The fast timing photo-polarimeter OPTIMA

Cosmic high-energy sources, like pulsars, stellar and galactic black-holes, neutron star and white dwarf binaries, and gamma ray bursts are characterized by extremely fast temporal variations of their emissions throughout the spectrum. Optical radiation from these high-energy sources is often closely tied to the non-thermal particle populations that generate the X- and γ-ray photons (e.g. synchro-cyclotron emission vs. inverse Compton and curvature radiation). Optical photons therefore carry unique spectral, timing and polarisation information about their origin and are readily measured from various telescopes on the ground.

For the multiwavelength extension in the study of high energy sources into the optical range we have built the sensitive, portable high-speed photometer OPTIMA ("Optical Pulsar Timing Analyzer" , Straubmeier et al., 2001, Kanbach et al., 2002).

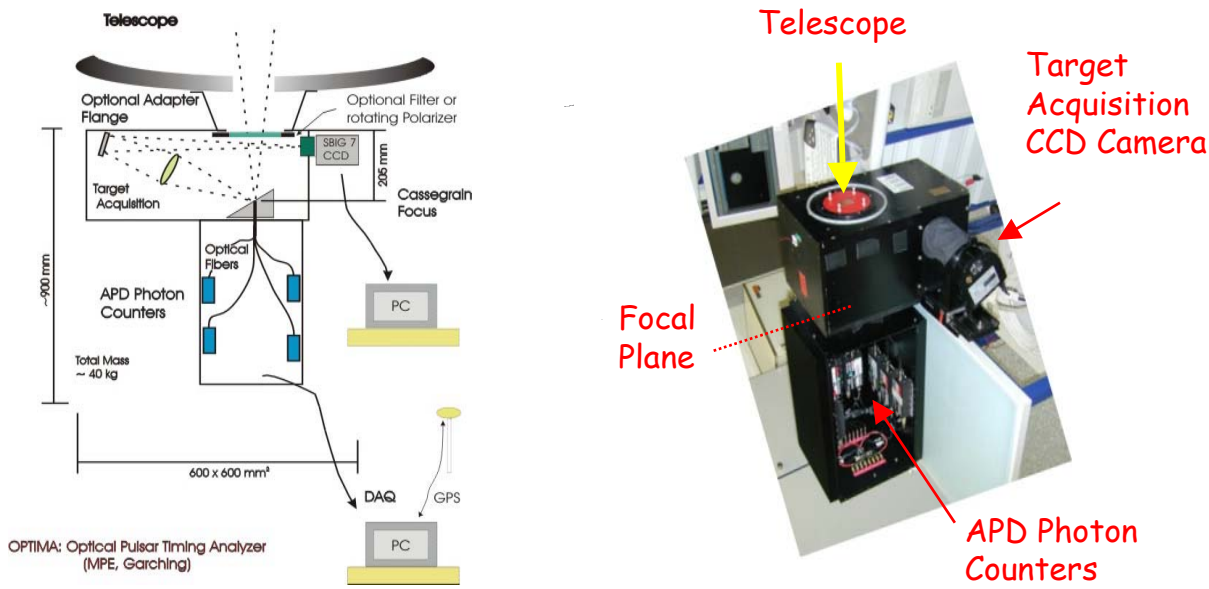

Figure 1: Schematic layout and photograph of the OPTIMA fast timing photo-polarimeter.

OPTIMA is based on 8 fiber fed avalanche photodiode (APD) single photon counters, a GPS timing receiver, a CCD camera for target acquisition and stand-alone PC control units. The target array of fibers is configured as a hexagonal bundle. A separate fiber is located at a distance of ~1‘ as a night sky background monitor. Single photons are recorded in all channels with absolute timing accuracy of ~2 μs. The quantum efficiency of the APDs reaches ~ 60% in the range 450-950 nm. Compared to similar photometers based on PMTs, OPTIMA has a ~6 times higher sensitivity due to its large bandwidth and high Q.E.

A rotating polarisation filter and a prism spectrograph that allows to simultaneously record photons in 4-color bands, have recently been added as optional equipment. The polarimeter has been verified in recent Crab pulsar observations; the spectrograph will be tested in forthcoming campaigns on X-ray binaries and selected blazars.

OPTIMA was used on the 1.3m telescope (Skinakas) and on the 3.5m telescope (CAHA). Observations in the southern hemisphere (74in. Mt. Stromlo, 2.2m La Silla) proved also the flexibility and portability of OPTIMA.

References:

Straubmeier, C., et al., (2001) Exp. Ast

Kanbach, G. et al., (2002), PASP Conf. Ser., in press

G. Kanbach, C. Straubmeier (now U. Köln), H. Steinle, S. Kellner, F. Schrey