Time-Resolved Measurements of Transverse Beam Excitation in an Electron Storage Ring

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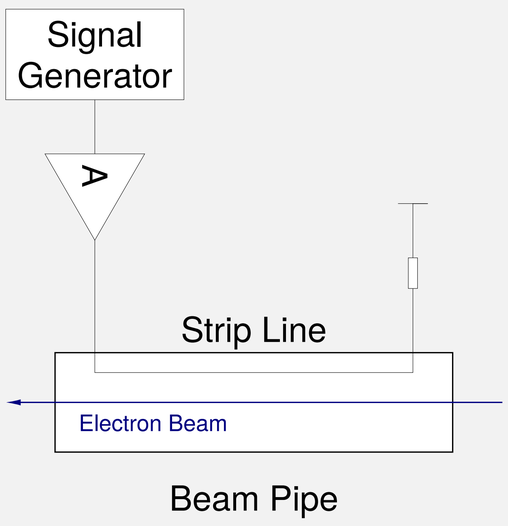
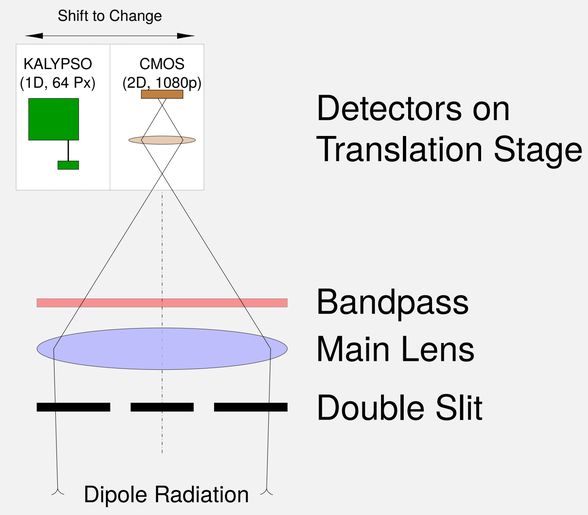
Motivation

- Transverse modulation can increase beam size, thus reducing intra-beam scattering
- KARA vertical beam size smaller than diffraction limit
- Use double slit setup to convert size changes into contrast modulation V[1, 2]
- In existing setup, V is measured with CMOS camera[3], ⇒ low time resolution
- Therefore sample with fast (turn-by-turn) line camera KALYPSO[4] to distinguish mere *position* modulation from desired *size* blow-up

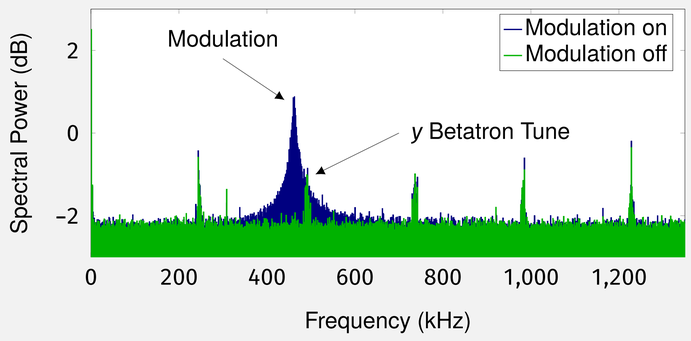
Transverse Beam Excitation and Measurement Setup at KARA





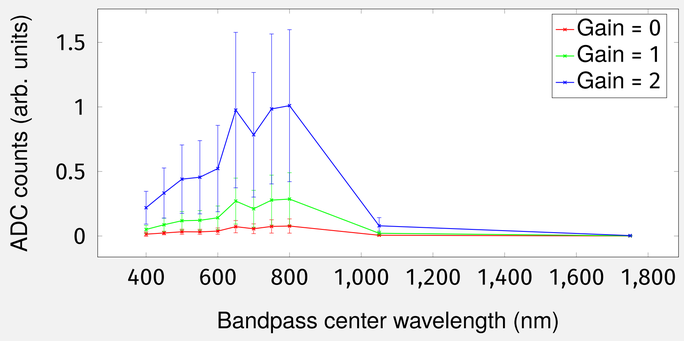
Characterization of the KALYPSO Turn-by-Turn(2.7 MHz) Line Camera

Periodogram of Modulation off and on



Response of one pixel to a beam modulation is measured without using the double slit

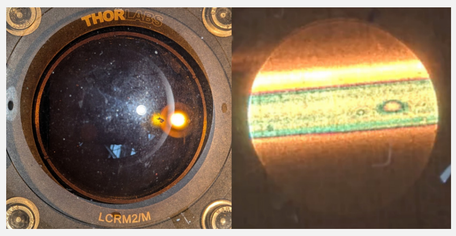
Mean Pixel Response



Spectral response measured with tungsten lamp and set of band-pass filters; Averaged over 1000 frames and all pixels

Upcoming Upgrades

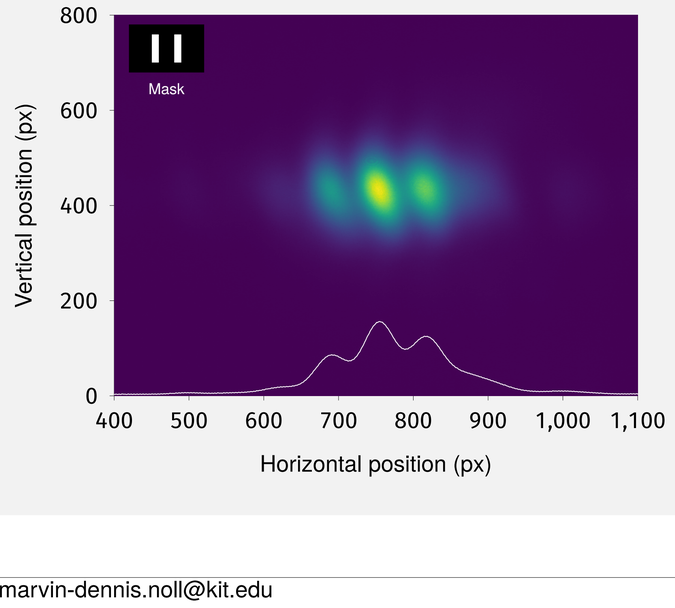
- Experiments show double slit measurements not possible due to (radiation-) damaged optics



- Mirror and windows are to be replaced
- Old green bandpass filter is switched for NIR(e.g. 850 nm) filter

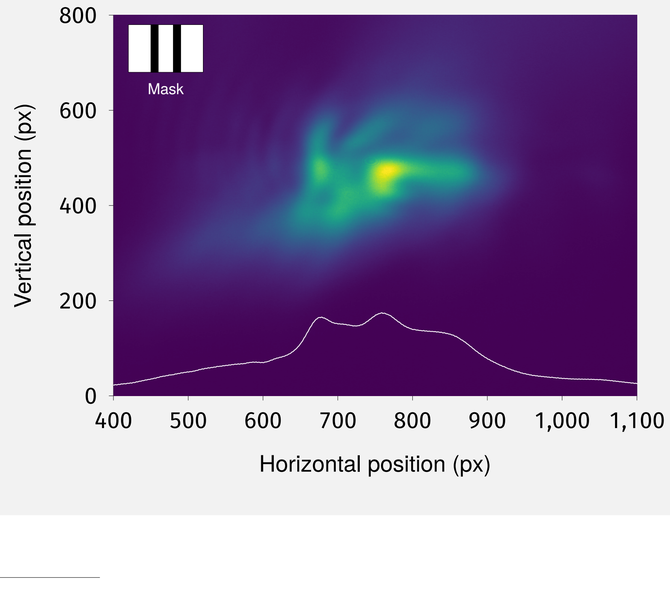
Double Slit

1080p CMOS Camera at Beam Line



Inverted Double Slit

1080p CMOS Camera at Beam Line



Summary and Outlook

- Feasibility of setup shown, however limited by the low-light conditions
- Characterizations of KALYPSO show spectral response similarity to CMOS camera
- Other geometries than the double slit, e.g. an inverted version, are studied
- After KALYPSO setup is in operation, systematical studies of different accelerator operation modes(injection, energy ramp, ...) will be done

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References

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[3] B. Kehrer et. al., “Visible Light Diagnostics at the ANKA Storage Ring” doi:10.18429/JACoW-IPAC2015-MOPHA0371
[4] M. Patil et al., “Application of KALYPSO as a diagnostic tool for beam and spectral analysis”, doi: 10.18429/JACoW-IPAC2021-WEPAB331

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