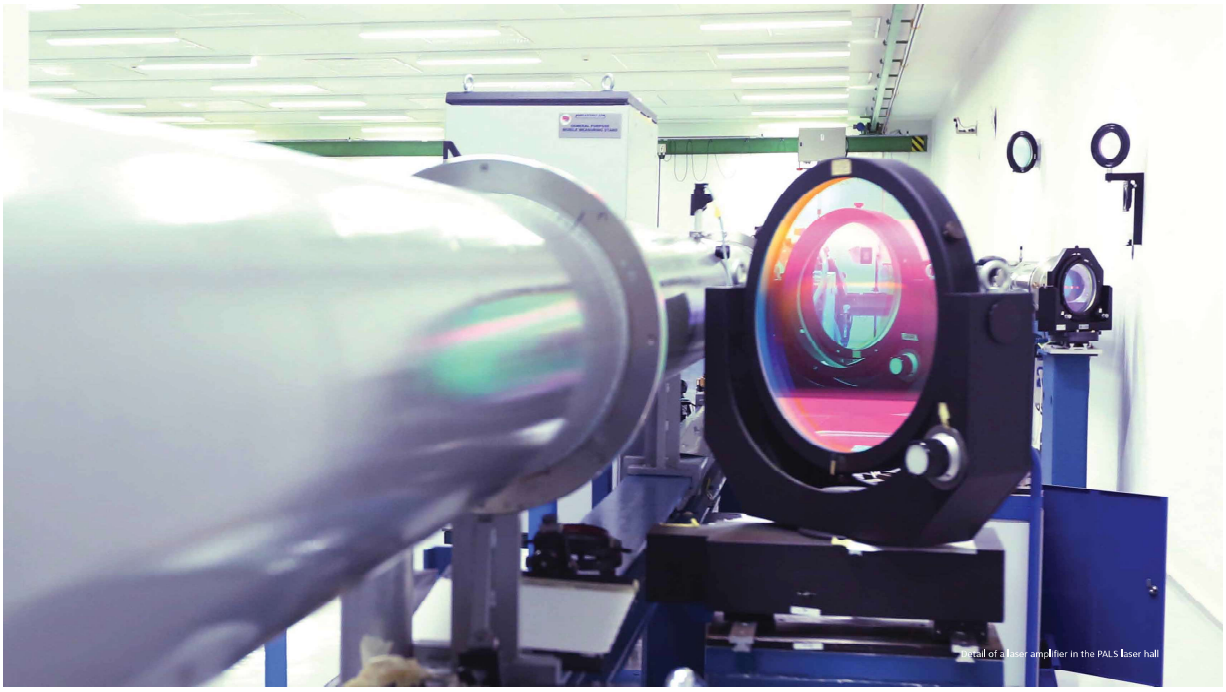
Laser Plasma Department

The Czech Academy of Sciences
Strategy AV21
Top research in the public interest

IPP


Detail of a laser amplifier in the PALS laser hall

INTRODUCTION

Mission: The Department conducts experimental and theoretical research of laser-produced and lasing plasmas.

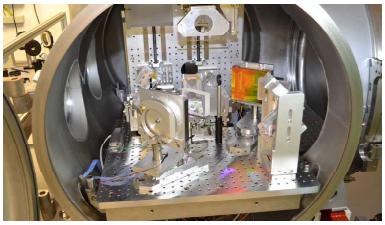
Main lines of research

- Basic experimental studies of laser-target interaction at radiation intensities as high as 10^{16} W/cm^2
- Inertial fusion relevant experiments
- Development and applications of laser-based XUV and ion sources, and plasma-based QSS X-ray lasers
- Tandem experiments with synchronized nanosecond and femtosecond lasers
- Laboratory astrophysical plasma experiments
- Theoretical studies of the interaction of electromagnetic waves with plasmas and of lasing capabilities of plasmas of various types

EXPERIMENTAL FACILITIES

- Terawatt kJ-class iodine photodissociation laser PALS (Prague Asterix Laser System) with an optional plasma-based zinc soft X-ray laser
- Auxiliary Ti:Sapphire high repetition rate 25-Terawatt femtosecond laser
- Target facilities with a rich set of equipment for plasma diagnostics


Laser amplifiers in the PALS laser hall


Compressor of the Ti:Sapphire laser

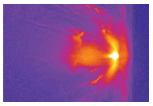
SCIENTIFIC INNOVATIONS

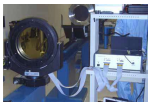
A proof of principle of using hydrogen ice as a target for laser acceleration of protons has been given in collaboration with the French laboratory INAC/SBT of the CEA.


Helium cryostat (left) producing a thin band of H-ice (middle), and interferogram-shadowgram of the hydrogen plasma

The polaro-interferometer developed in collaboration with IPPLM, Warsaw, makes it possible to visualize the distributions of plasma density and spontaneous magnetic fields with sub-ps precision.

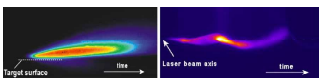
A large-aperture bimorph adaptive mirror has been developed in cooperation with FME CTU and 5M s.r.o.


A coloured fs shadowgram of laser produced plasmas


The bimorph adaptive mirror with a control system

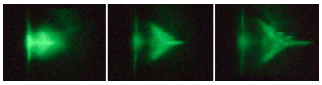
PILOT TARGET EXPERIMENTS

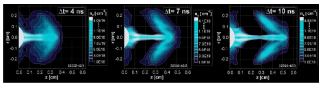
Systematic studies of the interaction of a focused laser beam with various targets are aimed at development and applications of laser x-ray and ion sources, and plasma-based X-ray lasers.



Axial expansion and radial motions of the laser-produced plasma plume viewed by side-on X-ray streak camera

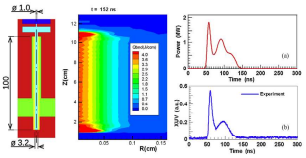
Experiments on shock waves and laser-produced plasma jets are motivated by their applications in inertial confinement fusion and laboratory astrophysics.


Shock waves in argon viewed by X-ray framing camera

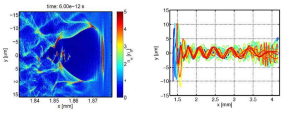

Densitograms of a plasma jet penetrating a neon gas-puff target

ADVANCED THEORETICAL STUDIES

Modelling of fast pinching discharges – prospective tabletop sources of XUV radiation in the so-called water window.


Parameters and integrated radiation of a nitrogen-filled alumina capillary

2-D particle-in-cell simulation of the wakefield acceleration of electrons showing how the electrons become trapped at the rear side of the ion cavity, being accelerated longitudinally, while their transverse oscillations lead to emission of X-radiation.


Electron density in the laser wakefield (left) and simulated trajectories of the electrons trapped in the ion cavity