An upgrade to the ultrafast optical trigger for TAP and new one for TAW

Contact waseem.shaikh@stfc.ac.uk

W. Shaikh

Central Laser Facility, STFC, Rutherford Appleton Laboaratory, HSIC, Didcot, Oxfordshire OX11 OQX, UK

Introduction

We last reported on a fast electrical trigger for TAP in the 2004/2005 CLF annual report[1]. Using a 10% leakage from the OPCPA pre-amplifier, and a suitable compressor, voltages in excess of 18V were produced. Although sufficient for triggering all equipment directly, the use of standard BNC cables to TAP, resulted in these degraded voltages requiring the additional use of coincrown[3] units for additional electrical amplification.

TAP trigger upgrade

Photec Ltd[2] had previously supplied IR enhanced S1 vacuum photodiodes for production of the required 18V voltages from the small scale OPCPA compressor[1]. The S1 sensitivity is specified at ~0.03 mA/W at 1053nm. Enquiries suggested they were now able to supply S20 tubes with a specified sensitivity of 15mA/W at 532nm. This implied only weak conversion efficiency to 532 nm was needed to provide direct high trigger voltages without coincrown units. Photek had also reported that their vacuum photodiodes could operate with outputs in excess of 10's of volts over extended periods of time.

TAP OPCPA frequency doubled trigger output

Using a 7.5% leakage from the OPCPA line into the small TAP compressor in LA1, the compressor output was weakly focused using a ~15 cm lens into a 1 mm thick BBO crystal and the output allowed to expand. After being reflected of a 532nm dichroic the ~10μJ of 532nm light filled the aperture of the ~1cm wide photocathode of the S20 vacuum photodiode.

This produced an electrical output of ~0.3 ns and ~150V (Figure 2) which was fed directly to TAP down a standard BNC cable and after suitable attenuation was used to trigger amongst other items, fast streak cameras.

TAW fast trigger using the SAM oscillator

The SAM oscillator is nominally stretched to ~1 ns before gain narrowing in the 9 mm disc amplifiers – this therefore did not require compression. After amplification through a double pass 9 mm amplifier, a waveplate providing an appropriate leakage off a polarizer was installed on the outer track just before the OPCPA optical leakage and was minimized ensuring no loss of energy on the outer track. As for the TAP trigger, the output of the leakage was weakly focused using a the same ~15 cm lens into the same Type 1 thin BBO crystal after making suitable adjustments for the polarization change. Reflection of a 532nm dichroic allowed dumping of the 1053nm and the beam was allowed to expand and fill the aperture of the ~1cm wide S20 vacuum photodiode.

As in the case of the TAP trigger, this electrical output of vacuum photodide had to be attenuated to ~5V using a 20 dB attenuator (×10). Therefore > 50 V was delivered to the TAW trigger cable in LA1 without additional coincrown units.

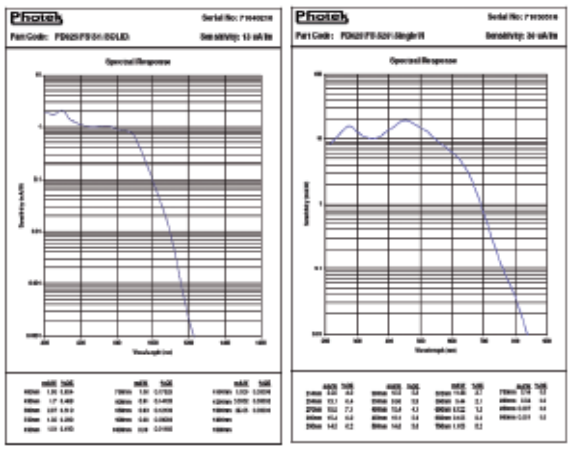

Figure 1. Spectral sensitivity of S1 IR and S20 visible photocathodes.

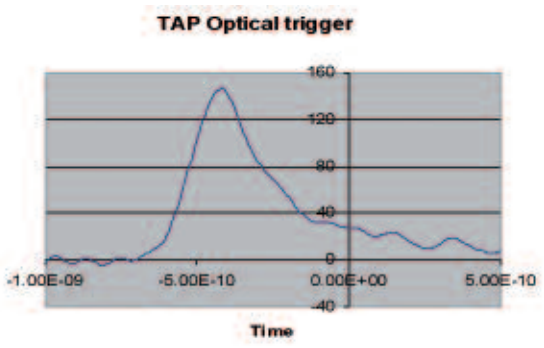

Figure 2. Output of S20 vacuum photodiode for TAP trigger.

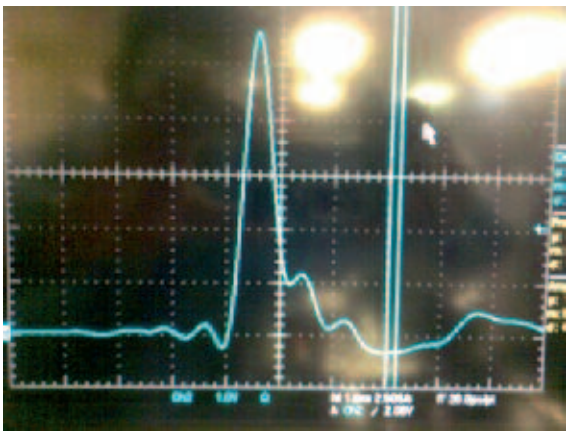

Figure 3. Output of S20 >50 V fast trigger for TAW.

References

1. W. Shaikh *et al.*, *'An ultrafast electrical trigger for TAP using the OPCPA pre-amplifier'*, CLF Annual report 2004/05.
2. Photek Ltd data sheet. http://www.photek.co.uk/.
3. Kentech Instruments Ltd, http://www.kentech.co.uk/index.html.