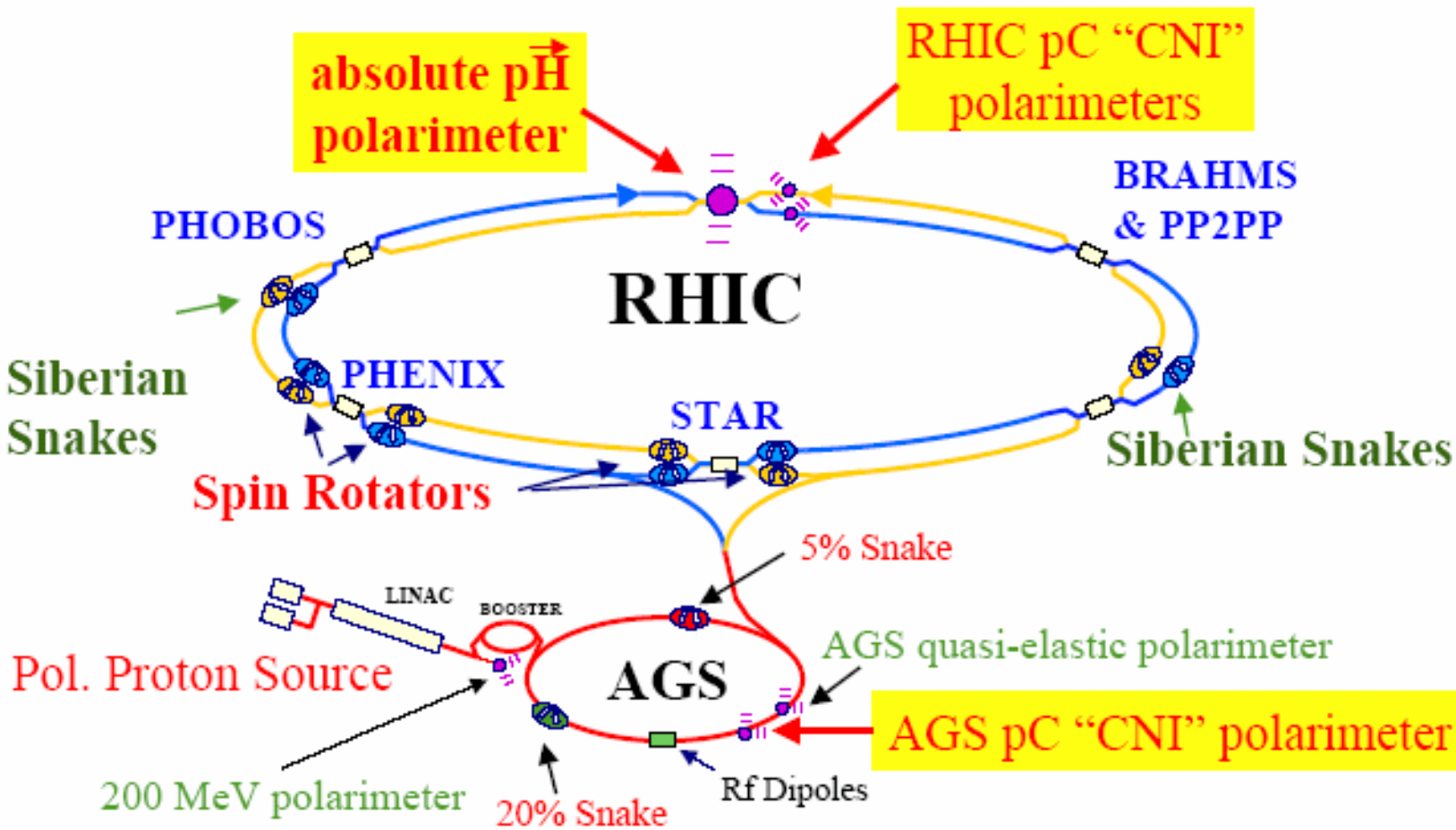
Beam-gas fluorescence measurements at the hydrogen-jet polarimeter

Roger Connolly, Dejan Trbojevic, David Gassner, Nicholas Luciano, John J. Woods, Steven Bellavia, Thomas Y. Tsang, Thomas Russo, Anatoli Zelenski, H Hseuh, and Peter Thieberger

Objectives

- Measure vertical emittance growth in RHIC.
- Measure fluorescence cross sections.
- Develop a gas fluorescence beam profile monitor for possible future use in RHIC.
- Try to measure jet contaminations to improve corrections of the absolute polarization measurements.

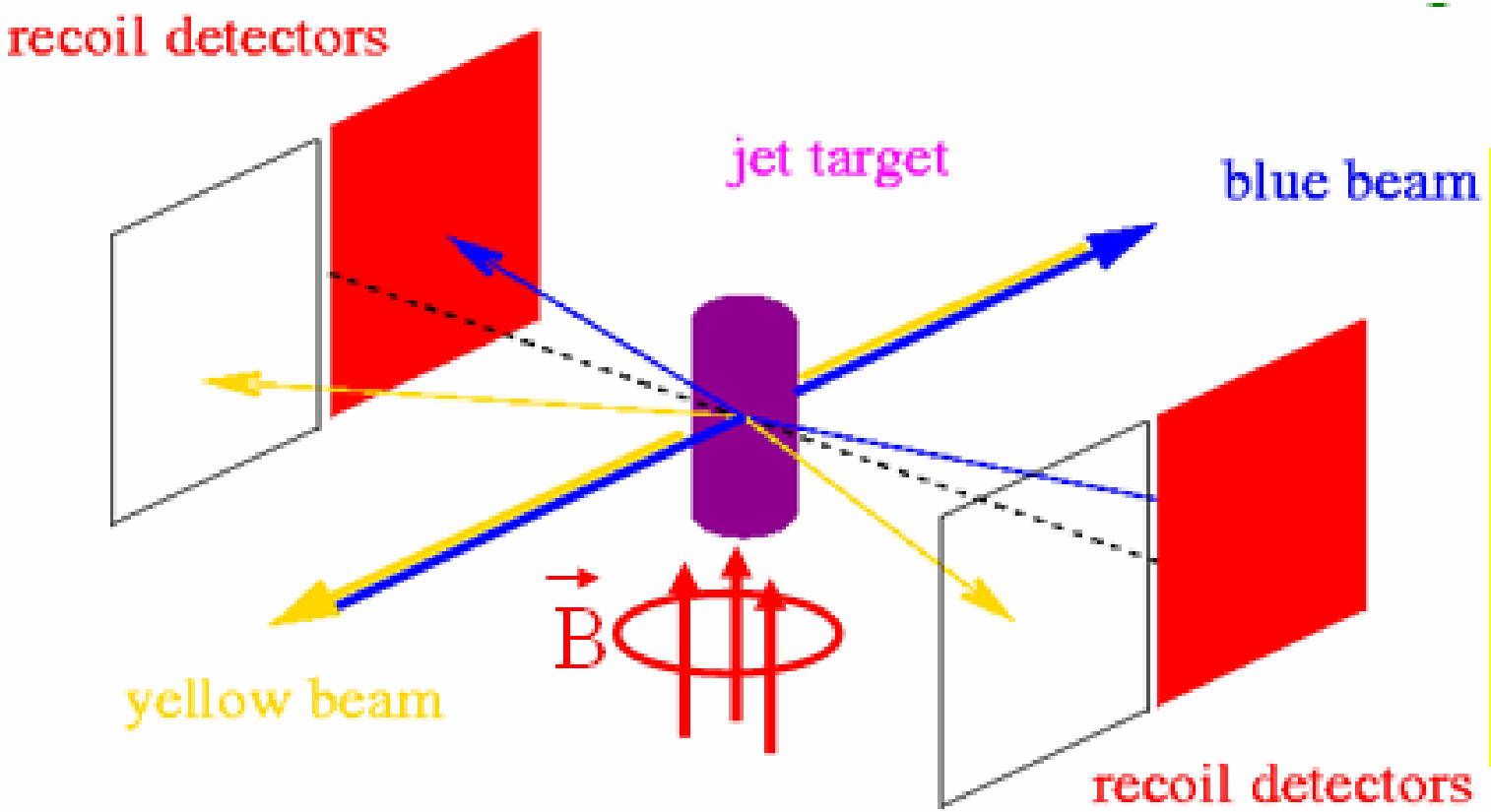
RHIC *pp* accelerator complex



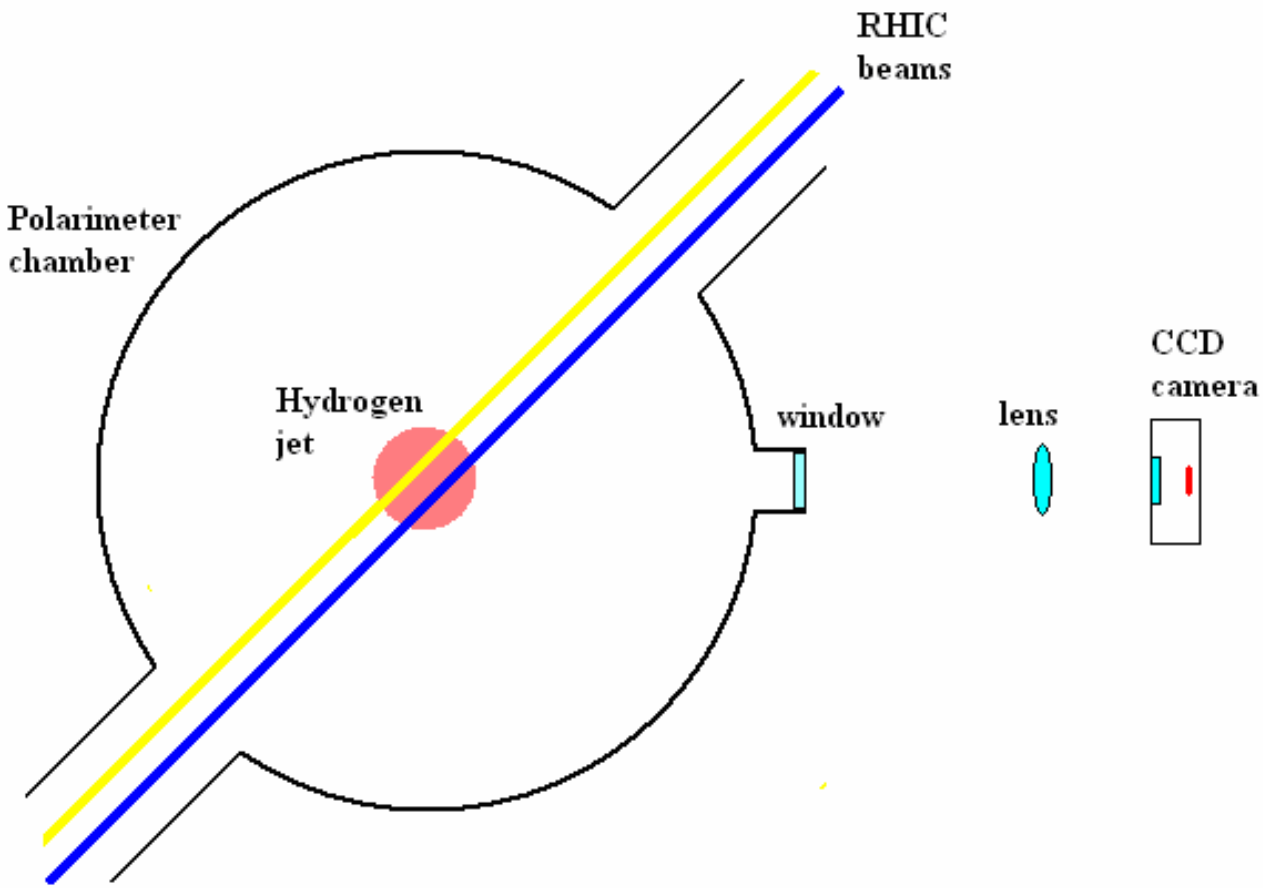
Alessandro Bravar

BROOKHAVEN NATIONAL LABORATORY

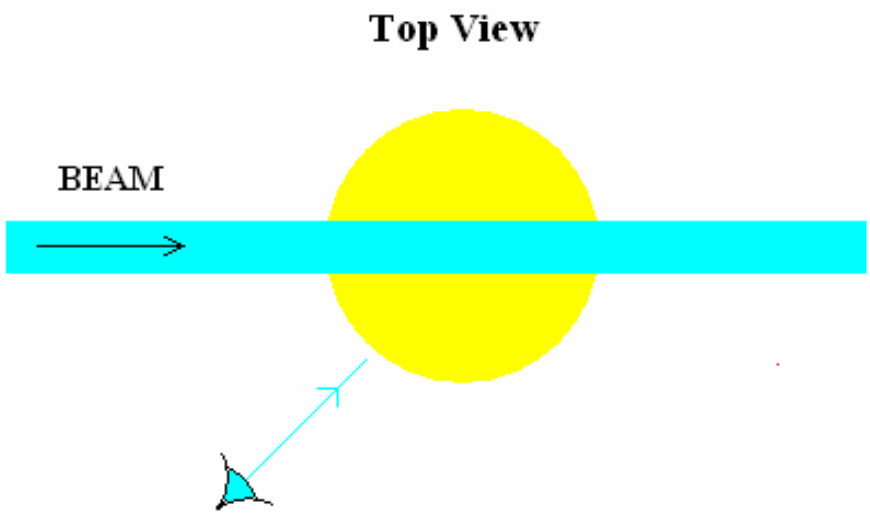
Schematic of jet-target and detector geometry

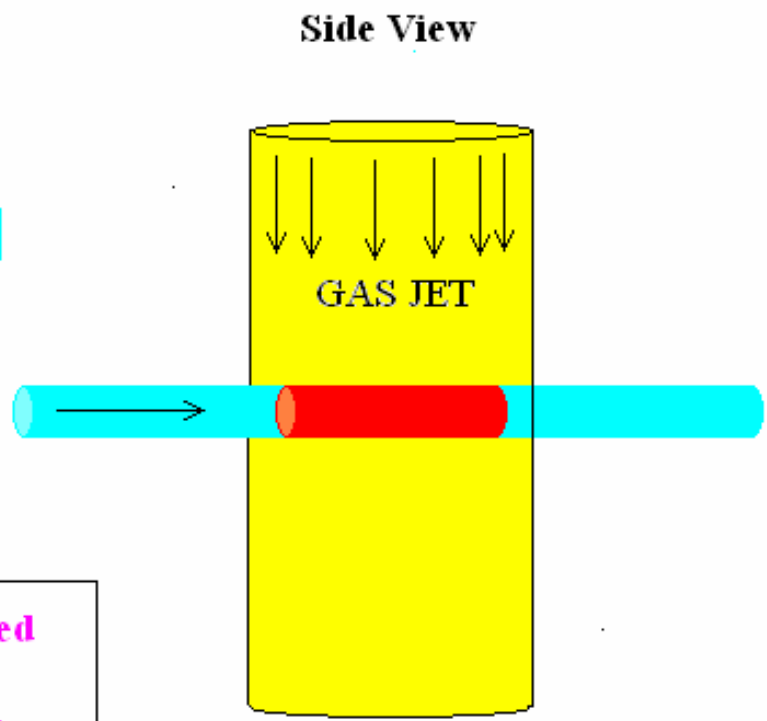


Geometry of the beam-gas fluorescence measurements during the 2005 run



BEAM-JET GEOMETRY

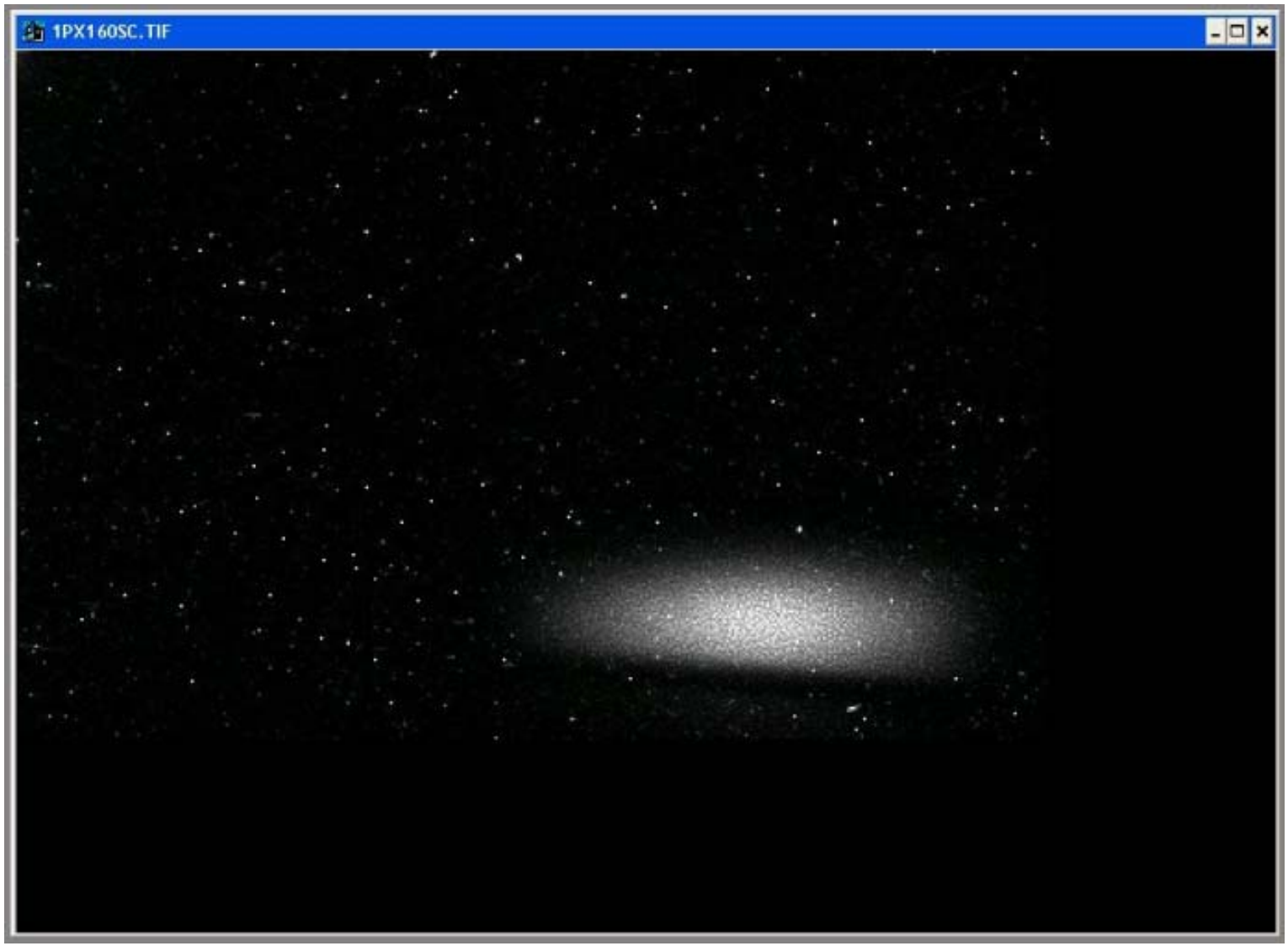




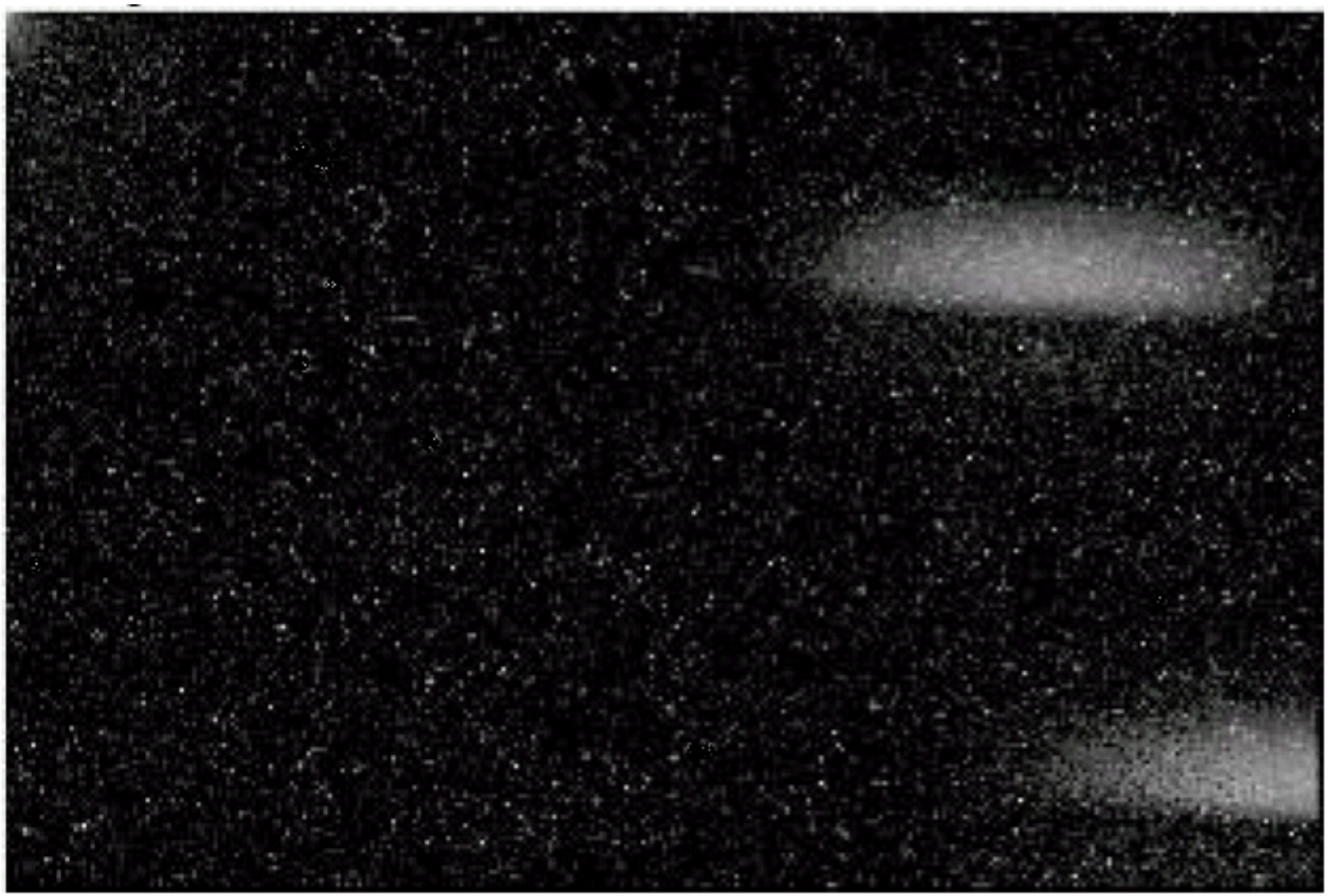
Only vertical beam profiles can be measured

With a flat, curtain-like jet, a full 2D beam cross section map coud be measured

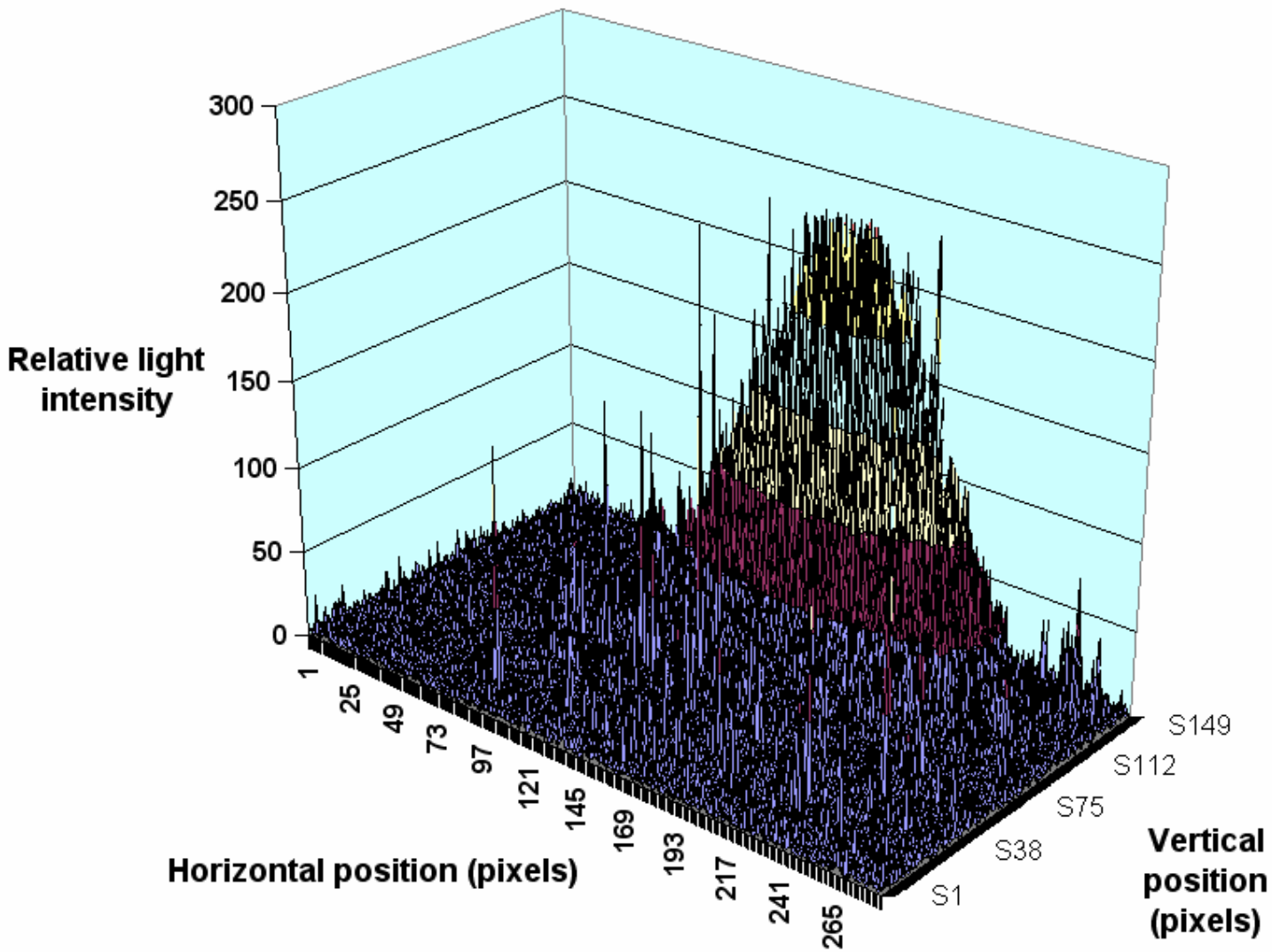
Image obtained with 160 s exposure

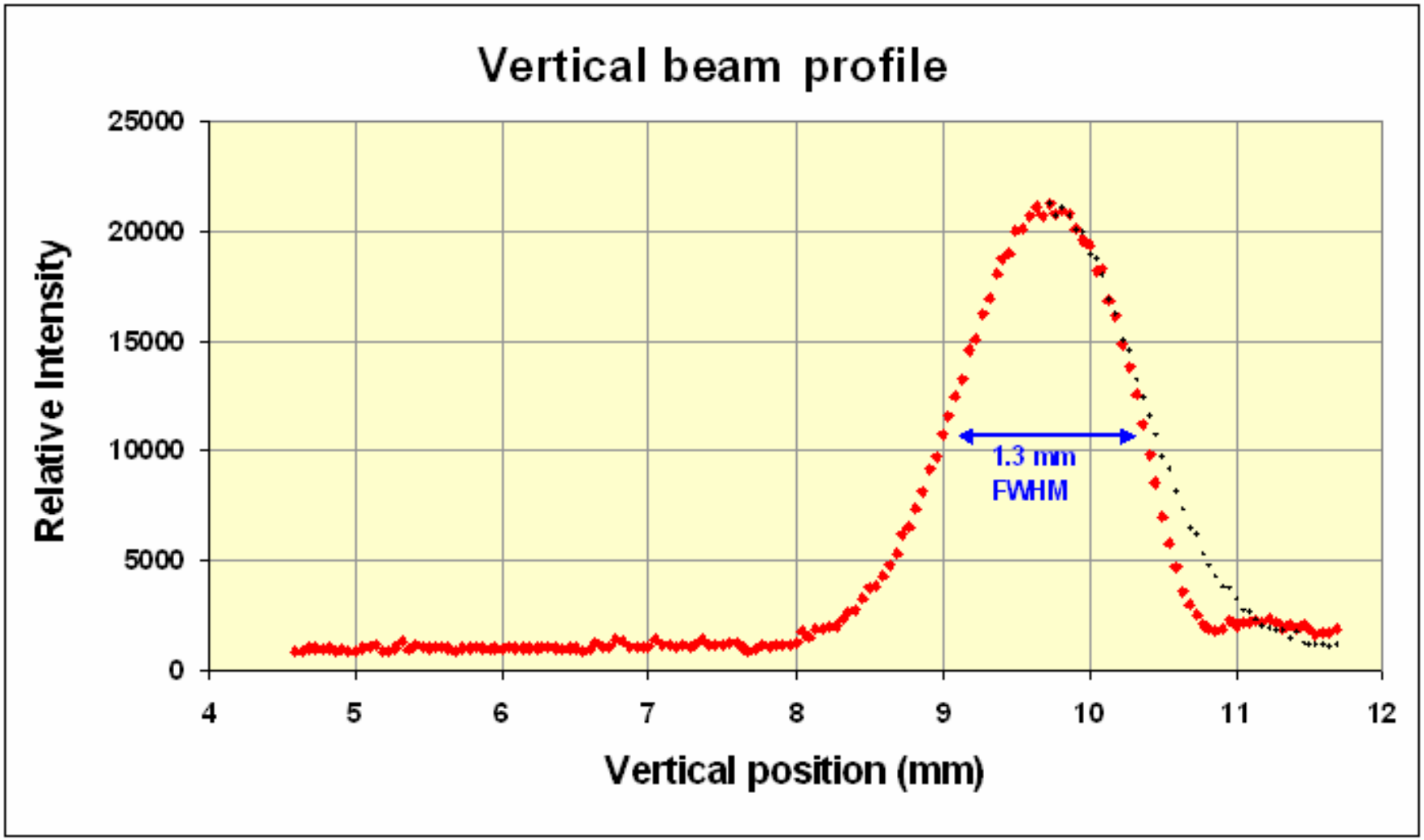


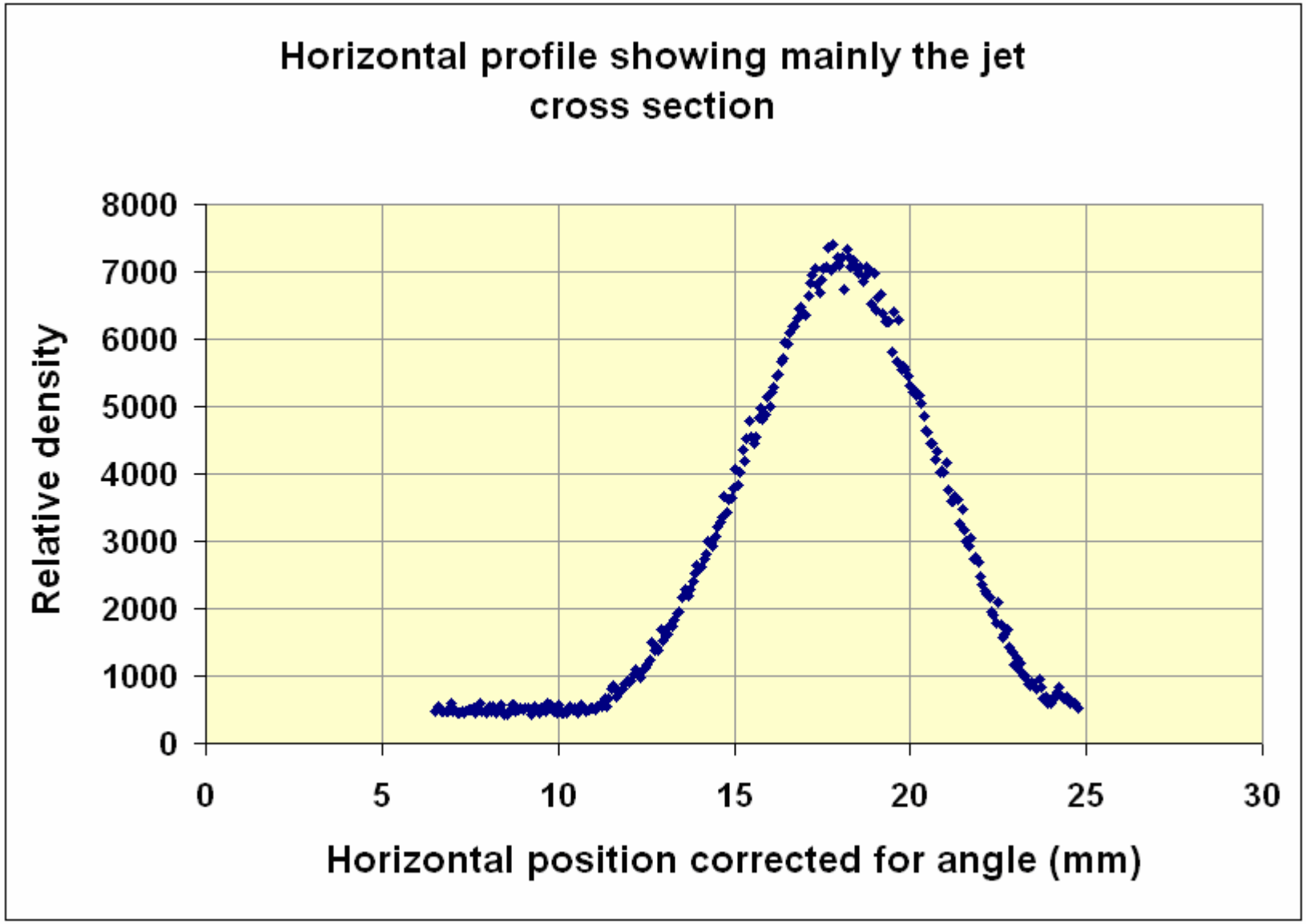
Blue and yellow beams captured in one exposure



Isometric view of intensity data



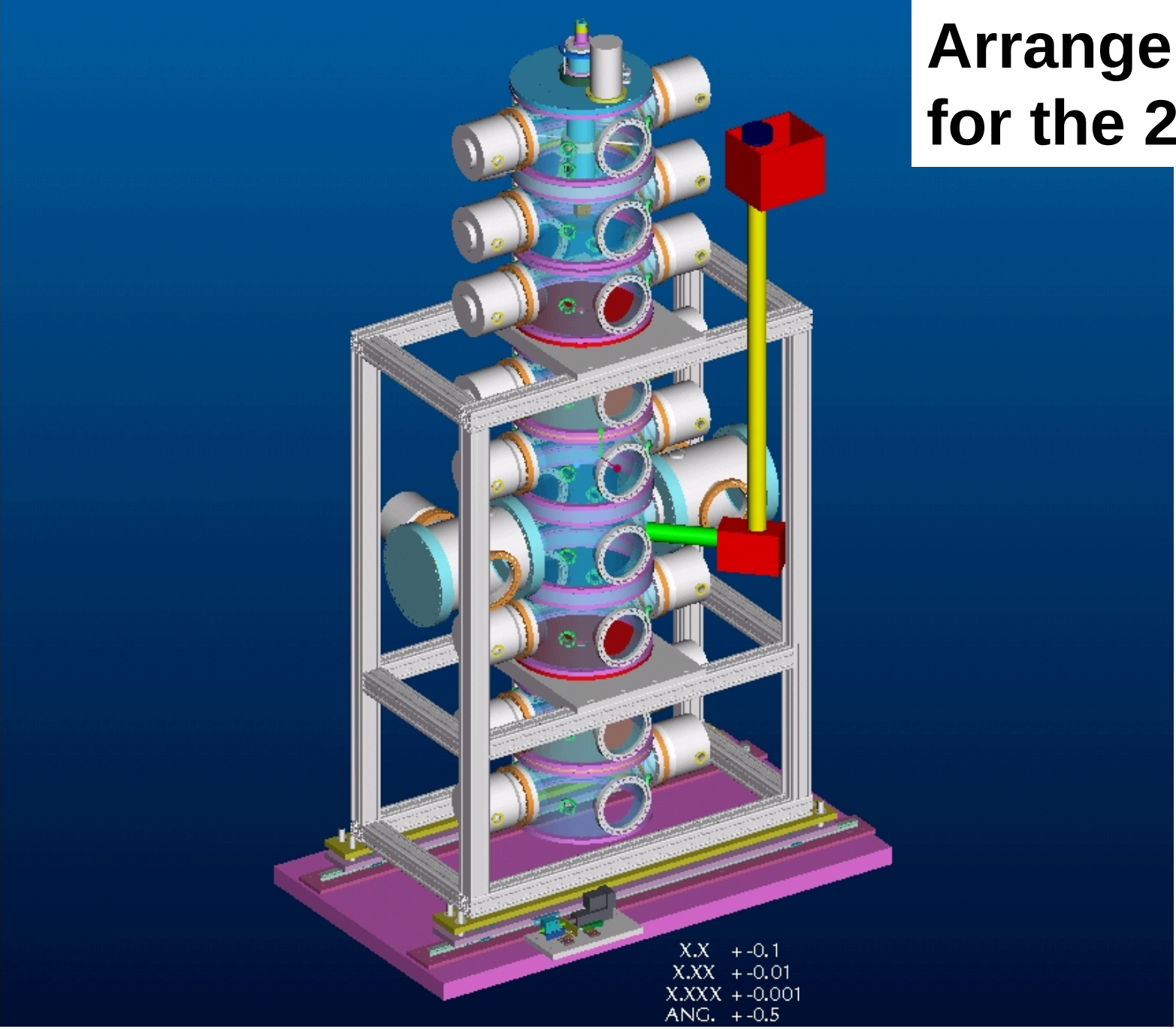

Vertical beam profile
Relative Intensity
25000
20000
15000
10000
5000
0
4
5
6
7
8
9
10
11
12
Vertical position (mm)
1.3 mm
FWHM

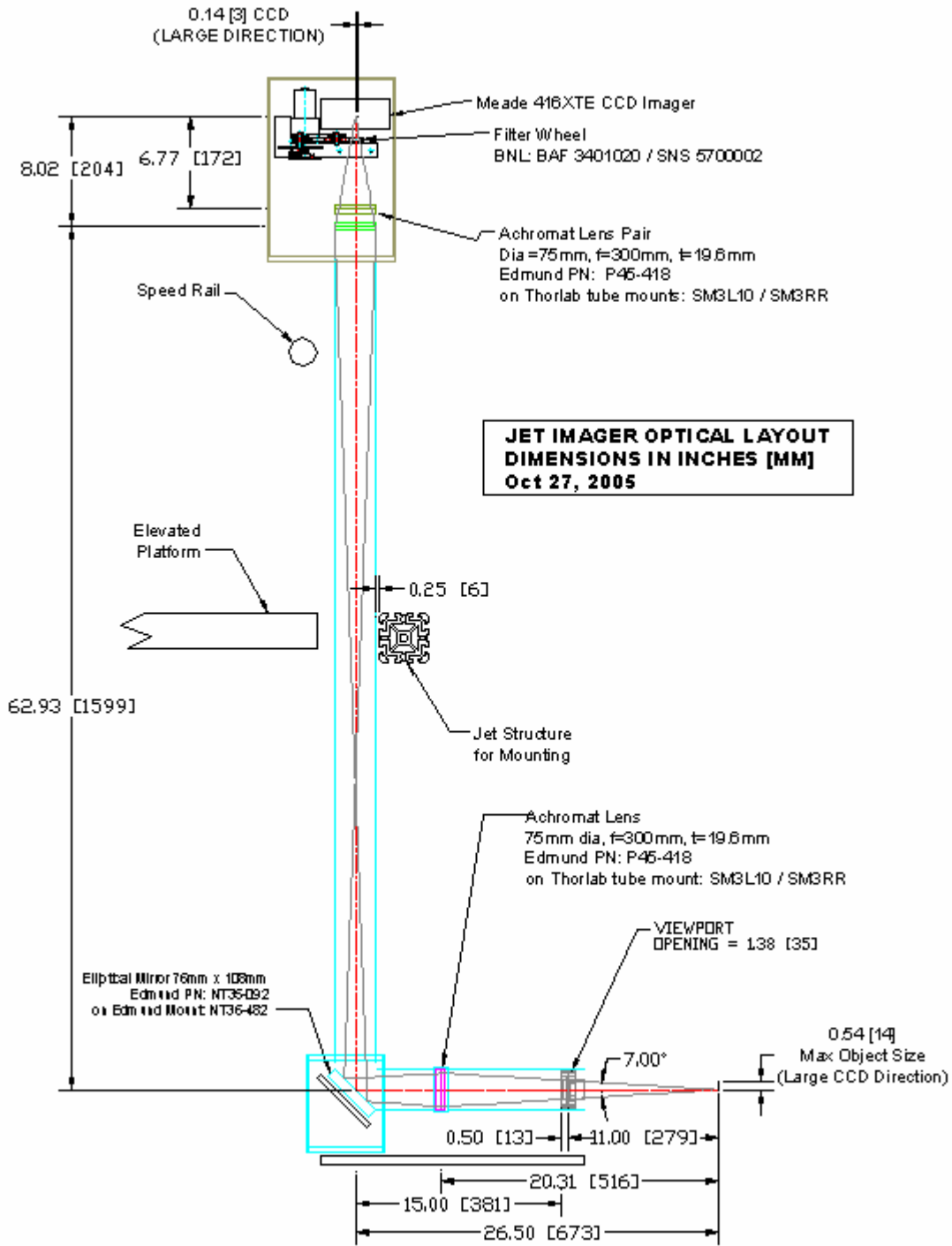

Horizontal profile showing mainly the jet cross section
Relative density
8000
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
25
30
Horizontal position corrected for angle (mm)

Preliminary results of the 2005 run

- Beam vertical FWHM 1.3 mm
- Jet FWHM 8.0 mm
- # photoelectrons/revolution ~0.9
- # photoelectrons/bunch ~0.012
- Visible photon production cross section for 100 GeV protons on atomic H ~1.2E-21 cm^2

Arrangement for the 2006 run




0.14 [3] CCD
(LARGE DIRECTION)
Meade 416XTE CCD Imager
Filter Wheel
BNL: BAF 3401020 / SNS 5700002
8.02 [204]
6.77 [172]
Achromat Lens Pair
Dia =75mm, f=300mm, t=19.6mm
Edmund PN: P45-418
on Thorlab tube mounts: SM3L10 / SM3RR
Speed Rail
JET IMAGER OPTICAL LAYOUT
DIMENSIONS IN INCHES [MM]
Oct 27, 2005
Elevated
Platform
0.25 [6]
62.93 [1599]
Jet Structure
for Mounting
Achromat Lens
75mm dia, f=300mm, t=19.6mm
Edmund PN: P45-418
on Thorlab tube mount: SM3L10 / SM3RR
VIEWPORT
OPENING = 1.38 [35]
Elliptical Mirror 76mm x 108mm
Edmund PN: NT35-092
on Edmund Mount: NT36-482
7.00°
0.54 [14]
Max Object Size
(Large CCD Direction)
0.50 [13]
11.00 [279]
20.31 [516]
15.00 [381]
26.50 [673]

Expected results for the 2006 run

- Observation of vertical beam-size evolution
- Improved fluorescence cross section measurements
- Further development of the fluorescence beam profile monitor design for RHIC
- Possible measurements of H-jet impurities

Future possibilities

- Develop a dedicated gas jet.
- Obtain 2D intensity maps, in addition to vertical and horizontal profiles.
- Measure profiles for individual bunches by using a gated image intensifier.