Thermal emittance and photo emission studies at PITZ

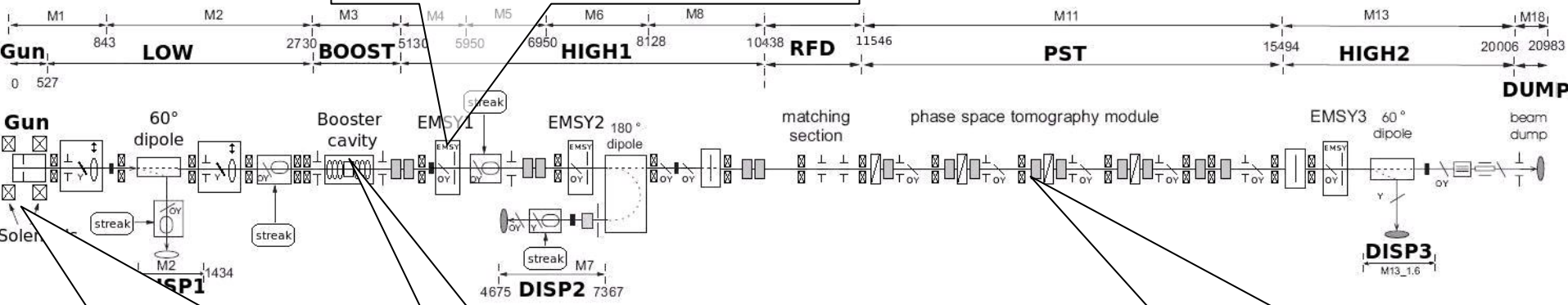
M.Krasilnikov,

Workshop on photocathodes for RF guns,

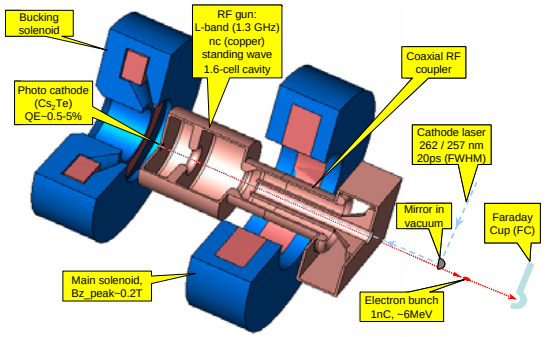
1-2 March 2011, Lecce,

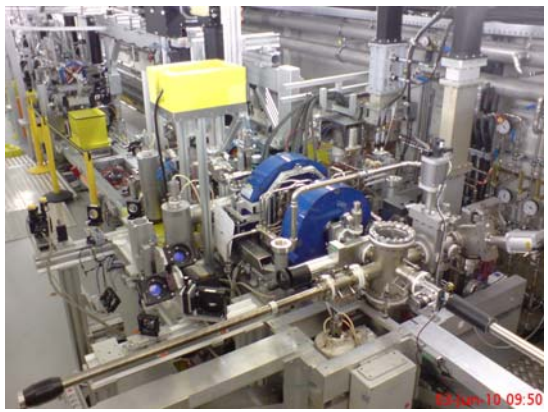
Photo Injector Test facility at DESY in Zeuthen

Slit-mask station (EMSY1)

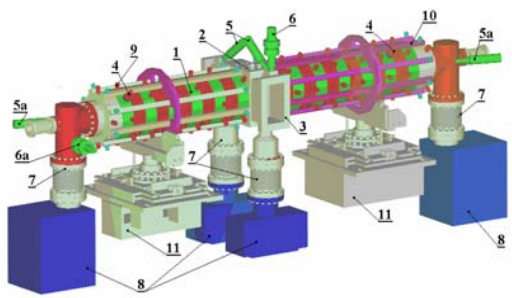


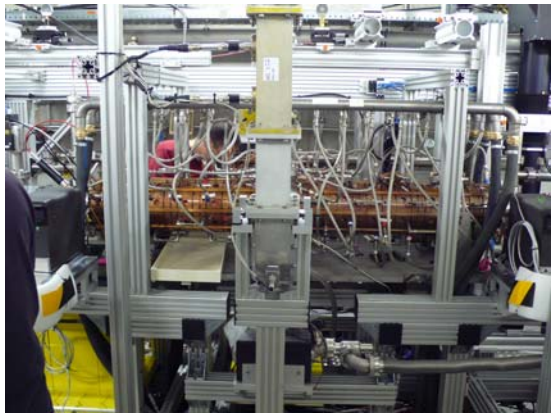
RF-gun (1.3GHz)



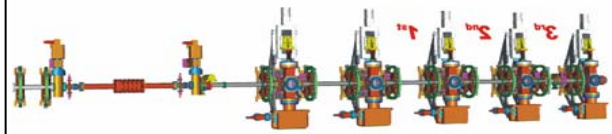


CDS-booster

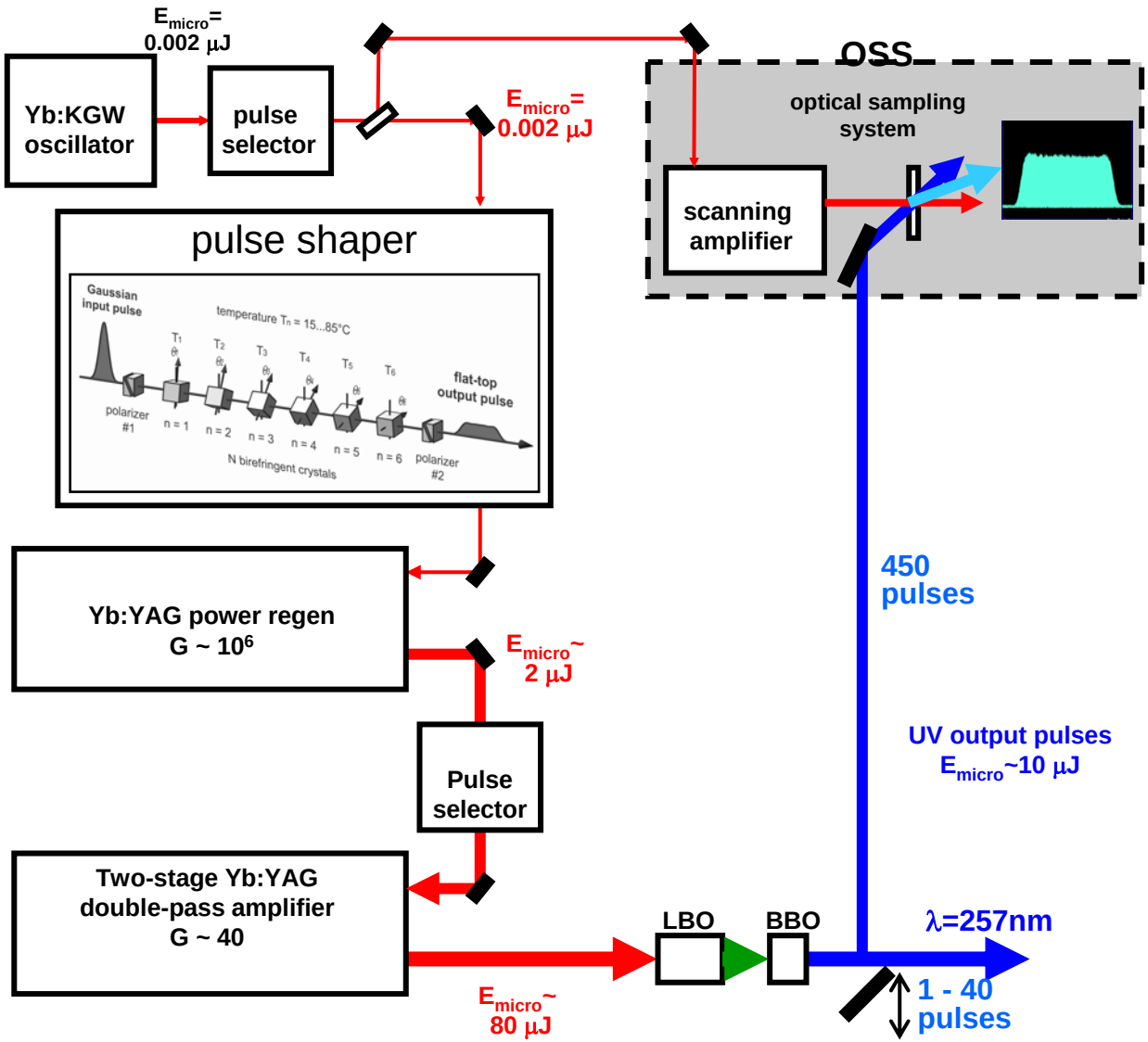


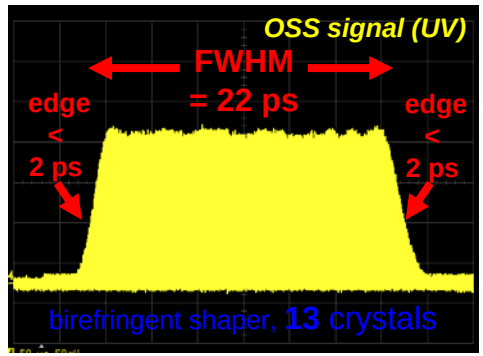


Tomography

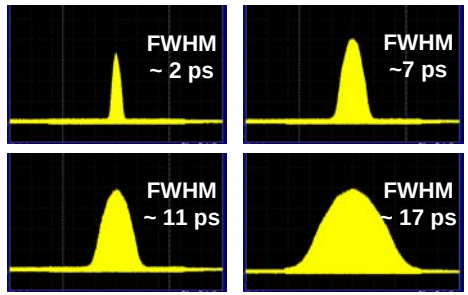


PITZ: photocathode laser system





Gaussian:



Simulated pulse-stacker

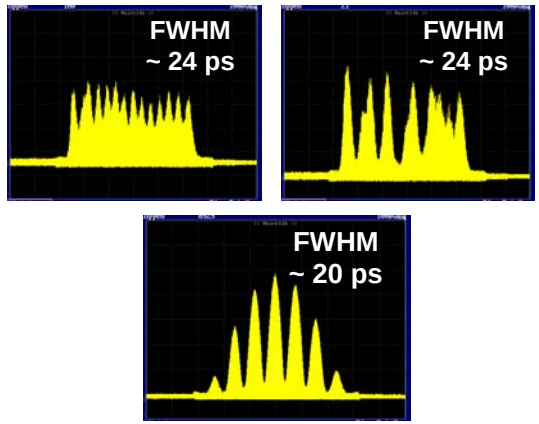
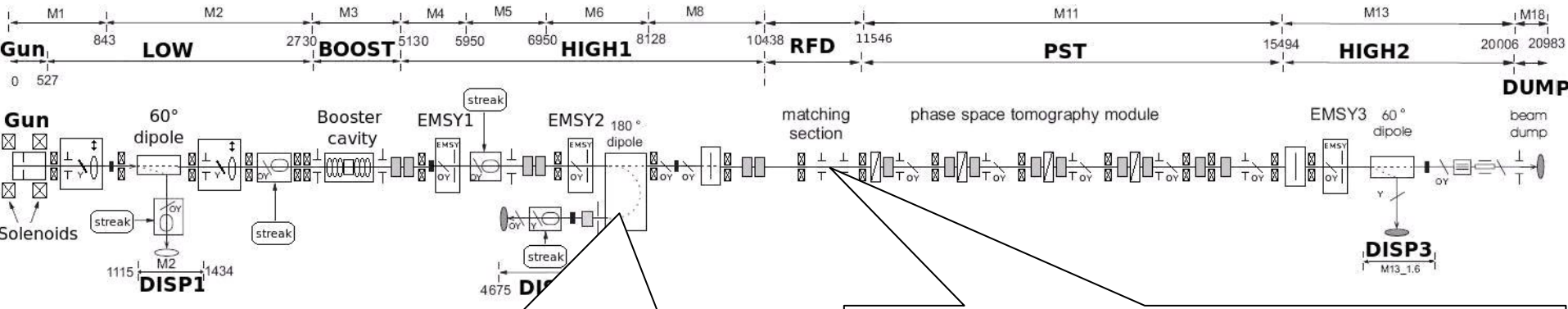
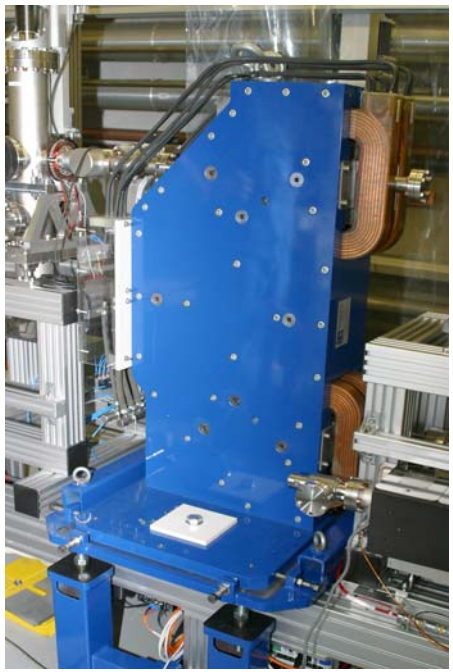


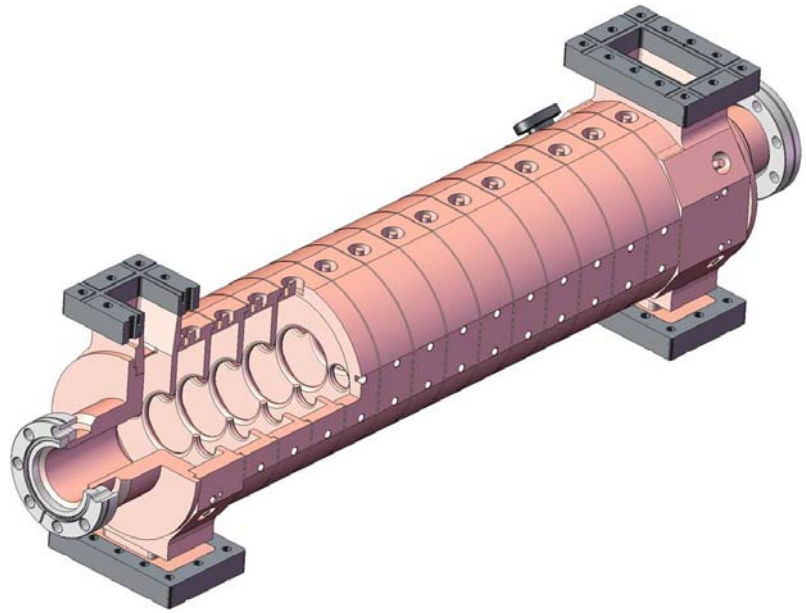
Photo Injector Test facility at DESY in Zeuthen



High Energy Disp. Arm (HEDA1)



Transverse Deflecting Cavity



Thermal emittance measurements at PITZ

Motivation:

•Beam dynamics simulations (ASTRA) yields smaller minimum of the projected emittance (<0.7 mm mrad for 1nC) than values measured at PITZ (0.9..1 mm mrad for 1nC)

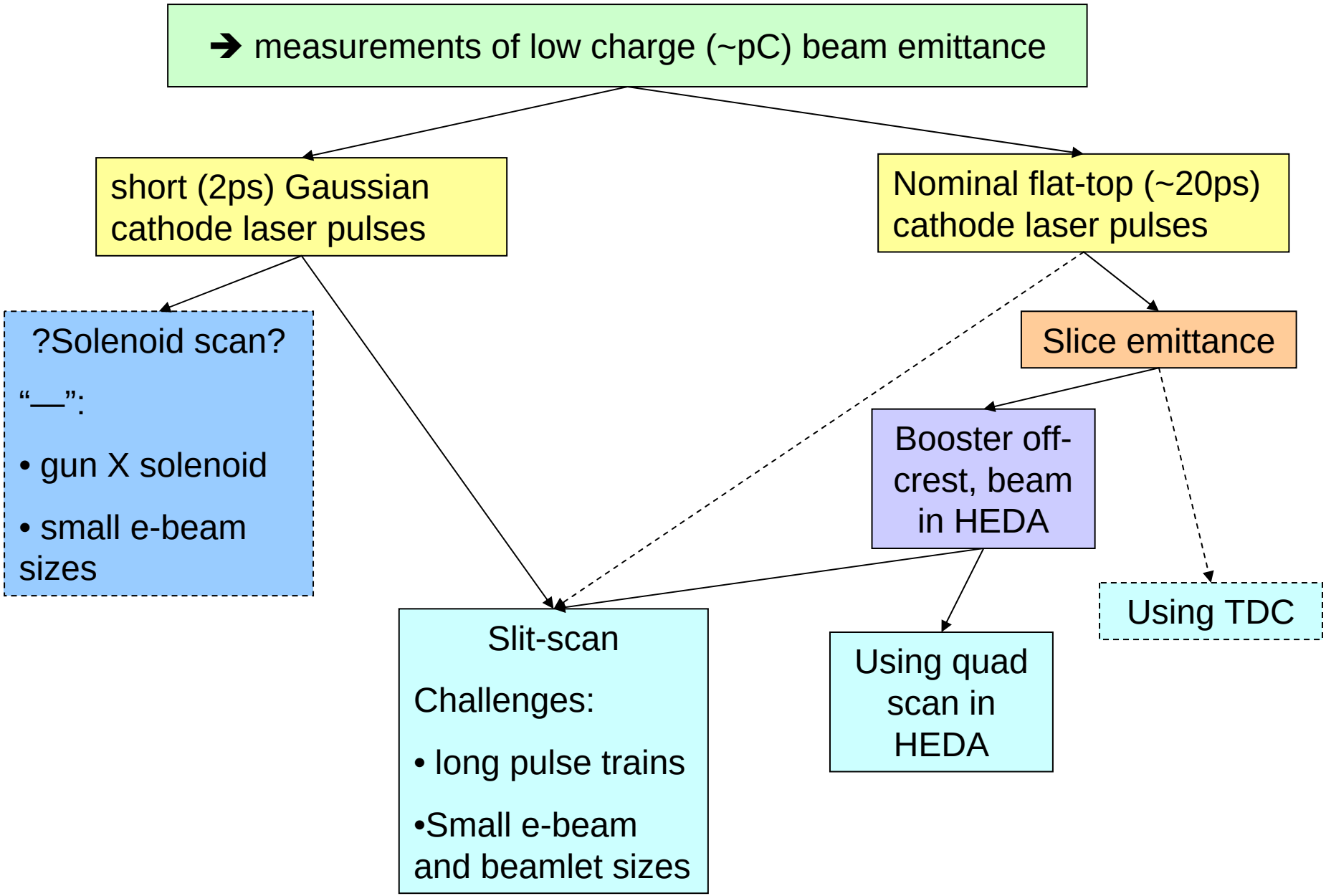
•Optimum simulated machine parameters deviate from the experimentally obtained ones, e.g. laser spot size

from simulations ~0.4 mm RMS (D=~1.6mm)

from experiment ~0.3 mm RMS (D~1.2mm)

•Emittance budget for the optimized photoinjector is mainly dominated by the thermal emittance (intrinsic emittance)

Thermal emittance measurements at PITZ



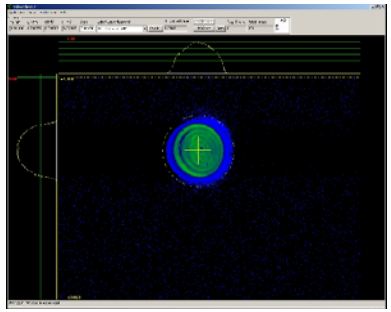
Photoemission benchmarking

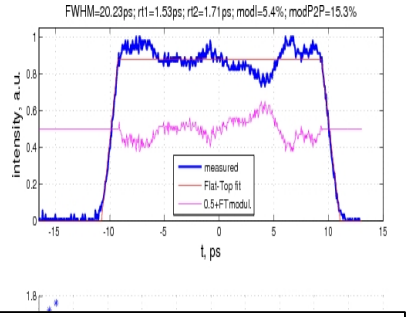
Phase scans for various machine parameters = Q(phase, Prf, Elaser, Imain)

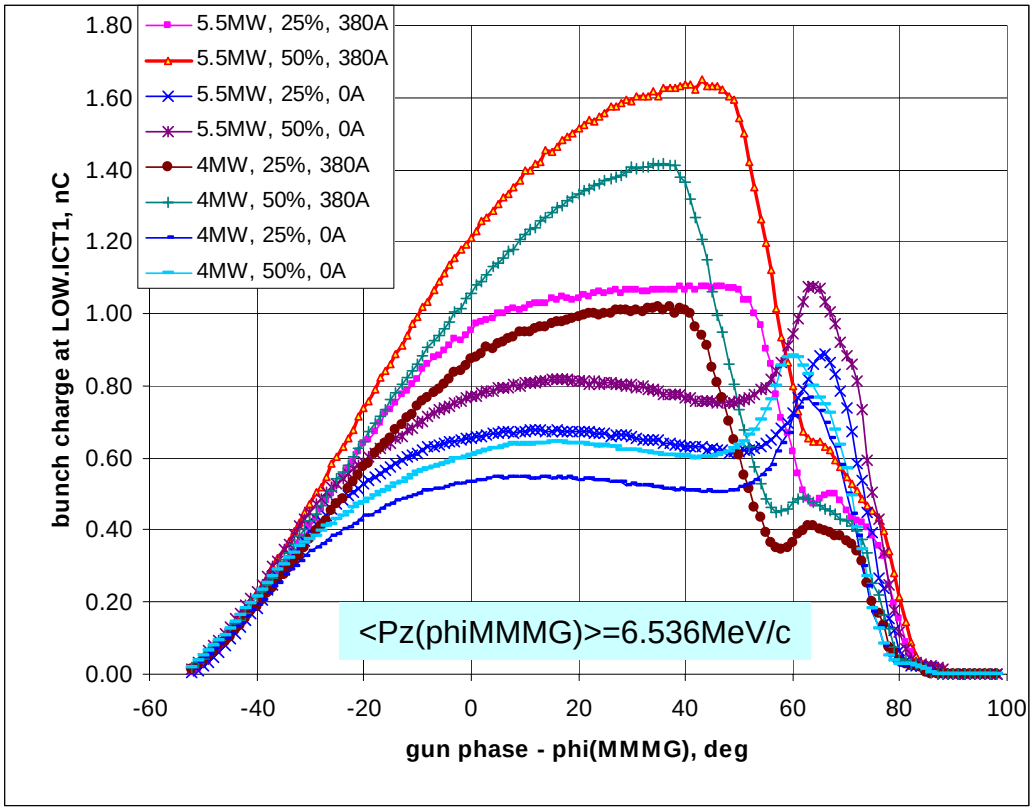
Eemis SC Focus, transport

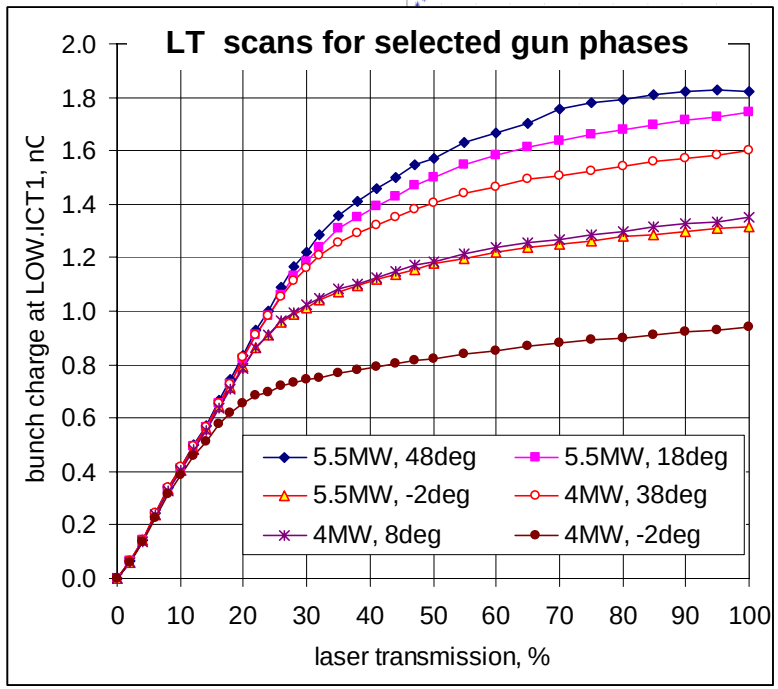
Prf={5.5MW;4MW}
X
LT={25%;50%}
X
Imain={0A;380A}

Cathode laser





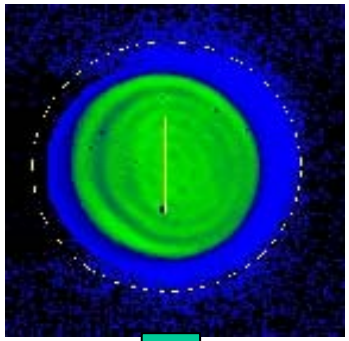


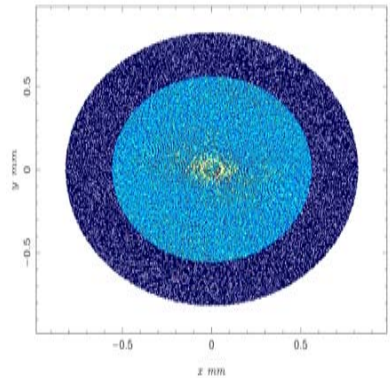


!strongly space charge dominated regime!

ASTRA simulations

Laser transverse halo modeling



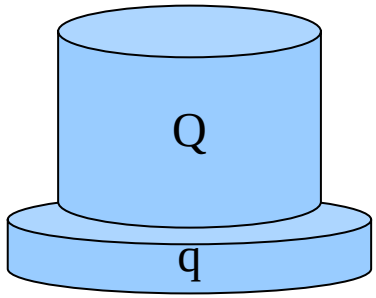


SoP_{core}, D_{core}

SoP_{full}, D_{full}

$SoP_{full}/SoP_{core}=1.16$

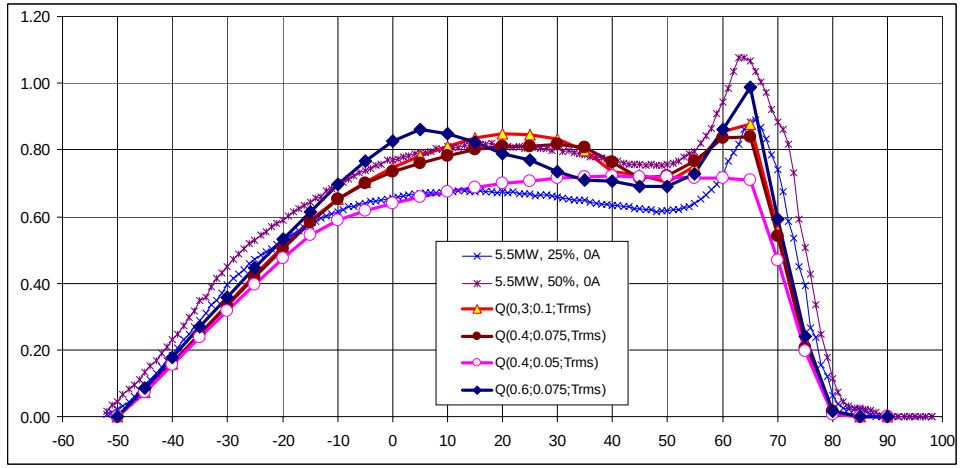
$D_{core}/D_{full}=0.67$



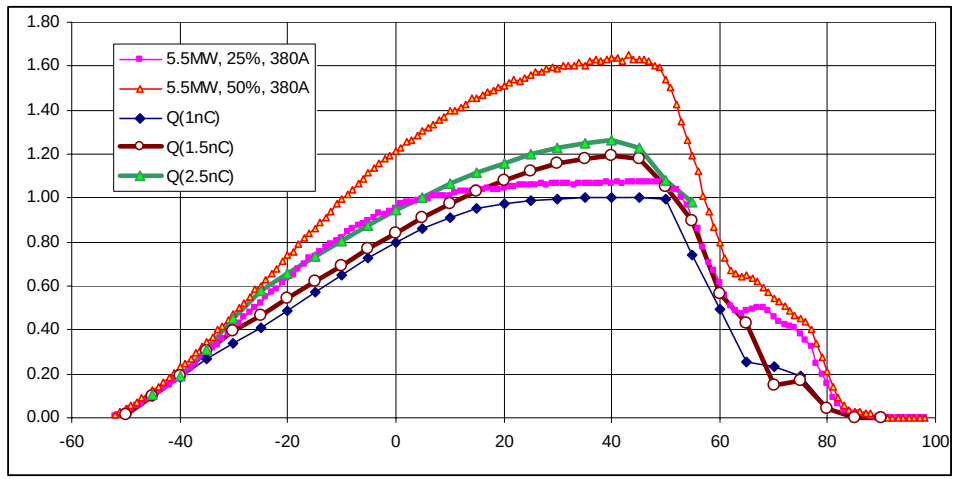
$$q = Q_0 \frac{SoP_{full} - SoP_{core}}{1 - \left(D_{core}/D_{full}\right)^2} \rightarrow 26\%$$

$$Q = Q_0 \cdot SoP_{full} - q \rightarrow 74\%$$

Qsimulated(Qbunch,SchottkySRT), Imain=0A



Qsimulated(Qbunch), Imain=380A



QE (map) measurements (proposals)