

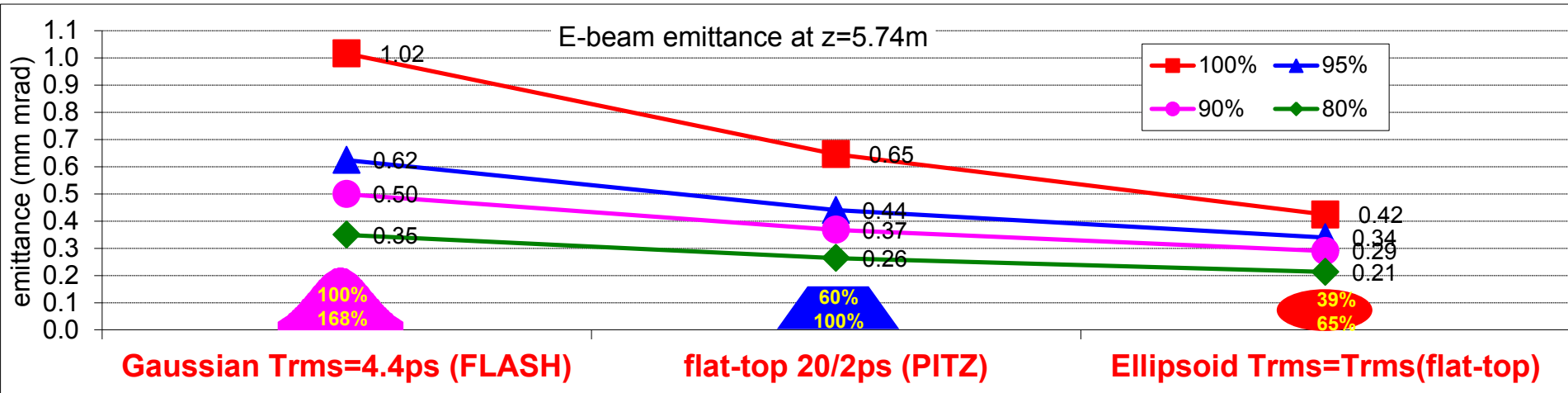
3D ellipsoid laser pulses: tolerance studies

M.Krasilnikov, PPS 27.09.2012

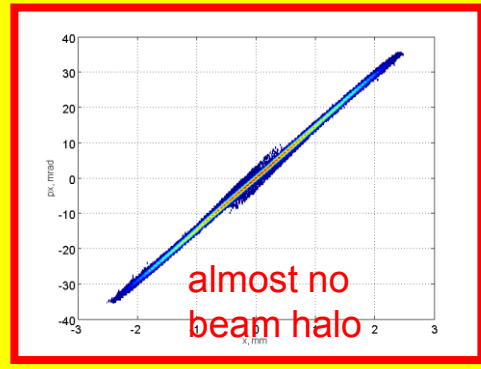
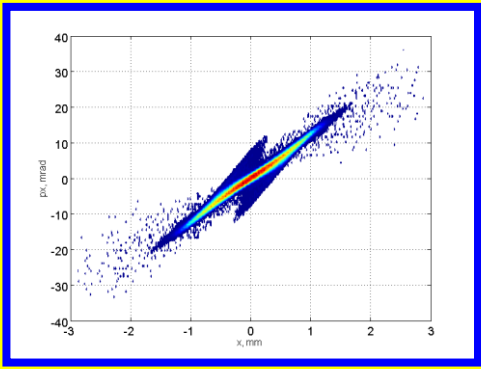
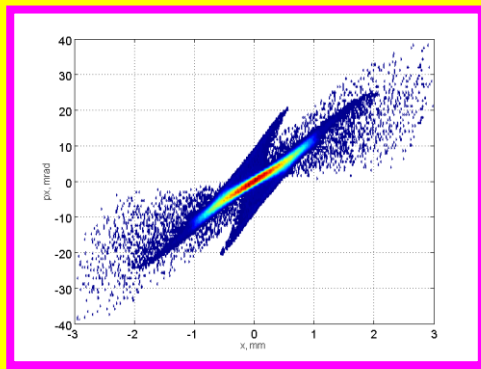
New option for the photo cathode laser → 3D ellipsoid



BD simulations for 1 nC bunch charge



Transverse phase spaces at z=5.74m



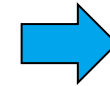
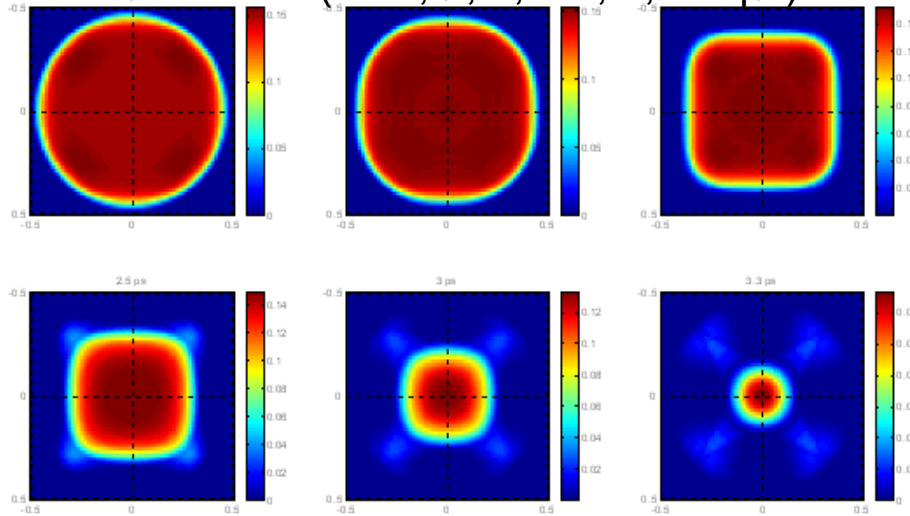
Advantages of 3D ellipsoidal cathode laser pulses:

- 30-50% lower average slice emittance → higher **brilliance**
- long. phase space +3rd harm. → better **compression**
- ~no beam halo → better signal/noise, reduced **rad. damage**
- less sensitive to machine settings → higher **stability**

Imperfections in 3D ellipsoid shape



3-D ellipsoid laser transverse distribution at different time cross sections (t = 0; 1; 2; 2.5; 3; 3.3 ps).



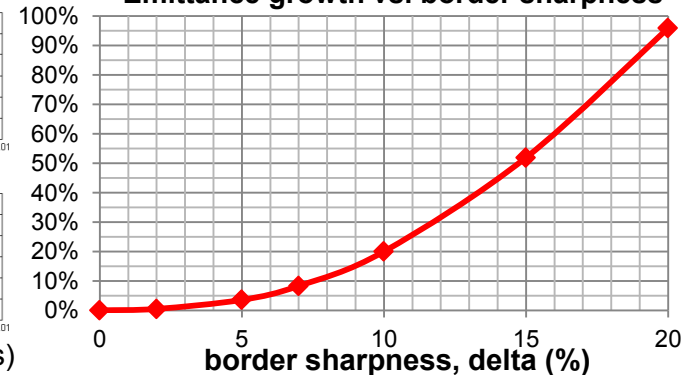
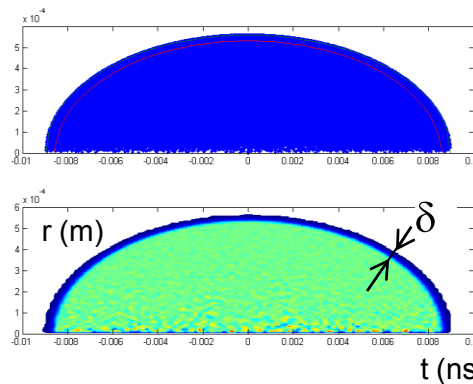
3-D ellipsoid laser pulse shape imperfections have to be studied for **tolerances**:

1. Sharpness of edges
2. Rotational symmetry distortions
3. Shape stability



BD Simulations (1.)

Emittance growth vs. border sharpness



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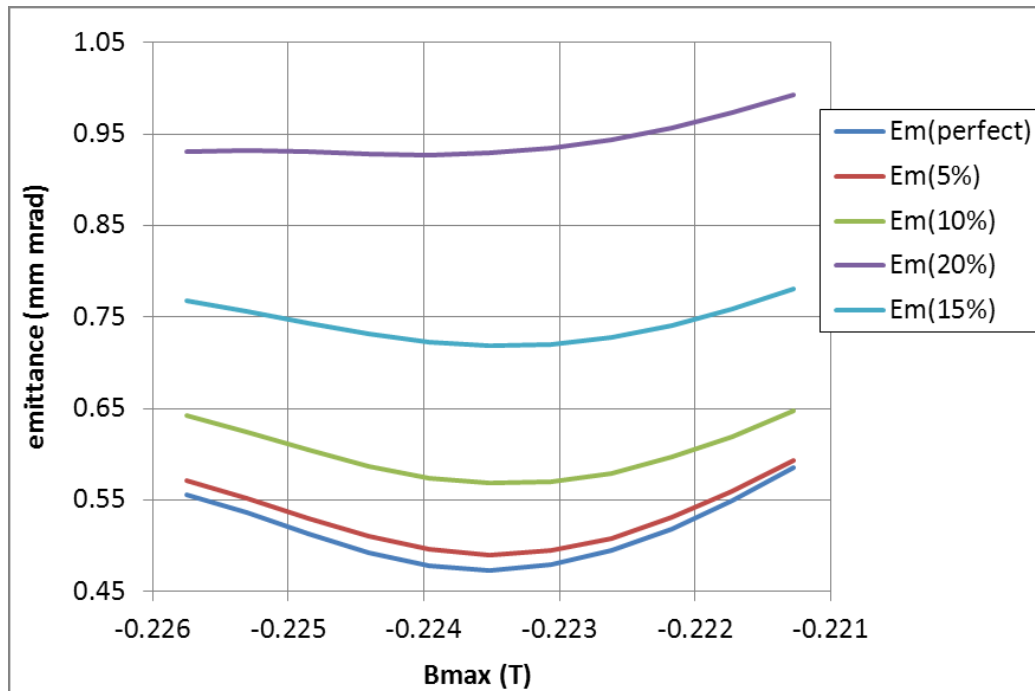
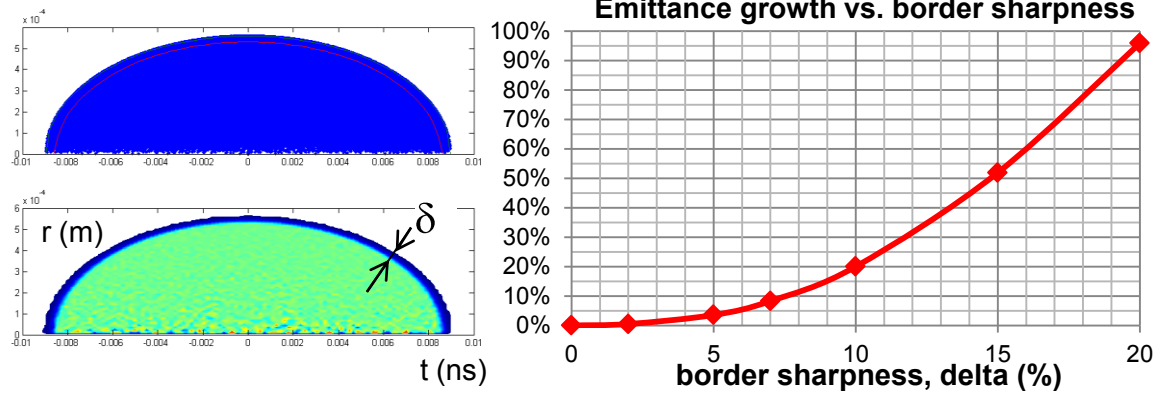
Modification of the initially homogeneous laser intensity distribution

$$- \begin{pmatrix} - & \text{---} & - \end{pmatrix}$$

Imperfections in 3D ellipsoid shape: vs. I_{main}



BD Simulations (1.)



Conclusions

> 3D ellipsoid imperfections

→ Border sharpness influence has been simulated:

- 30% emittance growth (critical) → 12% border width
- 5-7% border → emittance growth <10%

> To be done:

- Refine optimization
- Phase space dilution:
 - Core emittance
 - Slice emittance