RESEARCH

Various research fields of CASTECH are listed and introduced in details.

Toward high-order harmonic generation from ions by a femtosecond terawatt laser in plasma waveguide produced by clustered gas jet

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Motivation

This project covers the characterization of cluster formation, the study of the channel formation using clustered gas, the guiding of light in a waveguide and the generation on HHG from ions in the plasma channel.

Abstract

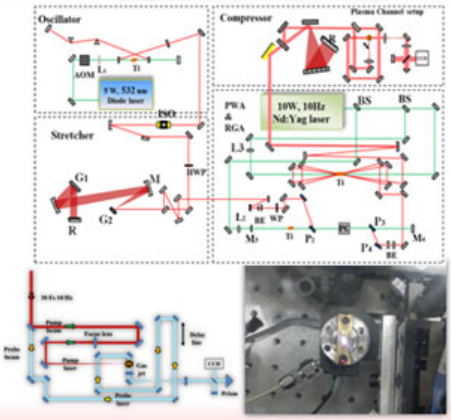
- This project covers the characterization of cluster formation, the study of the channel formation using clustered gas, the guiding of light in a waveguide and the generation on HHG from ions in the plasma channel.
- The waveguide is generated by plasma self-channeling in argon clustered gas jet using 30 fs, few mJ as a pump laser pulse to create the plasma channel and a delayed 1 mJ pulse of the same laser for probing the plasma channels by interferometric diagnostics.
- The radial distribution of the electron density confirms the formation of a plasma waveguide.
- Controlling the plasma waveguide length enhances the HHG intensity.
- The plasma channel length is controlled by the laser focus point (F), the laser intensity (I), the pump-probe delay time (t) and the laser height from the Ar nozzle (z).

Motivation

The formation of plasma channel as a waveguide using cluster gas jet

The generation of HHG from ions

Experimental setup



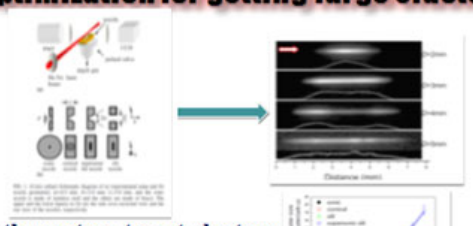
Why clusters?

A. For Atomic gases we need laser intensities ~ 10^{20} W/cm^2 to promote relativistic self-focusing, followed by whole-beam ponderomotive filamentation. But for clusters gases moder ate laser intensities (~10^{15} W/cm^2) is enough to have self-focusing in clusters following the hydrodynamic model of the cluster response.

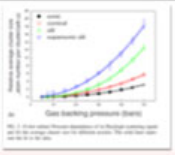
B. The generation of clustered argon enhances the absorption efficiency of femtosecond pulses which enables the use of pump pulses of only few mJ, approximately 30 times less energy than required for heating conventional gas targets, for plasma waveguide generation.

C. Plasma waveguide enhances the HHG formation.

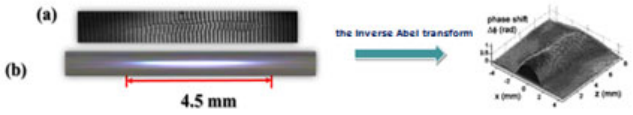
Exp. optimization for getting large clusters



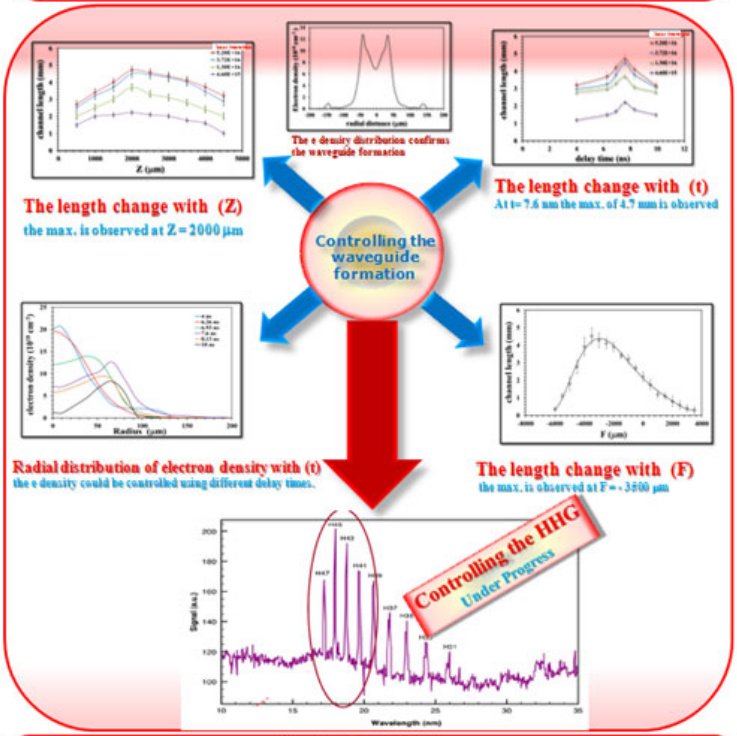
Optimizing the system to get clusters form gas jet using different nozzles under different backing pressures.



Converting the interferograms to electron density distribution



Conditions;
- 5.2 x 10^{16} W/cm^2 , 30 fs, 800 nm pulse
- Ar clusters at 75 bars backing pressure



Conclusion

- ✓ Optimizing the exp. condition for observing large size Ar clusters (~ 7.3 nm).
- ✓ Confirming the plasma channel formation as a waveguide of almost 5 mm length using low laser intensity.
- ✓ Controlling the plasma waveguide length and e density distribution.
- ✓ Optimizing the waveguide to enhance the HHG with is under progress.