APDCAM Application Example
Laser plasma interaction experiments

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The APDCAM family of detector cameras is not off-the-shelf product but are built considering the needs of each individual customer and their applications. This document describes a successful application of the APDCAM-1G camera at the Wigner Research Centre for Physics, Budapest, Hungary, where the laser plasma interaction studies required high sampling frequency simultaneously with high sensitivity.

In these experiments spatially extended rubidium plasmas are generated by ultrashort laser pulses. Such plasmas will be used in novel particle acceleration techniques based on plasma wakefield phenomena initiated by proton beams (AWAKE project of CERN). For this purpose, an ultra-homogeneous plasma with a density of about 10^{14}-10^{15} cm^{-3} is needed, where the density homogeneity must be better than 0.1% over tens of meters of plasma length.

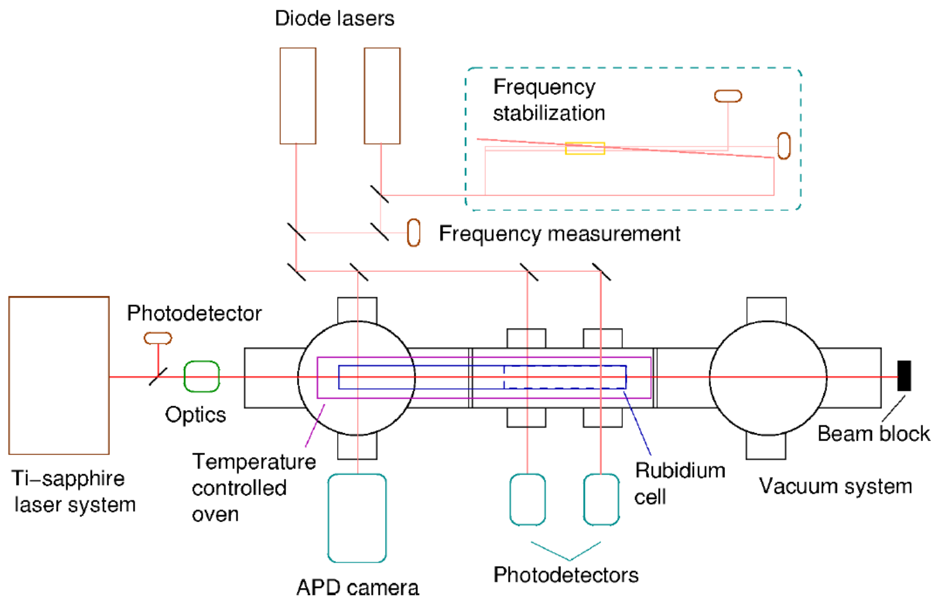

Figure. 1. Scheme of the experimental setup.

Since it is very important to know the ionization efficiency and the propagation properties of the laser beam in the medium, reserachers at the Wigner Research Centre for Physics in Budapest, Hungary are investigating these characteristics by time-resolved near-resonant absorption methods (*Figure 1*). A laser plasma is generated in rubidium vapor by Ti:Sapphire laser pulses of about 40 fs pulse width and 10^{11} W/cm^2 intensity. The transverse absorption of tunable laser light near-resonant with the rubidium atomic transitions is recorded at different positions along the plasma tube with an APDCAM-1G 4x8 pixel camera. (*Figure 2*). It was easy to integrate the APDCAM detector camera into the experiment as it has standard F-mount optical interface and a Gbit communication interface, which connects it to the laboratory computer.

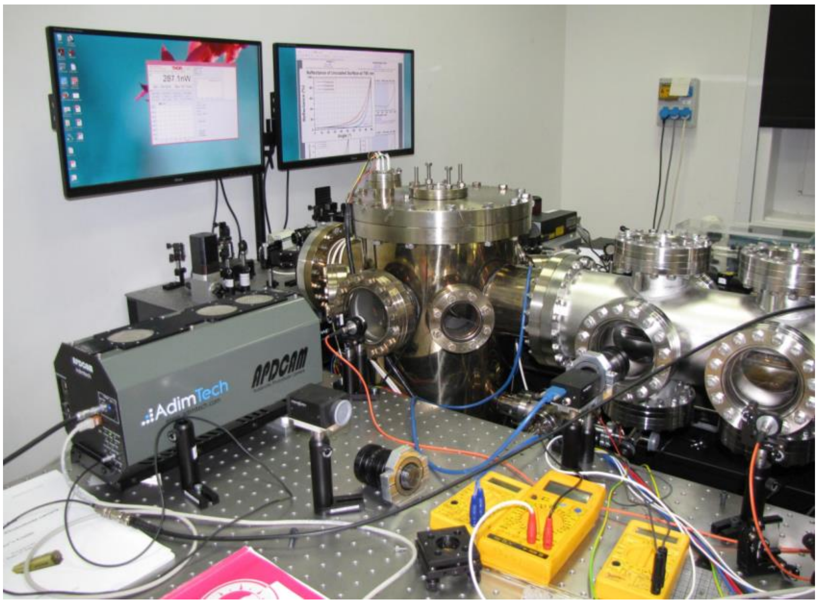

Figure. 2. Photo of the measurement system in the laboratory.

The temporal behaviour of the signals reveals the interaction processes between the rubidium atoms and the high-intensity laser pulse, while the dependence on the longitudinal position informs us about the homogeneity of the generated plasma. The APD camera is used for the measurement of the transverse absorption in order to determine the dependence of the signal on the vertical position. The curves in *Figure 3* depict the temporal dependence of the transmission signal at different radial positions of the laser plasma (with 2 mm distance between the neighboring points). Regions of different transmission properties were identified, also indicating the refraction effect of the plasma tube.

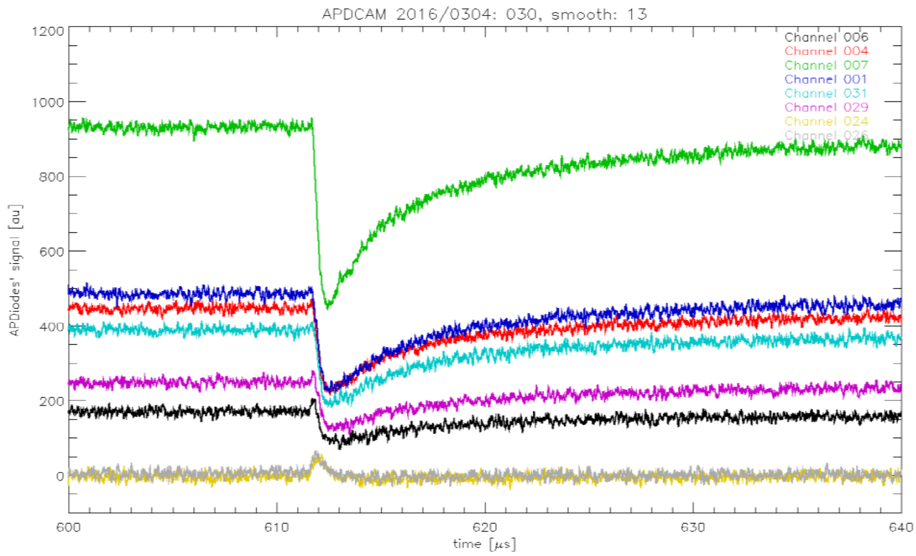

Figure. 3. Time traces of the probing laser light in APDCAM. The estimated maximum light level is about 10^{10} photons/s.