



Fermilab

Accelerator Physics Center

US LARP

T980 Crystal Collimation Status & Plans

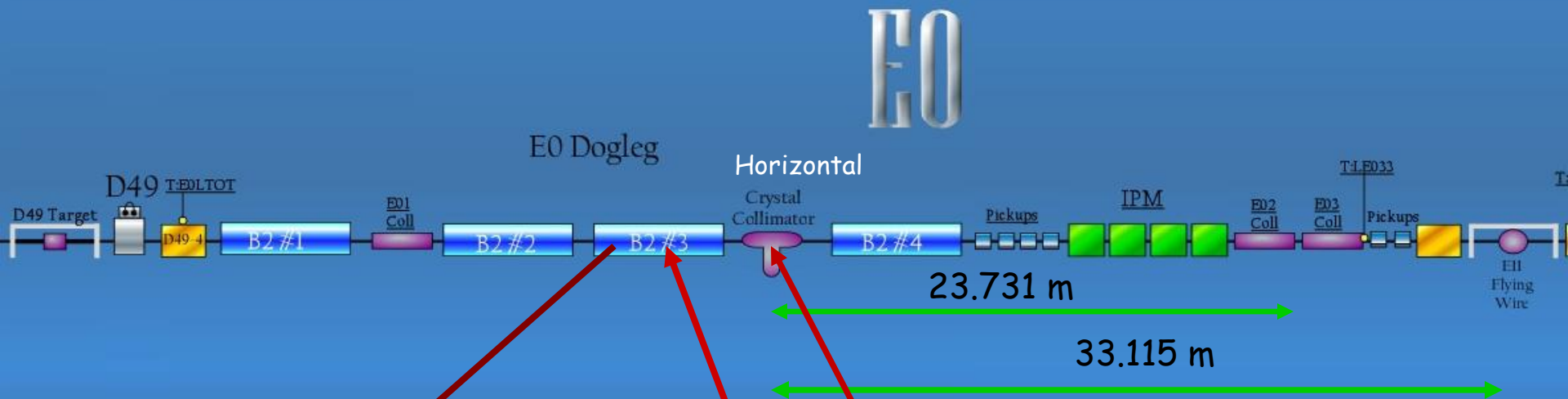
Nikolai Mokhov

LARP CM14 Collaboration Meeting
Fermilab
April 26-28, 2010

OUTLINE

- T980 Status
- New Crystal
- Enhanced Beam Diagnostics
- Beam Study Plans

T980 Setup in Tevatron E0



Removed B2-3 dipole

Installed new Vertical 2-xtal goniometer
4 m upstream of the Horizontal goniometer

Replaced old O-shaped xtal
with new 0.36mrad O-shaped
with negative 0.12mrad miscut

Now able to use 1 or 2 xtals in beam,
alternating them without breaking vacuum !

Installed new detectors at F17
to measure VR beam

Goniometer Installations



Newly built and installed (Summer 2009) vertical goniometer at E0. It is ~ 4m upstream of the Hor. one. Ver. goniometer houses old O-shaped crystal (reversed for negative miscut) and multi-strip crystal.



Modified horizontal goniometer. Replaced old large miscut positive angle O-shaped crystal with new small miscut negative angle O-shaped during Summer 2009.

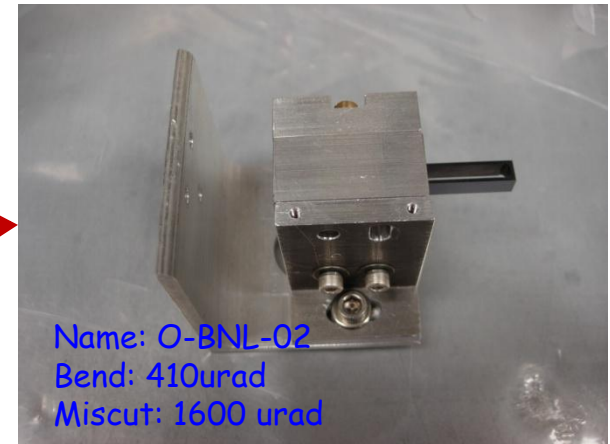
Crystals in EO



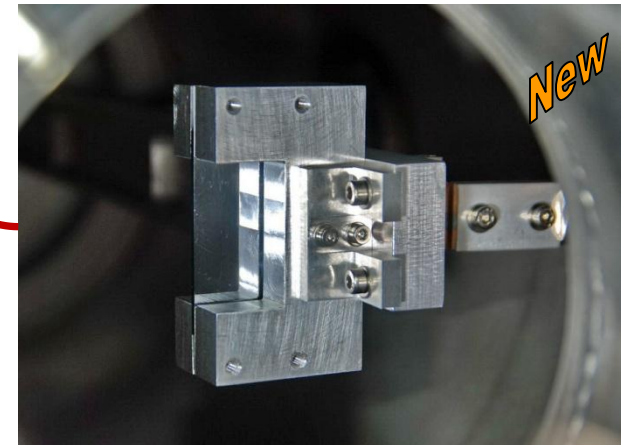
Ver Dnstrm goniometer



Hor goniometer



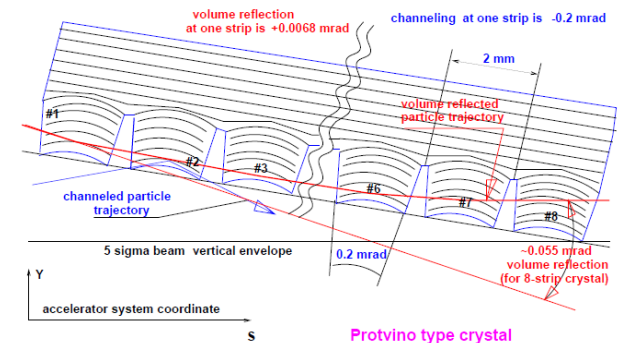
Ver Upstrm goniometer



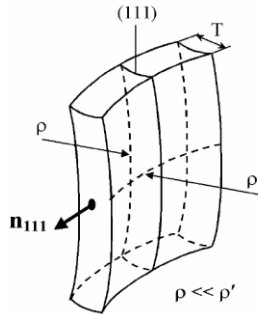
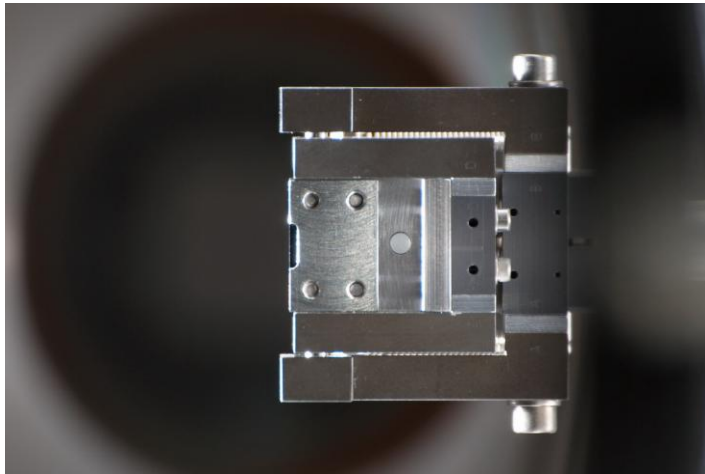
QM to replace O-BNL-02
this summer

End-of-Store Studies Since Fall 2009

1. Successful tests of new hardware, F17 detector and channeling with O-05-09, new O-shaped crystal in horizontal goniometer.
2. Last months focused on multi-strip MS-08-09 crystal in vertical goniometer:
 - Good match to TeV environment.
 - Easy to work with!
 - Measured losses of a multiple-VR beam at E03 collimator and a single-strip channeled beam at F17(2) collimator in a good agreement with simulations.



Quasi-Mosaic Crystal to Replace old O-BNL-02

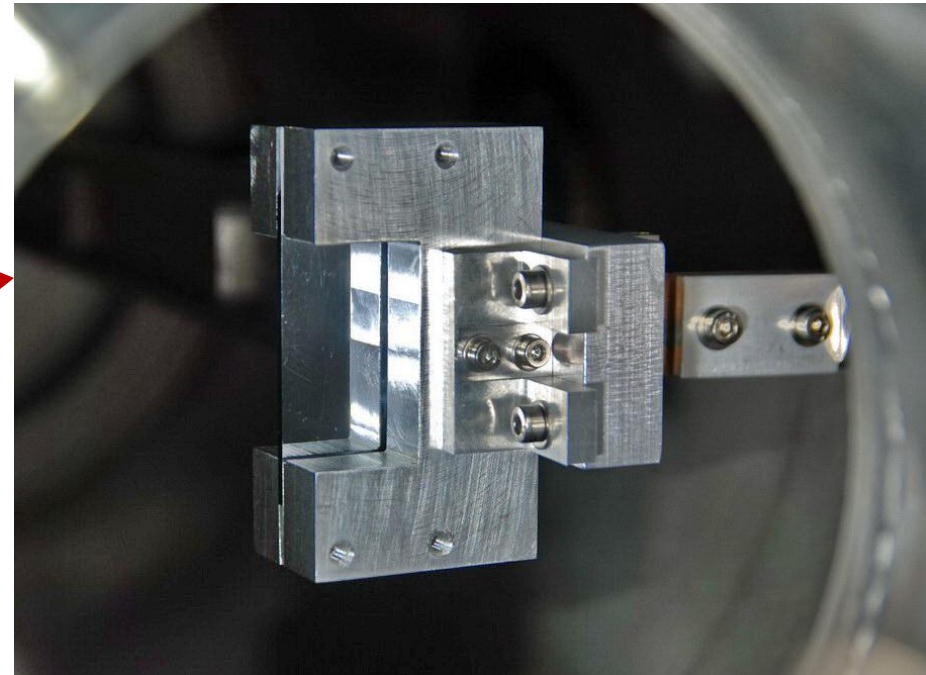


QM crystals used for UA9 measurements at SPS in 2009 and will be used in 2010: 2-mm thick, 160- μ rad bending

Opening in bending device 2x10 mm²

Opening in bending device 20x40 mm² →

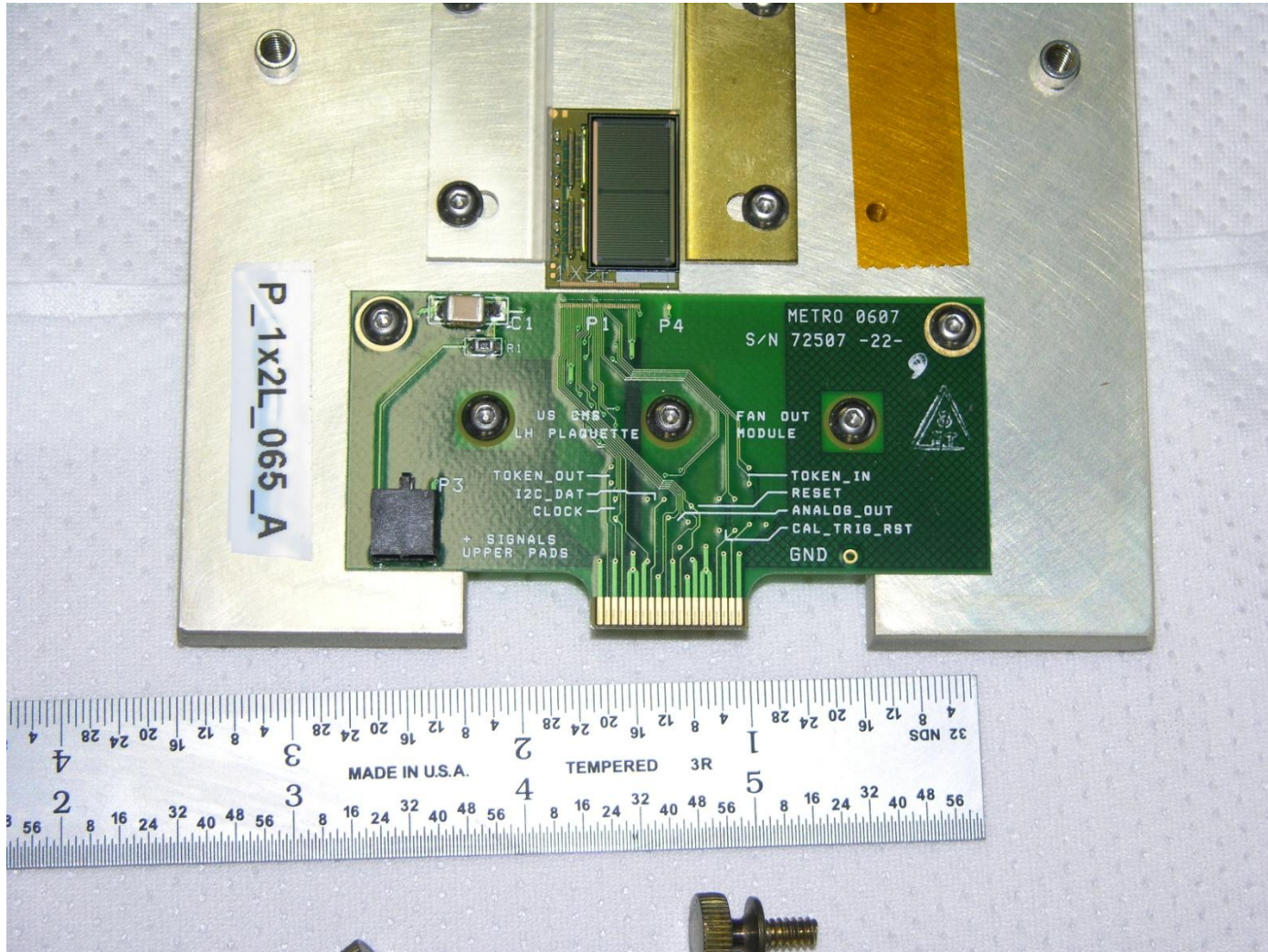
To be installed in T-980 in June-July:
1.6-mm thick, ~100- μ rad bending,
miscut angle ~20 μ rad vs 1600 μ rad
in O-BNL-02



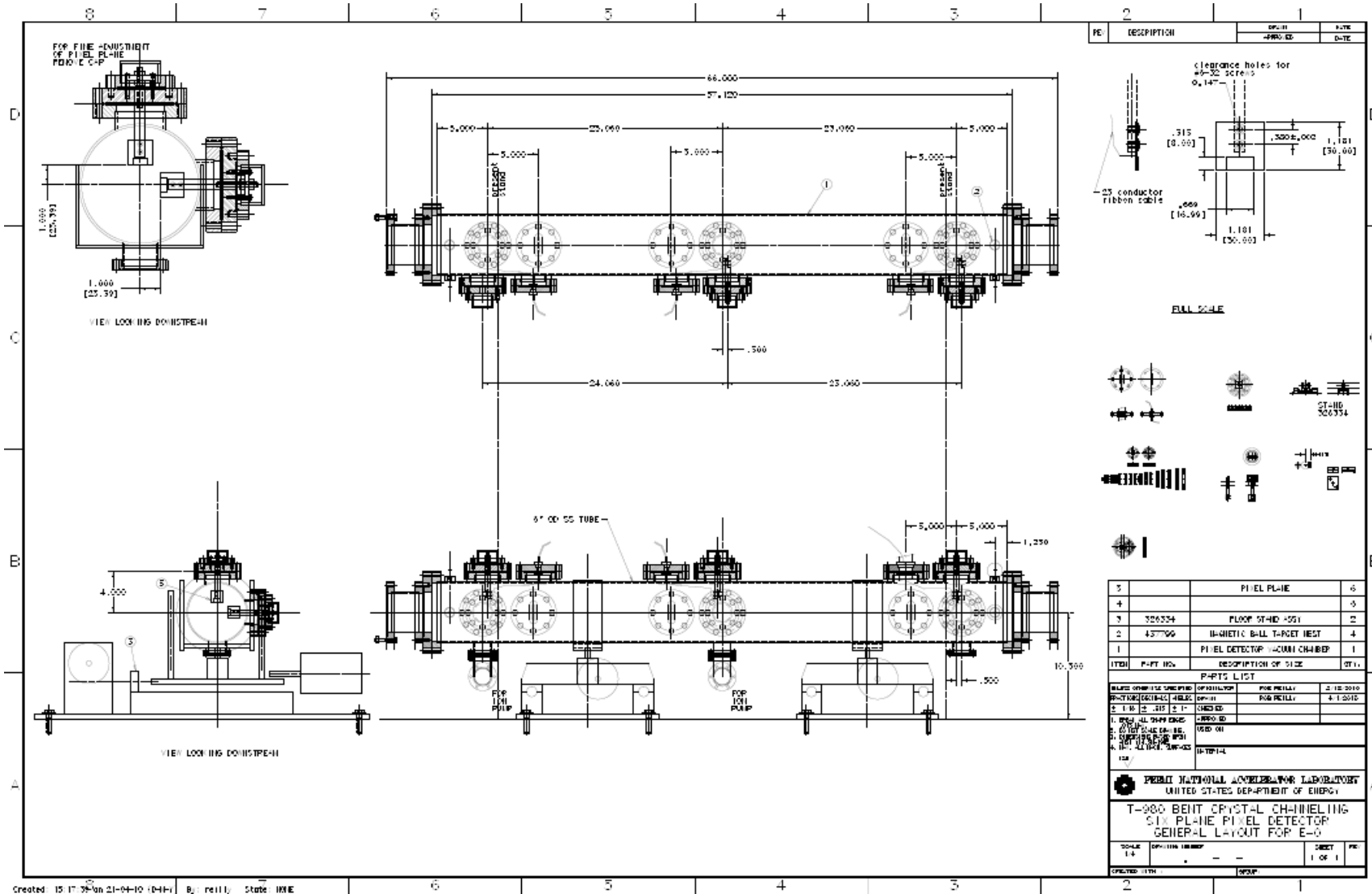
Pixel Telescopes

- Two pixel telescopes will be installed in the Tevatron tunnel this July - one in front of E03 collimator and another one in front of F17 collimator - to measure channeled and MVR beam profiles at those locations.
- Each telescope consists of three silicon modules for measurements in vertical plane and another three for horizontal plane.
- Multichip modules are of CMS forward pixel production, $1 \times 2 \text{ cm}^2$ with a sensitive area $0.8 \times 1.6 \text{ cm}^2$.
- Pixel size $100 \times 150 \text{ } \mu\text{m}^2$, estimated resolution 7-8 μm .
- Analog output digitized by DAQ ADC (12 bits).

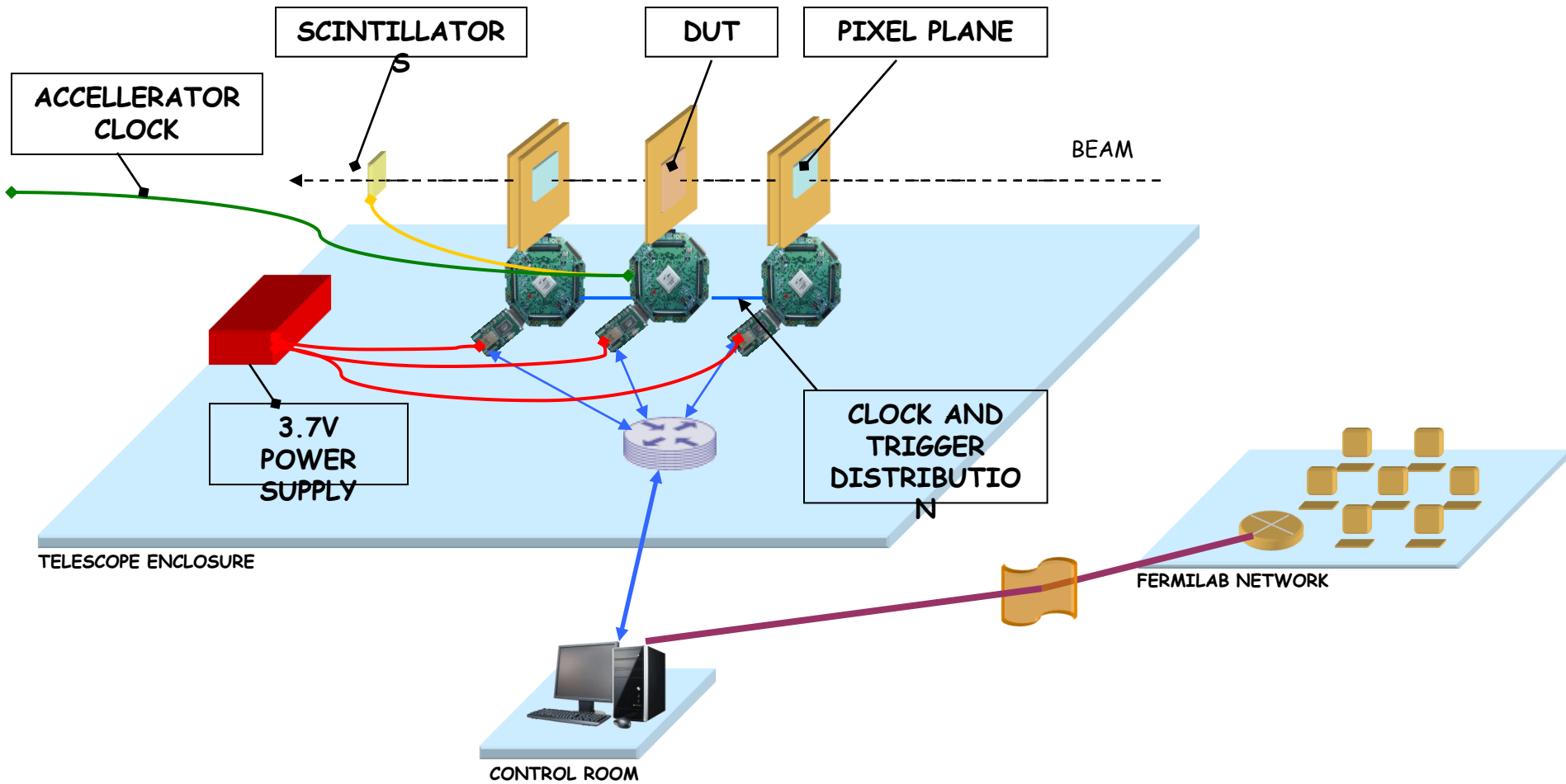
Pixel Module



Pixel Telescope Housing/Moving System



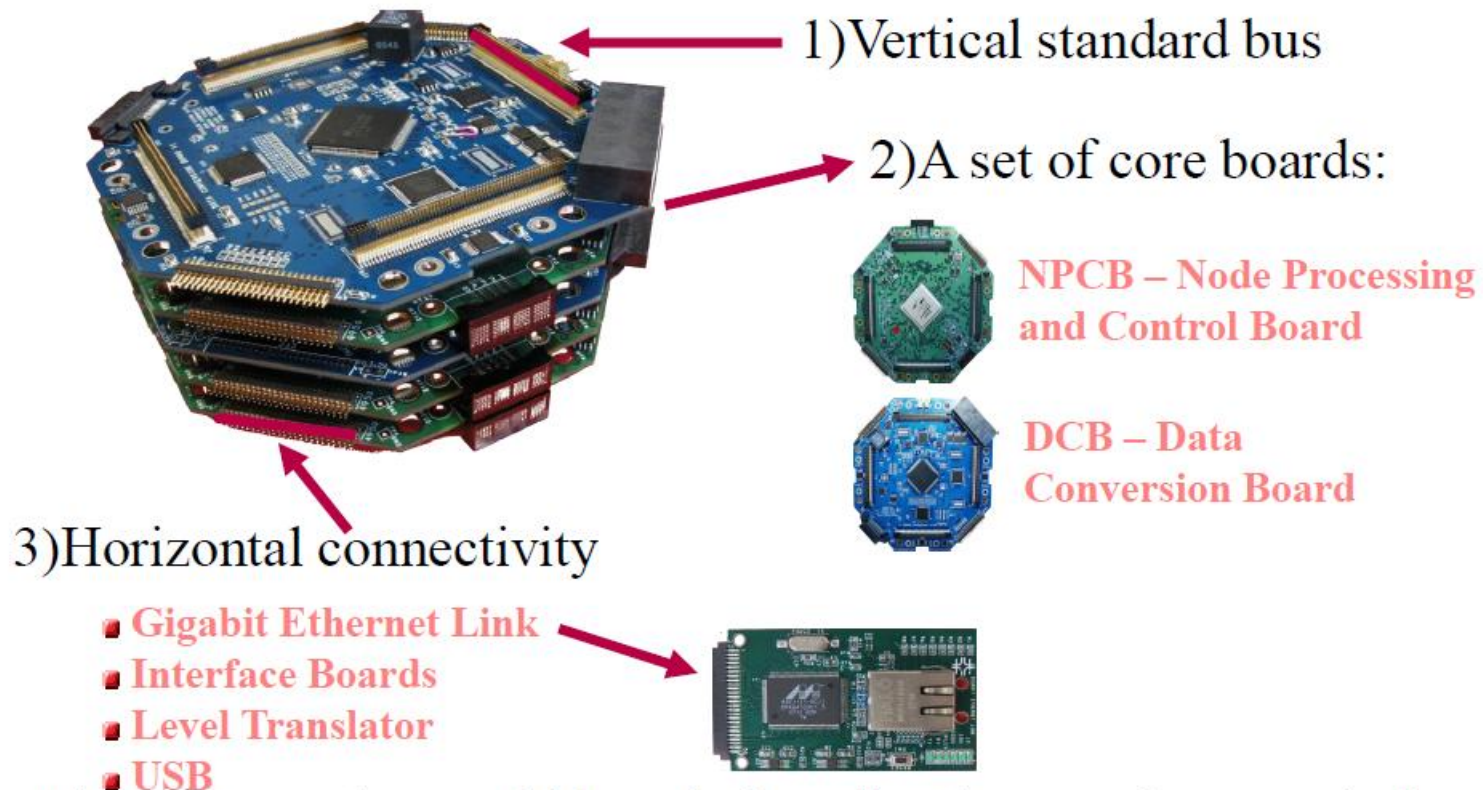
Telescope Overview



S. Kwan

CAPTAN DAQ System

- ◆ The CAPTAN DAQ system has been developed by the DIG (Detector Instrumentation Group) of CD/ESE. There are 3 basic concepts behind the system:



- ◆ The software is a multithreaded application running on windows

S. Kwan

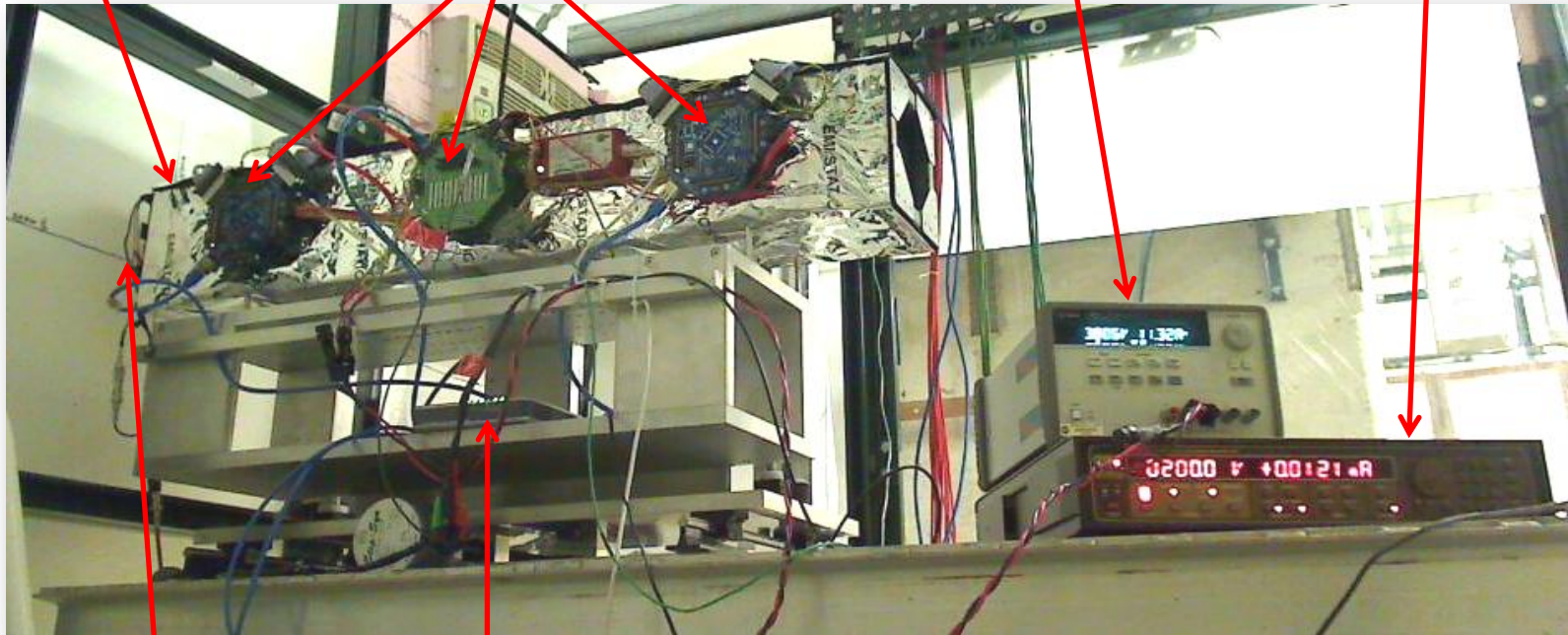
MTEST Pixel Telescope

TELESCOPE BOX

CAPTAN STACK

POWER SUPPLY

DUT SENSOR BIAS



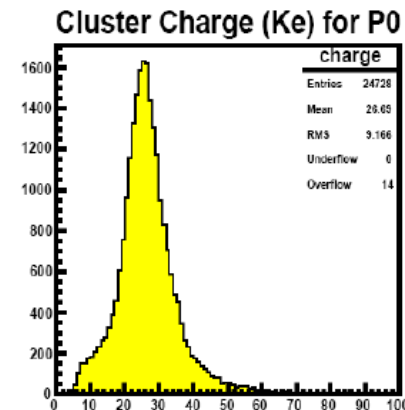
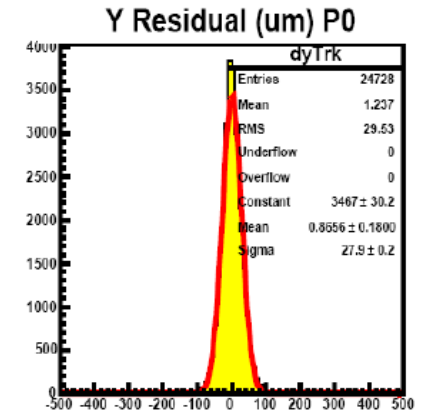
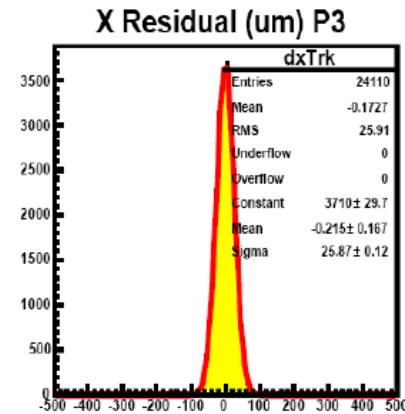
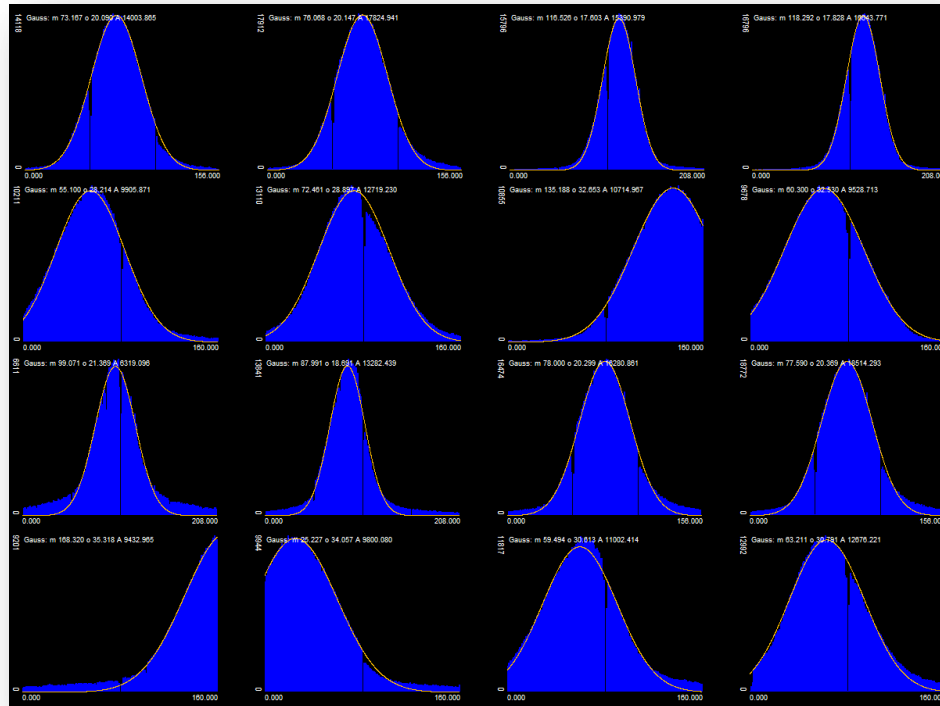
SCINTILLATOR

ROUTER

Only one power supply (- 5V, 20A current limit) is needed.
Everything could be placed far away from the beam line.

S. Kwan

Real Time Analysis: MTEST Results



S. Kwan

T980 Plans for 2010: New Hardware

1. Remove old O-BNL-02 crystal; after its cooling, send it to PNPI for investigation.
2. Install a new quasi-mosaic crystal into vertical goniometer, bake and vacuum-test this Summer shutdown.
3. Complete design, fabricate, test and install in the Tevatron tunnel at E03 and F17 two 6-plane telescopes with pixel detectors along with corresponding mechanics, electronics, control and software; installation - this July.

T980 Plans for 2010-2011: End-of-Store Studies

1. Compare channeling efficiencies for O-shaped crystals for large and small miscut angles, and for negative and positive miscut angles.
2. Measure crystal collimation efficiencies for O-shaped and Quasi-mosaic crystals and compare with a default amorphous primary collimator.
3. Investigate crystal collimation efficiency with a multi-strip crystal utilizing multiple volume reflection and compare it to that with a crystal in a channeling mode and with a default amorphous primary collimator.
4. Investigate simultaneous horizontal and vertical collimation for the most optimal crystal type and configuration.
5. Study crystal collimation system performance - with respect to beam losses in the ring and at IP - for the bunched beam and beam in the abort gap.
6. All of the above in comparison with simulation predictions.

T980 Plans for 2010-2011: Full Collider Stores

- Study crystal collimation system efficiency - in the most optimal configuration found in EOS - during full Tevatron collider stores with respect to beam loss localization in the collimator region, reduction of beam losses around the ring, and specifically in the collider detector regions.
- If a longer Tevatron run is confirmed, workout a corresponding plan and experiment design with a possible measurements with antiproton beam.

SUMMARY

- With new crystals, goniometers and instrumentation installed, and first encouraging results obtained, T-980 is well progressing with the 2010 program.
- A new quasi-mosaic crystal for the vertical goniometer and two high-resolution pixel detector telescopes at E03 and F17 for enhanced beam diagnostics - to be installed in Summer-2010 shutdown - will substantially increase T-980 capabilities.
- Need LARP support in FY10 and FY11 to accomplish this program.