

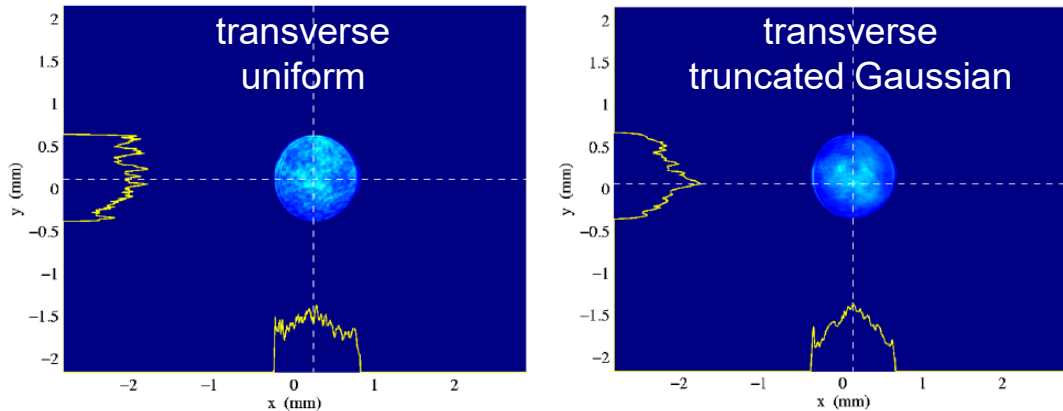
Emittance Reduction of RF Photoinjector Generated Electron Beams by Transverse Laser Beam Shaping

Matthias Gross and Houjun Qian for the PITZ Team
Virtual MT ARD ST3 Meeting 22.09.2020; speed talk

Motivation: Transverse Laser Shaping Reduces Emittance

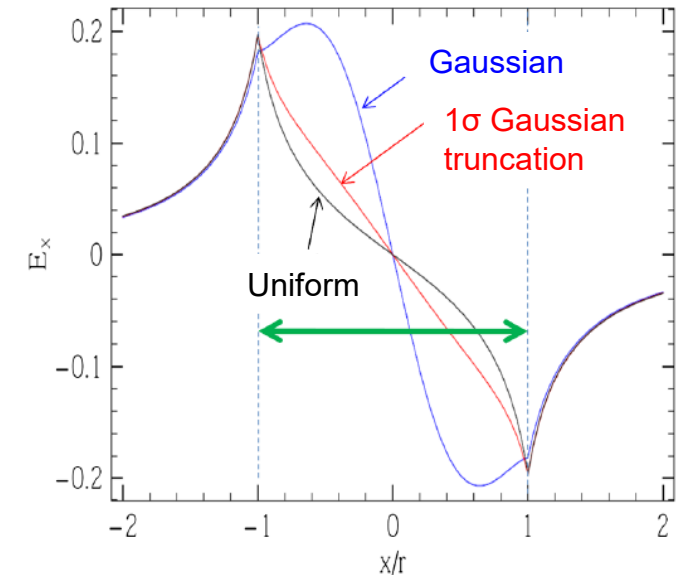
Simple method: can be applied everywhere

- **2012**, LCLS experience: (PRST AB 15, 090701)
 - 150 pC, ~1.3 ps (rms) laser
 - Uniform \rightarrow 1.1- σ Gaussian truncation: 25% reduction



- **2010**, Marc Hänel, PhD thesis (PITZ), 1 nC, 20 ps laser (simulation)
- **2013**, Tim Plath, Master thesis (FLASH), 20 pC, 1 ps laser (experiment)

- Why is truncated Gaussian better than flat-top?
 - \rightarrow Transverse space charge force is more linear (See also: **2013**, T. Rao and D. Dowell, *An engineering guide to photo injectors*)



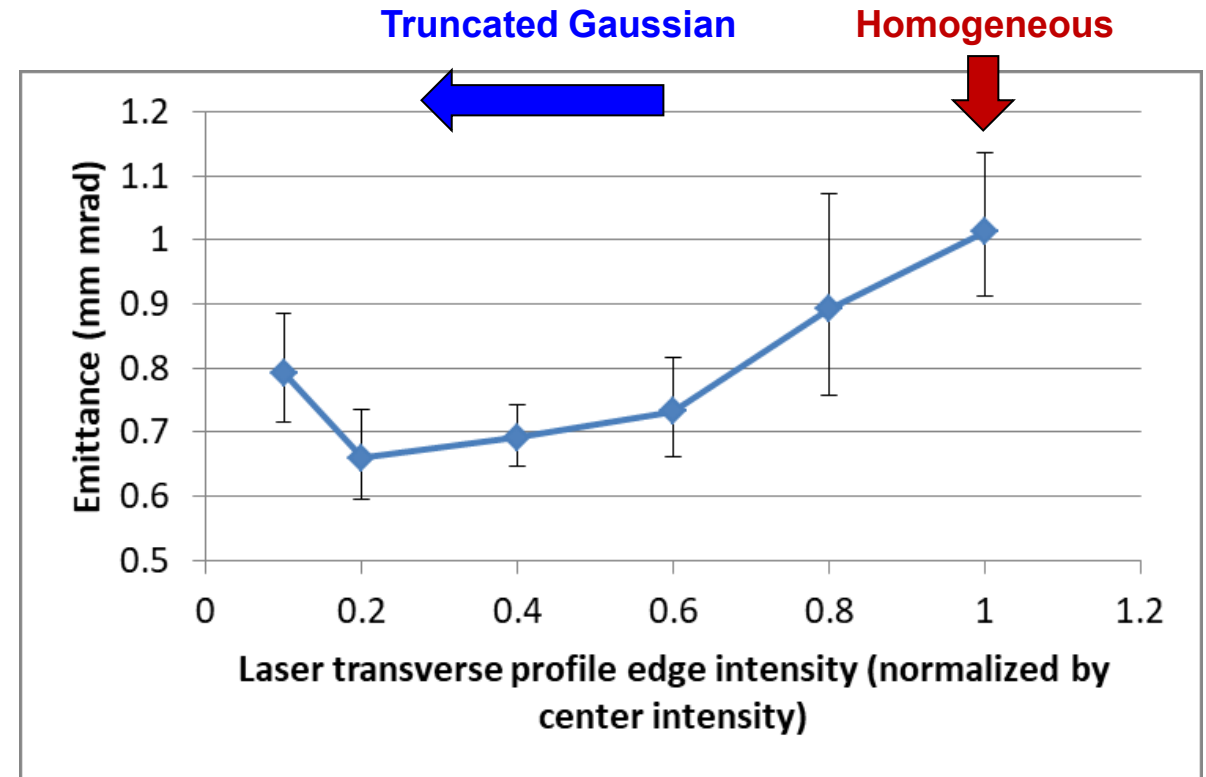
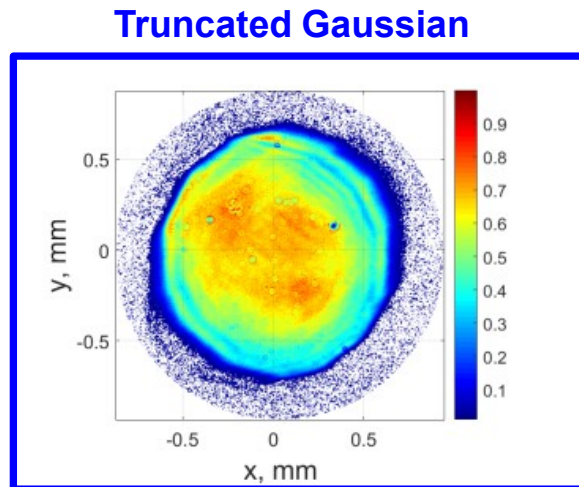
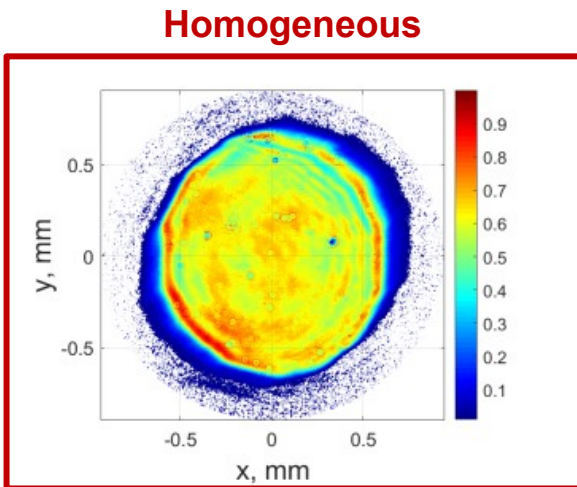
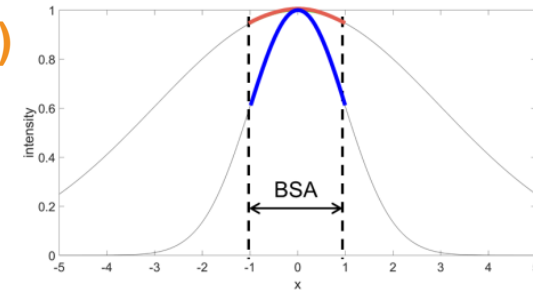
- Additional advantage: higher efficiency when using standard beam shaping aperture (BSA)
- **Now at PITZ: systematic study**

Experimental Studies at PITZ

Use telescope to adjust laser transverse size (range of truncation for given BSA size)

Projected emittance measurements:

- Laser temporal: 6 ps (FWHM) Gaussian
- Bunch charge: 500pC
- Gun: 6.3 MW_p (~60 MV/m)
- Electron momentum after booster: 20 MeV/c
- Beam shaping aperture (BSA) diameter: 1.3mm



34% emittance improvement!

- 15% for 250 pC bunch charge

Thank you

Contact

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