The Open University

Developing an Electro-optic Beam Position Monitor

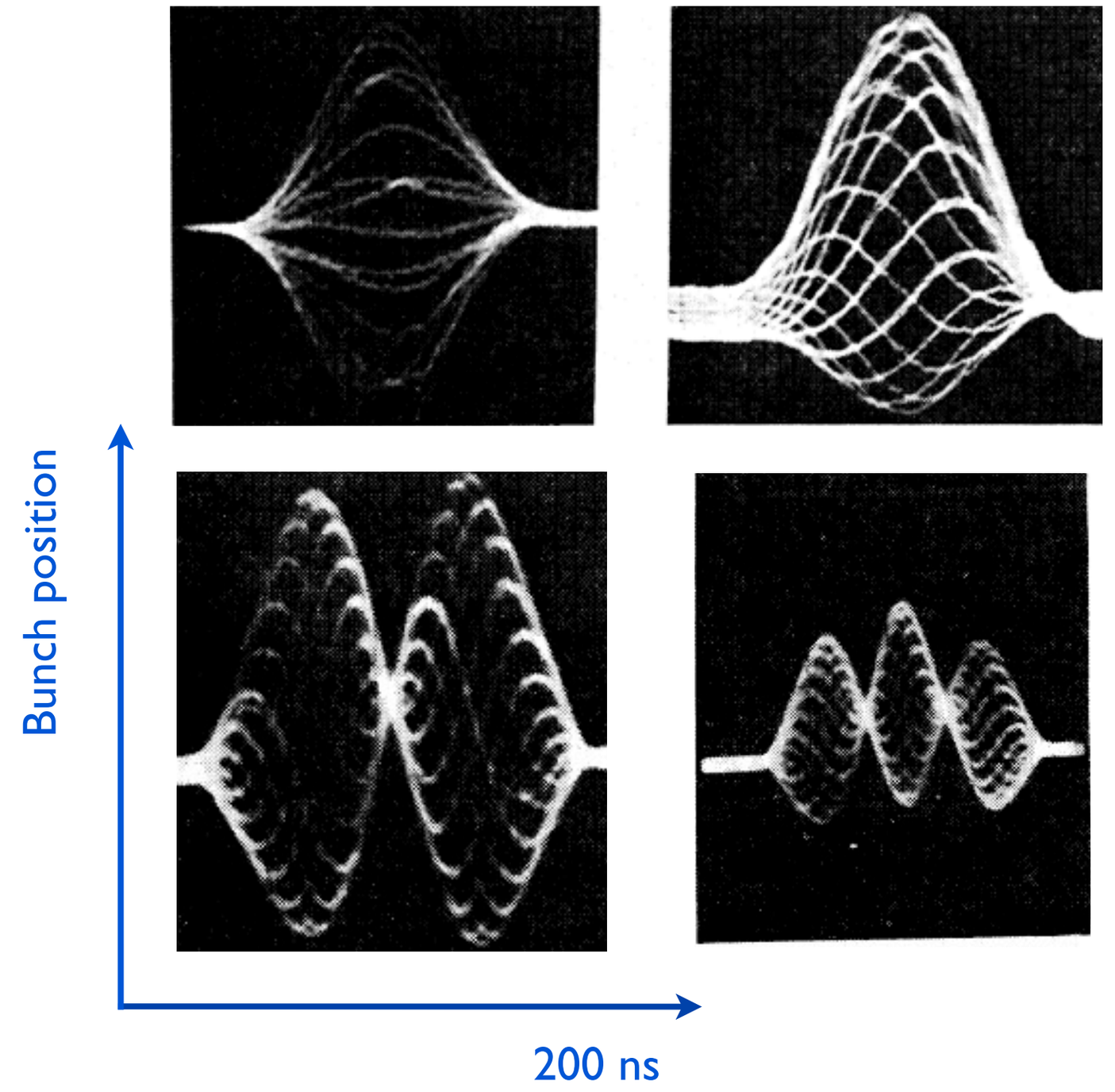
James DOHERTY

23 August 2013

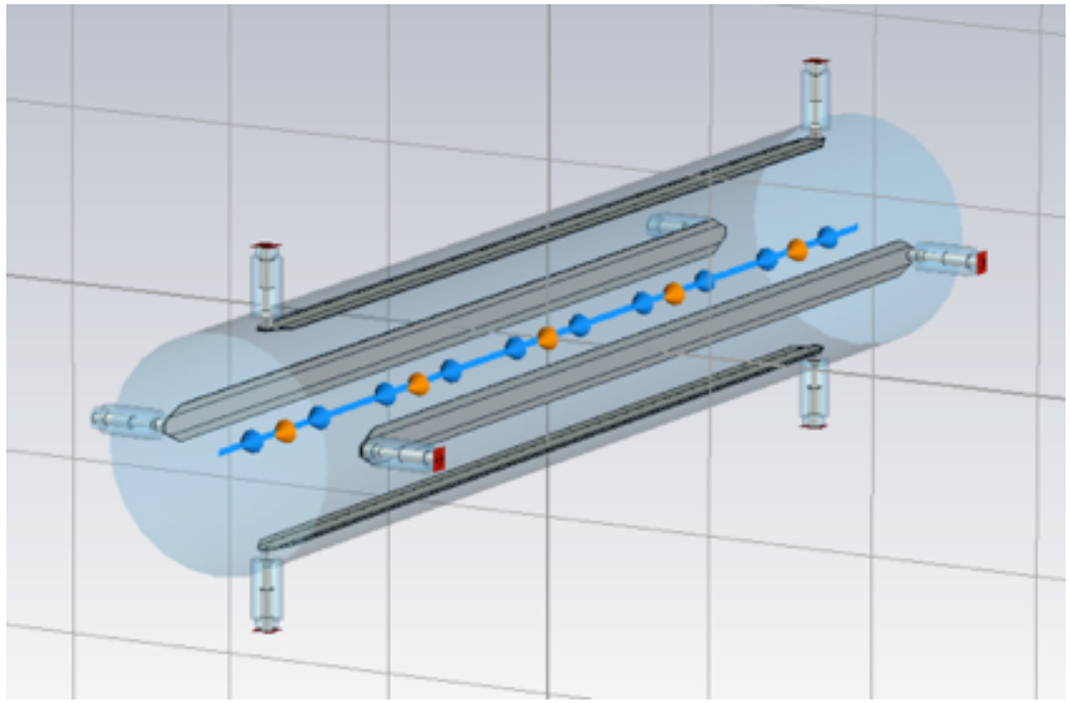
What is a beam position monitor (BPM)?

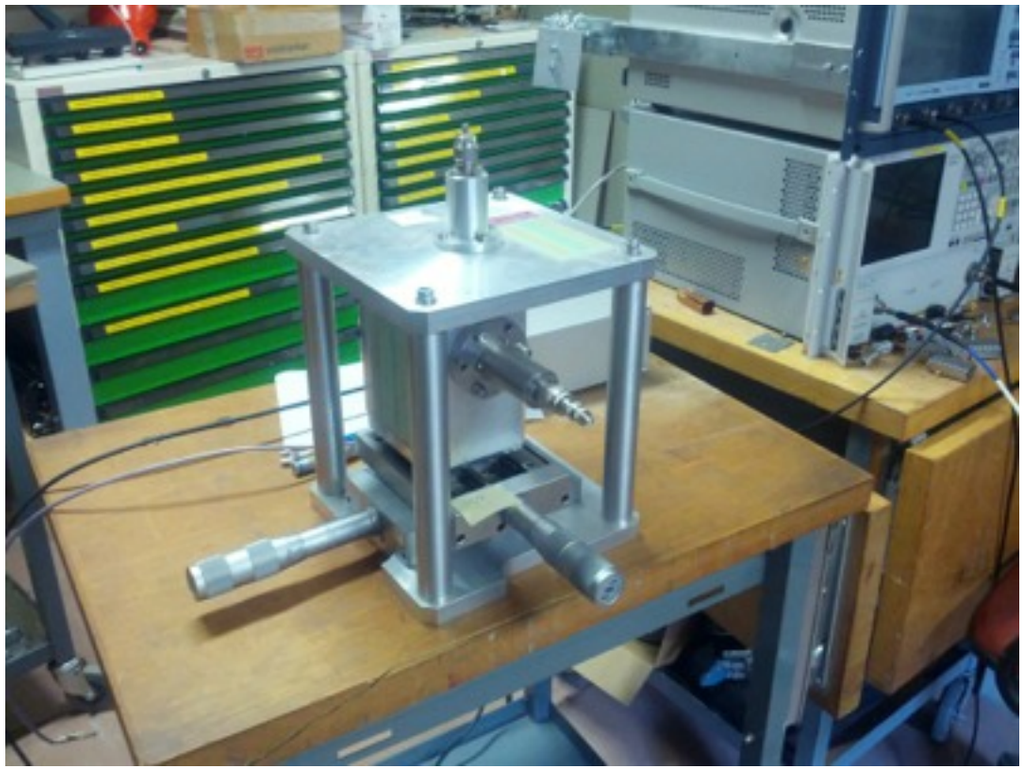
Why do we need a new type of BPM?

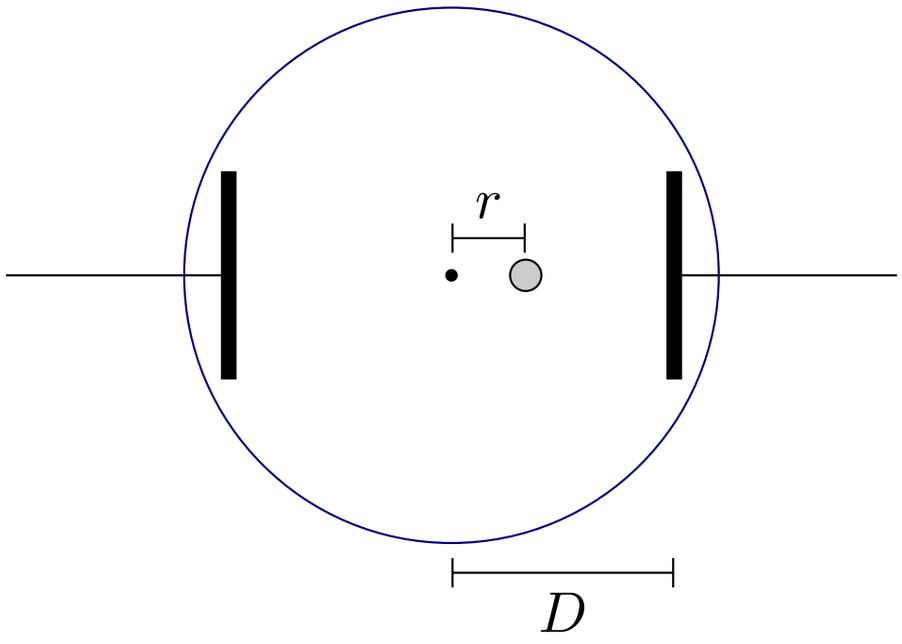
- Intra-bunch head-tail instabilities
- Need pick-ups with higher bandwidth



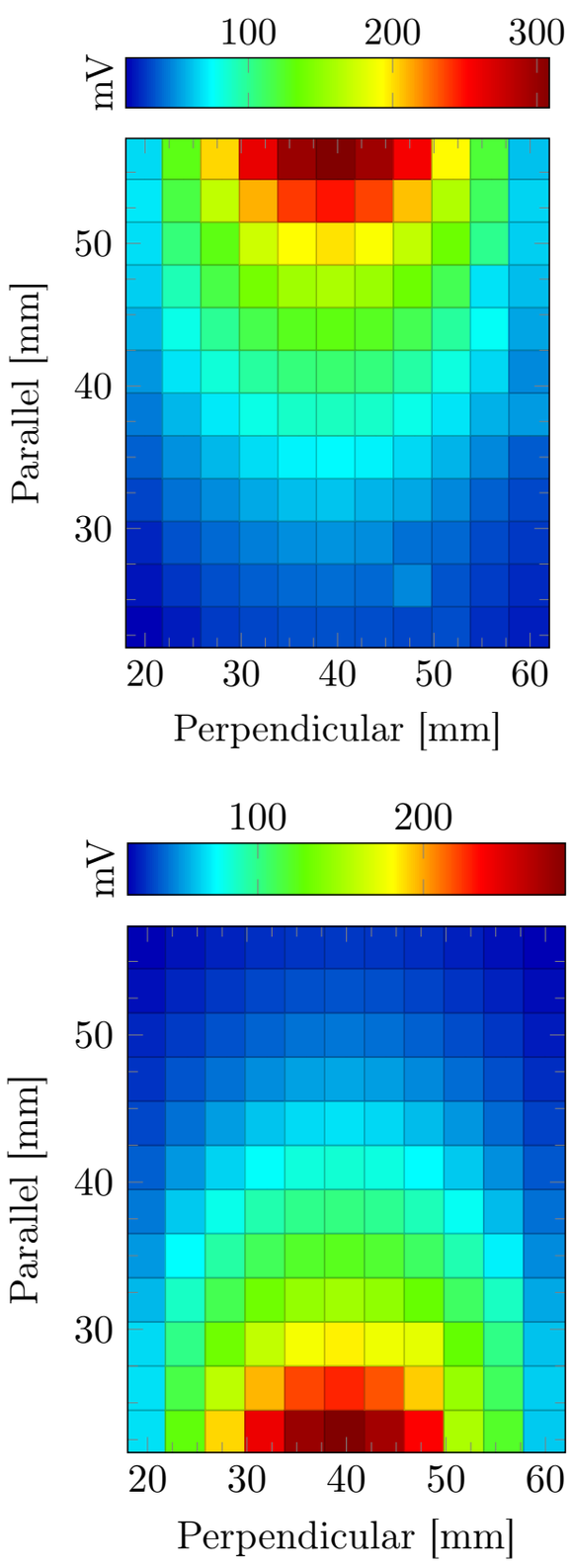
BPMs - the current generation

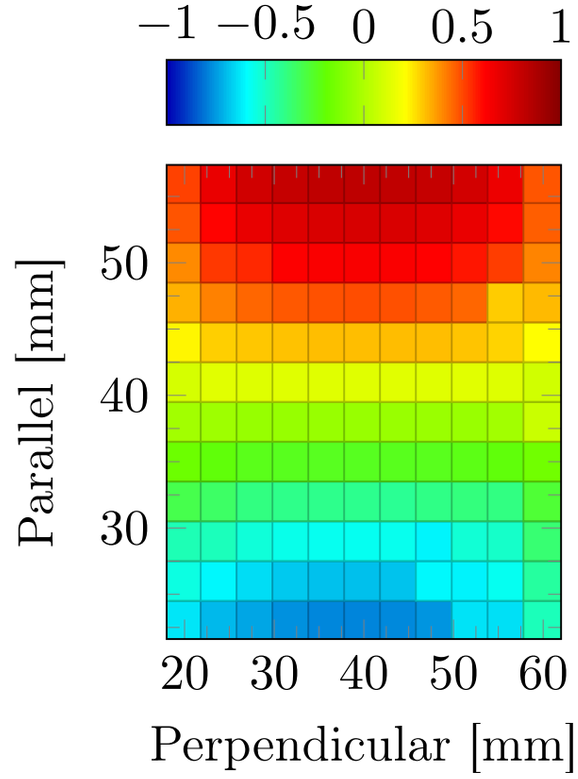


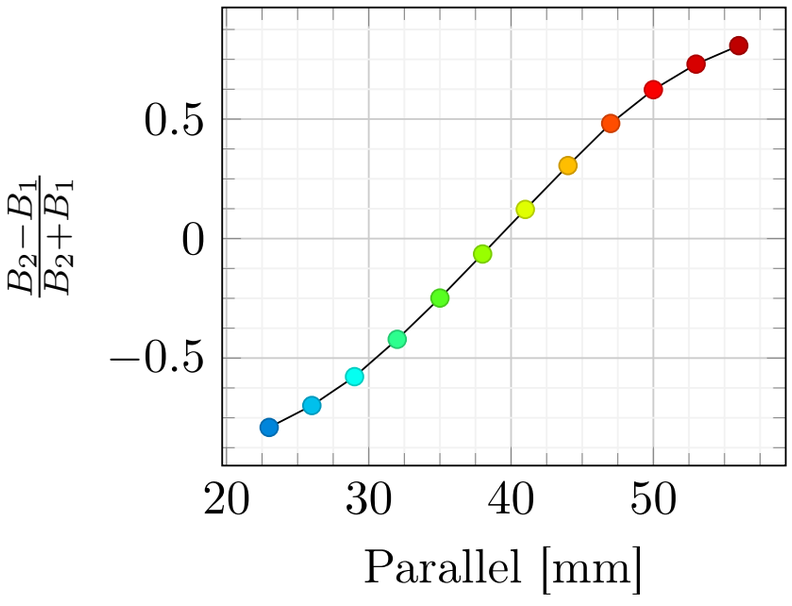




BPMs - the current generation

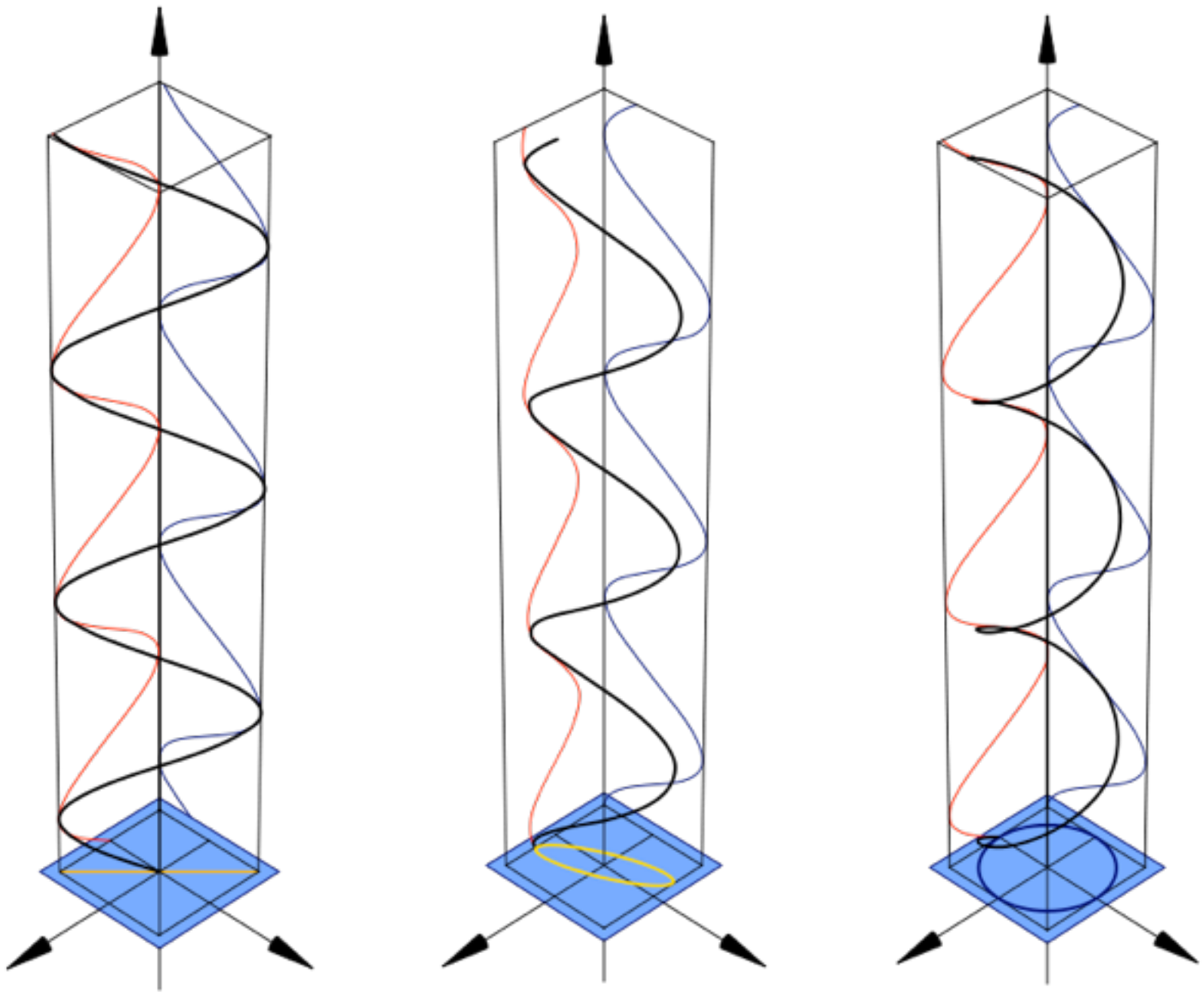






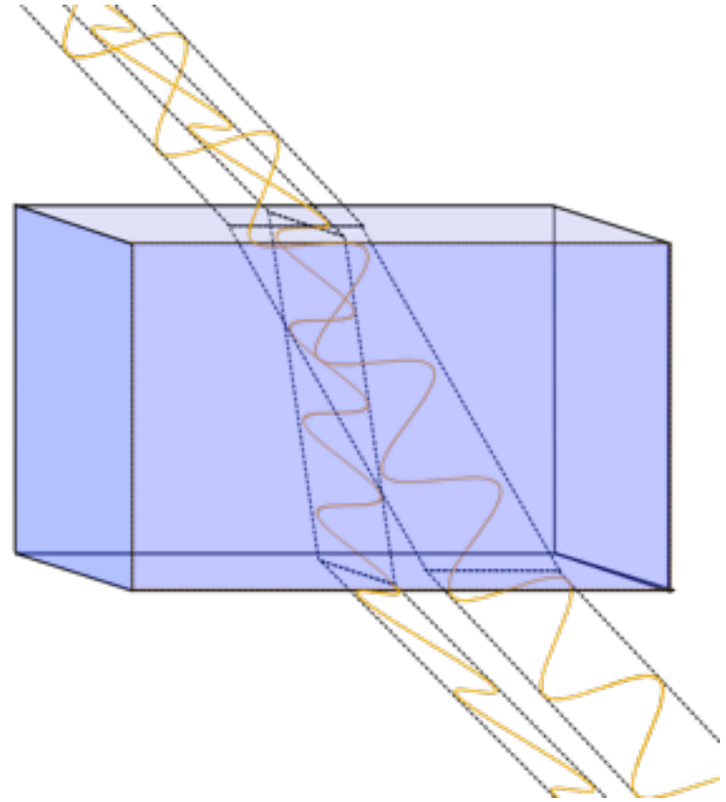
Optical refresher

Polarisation - linear, circular and elliptical



Optical refresher

- Birefringence - medium has two refractive indexes depending on plane of polarisation



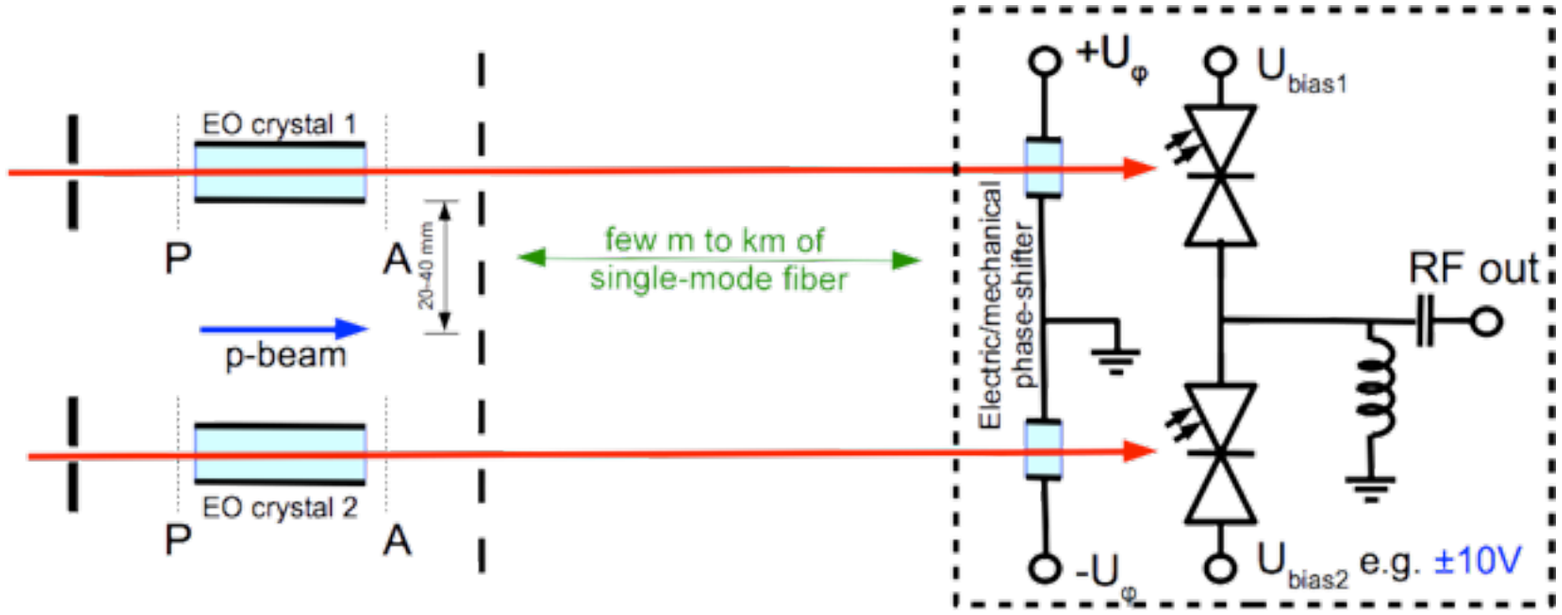
- Pockels effect

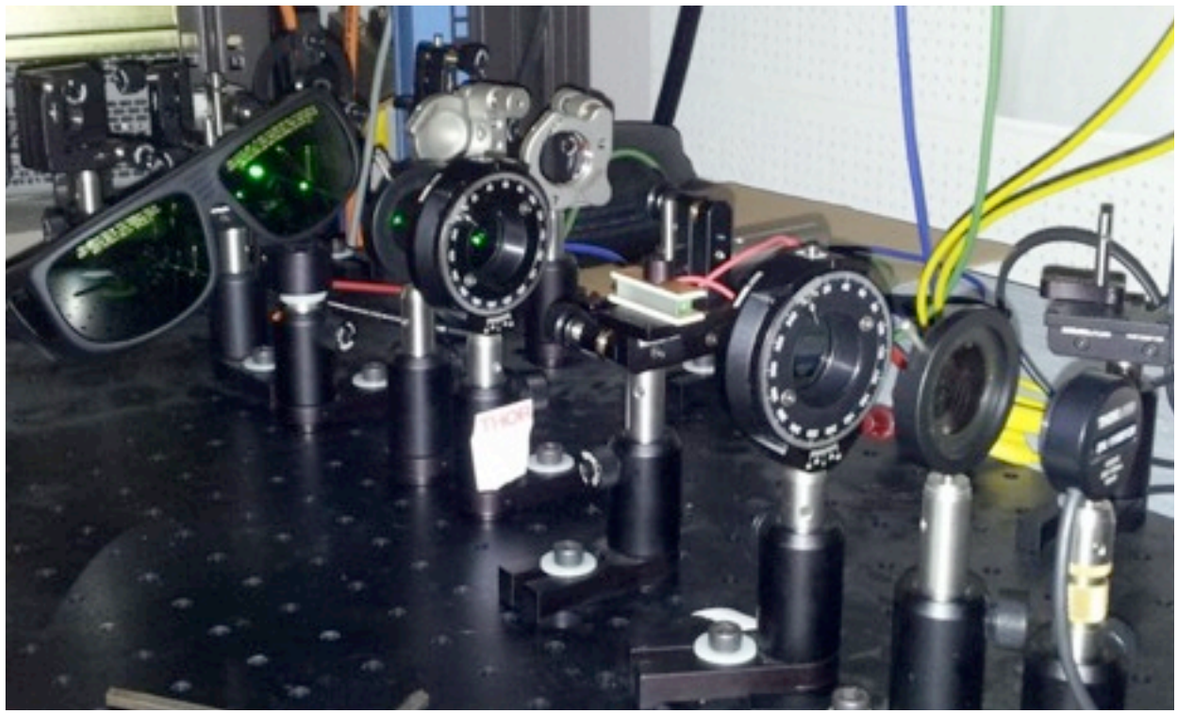
$$n(E) = n_0 \underbrace{+ r_{ij} \cdot E}_{\text{Pockels effect}} \underbrace{+ s_{ij} \cdot E^2}_{\text{Kerr effect}}$$

- Stress induced birefringence

The electro-optical BPM

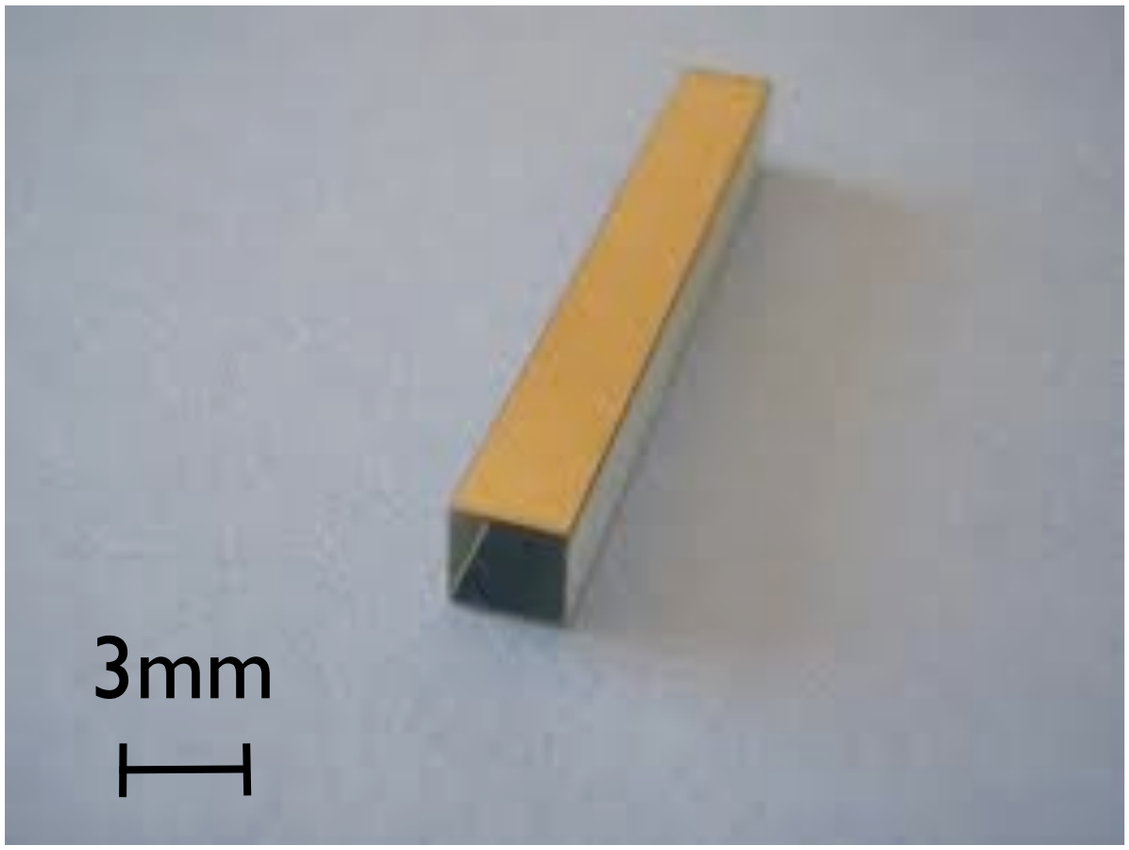
- Chosen to use a polariser/analyser dual crystal setup similar to LCD screens and Pockels cells





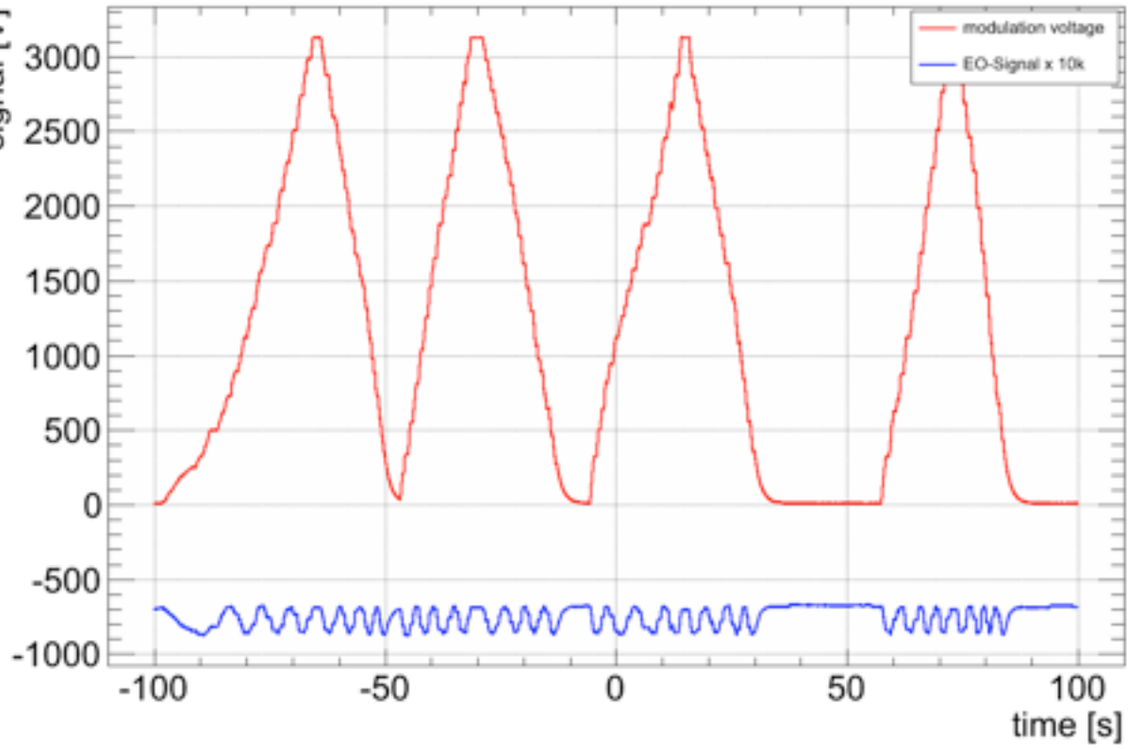
- Initial experimental setup in air but ultimately wish to couple laser into optical fibres and replace film polarisers with paddles

Advantages of an electro-optical BPM



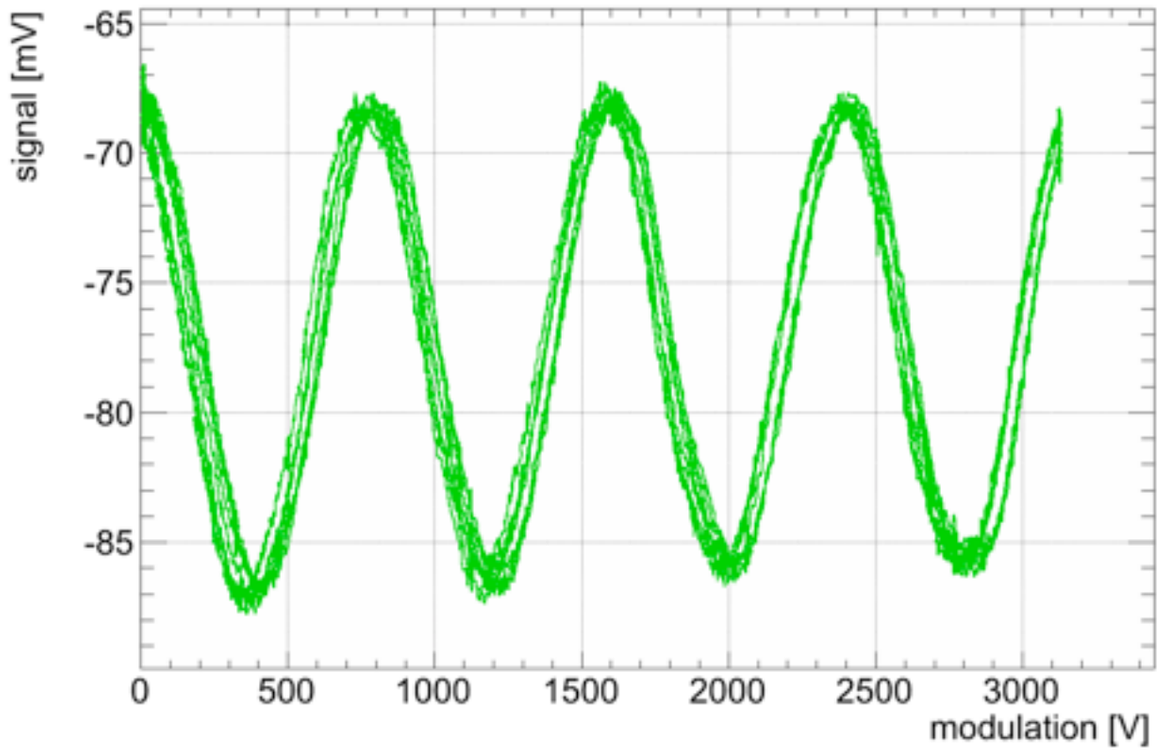
- Crystal offers higher bandwidth pick-up than EM BPMs
- Benefits of optical signal transmission
- Easier to calculate sum and differences than when using voltages
- Crystal smaller than strip-lines at similar bandwidths

Experimental results

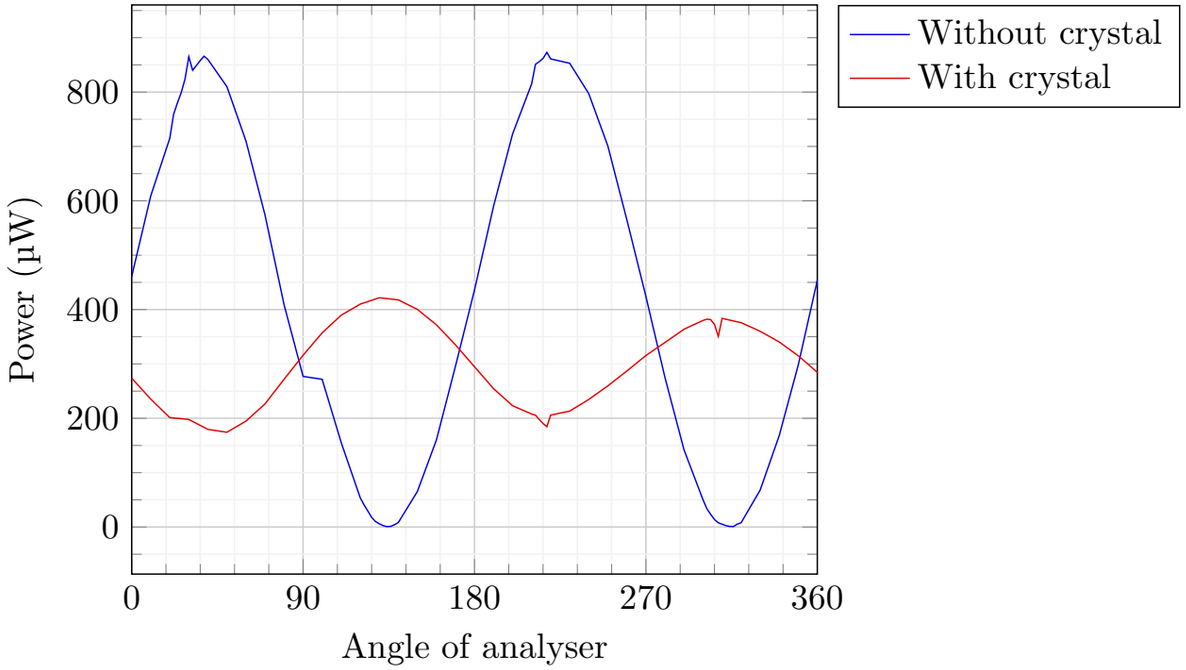


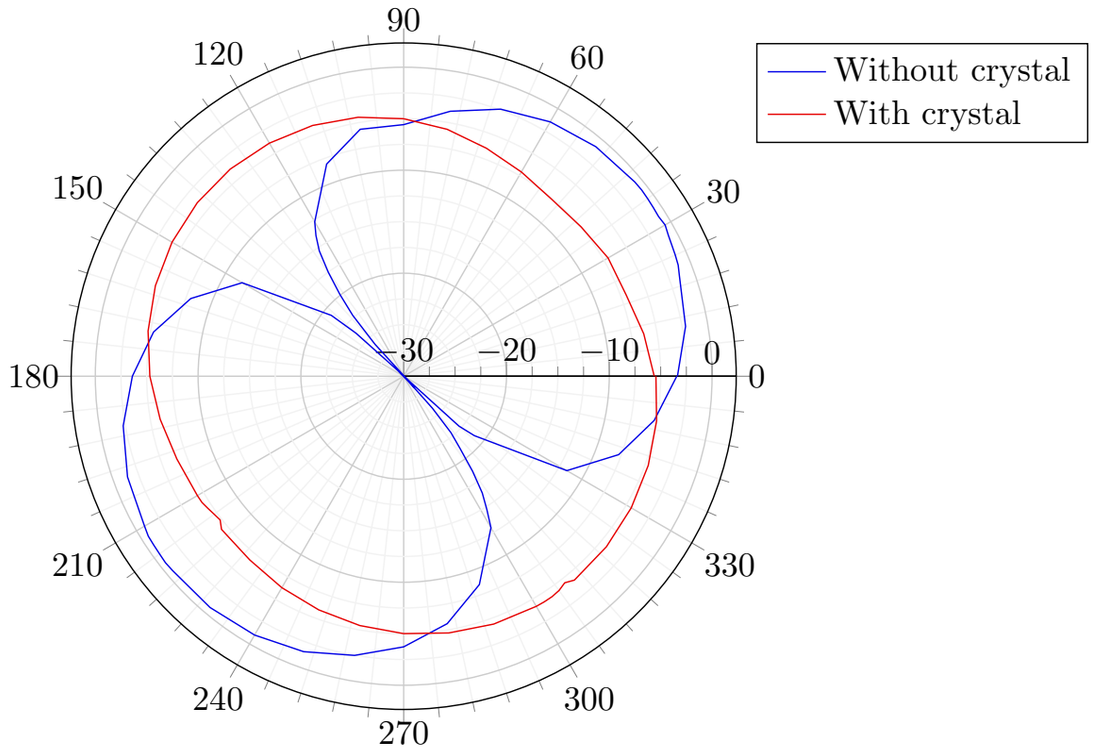
On applying voltage to crystal the light intensity varies

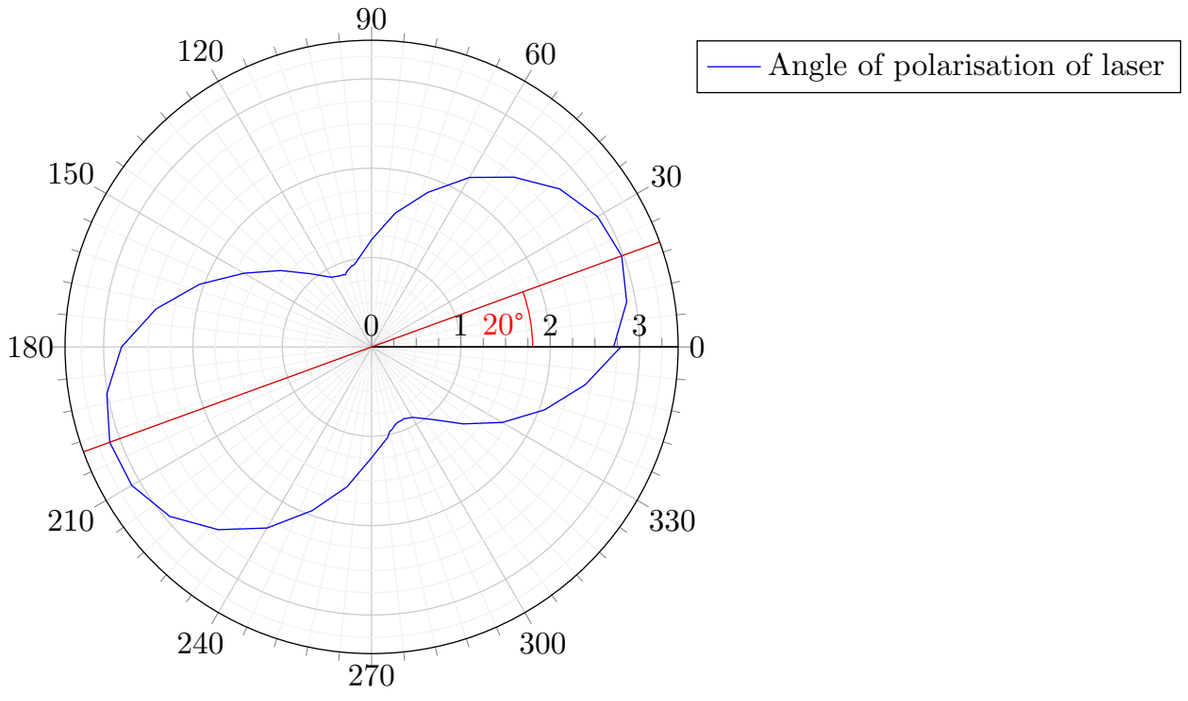
The higher the voltage applied to the crystal the higher the light intensity



Experimental results

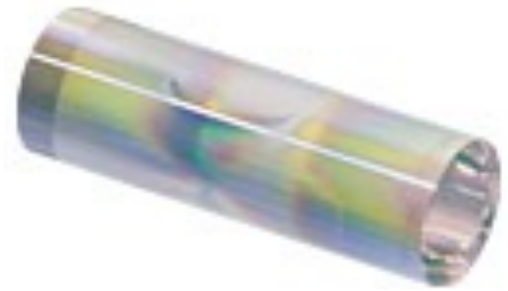






Next steps

- Coupling laser into optical fibre
  - not trivial to fit into 7μm fibre



- Using wave plates to effectively control input and output signal

Thank you

Questions?