



A laser-wire scanner for the ATF extraction line

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Introduction

- Non-invasive technique
- Development of a system capable of reliably measuring electron beam of order one micron.
 - F#2 triplet aspheric lens used to correct aberrations
- Below 5 micron challenge
 - Either electron beam or laser optical system
 - Electron beam
 - Emittance? Coupling/dispersion
 - Optical system
 - Final focus lens alignment
 - Laser transverse quality factor (astigmatism)

Laser-wire introduction

- Compton scattering

- Need to monitor a great deal

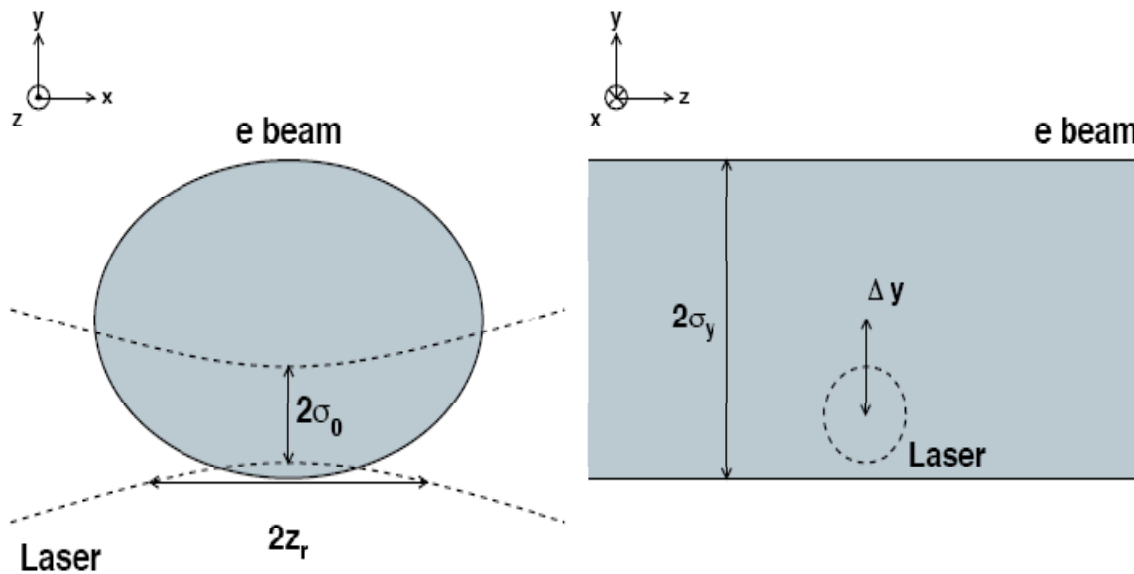
- Laser

- Focus quality
- Pulse power
- Pointing stability

- Electron beam

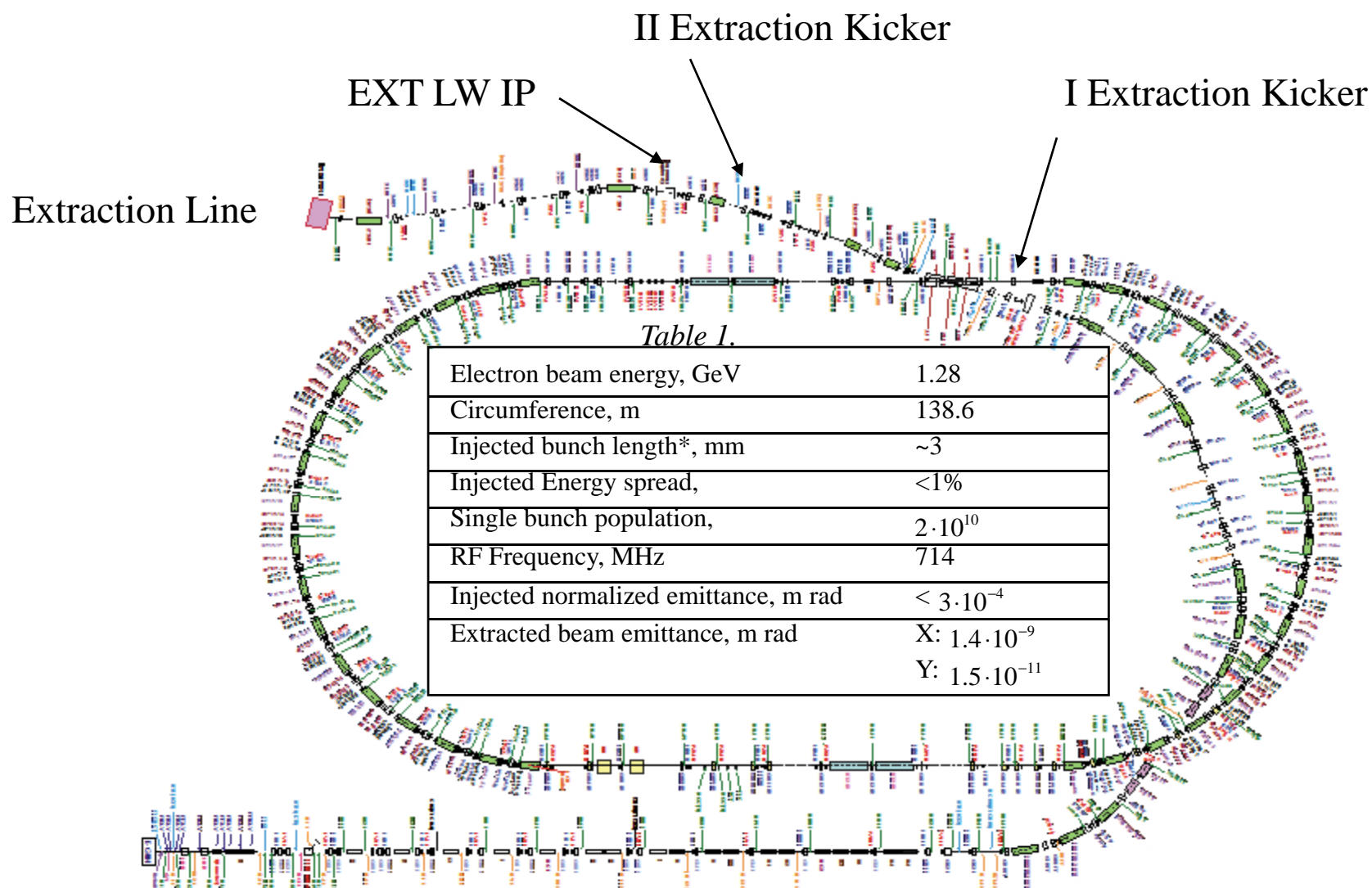
- BPMs
- Charge

- Report some improvements in monitoring

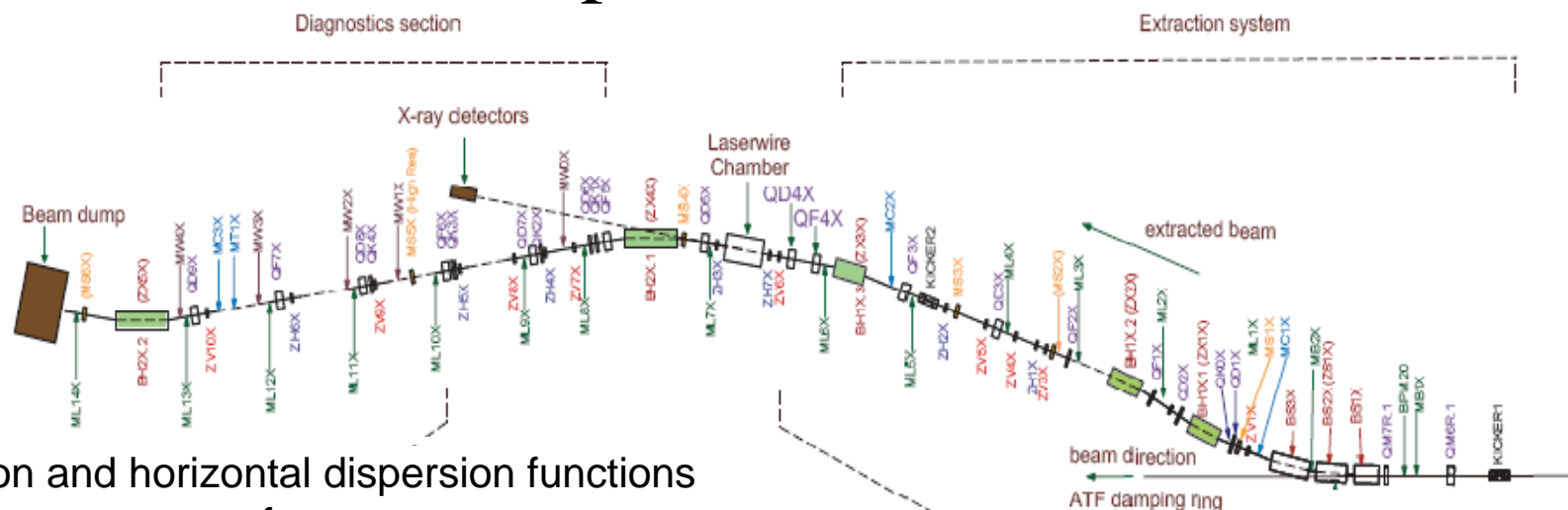


$$\langle N_\gamma \rangle = N_b P_L \frac{\sigma_C \lambda}{ch} \int_x \int_y \int_z \rho_e(x, y, z) \rho_L(x, y, z) dx dy dz$$

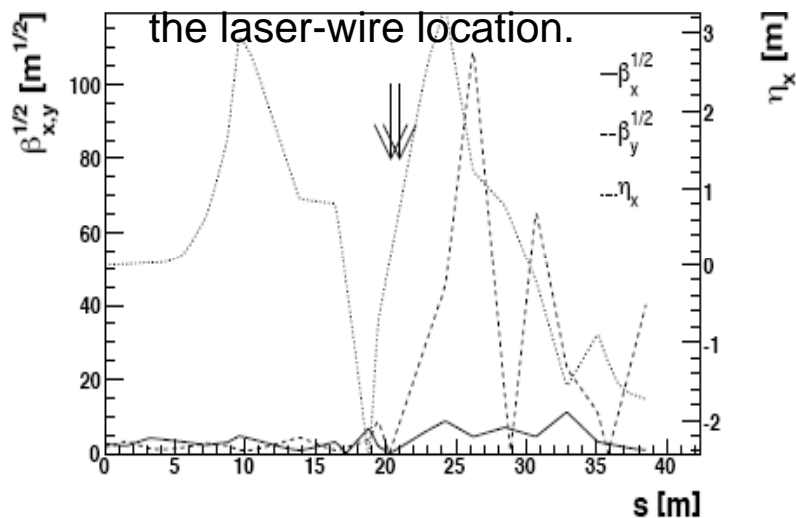
KEK-Accelerator Test Facility



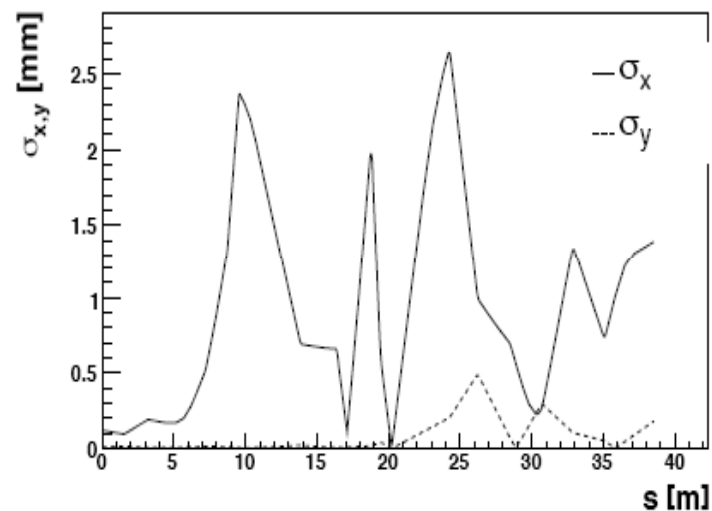
Electron beam optics at ATF extraction line



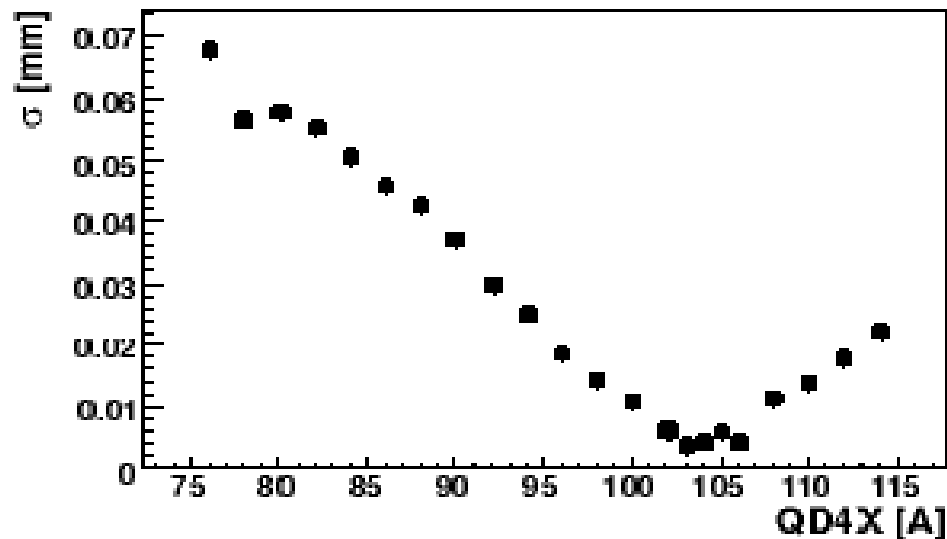
Betatron and horizontal dispersion functions for the ATF extraction line, the arrow marks



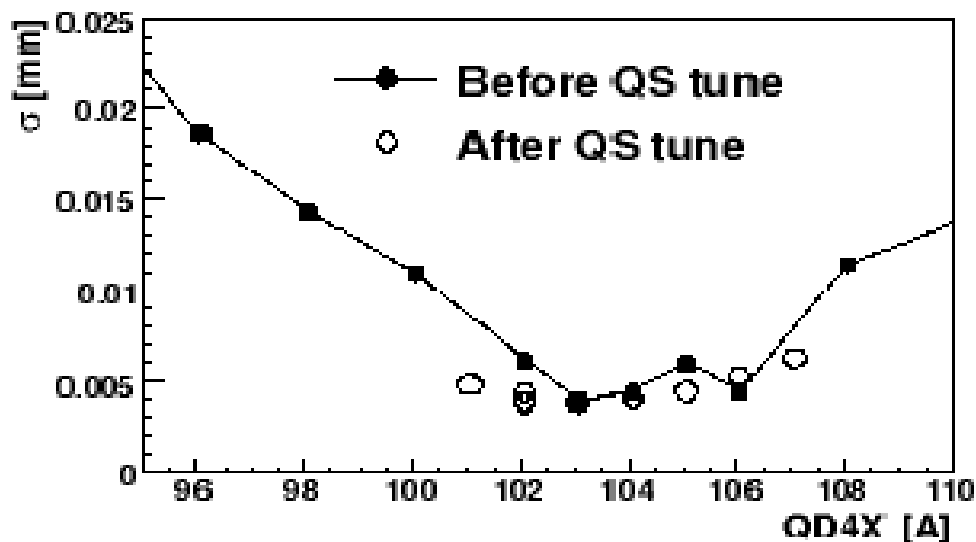
Horizontal and vertical beam sizes



Electron beam optics measurements (15/05/08)



Wire-scanner beam size measurement as function of QD4X current

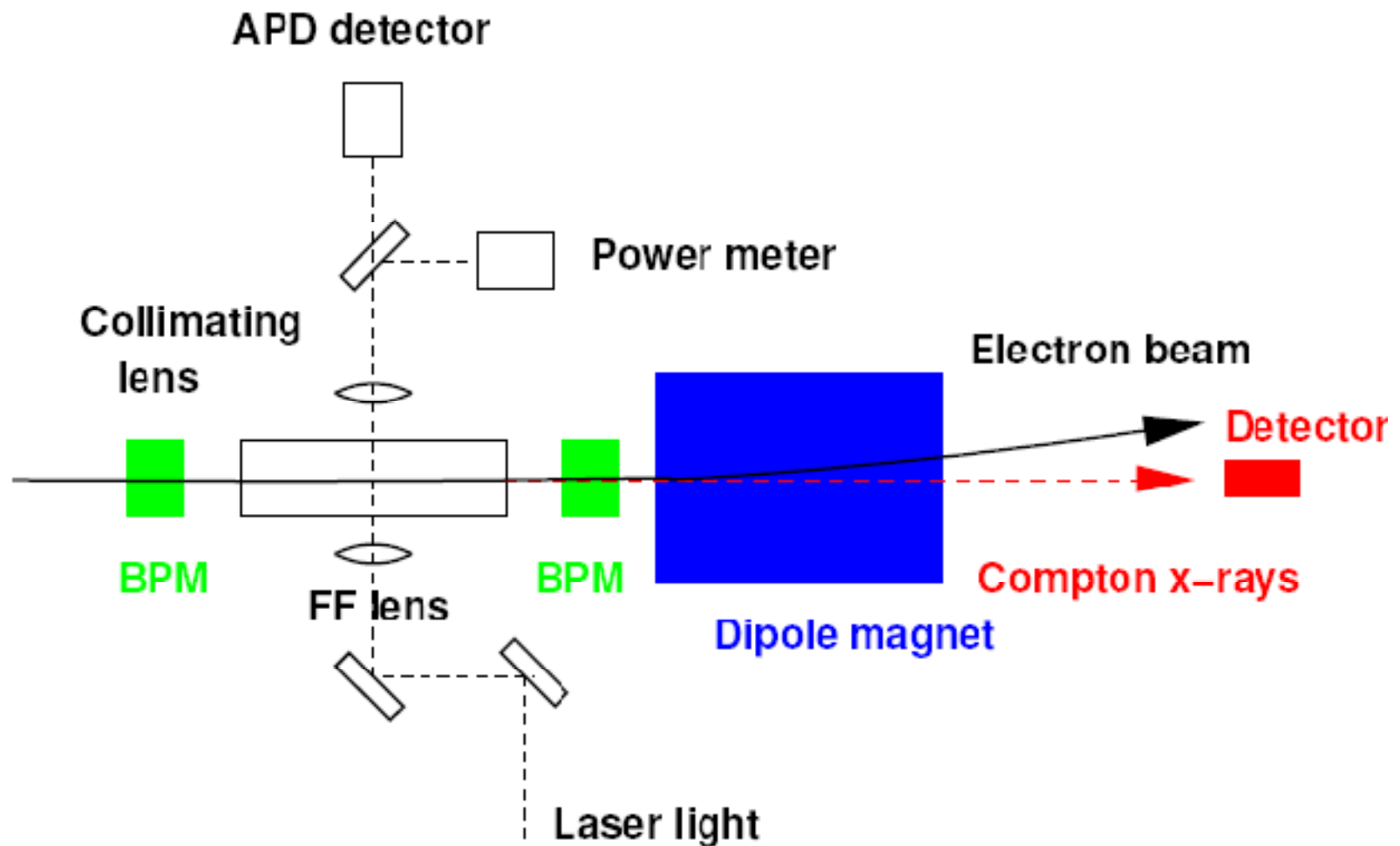


Wire-scanner beam size measurement as function of QD4X current

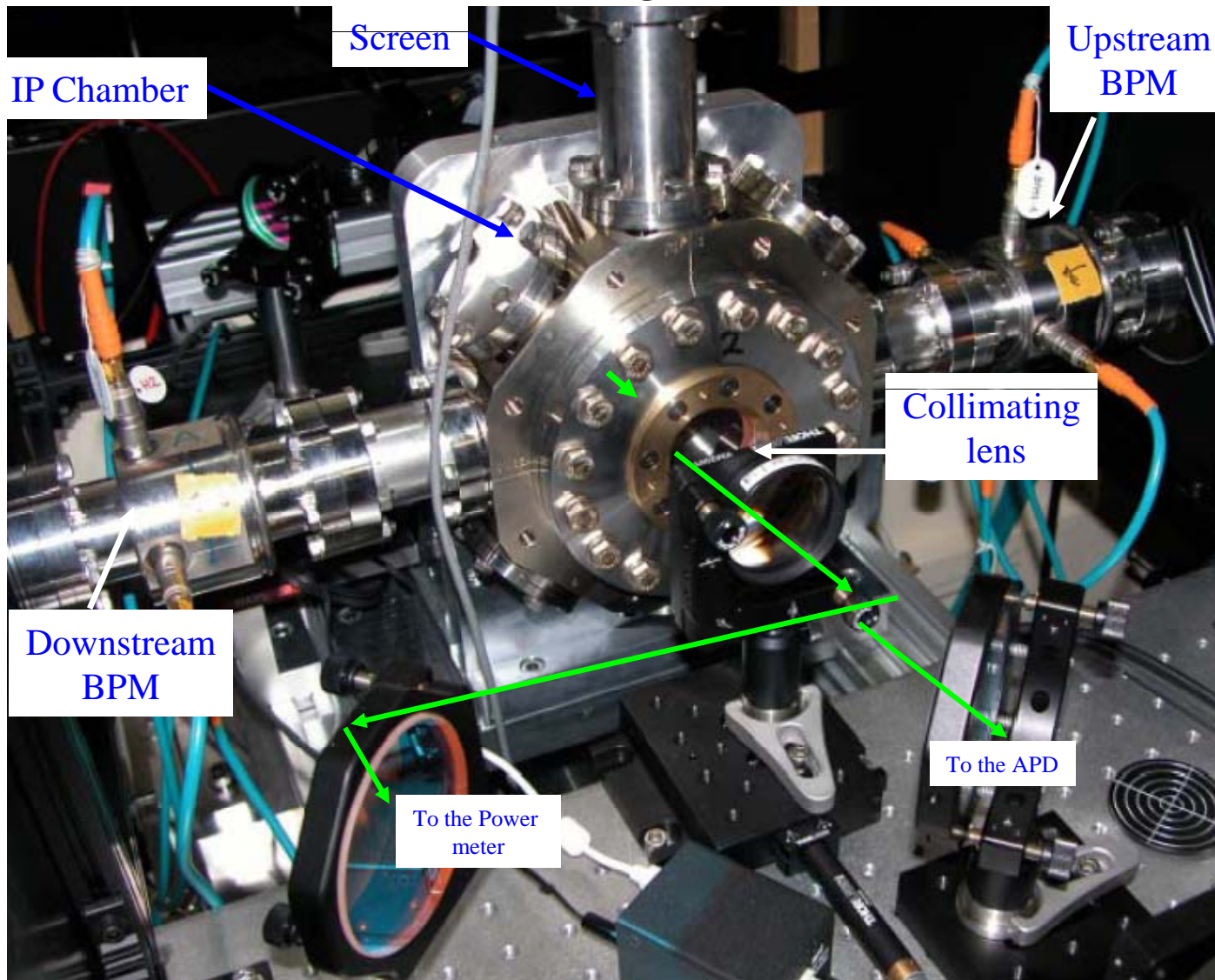
Laser system

- High power laser system
 - 357MHz Mode locked seed
 - pulse length 30ps
 - Average power ~600 mW
 - Nd:YAG regenerative amplifier and linear amplifier
 - Pulse duration 300ps
 - Pulse energy at IP ~ 300 MW

Interaction region hardware



Interaction region hardware



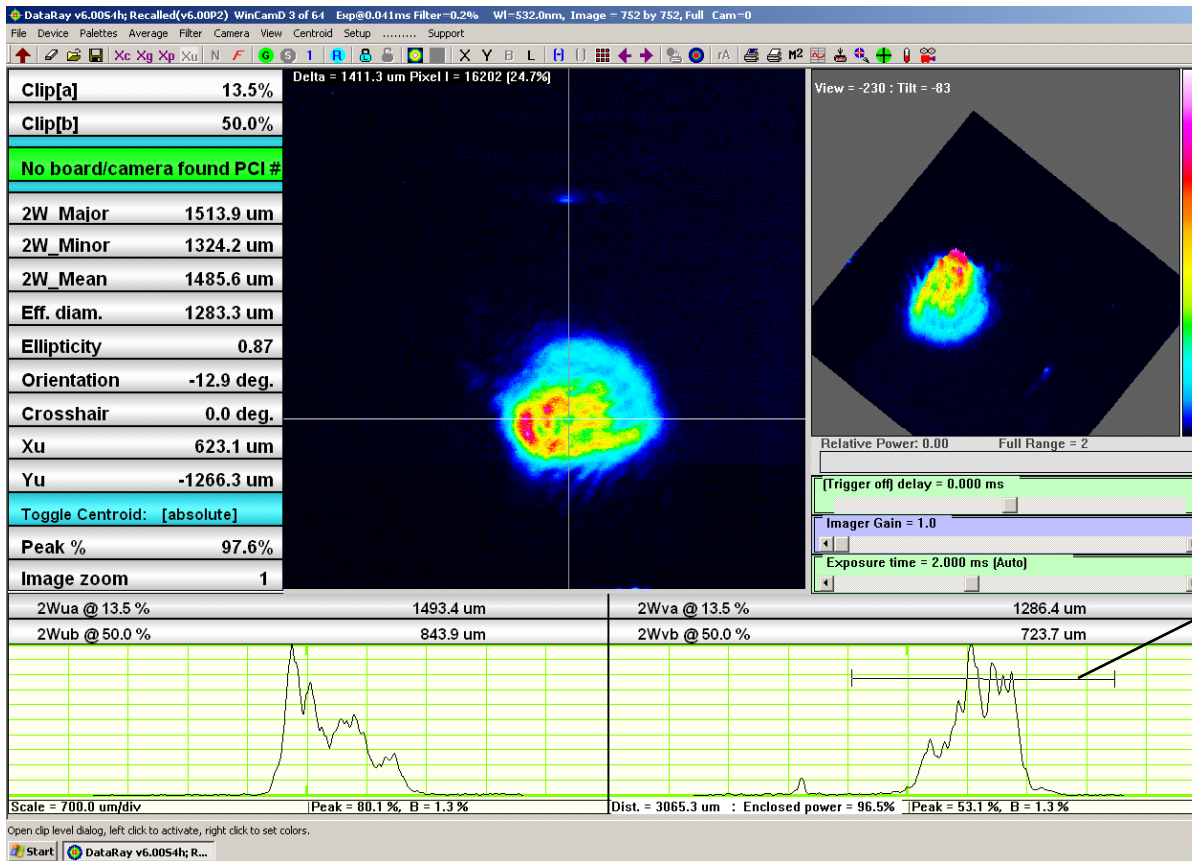
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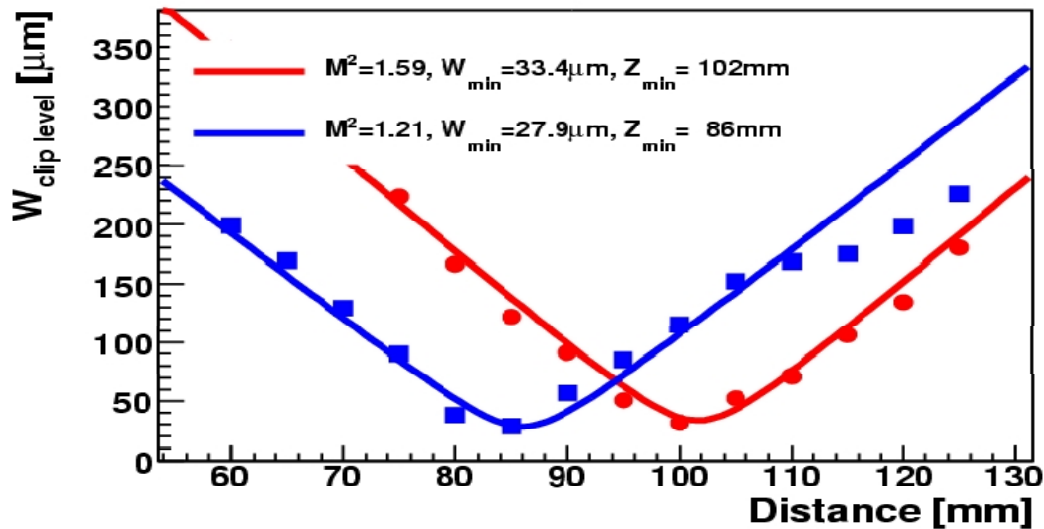
Input laser beam size measurement (24/05/08)

Input beam size measured on diffusive screen and video CCD optics

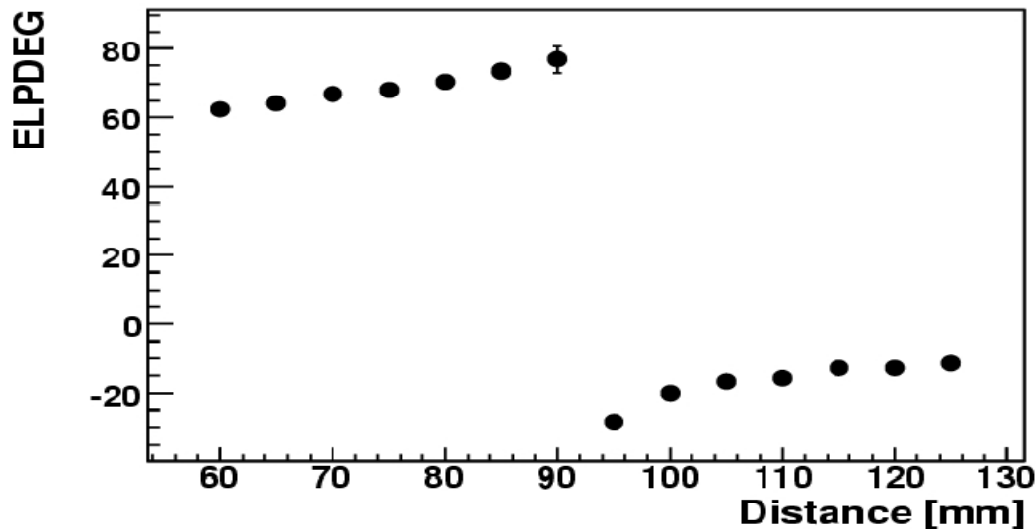


W = 10.72 mm

Laser transverse mode quality

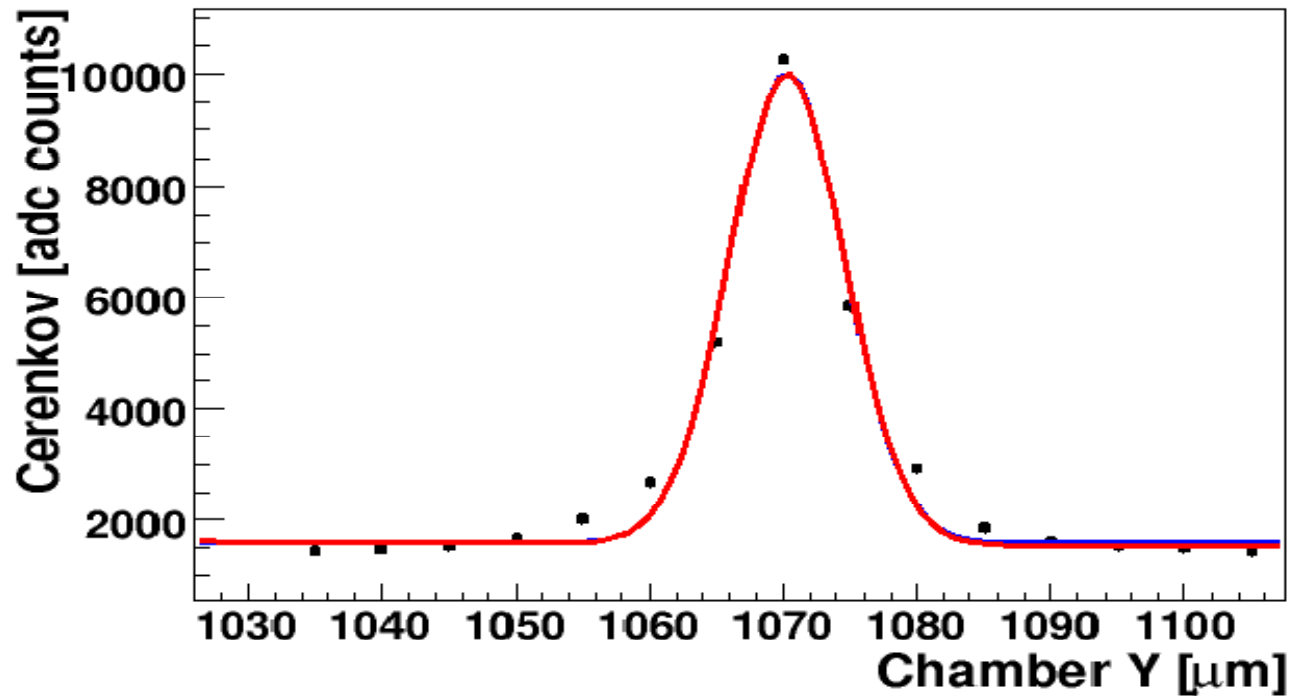


Laser beam radius as function of distance from 1m focusing lens



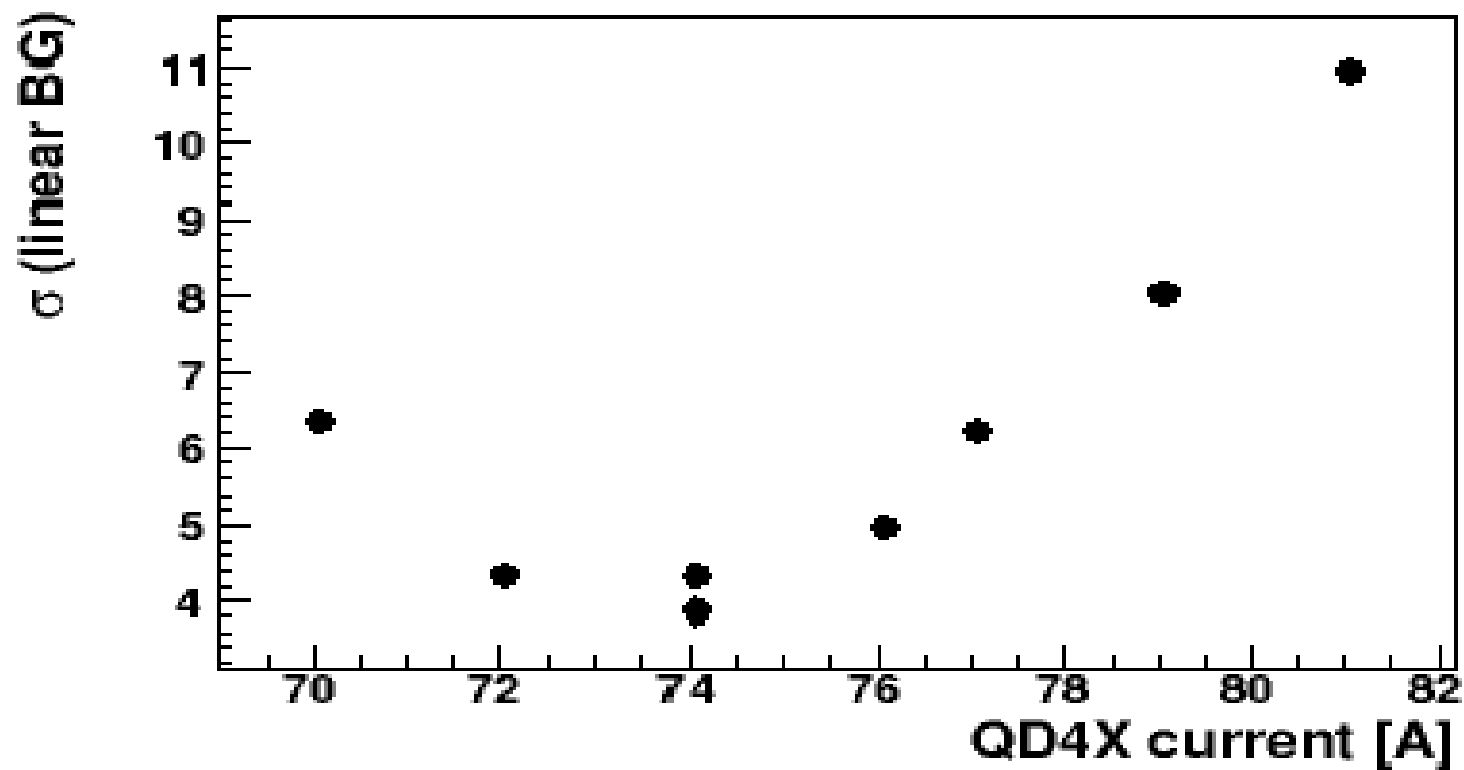
Angle of major axis of laser beam, clear 90 degree change

Example vertical beam profile



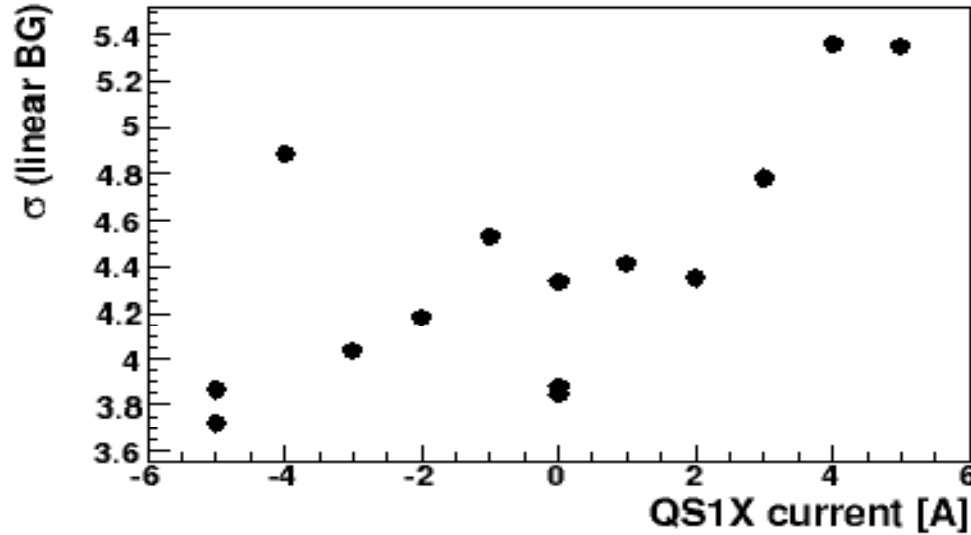
Taken from minimum of QD4X quadrupole scan
All collision data from 23/05/08

Focusing quad (QD4X) scan

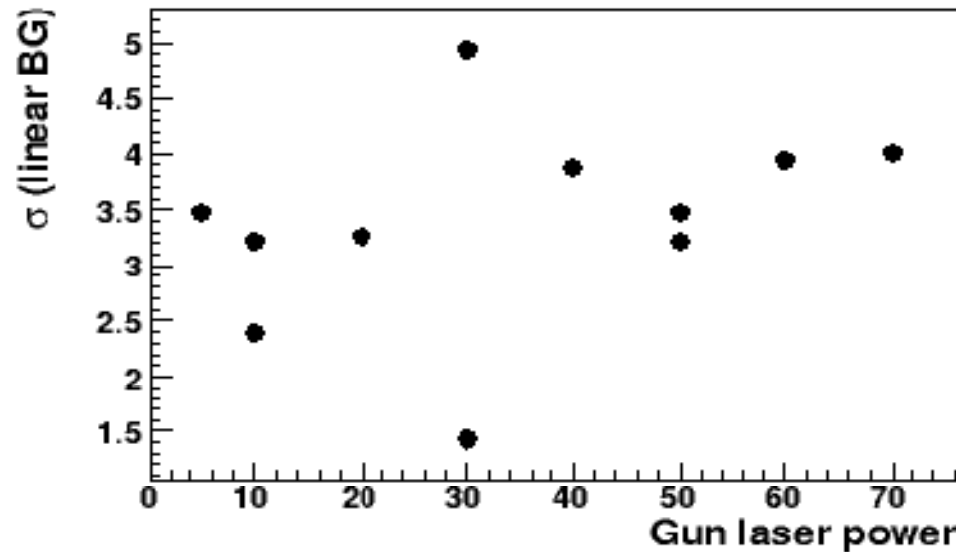


Laser-wire beam size measurement as
function of QD4X current

Skew quad and bunch charge scan



Laserwire vertical beam size
as function of QS1X



Laserwire vertical beam size
as function of gun laser power

Summary

- Measure a “beam size” of 4.5 micron
 - Below this is problematic
 - Normalisation (laser and charge needs to be improved)
 - Final focus lens alignment/performance (with high power laser)
 - Electron beam size, verification of coupling/dispersion free beam at IP
 - Last chance this week to get an ILC like measurement ~1-2 micron

ATF 2 infrastructure

- New laser hut constructed
- Move laser and IP hardware to new location over next few weeks
- Location after coupling correction
- New detector(s)