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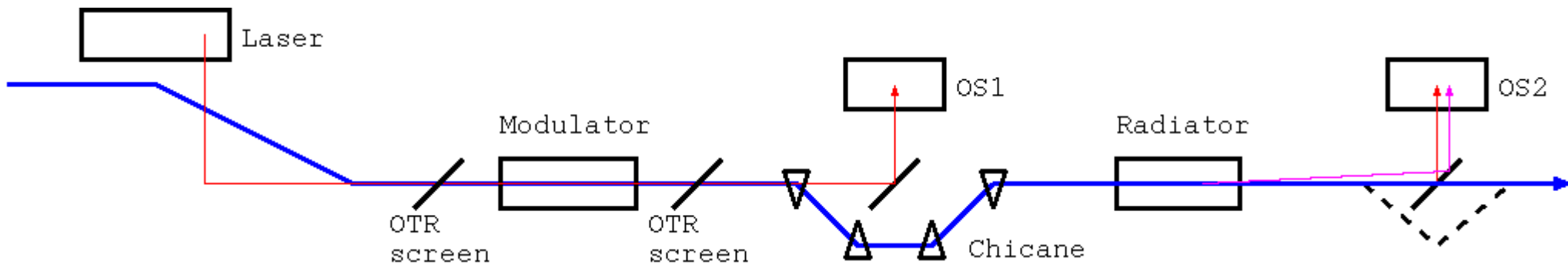
Achieving transverse and longitudinal overlap of electron and laser in the Optical Replica Synthesizer

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April 26, 2013



ORS

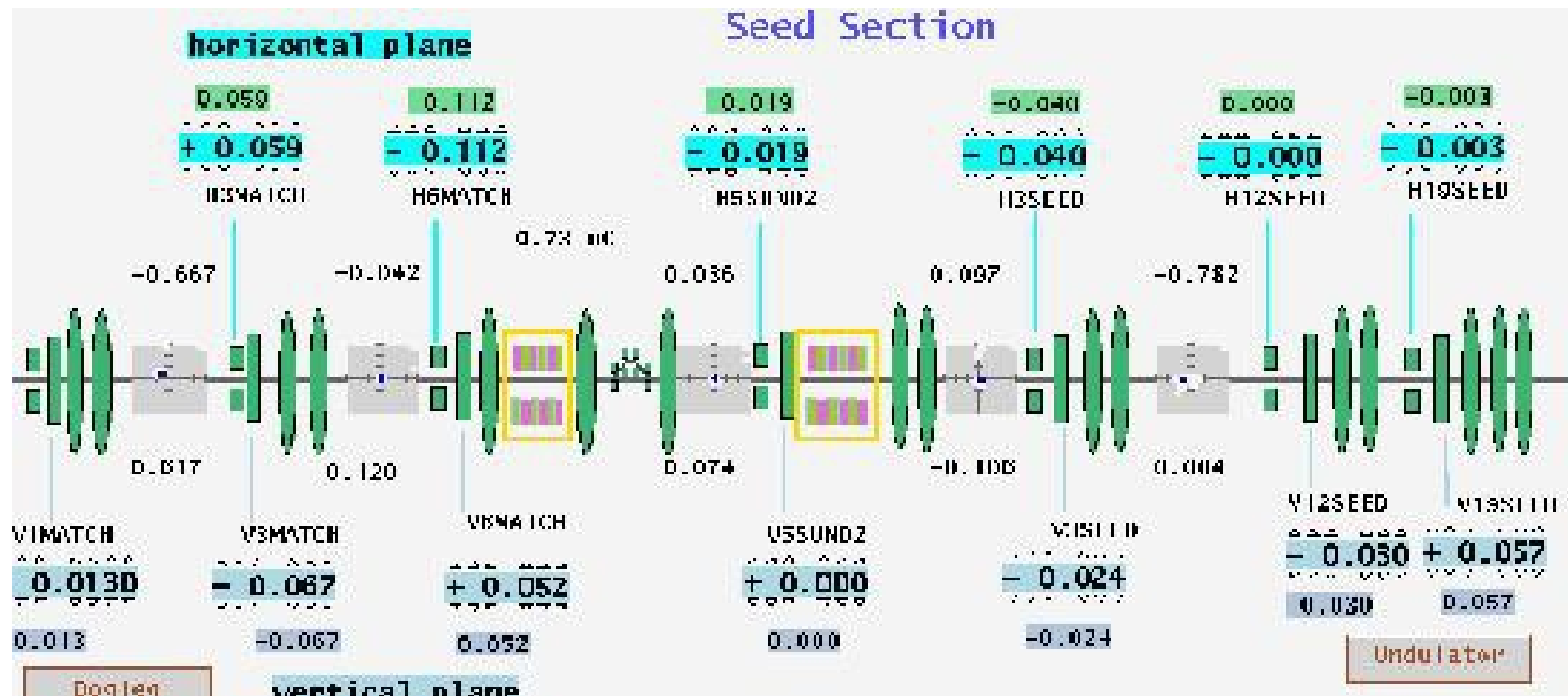
- Problem: measure ultra-short bunches in the 10s of fs range: EOS, TEO, LOLA, ORS
 - too fast for electronics (10 Gsamples/s --> 100 ps)
 - but laser folks know (autocorrelation, FROG)
- Solution: make an optical copy of the electron bunch and analyze that with laser methods.





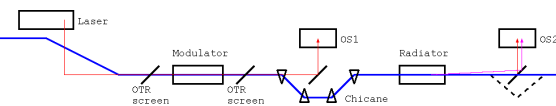
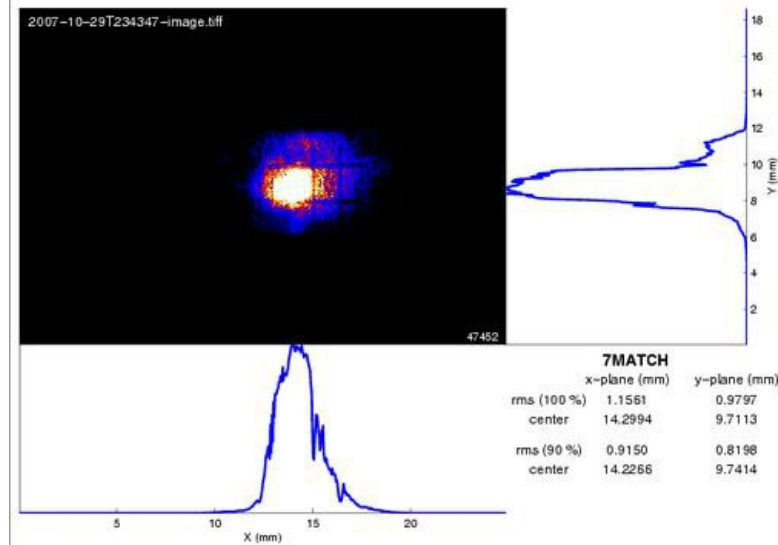
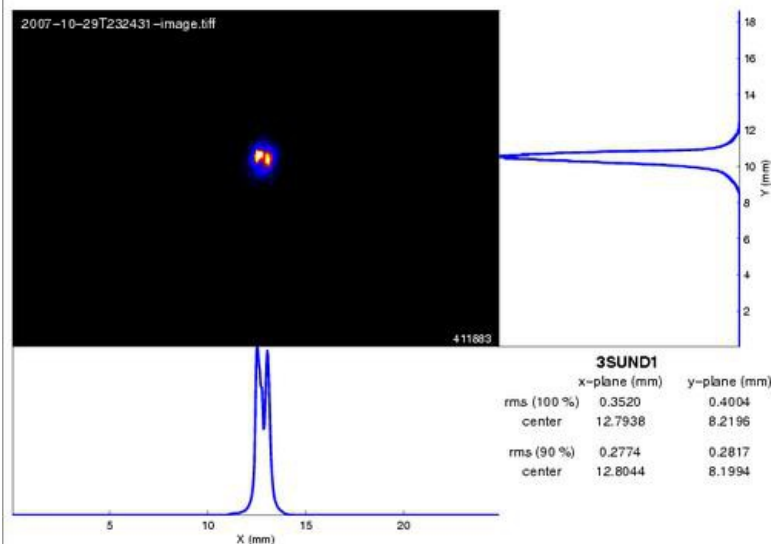
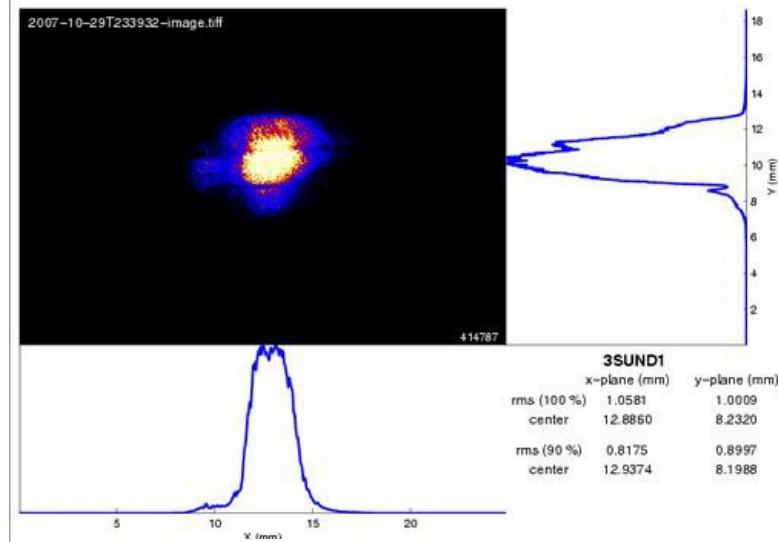
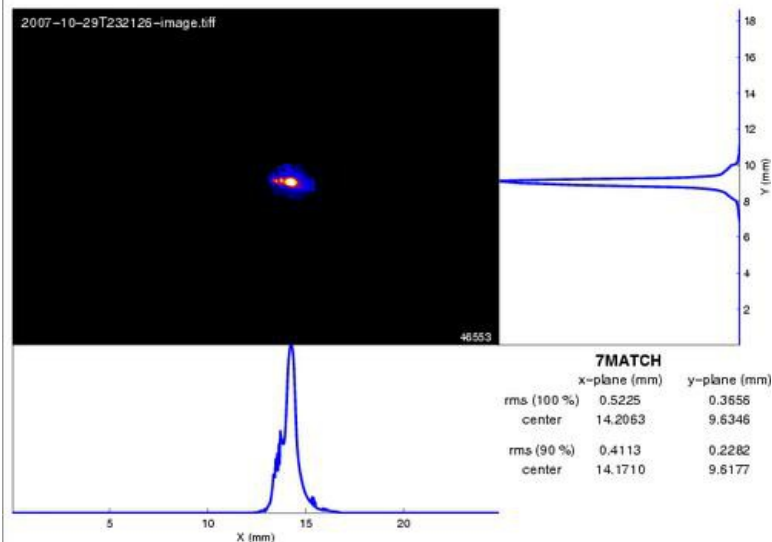
Overlap preparations

- Flatten orbit in 'our section' with undulators off
 - BPMs < 0.1 mm and small steering magnet excitations





Transverse Overlap

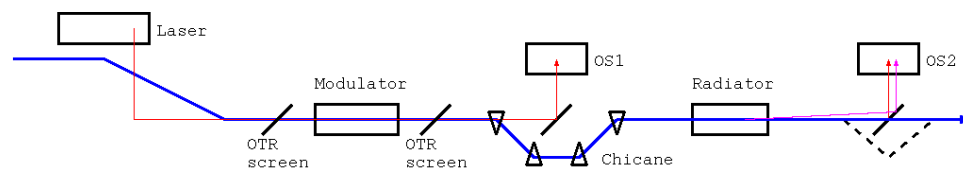




Rough temporal Overlap



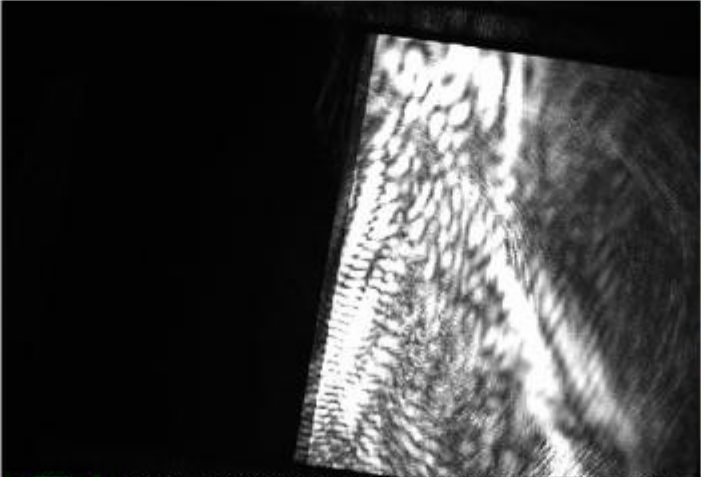
- Turn on Veronica+Chicane
- Remote 1 GHz scope
- Photo diode on OS1
- Detect signal from
 - attenuated seed laser
 - spontaneous synchrotron radiation from VERONICA
- on photo diode
- good to ≈ 100 s ps
- move relative timing with the phase shifter



Problem with Seed laser leakage

OS2 . CAM1

Info: Online TCP: disconnected Camera: 20710938 0



Images
 on STOP
 Help

Brightness ▲▲▲▲ + 46
 Gain ▲▲▲▲ + 192
 Shutter ▲▲▲▲ + 88

Trigger
 on Grab Mode
 Rate [Hz] 5

RAW Image
 Image

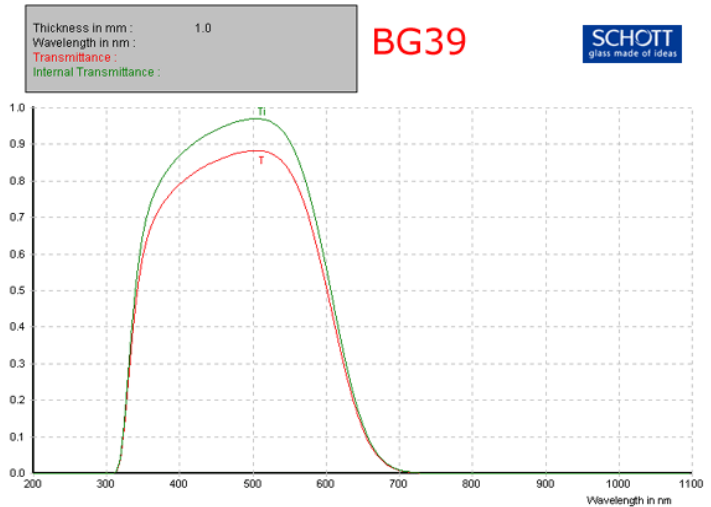
Tool Box
 BG Subtraction X & Y Spectrum Camera Toolbox
 Histogram Region of Interest

Status
 OK

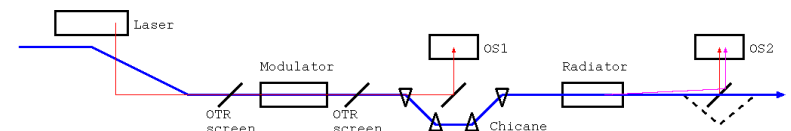
Video Mode: Format_0, Mode_6: 640x480 Mono 16bpp
 Bits per Pixel: 16 Height: 480 Frame: 65280
 ImagePoints: 307200 Width: 640 7.5 fps

DAQ
 send Data -> DAQ

Expert
 Server
 Timing

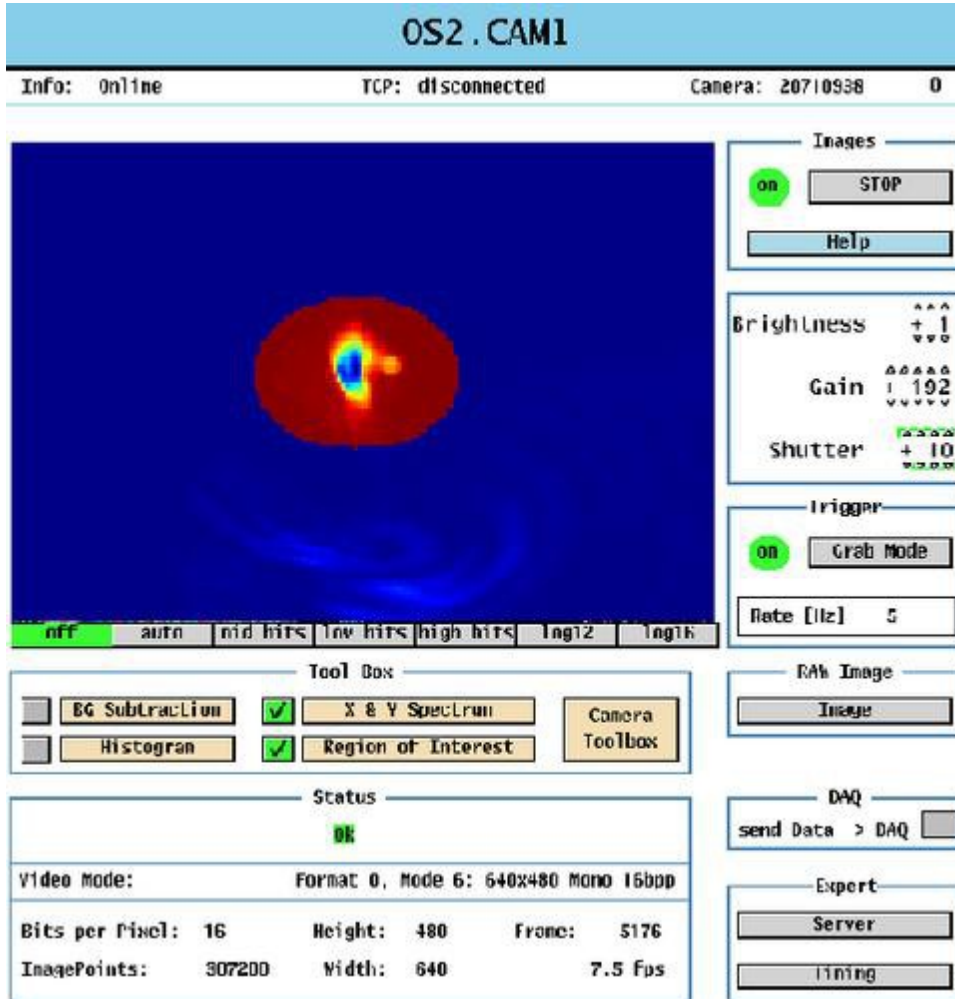


- Bunching also causes radiation at higher harmonics
- Insert BG39 filter before camera

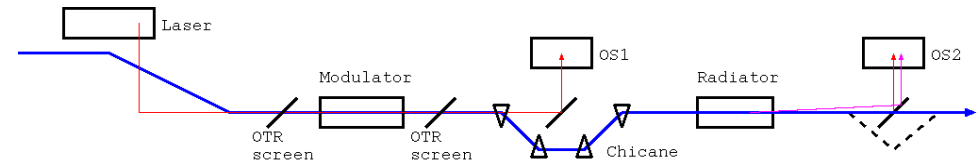




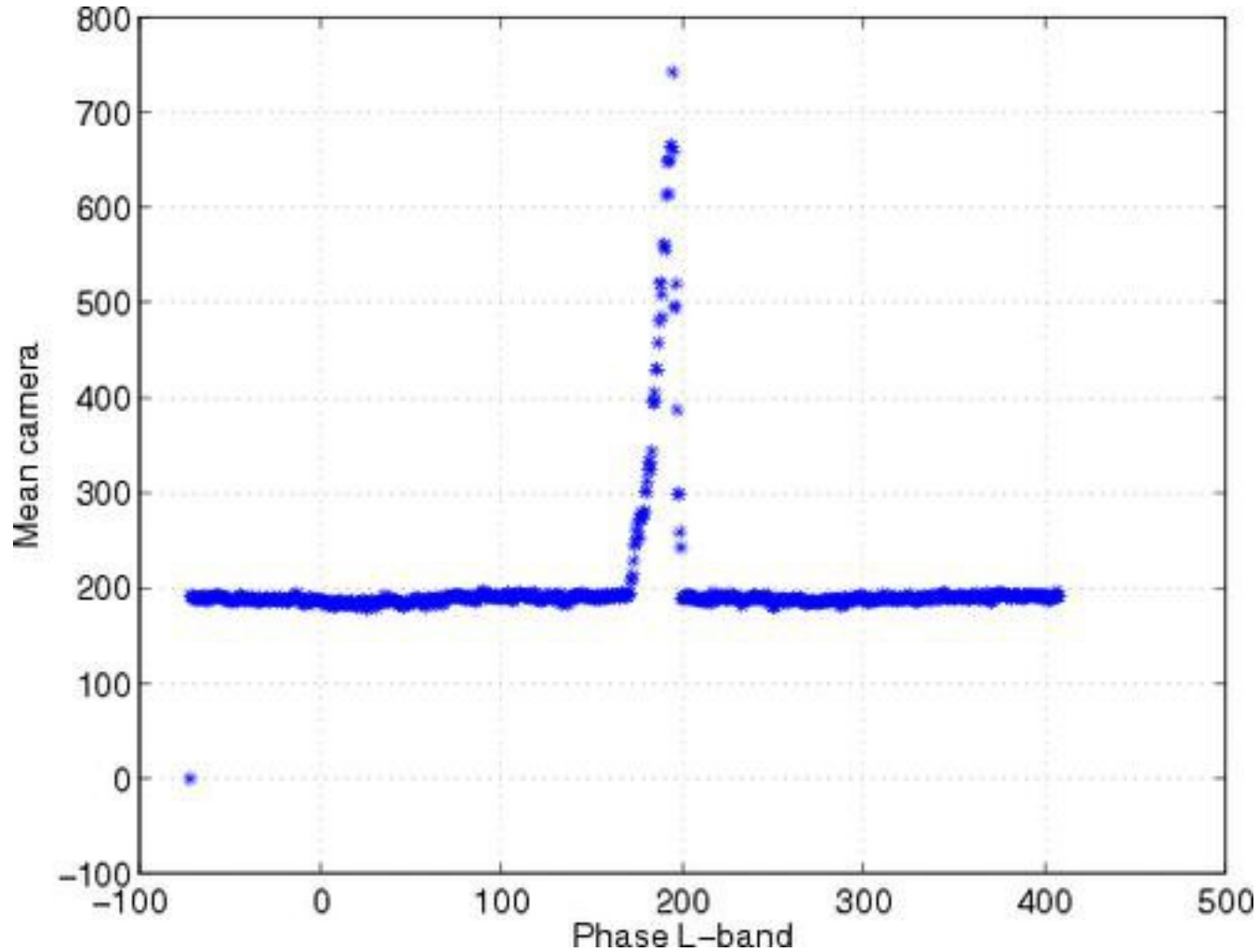
With Seed laser filtered



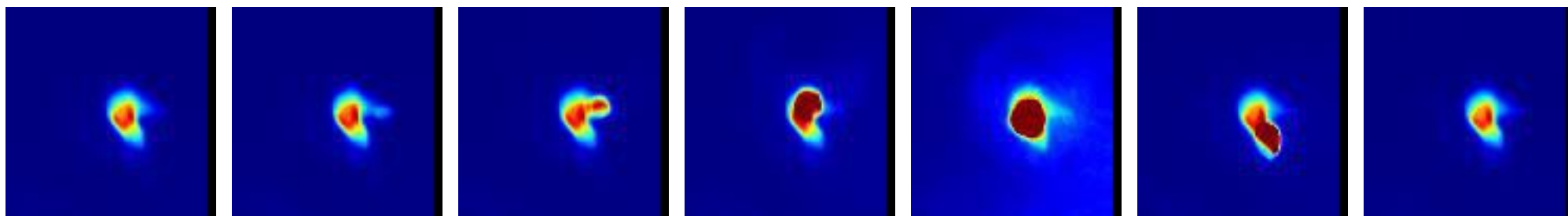
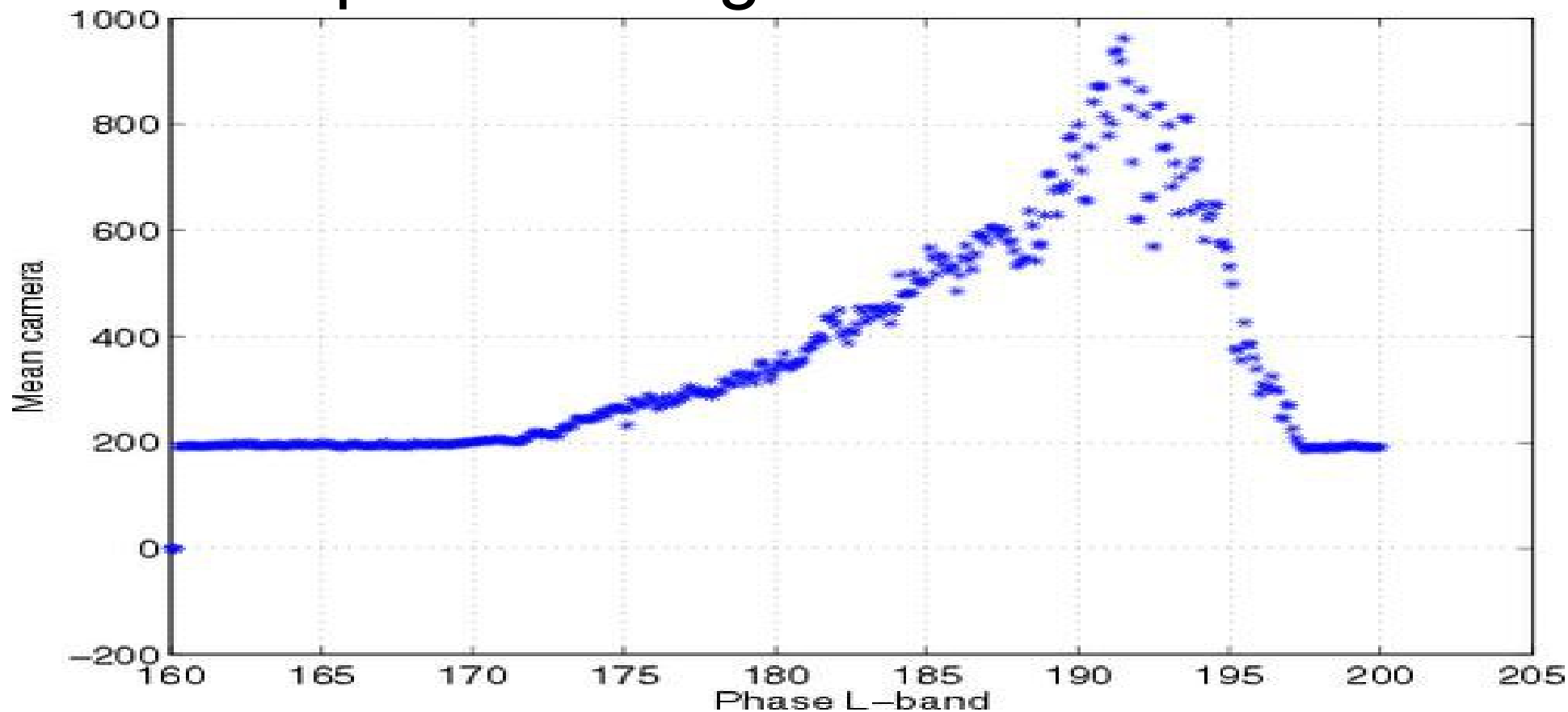
- OTR at 2nd harmonic
- Radiator OFF
- Need signal that identifies overlap
- Use average pixel value in *Region of interest*



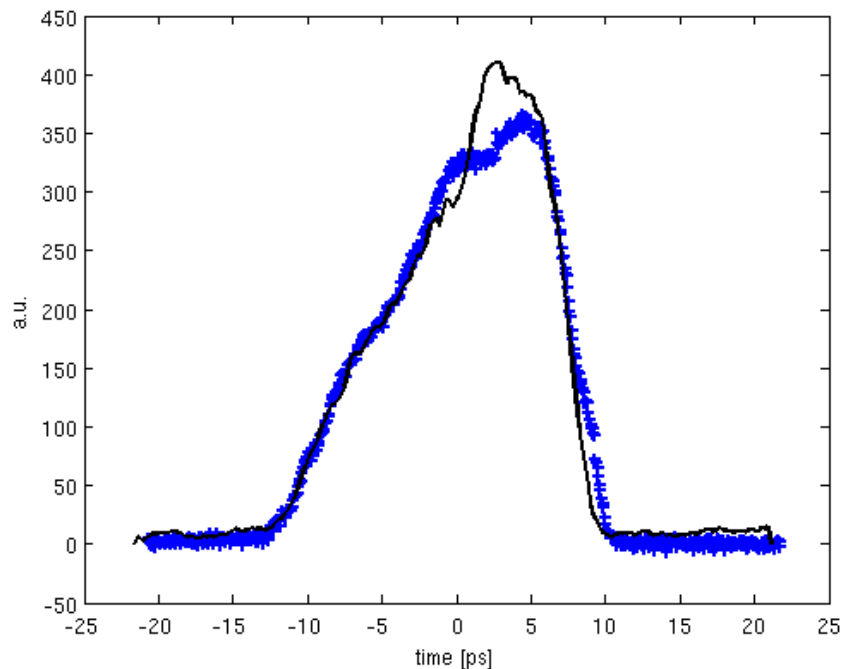
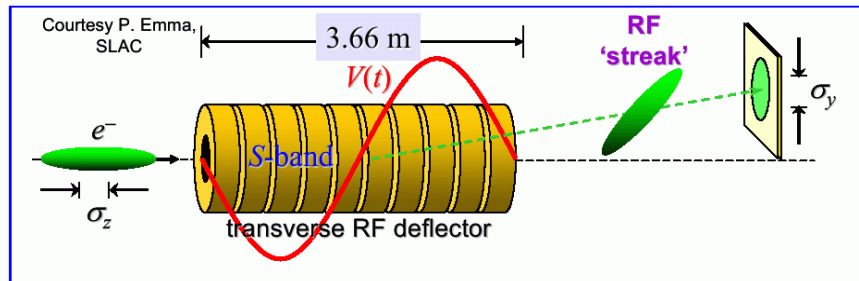
After some scanning...



CTR on screen 1SEED while passing a 200 fs laser pulse through an electron bunch



Comparison with LOLA



- Simultaneous (almost, 30 min) measurement of bunch profile with transversely deflecting cavity LOLA (blue) and ORS (black).
- Initially the time calibration of LOLA was off by 20 %, now fixed.
- OD2 Neutral density filter before the Basler camera to prevent saturation
- smoothing and sqrt(ORS)
- Very good agreement of the recorded bunch length
- Some saturation of LOLA?