



## **Final Report for the Laser Beam Profile Monitor (LBPM) Task**

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### **Abstract**

A summary is presented of the deliverables of the LBPM task within the EUROTeV Work package “Diagnostics” (DIAG). The task concerns the measurement of transverse size of an electron beam by scanning a laser beam across the electron beam and detecting Compton-scattered photons downstream. The key deliverables are summarised and further references provided.

## Deliverables

The laser-wire effort has delivered on the following main areas:

- Design of the diagnostics section of the BDS to include laser-wires. A paper based on this work was published in PRST-AB [1].
- Simulation of the laser-wire signal and the influence of the layout of the laser-wire detectors in the vicinity of the ILC upstream polarimeter [2, 3]. This work showed that operation of the laser-wire is likely to cause unwanted backgrounds to the polarimeter and indicates that it would be advisable to design separate, well separated, stations for each system.
- Specification and purchase of a laser for the PETRA laser-wire and construction and commission a 2-dimensional laser-wire scanner at the PETRA accelerator.
- Completion of data taking using a 2-dimensional laser-wire scanner at the PETRA accelerator; this was accomplished and the results published [4-7]. This laser-wire system was dismantled in 2007 to make way for the dismantling of the PETRA II machine; in 2008 an upgraded laser-wire system was tested at RHUL; in October 2008 it was transported to a new location in the PETRA ring and was set up for data taking for the start-up of PETRA III.
- Specify and set up a fast scanning system based on electro-optic techniques. An HV driver system was set up and commissioned at RHUL. A new scanning system was developed using lithium niobate crystals. First results were very promising and indicate that a workable solution is possible using this technology; results were presented at accelerator conferences [8-11]. A publication for Applied Optics is also well advanced.
- Investigate the requirements of a mode-locked laser-system with ILC specifications [12].
- Construct the first prototype of an ILC-specification fibre laser. An industrially built driver laser was set up at Oxford for this purpose. A commercial (Amplitude Systèmes) seed laser for a laser-wire laser system was delivered to Oxford and was successfully set up and commissioned. The first prototype of an ILC-specification fibre laser amplifier was designed, built and commissioned using the commercial laser system as a seeder. First results are very encouraging and indicate that photonic crystal fibre technology may be suitable for ILC-specification laser-wire systems [13].
- Construction and commissioning of a laser-wire system at the ATF extraction line at KEK in Japan [14-15].
- A new custom-designed lens was been installed and was been tested in 2008 for micron-scale laser-wire scans. Data taking using a micron-scale laser-wire system at the ATF extraction line at KEK in Japan yielded excellent results [16]. Data-taking runs using a commercial lens were completed and compared to results with a custom-designed optic; the custom system showed markedly improved performance with laser spot-sizes of order 3 microns being achieved. The final publication of these results is on hold while more detailed investigations of systematic effects, including residual lens aberrations, are studied. Publication is planned for early 2009.
- The wider use of laser-based beam diagnostics, including laser-wires, was researched and presented at the Beam Instrumentation Workshop in 2008 [17]

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