innovations

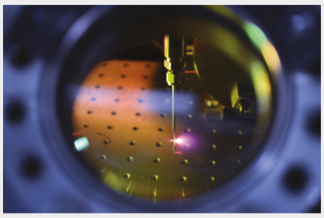




Up to 0.1 µW @ 3 kHz high-harmonic power in neon.

Left: Inside of NEPAL's chamber showing the motorized XYZ translation stage and the gas jet setup for HHG. Vacuum feedthroughs are used for the electrical connections and the noble gas supply. Two viewports allow observing the plasma channel in the gas target and in the chamber interior. The HHG stability is enhanced by mechanical decoupling of the gas jet target from the chamber. Right: Generated high-harmonic spectrum in neon. The spectrum reaches easily beyond the silicon 2p-edge around 100 eV.

High Harmonic Generation with NEPAL:



The laser beam is focused non-dispersively by a concave mirror into the gas cell filled with noble gas, reaching intensities of approximately 10^{13} - 10^{14} Wcm^{-2} (for typical state-of-the-art table-top laser systems), where the HHG process takes place with conversion efficiencies of 10^{-5} - 10^{-8}. NEPAL is compatible with long and short focal lengths including very short foci (f ≈ 6 cm). An XUV spectrometer can be mounted directly to optimize the high-harmonic-generation process.

Application - Isolated attosecond pulses:

NEPAL can be used to generate isolated attosecond pulses. In combination with SAVANNA, our hollow-core fiber compressor, and our in-house XUV/soft X-ray multilayer mirrors, NEPAL can generate isolated attosecond pulses in argon, neon or helium. The compressed pulses after SAVANNA allow amplitude gating while the mirrors isolate the HHG cut-off, resulting in single isolated attosecond pulses. The choice of noble gas and pressure is based on the spectral region of interest and the mirror center energy and bandwidth can be customized based on your experimental (spectral and temporal) requirements.

Differential Pumping Stage (accessories included):

- Two-stage differential pumping stage
- Vacuum chambers in CF technology
- Turbo pumps and pre-pump included
- Cold-cathode pressure gauges
- Vacuum exit valves and view ports possible
- Motorized beam iris for alignment and intensity control
- Footprint 60 x 60 cm^2

References:

[1] M. Behrens, L. Englert, T. Bayer, and M. Wollenhaupt, „XUV-beamline for photoelectron imaging spectroscopy with shaped pulses“, Rev. Sci. Instrum. **95**, 093101 (2024)