H- Low Energy Emittance measurements to Optimize Injections into an RFQ

Christoph Gabor

ASTeC(south),

Rutherford Appleton Laboratory

THE UNIVERSITY OF WARWICK

Imperial College London

ASTeC

ISIS

Royal Holloway University of London

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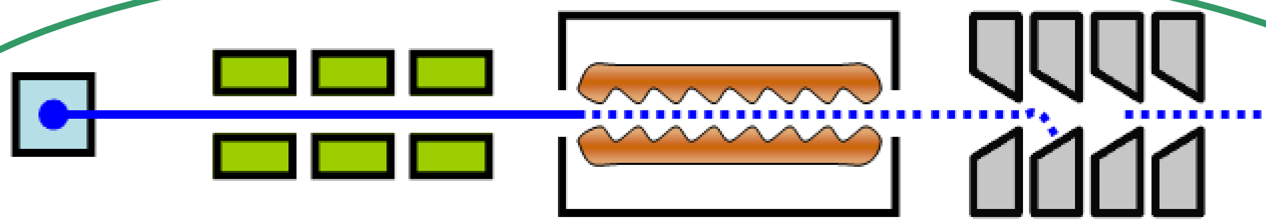
Universidad del País Vasco
Euskal Herriko Unibertsitatea
The University of the Basque Country



The Front End Test Stand Collaboration

Dan Faircloth
Simon Jolly
Scott Lawrie
David Lee
Alan Letchford
Jürgen Pozimski
Peter Savage
Christoph Gabor
Mark Whitehead
Trevor Woods
Gary Boorman
Alessio Bosco

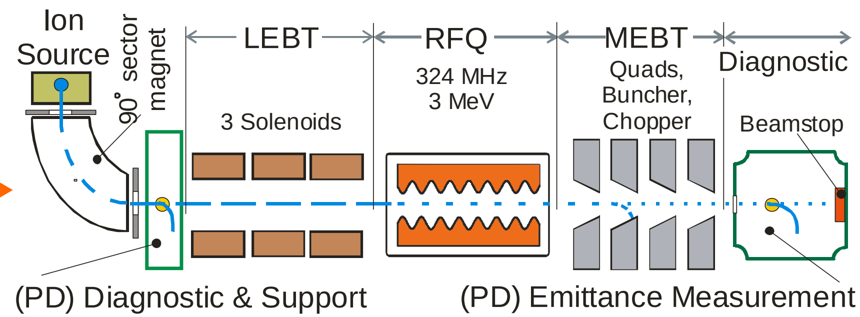
Companies:
Tekniker, Jema, Elyt
Diversified Technology
Toshiba

Further collaboration:
CERN
IHEP, China
Fermilab
IAP, Frankfurt University

Mike Perkins
John Back
Ajit Kurup
Ciprian Plostinar
Mike Clarke-Gayther
Phil Wise
Javier Bermejo
Julio Lucas
Jesus Alonso
Rafael Enparantza
Grahame Blair
Zunbeltz Izaola
Ibon Bustinduy

Outline of the talk

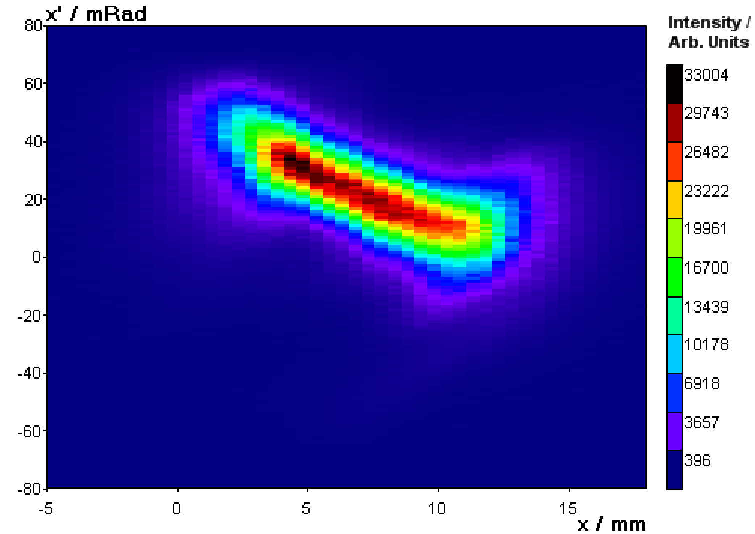
Front End Test Stand FETS at RAL
Overview of the project



Front slit of the ISIS emittance scanner, water-cooled, power deposition up to 600W possible

Details of the Low Energy Beam Transport (LEBT), diagnostics hardware, i.e. emittance scanner

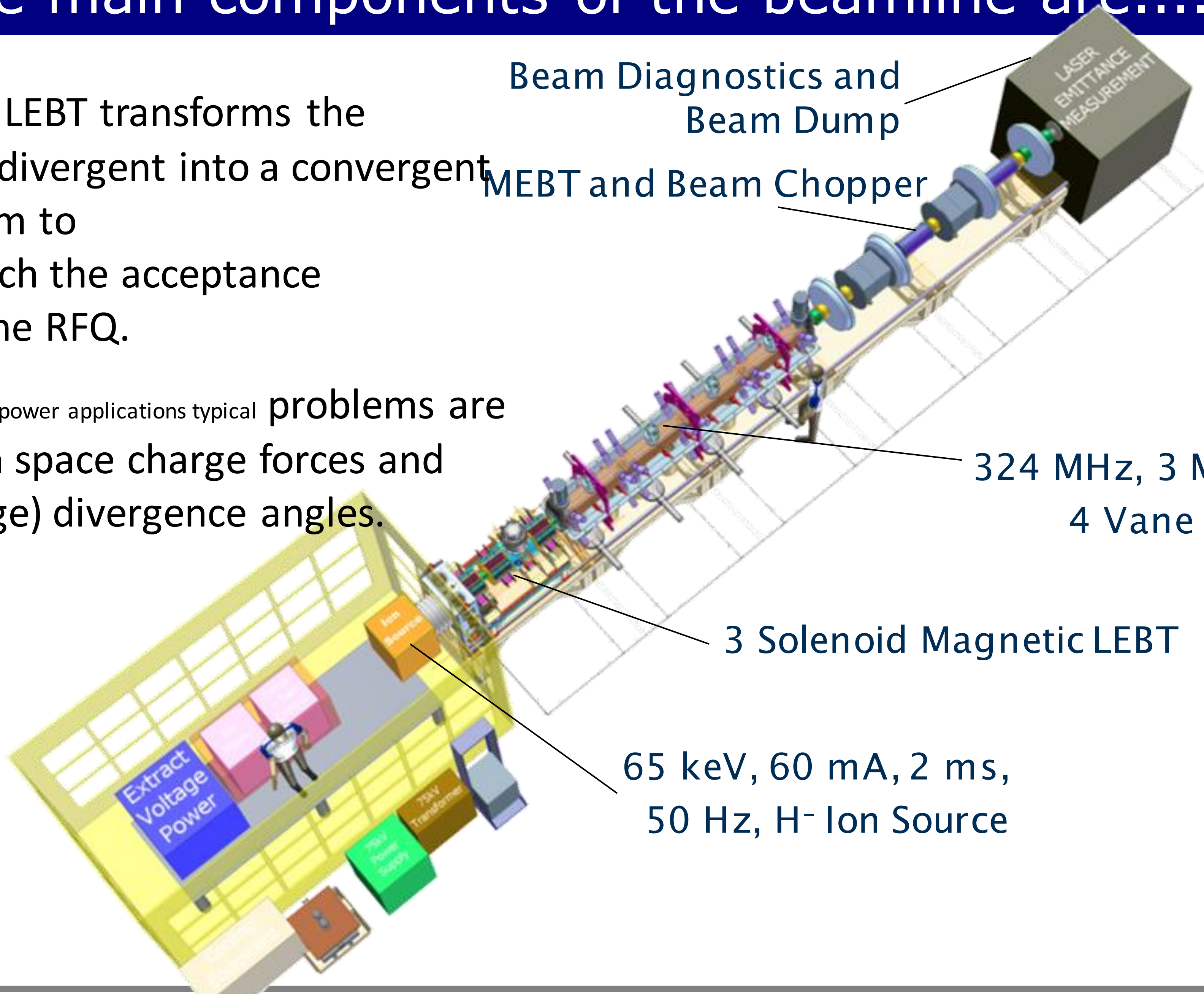
Experimental results and discussion of measurements



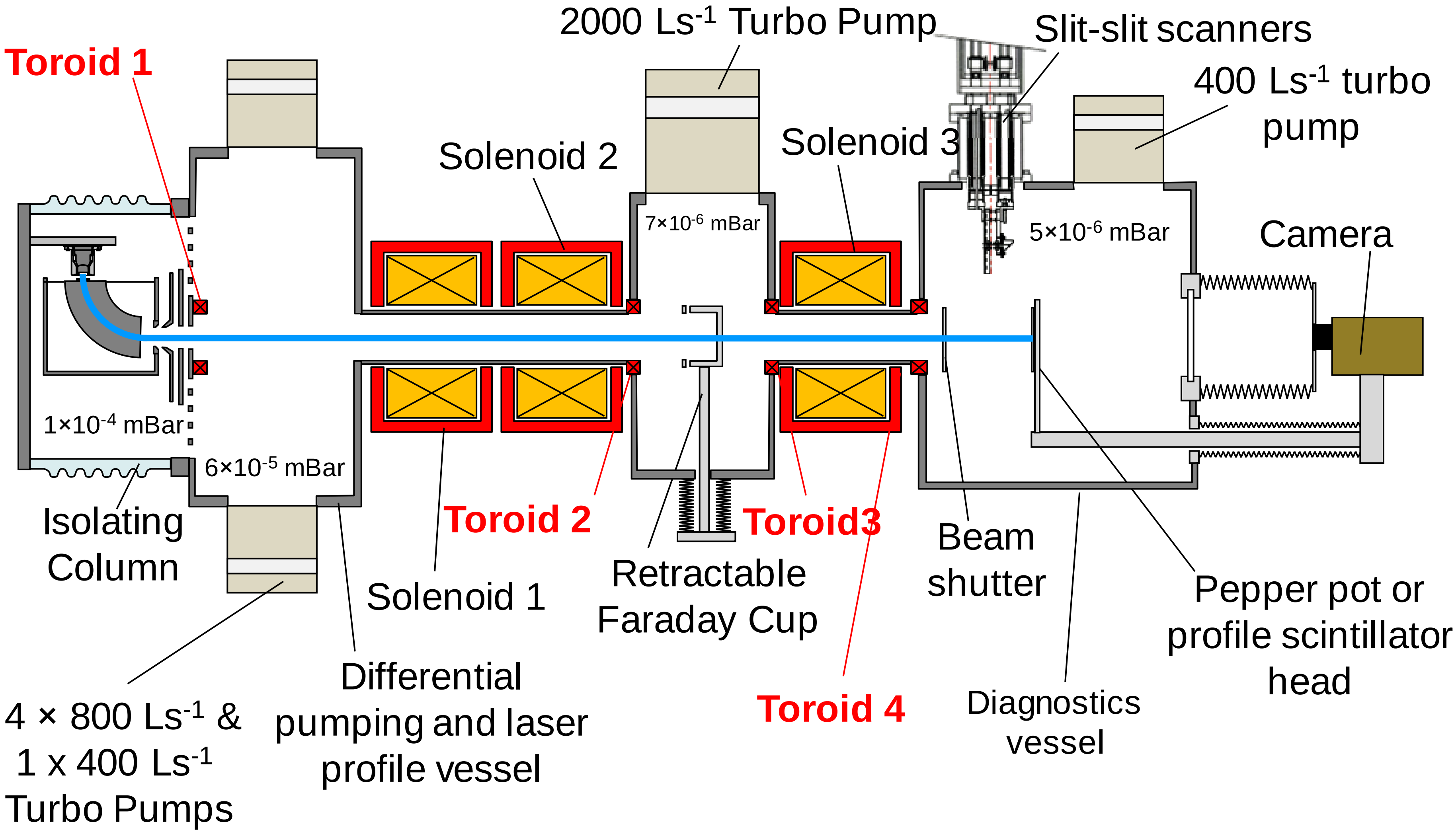
The main components of the beamline are.....

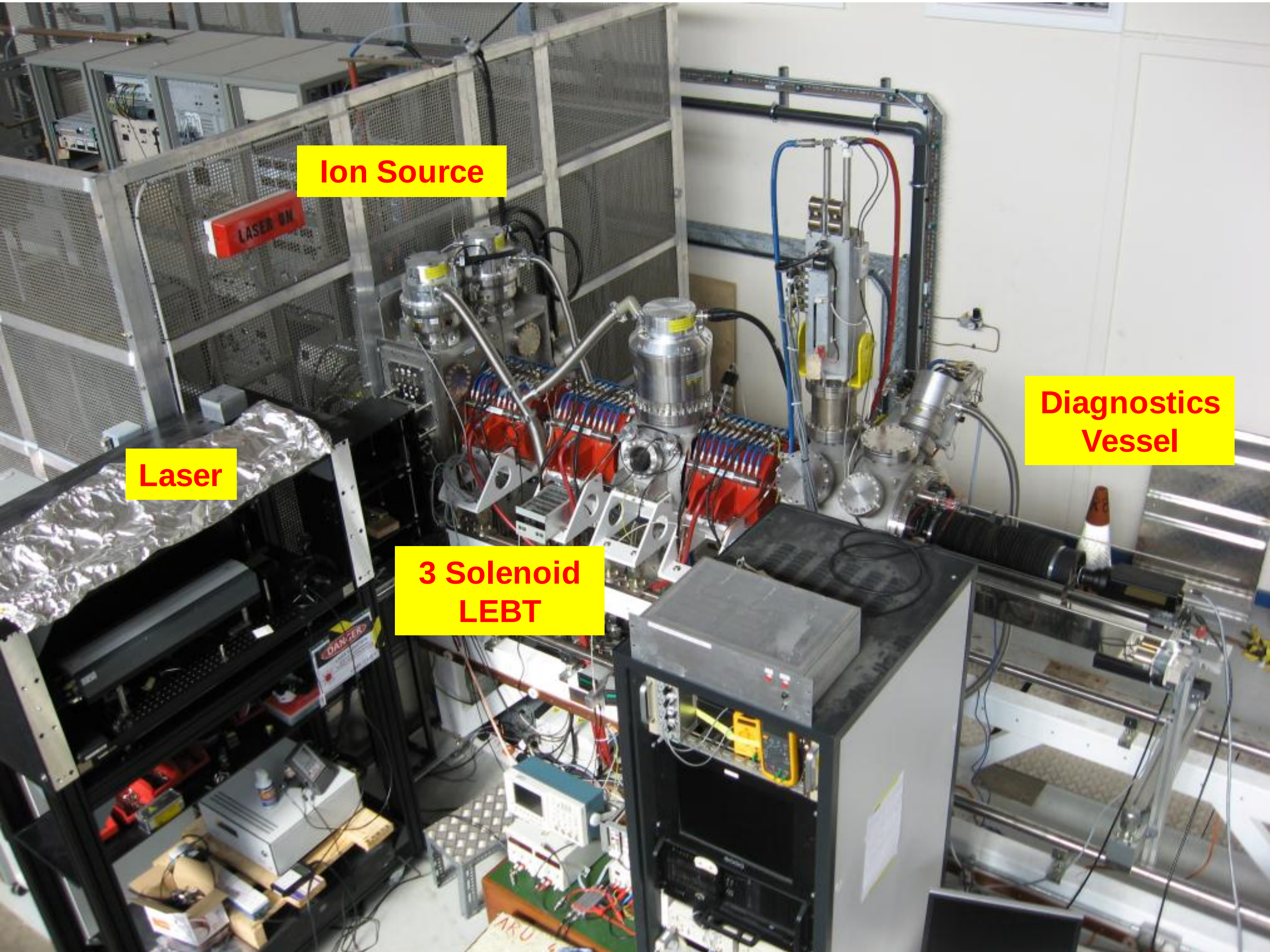
The LEBT transforms the
the divergent into a convergent
beam to
match the acceptance
of the RFQ.

In high power applications typical problems are
high space charge forces and
(large) divergence angles.



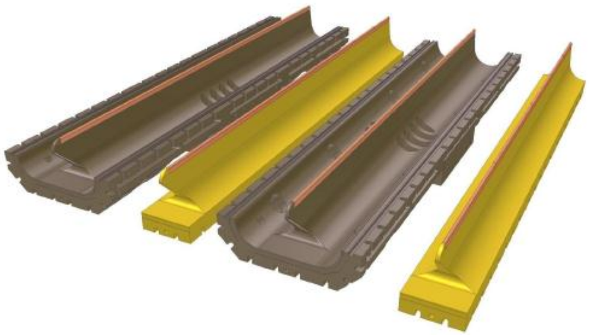
Beam travels through sector magnet, post acceleration and solenoid LEBT.




Ion Source
Laser
Diagnostics Vessel
3 Solenoid LEBT
LASER ON
DANGER

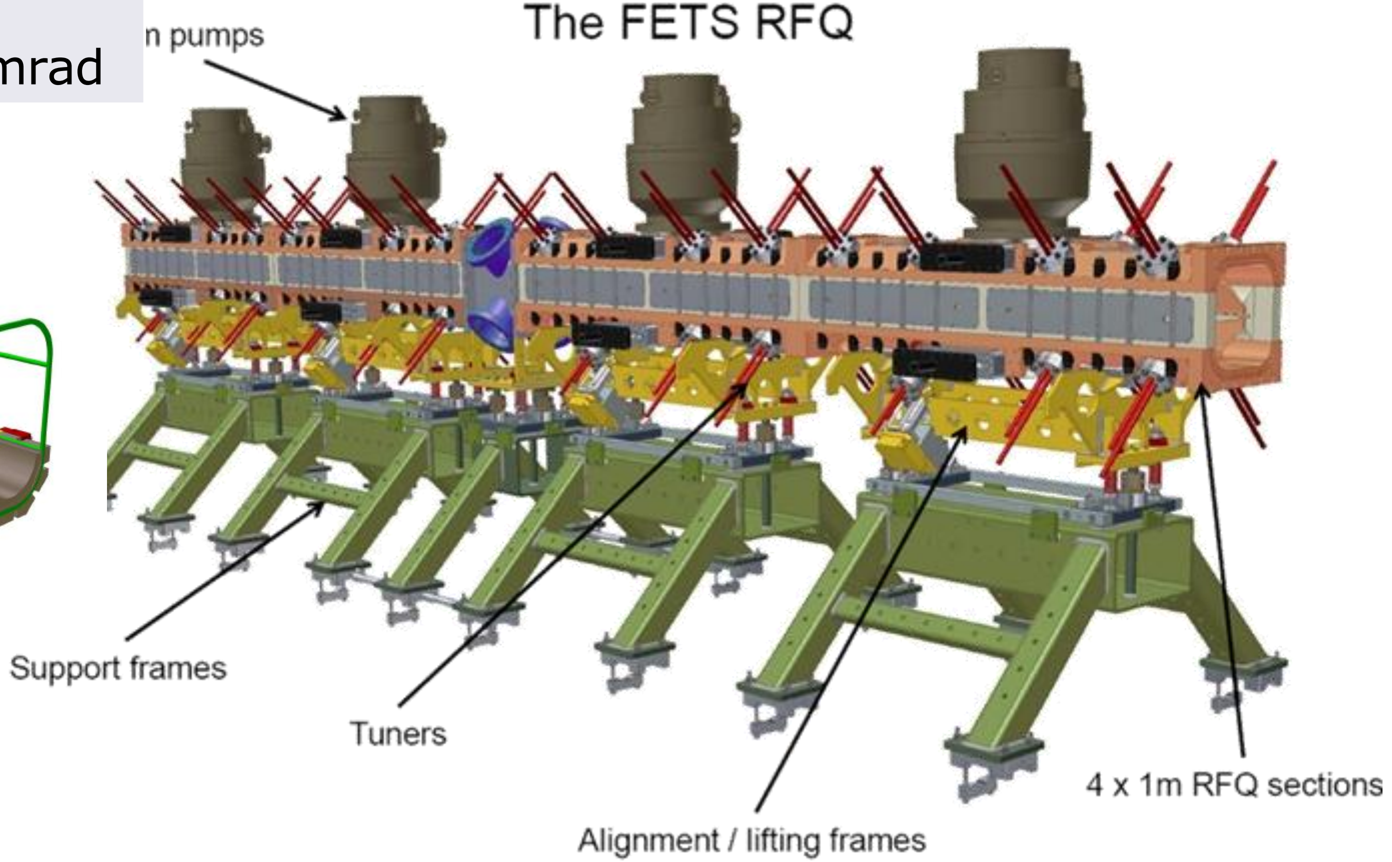
Design now complete for the 4m long, 3MeV, 324MHz 4—vane RFQ

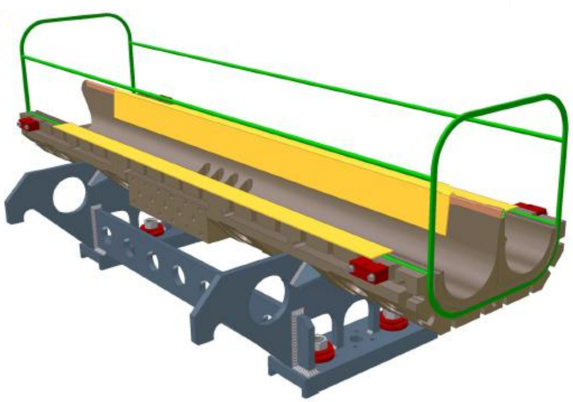
	horizontal, vertical
x, y x′, y′	+/- 2mm +/- 100mrad
ε_{rms} α β	0.25 πmmmrad 0.84 0.032 mm/mrad



Sections made of 2 major and 2 minor vanes

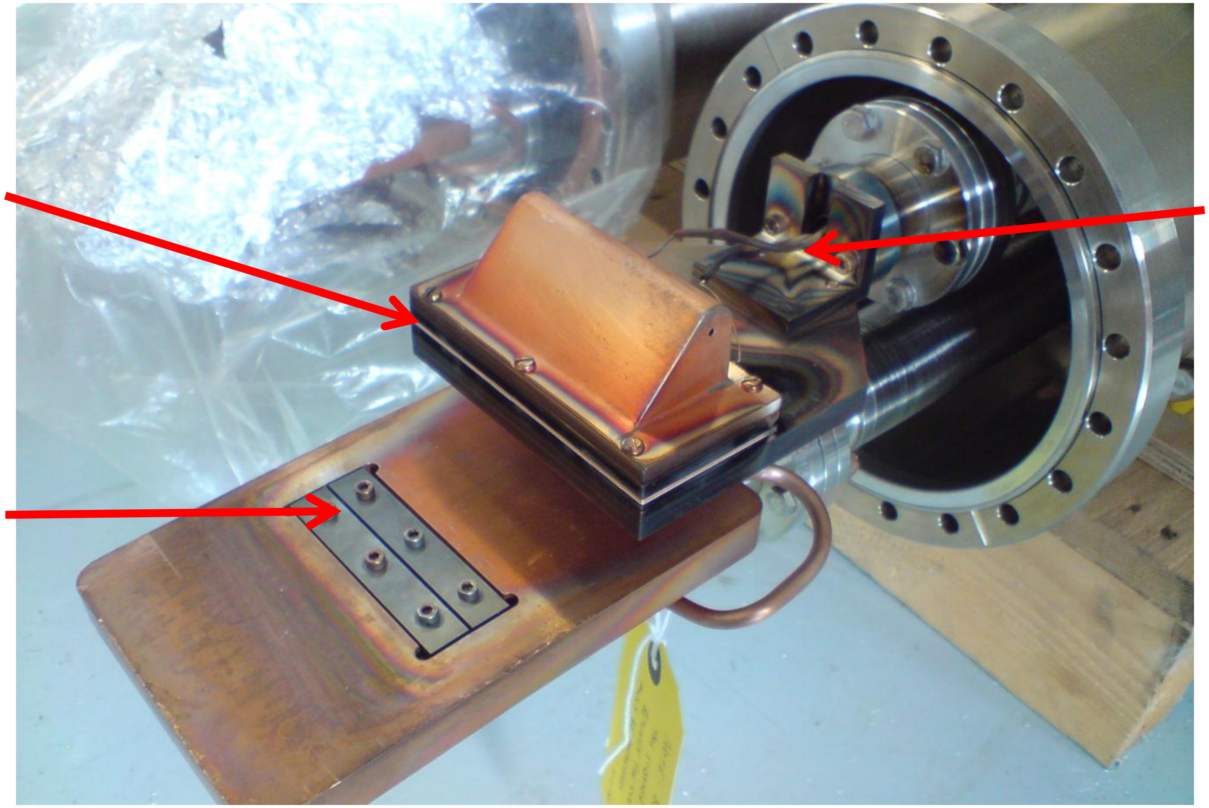
The FETS RFQ





3D o-ring

Two independent slit—slit scanner are installed in a multipurpose diagnostics vessel.



0.08 x 60 mm slit and Faraday cup

0.25 x 60 mm position sampling slit

500 V Electron Suppressor

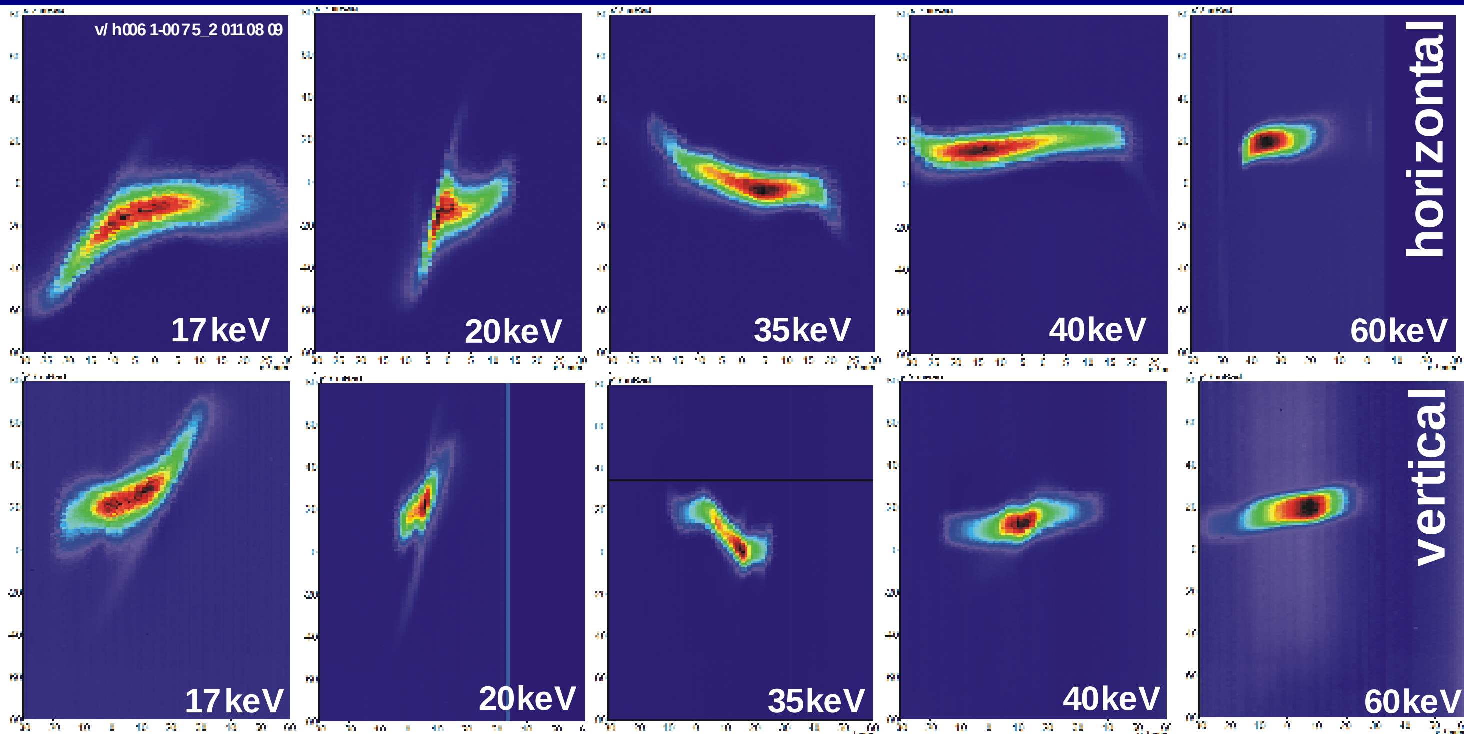
Scan in one plane with resolution used for this work ~13min

1mrad, 0.25mm: Mechanical resolution is enhanced by oversampling (Lucy—Richardson Deconvolution)

For data processing, bias, threshold and SCUBeX can be applied.

(for more information see M.P. Stockli et al., AIP Conf. Proc. 639, pp135 2002)

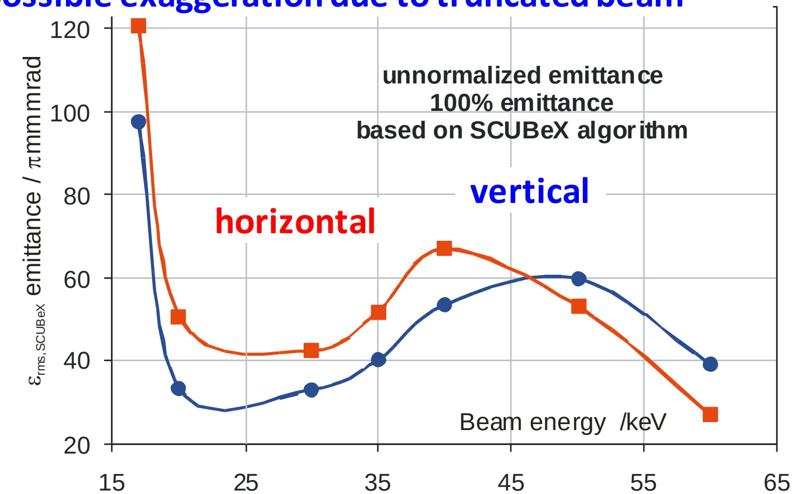
Variation of the beam energy with constant extraction voltage of 17kV.

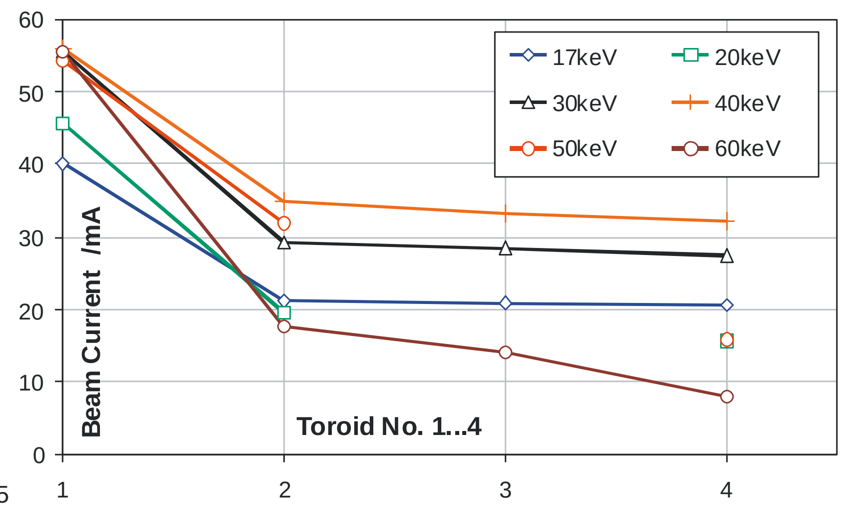


Solenoids were set to same field, equivalent to 70A.

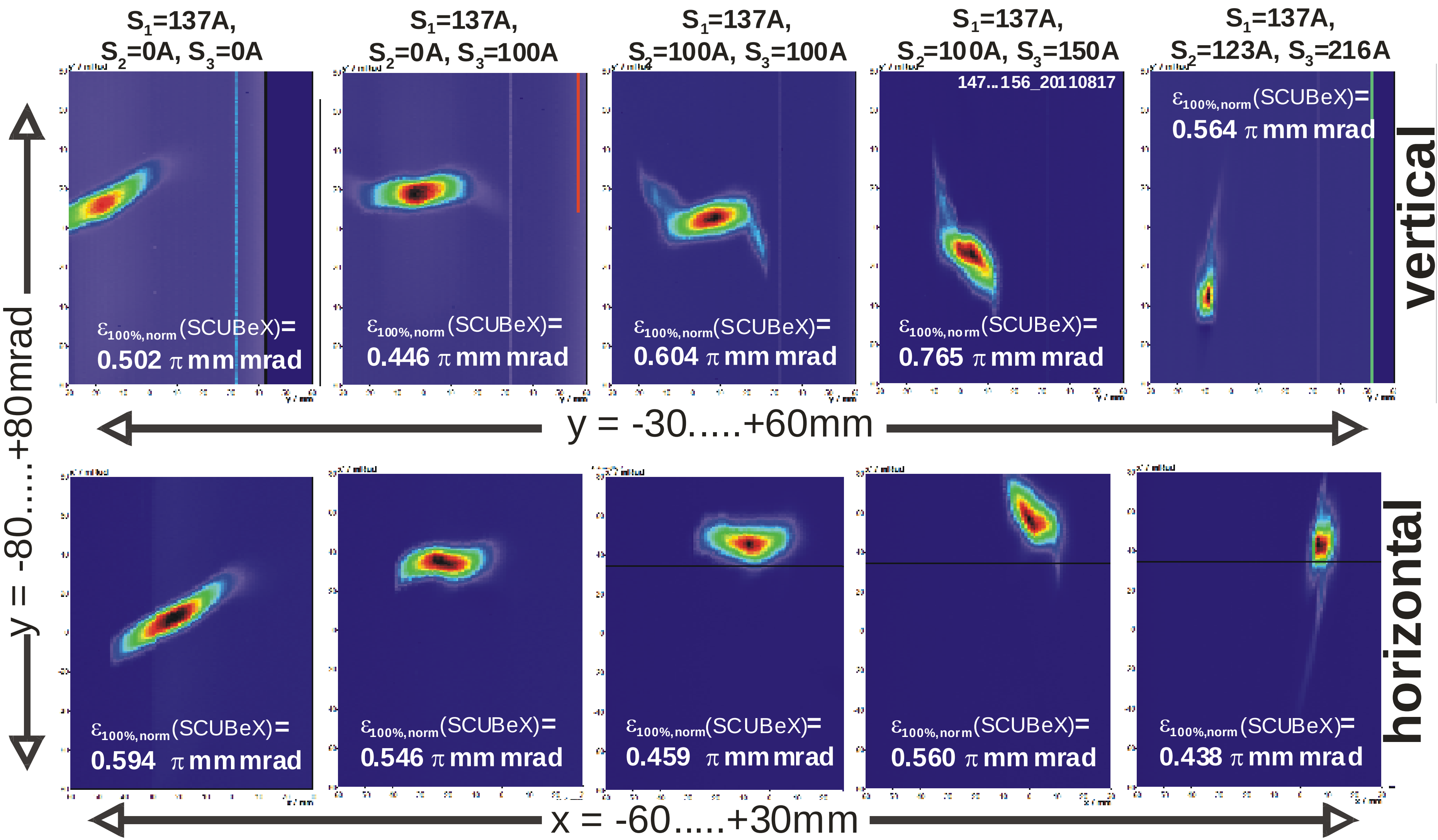
B [T] ~ $1.4*10^{-3}*I$ [I / Ampere]

possible exaggeration due to truncated beam





Constant beam energy of 65keV at different solenoid settings and beam currents up to 60mA.



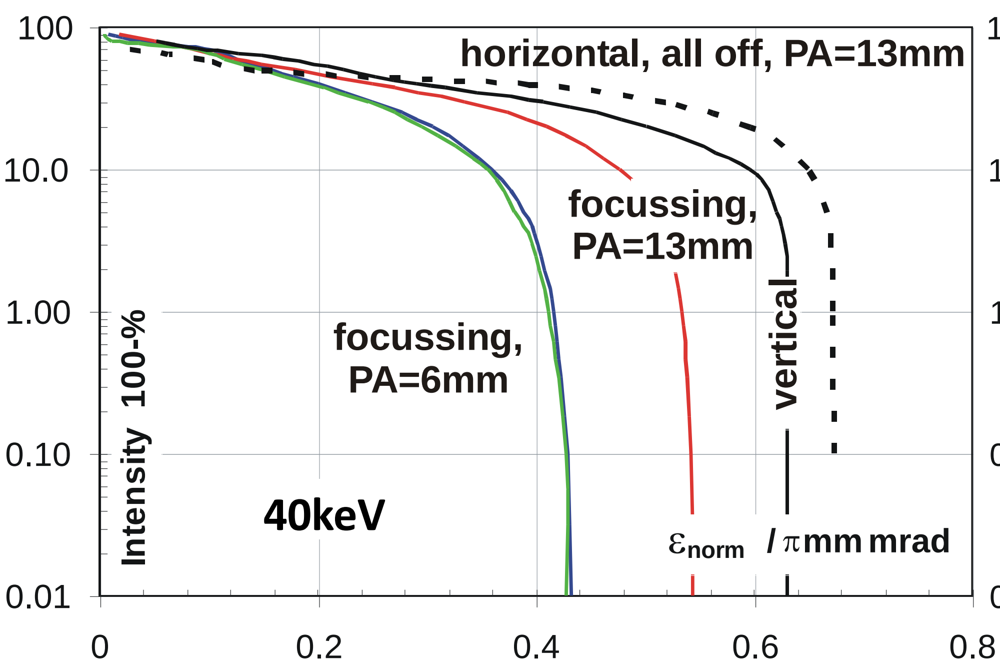
Fractional rms—emittance versus different post acceleration gap lengths & extraction system.

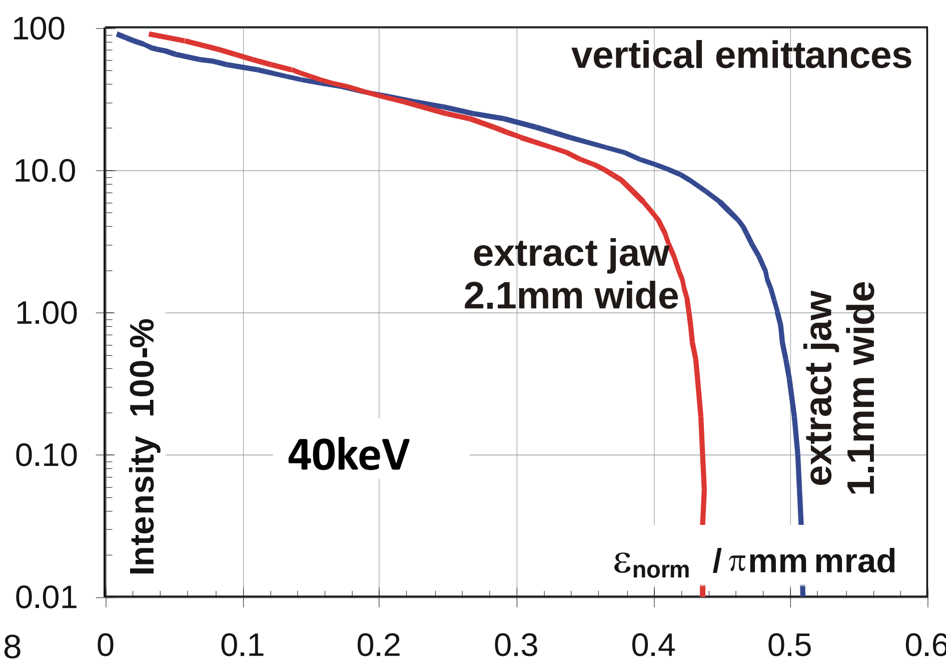
Green: PA=13mm (v)
Red: PA=6mm (v)
Blue: PA=13mm (v)
Solenoids off:
Black: PA=13mm (V)
dash: PA=13mm (h)

S1=115A, S2=0A, S3=70A

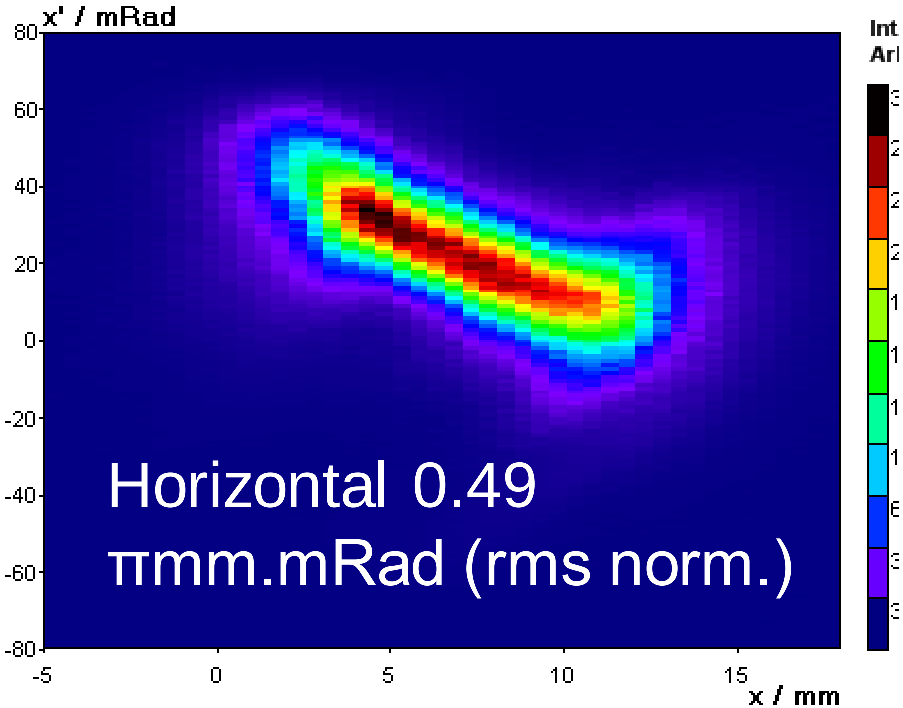
Definition of fractional rms-emittance

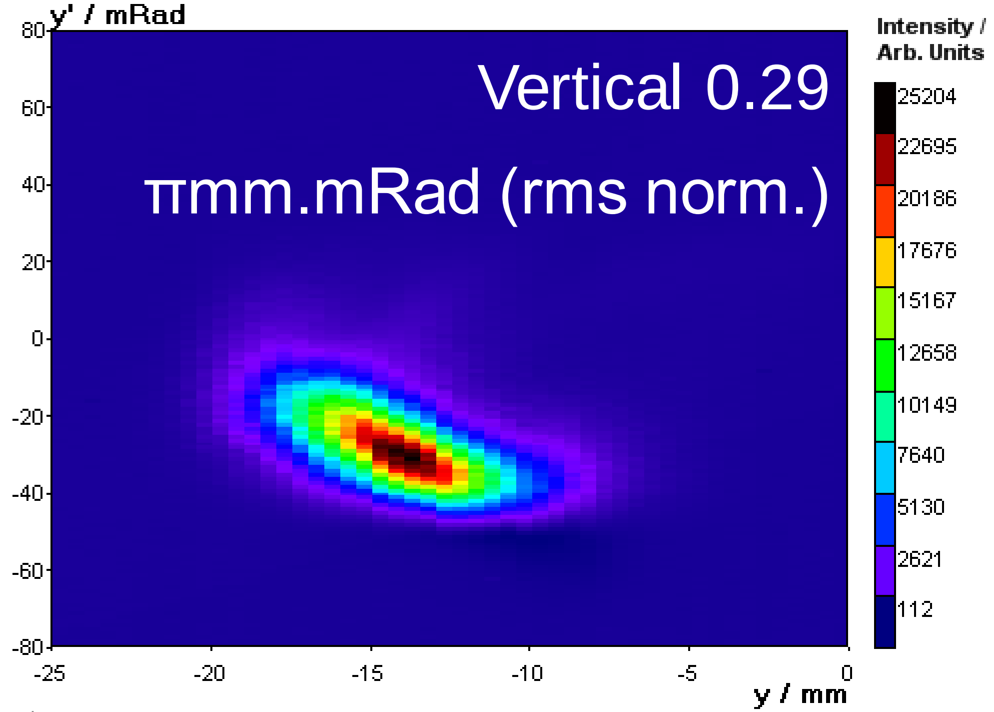
- Calculate sum of Σ_{100} of all pixel-intensities
- Sort intensities from top by their contents
- Sum them up until the fraction p% from Σ_{100} is reached
- Use the pixels included in this sum for the rms—emittance.

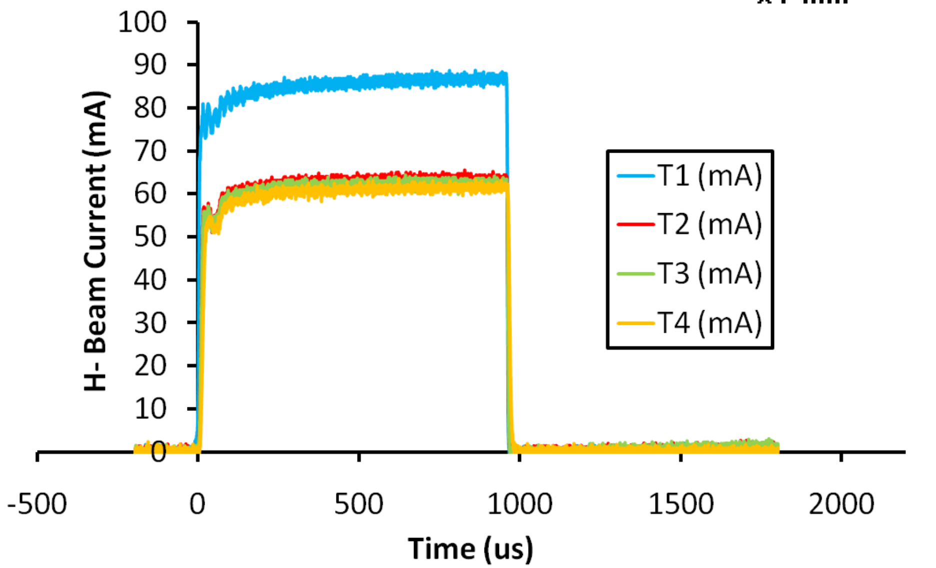




Summary and Outlook.







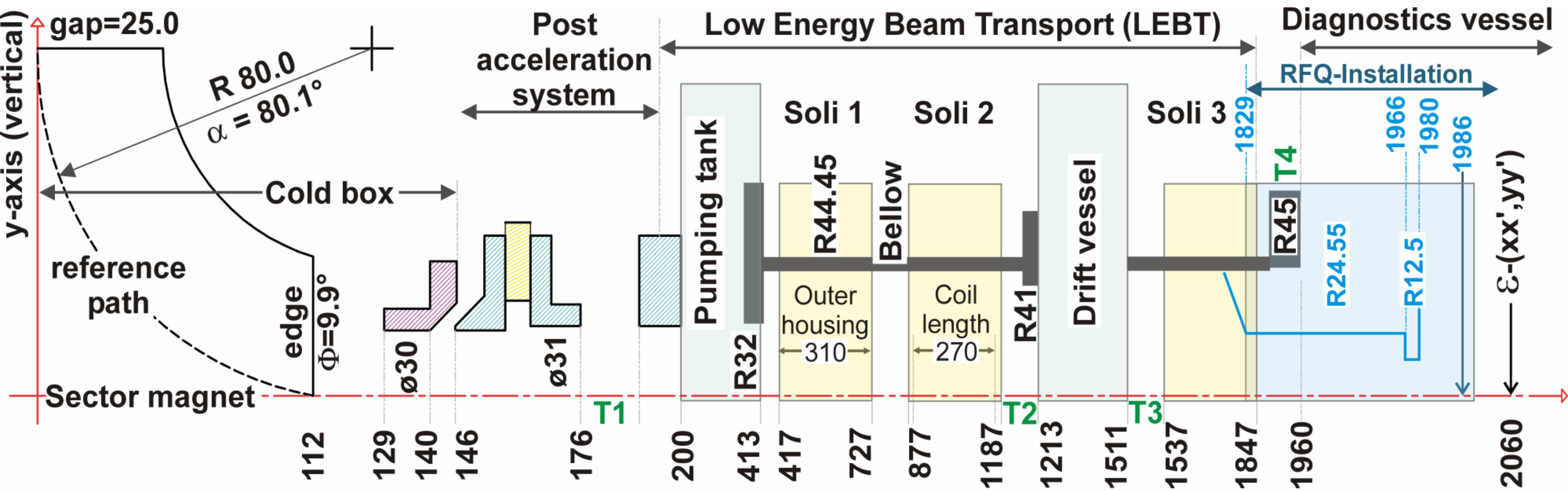
The most urgent problem to solve is the misaligned beam in both transverse planes.

Displacement depends heavily on solenoid/ PA settings and is not easily to correct with implemented steerer magnets.

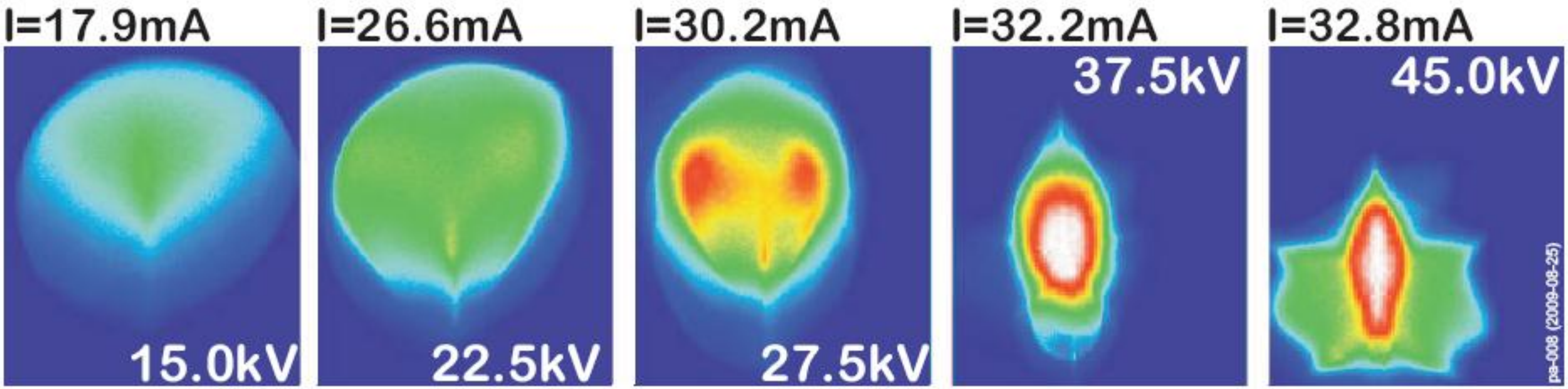
Thank you for your attention

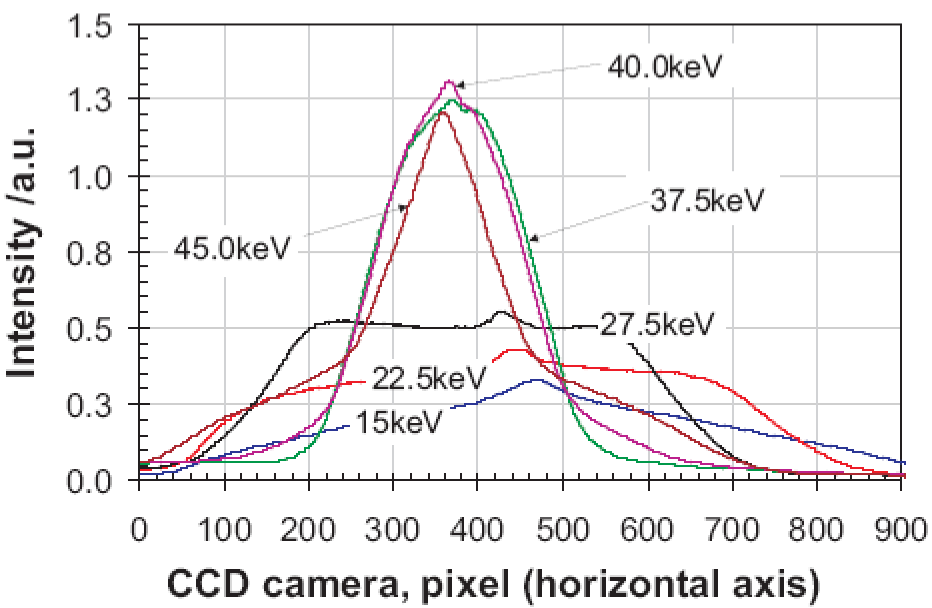
Questions, Comments?

Sector magnet, post acceleration and LEBT with dimensions in long./ radial direction.



The PA influences the beam with its lens effect, measured with a scintillator at z~1st solenoid.





The effective focusing depends on current and chosen beam energy, assuming that the gap is constant. It is difficult to estimate the best compromise for both transverse planes.