2024

AWAKE —Taking part in the AWAKE Collaboration [1] aimed at building a novel, proton-driven plasma wakefield accelerator at CERN, we continued our experimental and development work on the study of the properties of the laser plasma in rubidium vapor. The new schlieren measurement setup applying a pair of knife edges as the mask was tested and the energy dependence of the plasma column width was determined in collaboration with Patric Muggli's group (Lucas Ranc and coworkers). In Figure 1 an evaluated schlieren image (left), and the obtained dependence of the peak distance and width on the pulse energy of the ionizing laser (right) can be seen. The arrangement was developed and extended to be used remotely also in the presence of the proton beam, to study the effect of wakefields on the plasma column.

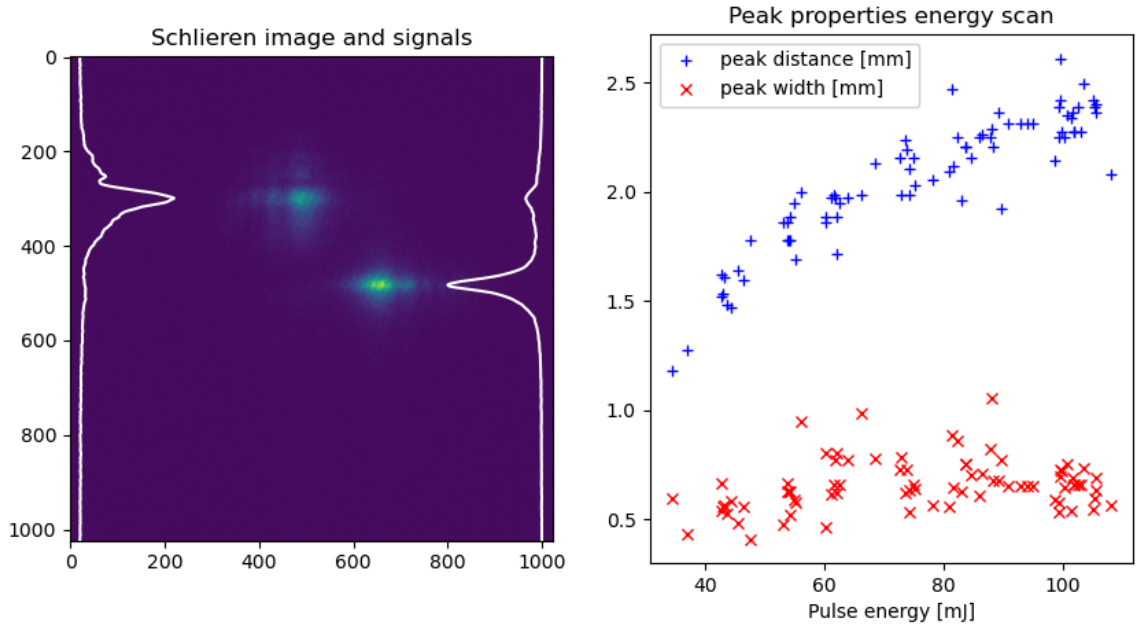

Figure 1. Schlieren image and signals of the plasma column, and the dependence of the signal peak properties on the laser pulse energy.

NAPLIFE laser acceleration and fusion studies — A series of experiments has been carried out at the ELI-ALPS laser facility to study the energy distribution of the accelerated ions and the different interaction products resulting from high-intensity laser irradiation of different target materials doped with nanoplasmonic constituents. In the measurements on polymer samples containing boron-nitride and resonant gold nanorods, a dip in the proton yield dependence on the laser pulse duration at 120 fs was observed, which indicated a decrease in proton number at the energy belonging to the proton-boron reaction cross-section resonance at 148 keV. This feature was attributed to the onset of p-B fusion reactions [2]. Thomson Parabola Spectrometer measurements were also carried out at the Wigner RCP on different thin target foils and proton cut-off energies up to about 300 keV were obtained.

Laser plasma Fourier filtering — The results of the experiments made on the enhancement of laser pulse contrast by nonlinear Fourier filtering in laser plasma have been published [3]. Further measurements have been carried out by studying the effect of the propagation of the laser pulse in plasma on the beam polarization.

EuPRAXIA — EuPRAXIA is planned to be the first active and functioning plasma based particle accelerator with scientific and industrial applications. In the framework of the coordination of the Hungarian activity, experiments were performed at the WRCP laser plasma laboratory by Prof. Hebling's group of the University of Pécs to investigate the propagation of radially polarized Terahertz radiation.

Mathematical physics —The work on solving physically relevant linear and non-linear partial differential equations or equation systems with the reduction mechanism was continued, and important solutions, which have analytic forms, were found. Problems from the field of diffusion, surface growth phenomena and a dark fluid hydrodynamic model were investigated. This last analysis showed that a relatively simple model is capable to explain the accelerating inflation of the Universe. Works are in progress to generalize and enhance the solution methods for more complex and compound systems. Figure 2 presents the velocity distribution in a non-newtonian boundary layer flow described with the Kummer's M function [4].

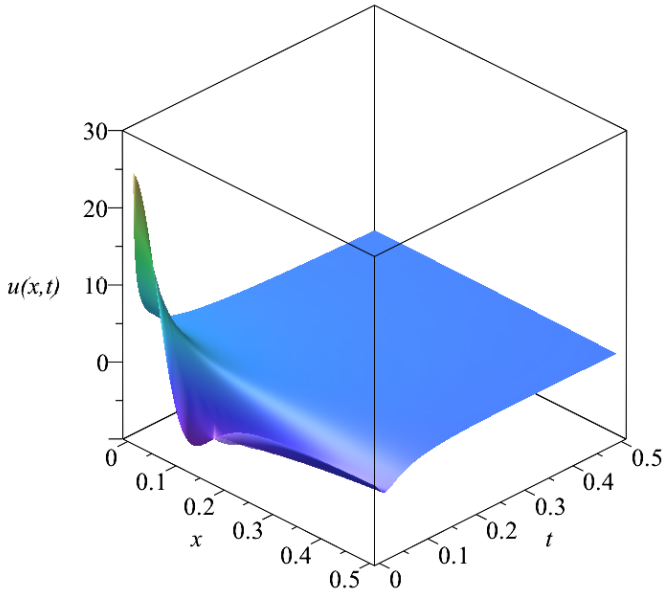

Figure 2. The velocity distribution in a non-newtonian flow, described with the Kummer's M function.

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