STUDY OF LASER SHAPING USING DIGITAL MICRO-MIRROR-ARRAY DEVICE

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outline

- Motivation
- Experiment setup
- Round beam generation
- Arbitrary beam generation
- Implementation design
- Summary
Motivation for laser shaping

Laser shaping for photo-injector

Main idea: minimize the impact of the space charge on the transverse emittance.

Credit: Frank Stephan from PITZ of DESY

Gaussian to flat top clipping

Credit: PITZ and ATF/DESY
Existing schemes for laser shaping

Shaping with lenses system


Shaping with Spatial light modulator (SLM)

Credit:const.J. Maxson, et. al.

Shaping with Deformable Mirror

Credit: H. Tomizawa, et. al.
Core device for laser shaping

Digital Micro-mirror-array Device (DMD)

- 1024 x 768 pixels (XGA) [Discovery 1100]
- USB Interface
- High-speed port 64-bit @ 120 MHz for data transfer
- Up to 9,600 full array mirror patterns/sec (7.6 Gbs)

Segment of DMD:

13.8 um

Micro-mirror architecture:
DMD optics setup and shaping principle

- Diode Laser
- Aperture
- Gaussian Shape or worse
- L1
- L2
- L3
- ND filter
- CMOS Camera
- Control PC
- DMD

Arbitrary shape

Arbitrary shape

\[ \varphi = 24^\circ \]
Compensations and calibration
GUI interface
Results: Aperture or not
Regular shape beam generation

Projections!!
Regular shape beam generation (Cont.)

Projections!!
Slit beam for beam line study
Implement design into injector laser system for transverse beam shaping

- Laser Beam
- Mirror
- Beam splitter
- Beam expander
- Camera
- L3
- DMD
- Cathode
Summary and future plan

- Developed a system for arbitrary laser beam shaping in bench
- Discussed transverse shaping quality
- Proposed design principles for transverse laser shaping using DMD

In the future, we want to implement this system into the laser injector system which could be either in VELA or Alice.
Thanks for your attention
References

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J. Liang, et al., High-precision laser beam shaping using abinary-amplitude spatial light modulator, APPLIED OPTICS, Vol. 49, No. 8, 2010