Extraction line Laser-wire

ATF Technical board meeting 11/06/2008 (WebEx)

SB ill so unable to present

ATF Technical board meeting 17/12/2008 (KEK)

SB well and able

A. Aryshev, G. Blair, S. Boogert, A. Bosco, L. Deacon, P. Karataev

N. Delerue, L. Corner, B. Foster, D. Howell, L. Nevay, M. Newman, R. Walczak

Develop ILC like 1 micron non-invasive scanner

Introduction

- Review of hardware upgrades
  - Custom F/2 Lens system
  - New chamber mover system (1 um precision)
  - Laser performance (high pulse energy, poor transverse mode)
- Recent results
  - Quadrupole scans (electron optics)
  - Skew scans
- Putting it all together....
- ATF2

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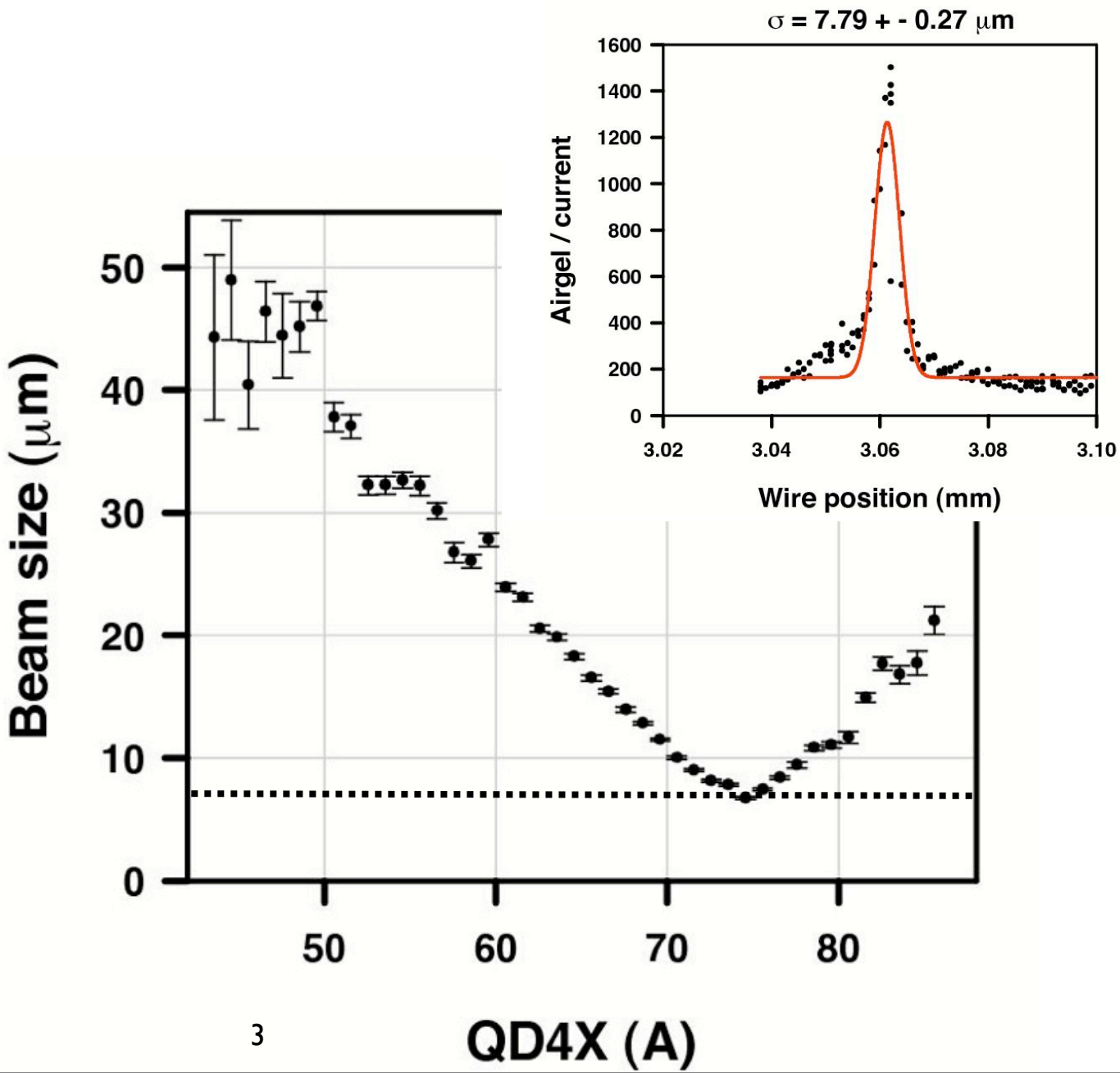
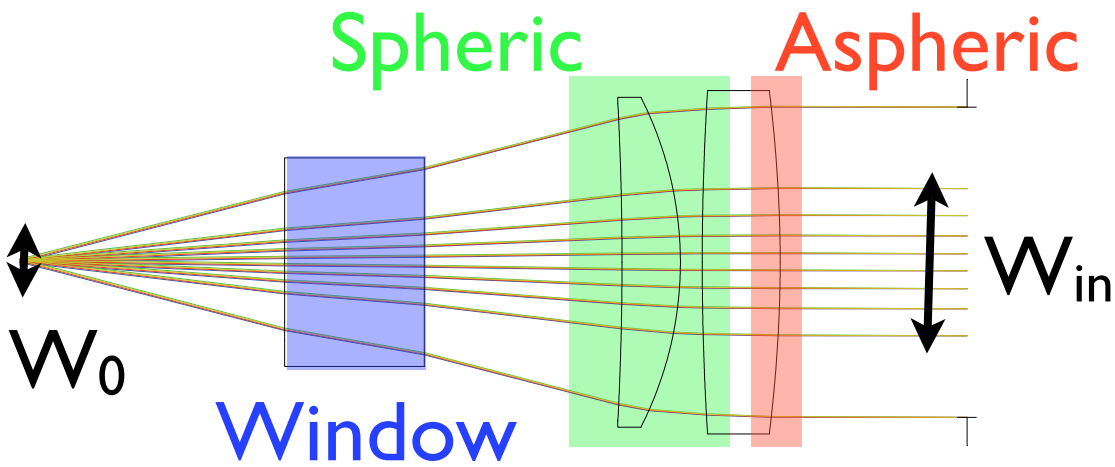
Previously (last TB meeting)

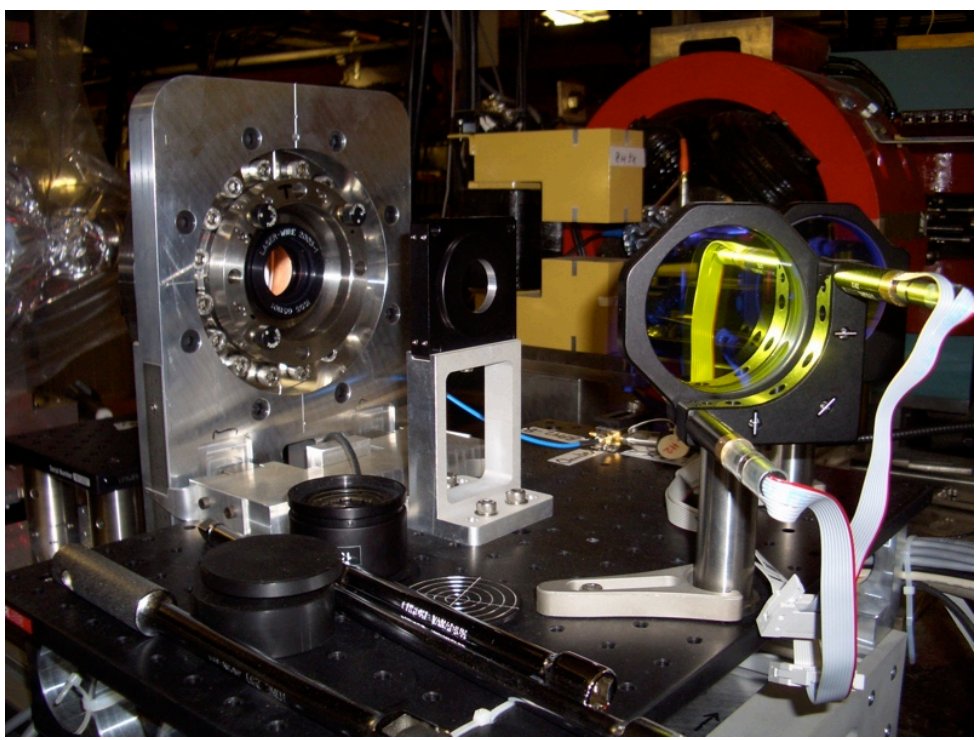
- Commercial lens
  - Spherical aberrations significant
  - Reached approx. 8 micron minimum
- Coma significant



F/2 custom lens

- F/2 lens
  - 3 Elements (aspheric, spheric, window)
  - Parameters
    - Focal length 56.4mm
  - Lab measurements indicate excellent performance
  - Analysis of lens performance data/ simulation ongoing





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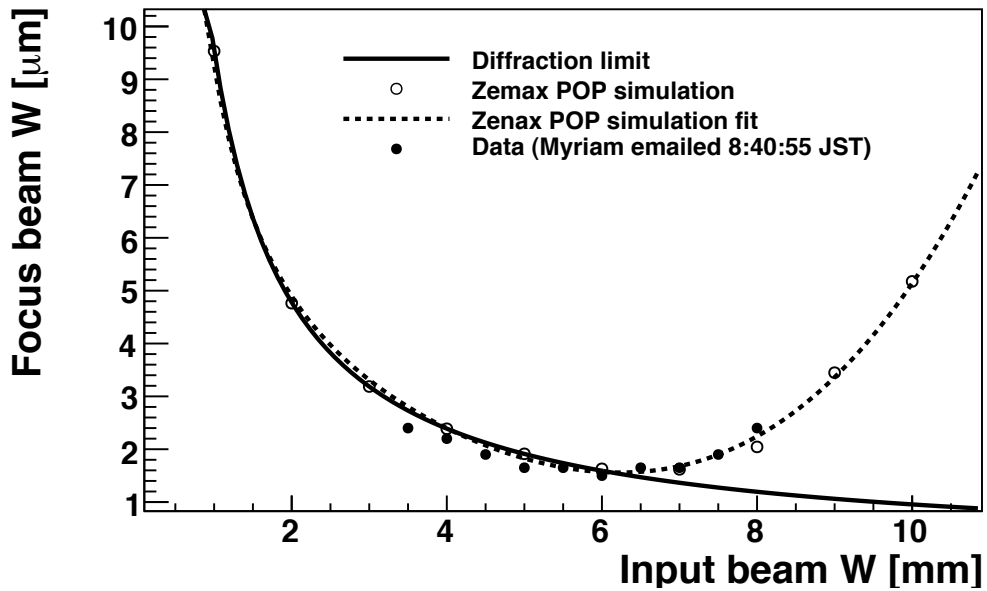
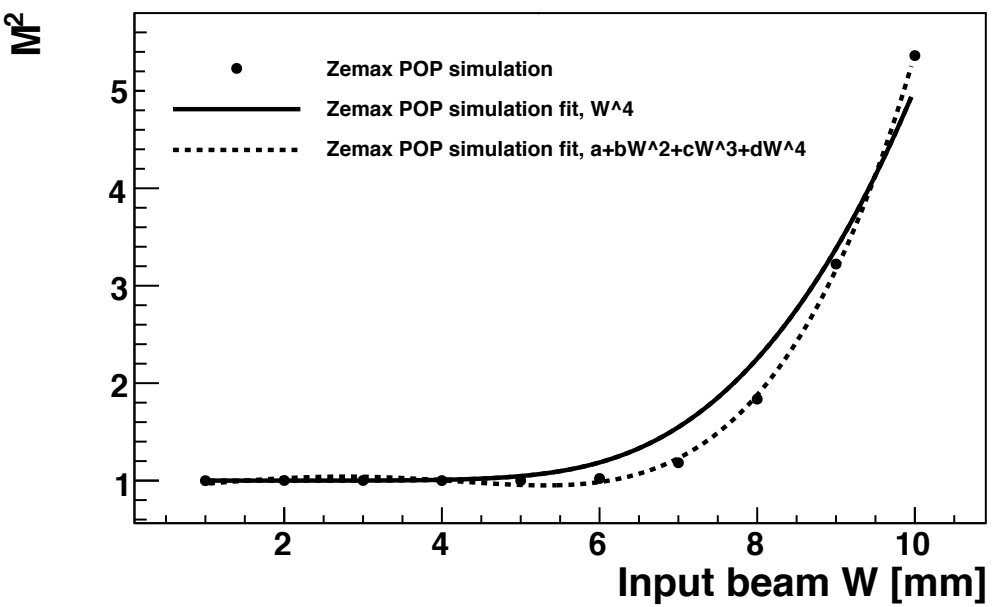
Lens performance

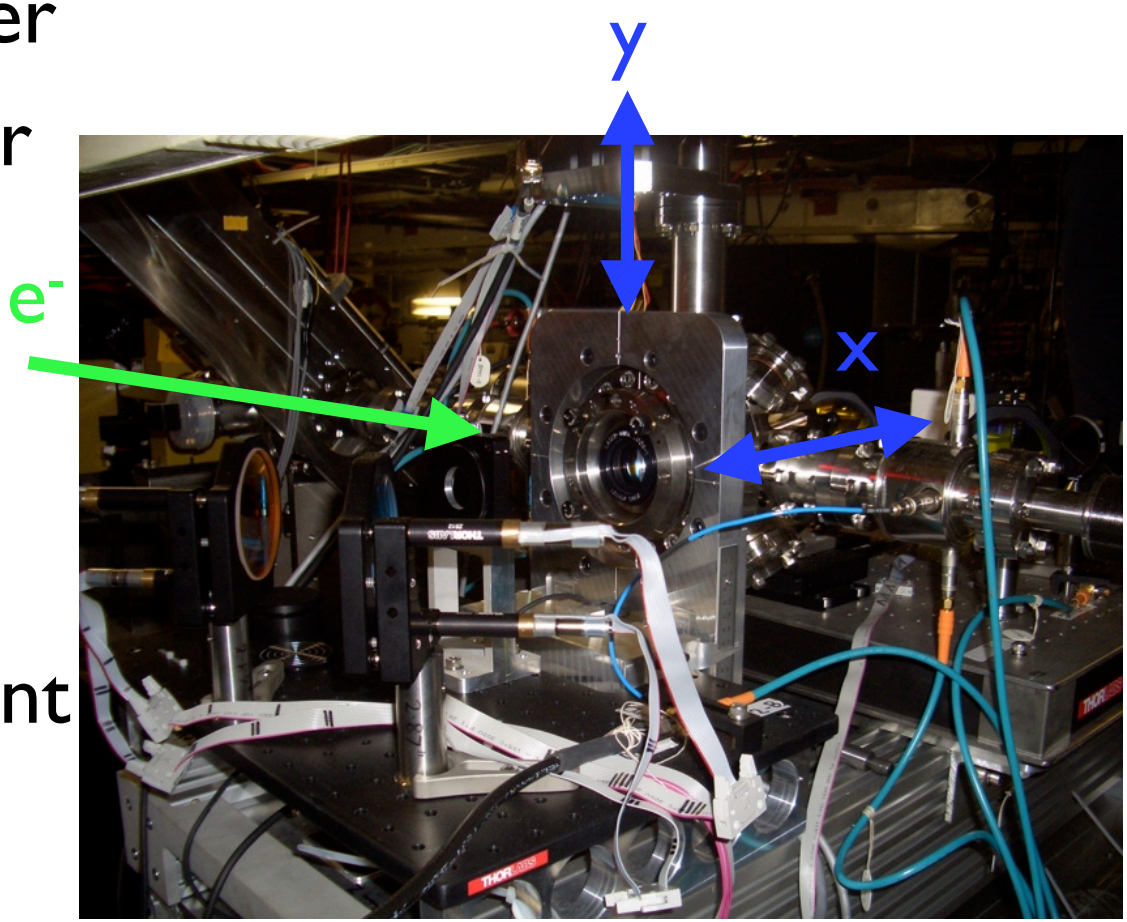
- ZEMAX simulation
  - 4th order model of propagation
- Measurements using knife edge profiler (Oxford laser lab, Newman)
- Measurements taken with same profiler in KEK (chamber removed)
  - Not yet analyzed





Chamber mover system

- Lens fixed to chamber
- Move whole chamber with respect to electron beam
- Chamber can be removed without disturbing lens
- Sub-micron movement
  - Laser beam scanned using this system



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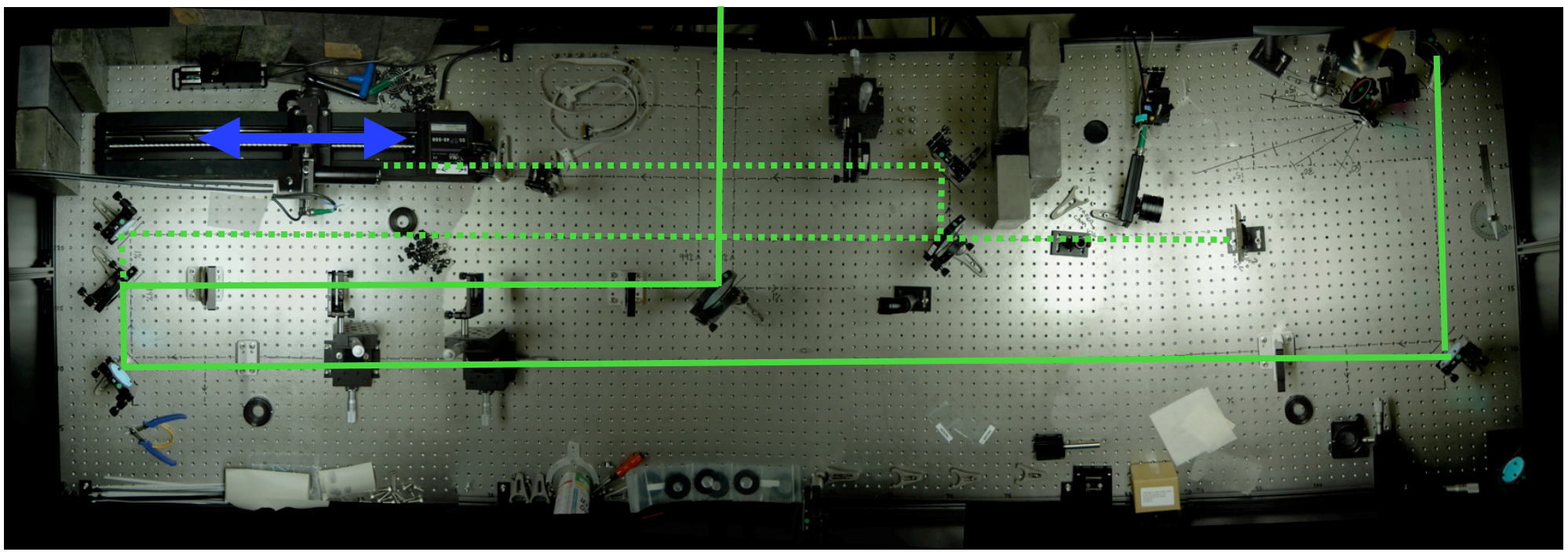
Pre-collision diagnostics

- Added laser diagnostics
  - M^2 measurement (CCD on long translation stage)
  - Input beam size (Paper screen, CCD+optics)

M^2 Measurement

Input W



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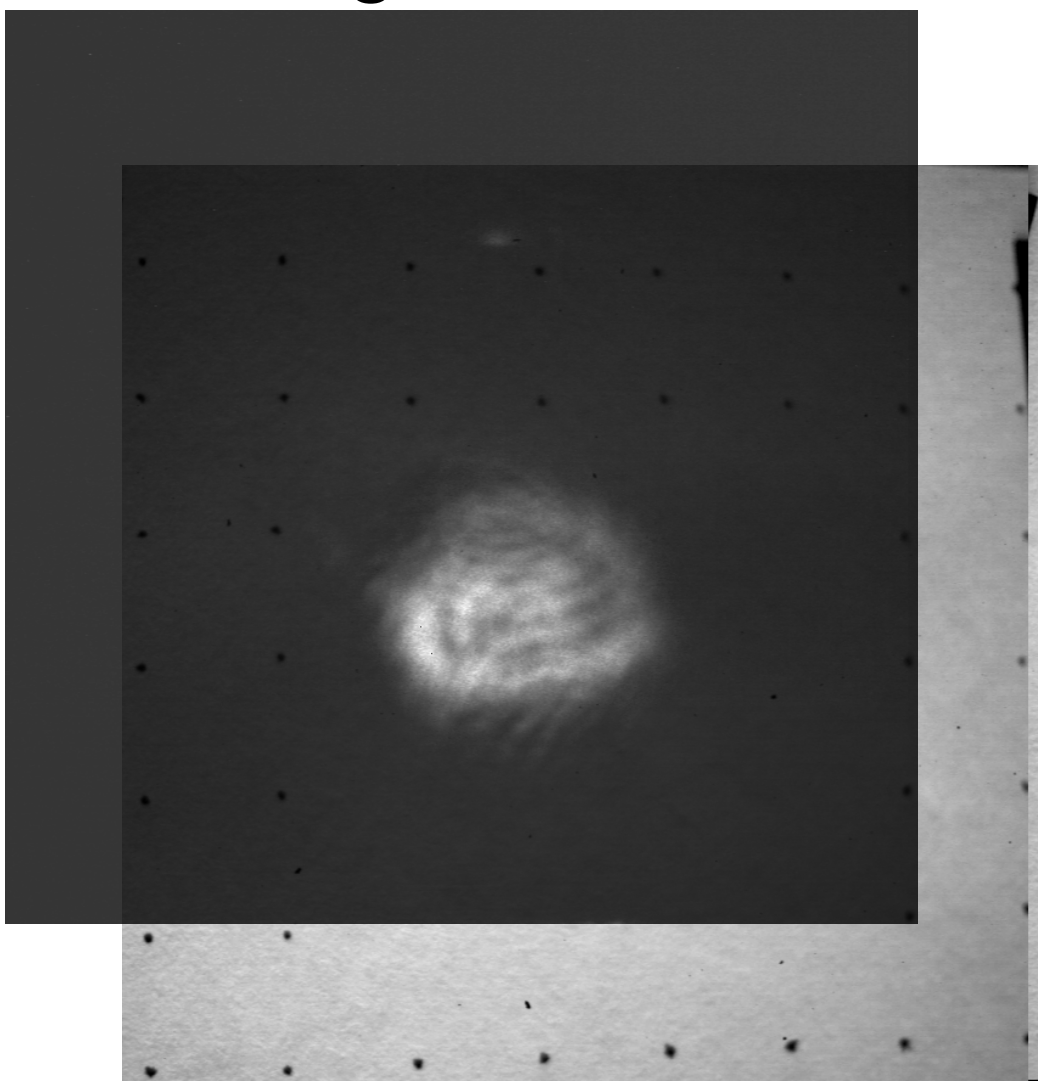
Laser diagnostics results

Laser image



- Input beam size
  - Calibrate optics
  - Image large input laser on screen (1cm separation points)
  - Measure pulsed laser size
  - Measurement indicates radius of approximately 8.5mm

Calibration image

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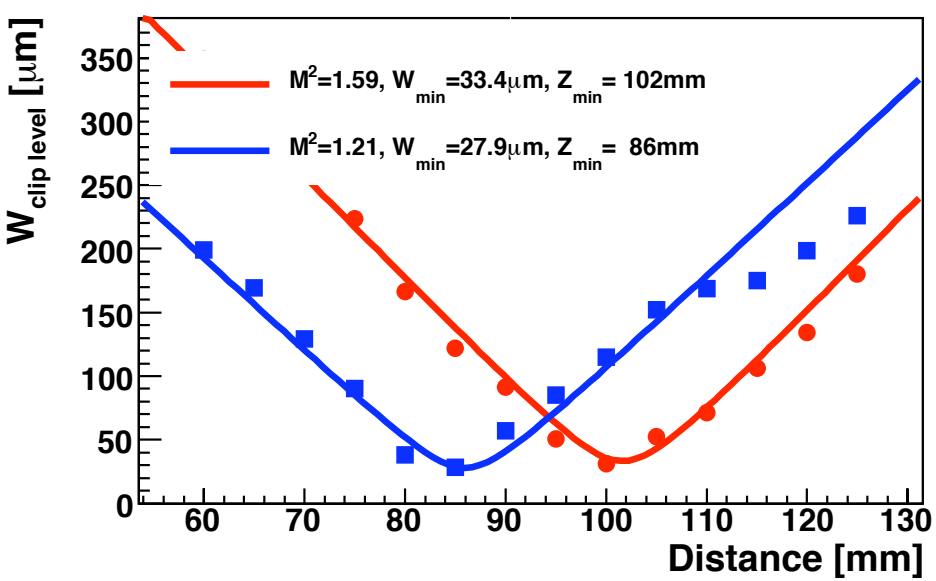
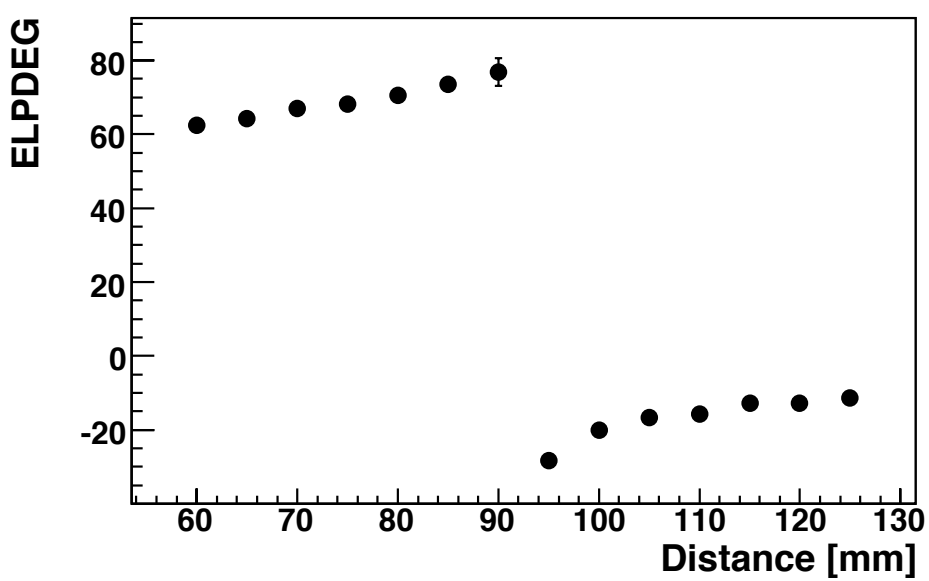
M^2 measurement

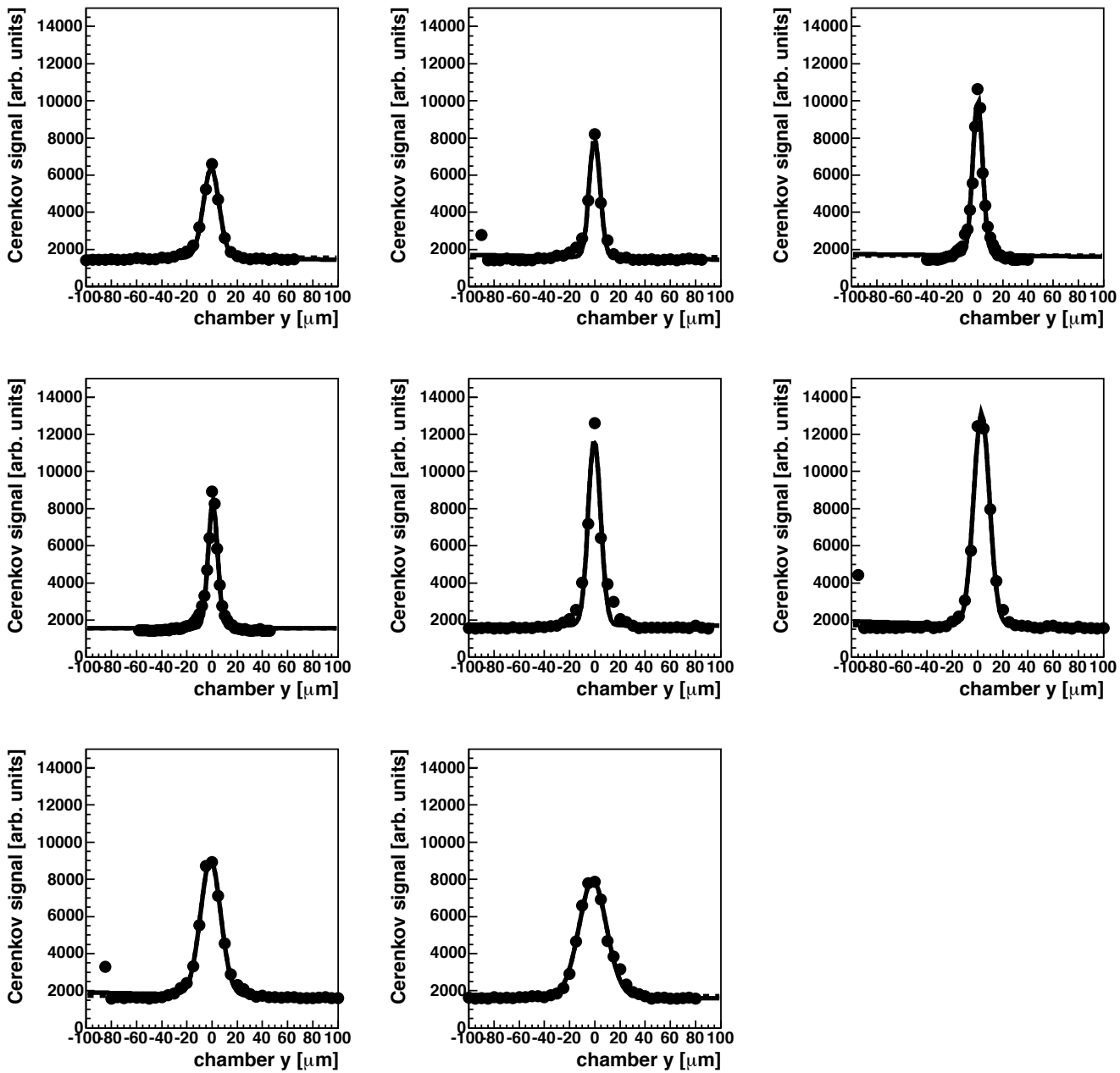
- Laser is significantly astigmatic (simple or general...)
  - Propagation different in two orthogonal planes
  - Measured just before IP but after 5 degree wedged splitter
  - ELPDEG is measure of laser ellipse orientation





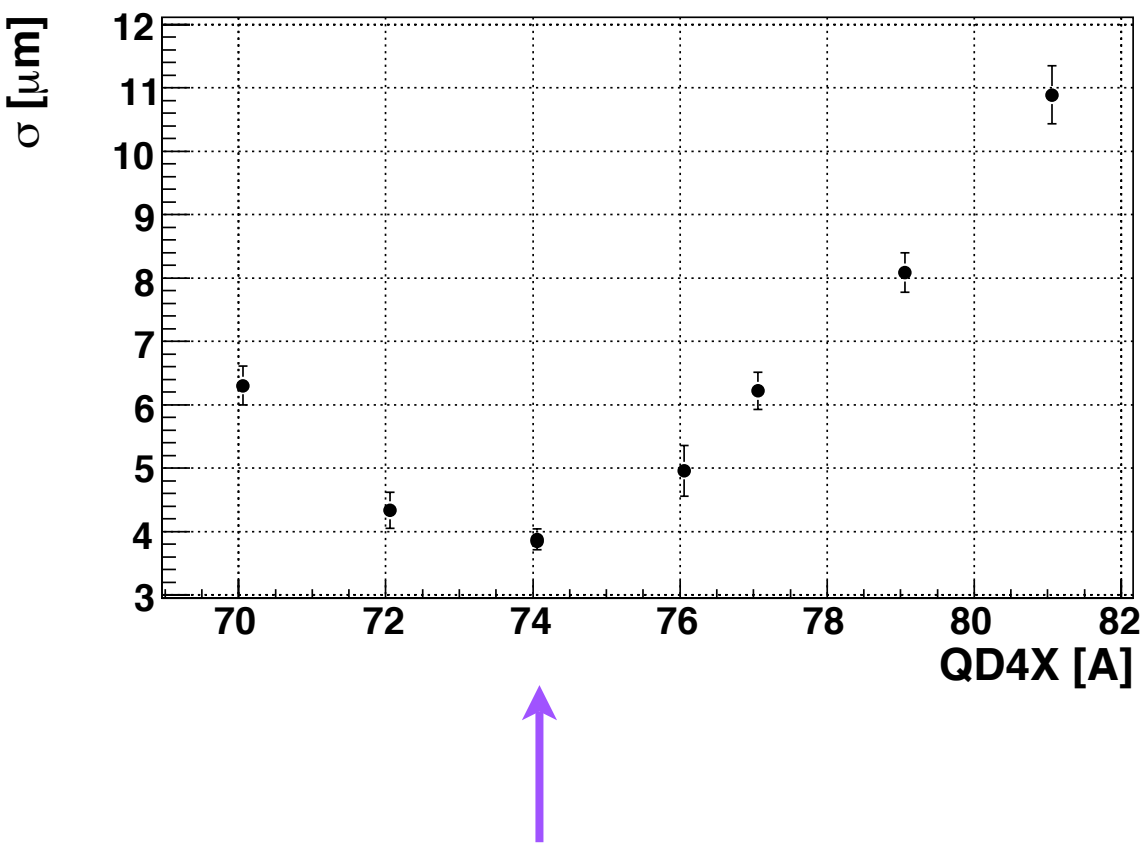
Example scans

- Gaussian fit with linear background
- Nice gaussian shape
- Stable background
- Quad scan profiles (see next slide)



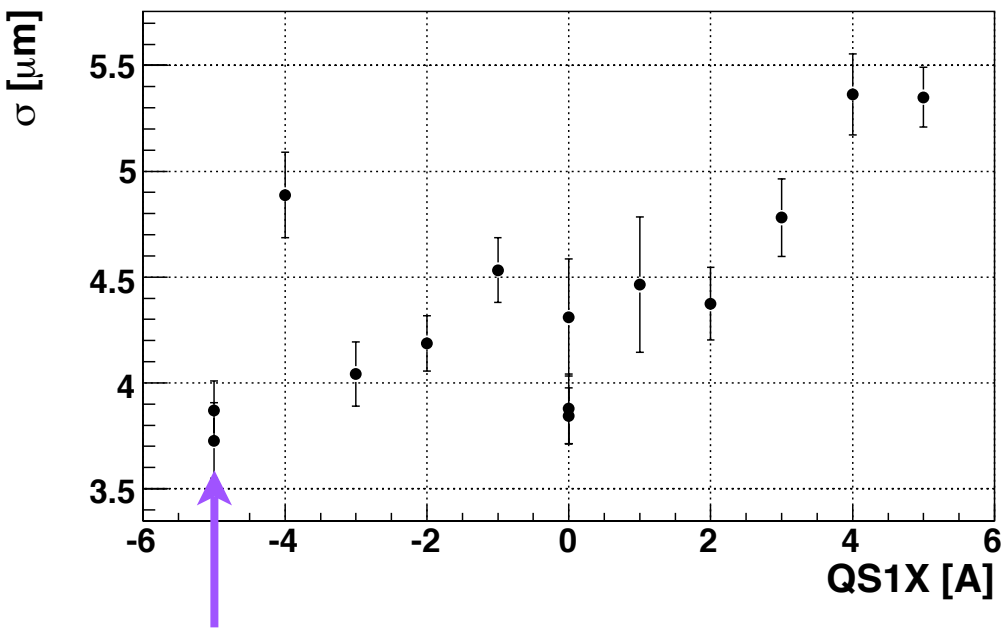
Quadrupole scan

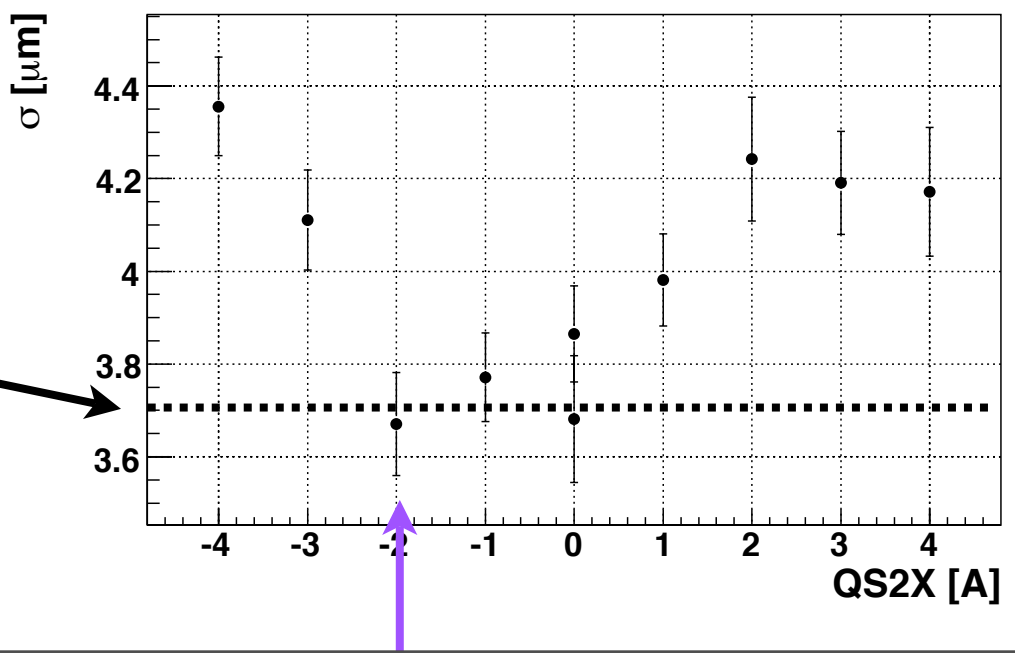
- Vary strength of QD4X
  - Can get steering
    - Scan vertically (set to maximum)
    - Scan horizontally (set to maximum)
    - Scan vertically again
    - Fitted gaussian sigma plotted as function of QD4X strength



Skew quads

- QS1X and QS2X
  - QD4X = 74 A
- QS1X
  - Minimum at -5 A current limit of magnet
- QS2X (QS1X = -5A)
  - Minimum at -2 A
- General minimum of 3.7 micron





Summary

- Prediction for W_{in}=8.5mm is W_0=2sigma=3 micron
- Measured minimum size
  - 3.7 micron
- Laser properties
  - M^2 ~ 1.5
  - Astigmatism, 60 degrees
- So putting roughly together
  - 1.5 micron (lens) x 1.5 (M^2)x 1.5 (Astigmatism) = 3.4 micron
- Roughly consistent need work work on the laser!

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Summary

- Need more work on laser+focus laser model
  - Zemax combined with M^2 model
  - Model astigmatic beam using perfect laser and cylindrical lenses
- First indications
  - Laser data consistent with collision data
  - Astigmatic and non perfect gaussian laser almost worst case
- New laser should improve dramatically performance (Oxford fiber laser)

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ATF2

- Beam line installation
- Laser propagation issues
  - Robust diagnostics in tunnel
  - Ability to simulate complicated beams (astigmatic)
- Electron beam study important (summer 2008)
  - Signal extraction (recheck work of Deacon, given real beam line)
  - Optics model in conjunction with data taking essential
- Seed laser needs a service
- End of old TB talk : additional slides ...

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ATF2 floor layout

- Looking back towards DR
  - In beam propagation direction
    - Single strip-line
    - LW
    - Wire scanner
  - Laser enclosure on left
- Hardware will be ready for beginning ATF2 operation

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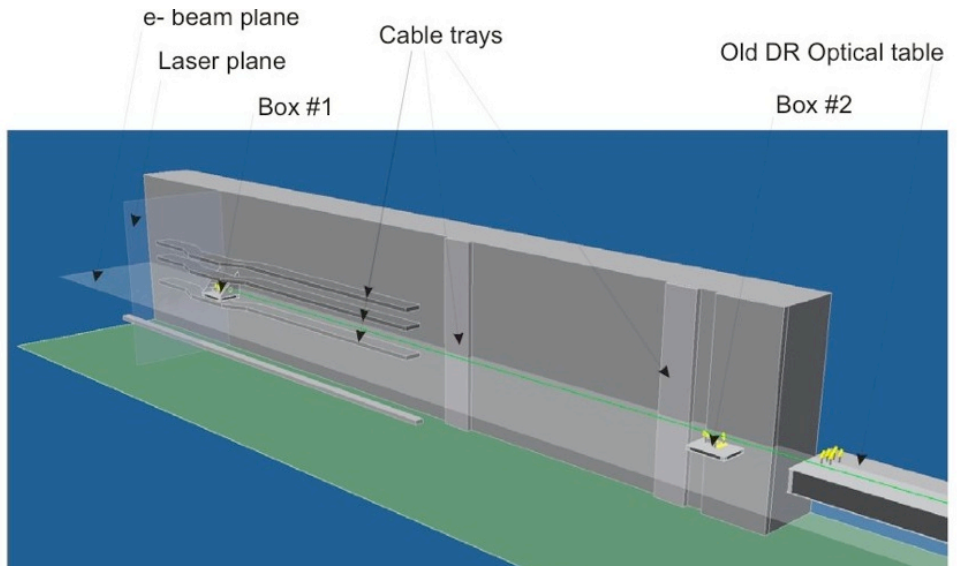
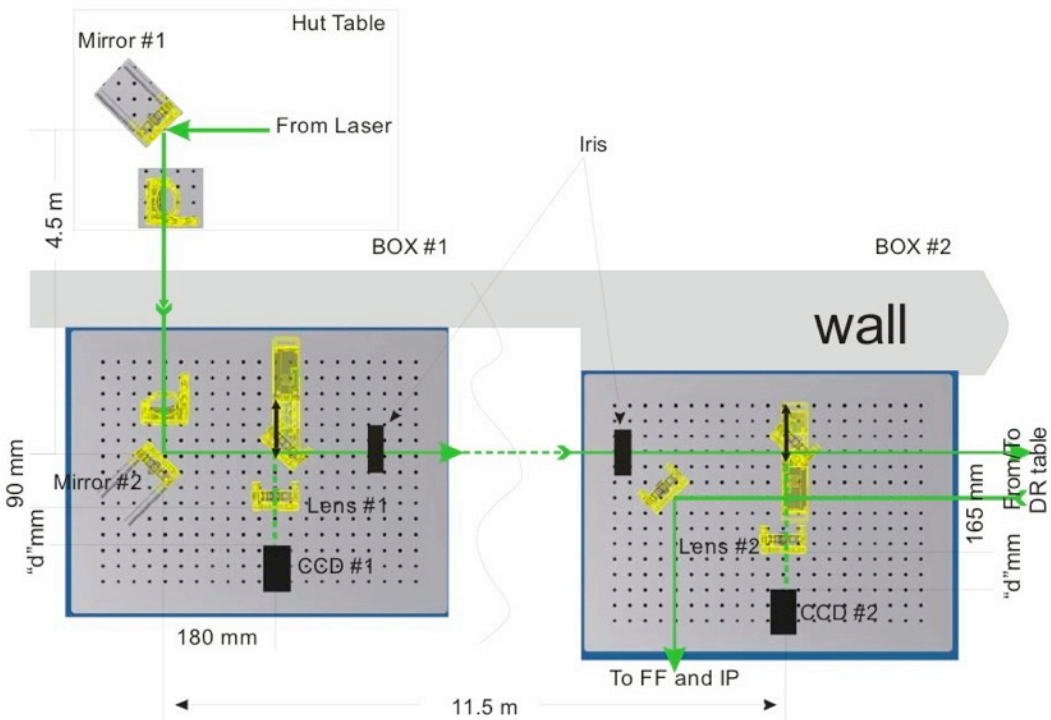
Laser transport line

- Instrumented transport line
  - Two tables needed to deliver light
  - Add position and size diagnostics
- Remove need for large "in accelerator" optica system
- Optical transport dow to tunnel
- Opto-mech already at RHUL





New laser hut

- Installed on ATF2 shielding blocks
- Clean laser area for new 6m optical table (already at KEK)
- Installed electronics
- Table support to be fabricated Jan/Feb
- Install laser and perform diagnostics (import input for final small laser focus size)

Towards ILC specification

- Installed Oxford optical profiling system
  - Capable of 1 um beam size measurement
  - Verify focusing scheme
- Upgrade diagnostics for the laser
  - Wavefront detector
  - Divergence and propagation
- Electron beam optics
  - Dispersion could not be well corrected at old location
  - New location (new c-Band BPM system should help immensely)

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ATF2 operation plan

- Reasonable time line
  - Jan 2009 : Install optical table (laser measurements and modifications until summer 2009)
  - Feb/Mar 2009 : Install chamber and related systems
  - April - Summer 2009 : Study optics and backgrounds for laser-wire operation (high beta, LW specific)
  - Fall 2009 : Collisions with 1 um system
  - Summer 2010 : Conclude ILC 1 um laser-wire program
- Black December caused a slowing down of the LW program. Plan for slow more non-beam related work (i.e laser, limiting factor probably)

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