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

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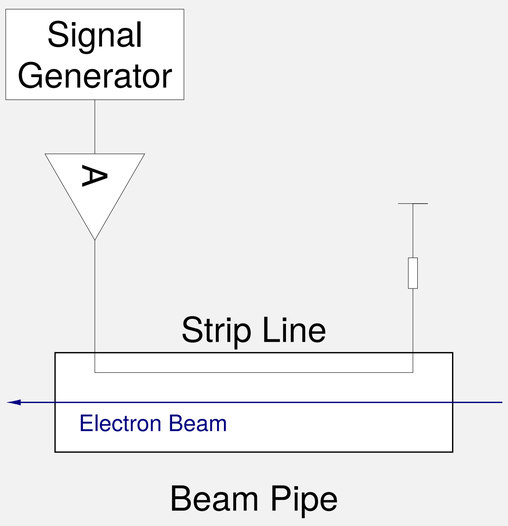
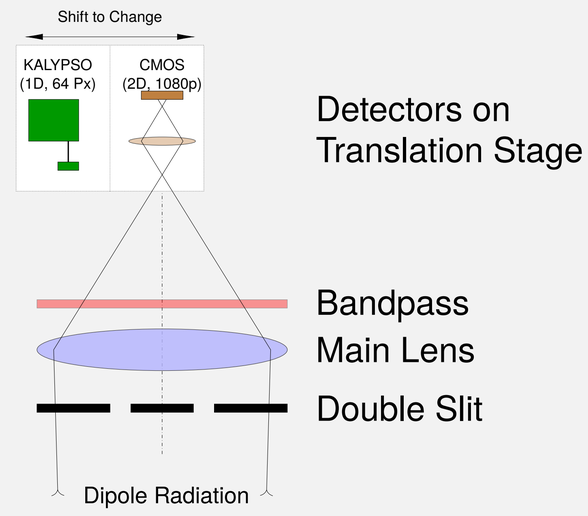
Motivation

- Transverse modulation can increase beam size, thus reducing intra-beam scattering
- KARA vertical beam size too small for crotch absorber set diffraction limit
- Use double slit setup to convert size changes to contrast modulation V[1, 2]
- Conventionally, 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

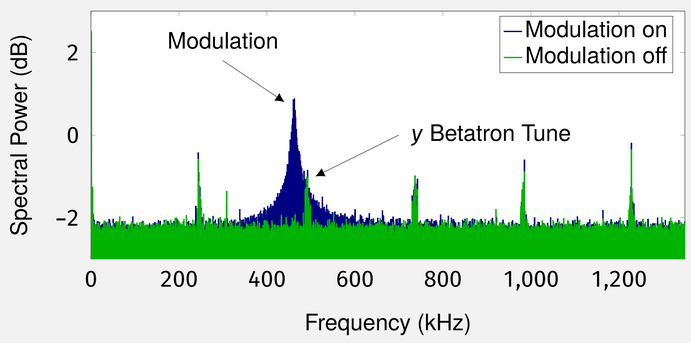
Excitation and Measurement Setup at KARA





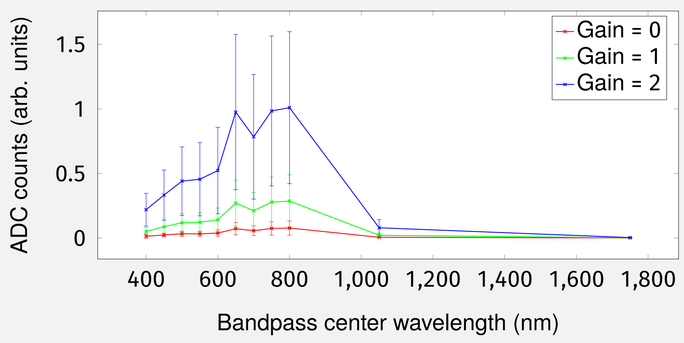
Characterization of the KALYPSO Turn-by-Turn(2.7 MHz) Line Camera

Periodogram of Modulation off and on



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

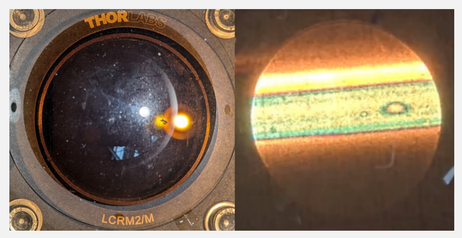
Mean Pixel Response



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 by new components
- Old green bandpass filter is switched for NIR 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
[1] S. Hiramatsu et. al., “Measurement of Small Beam Size by the Use of SR Interferometer”, in Proc. Particle Accel. Conf., New York, USA, 1999, pp. 492-494
[2] L. Torino and U. Iriso, “Transverse beam profile reconstruction using synchrotron radiation interferometry”, doi: 10.1103/PhysRevAccelBeams.19.122801
[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

Acknowledgments
M.-D. Noll acknowledges of the KIT IBPT mechanical engineering department and the mechanical workshop staff”

Conference
IBIC 2025