

# FNAL Crystal Collimator Modifications

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Accelerator Division  
Division Head's Review  
7 August 2008

- Crystal Collimator or Goniometer, problems with original design
- Summary of changes, modifications and improvements
- Installation plan
- Crystal Collimator as received from BNL, history at FNAL

# FNAL Crystal Collimator Modifications

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Accelerator Division  
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Major problems to be solved

- Overall size, fit in tunnel at E-0
- Alignment methods
- Angular swing motion inchworm motor and limit switches, numerous problems
- Internal angular motion LVDT unreliable
- Ball-screw type horizontal insertion drive slide affected by vacuum load
- Electric brake on horizontal motion suspect
- Crystal vibration observed, strip crystal not desired
- No provision for manual operation, in case of motor or controls failure the crystal cannot be moved out of the beamline by hand
- No provision for external observation of angular swing motion, limit switches internal to the vacuum

# FNAL Crystal Collimator Modifications

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7 August 2008

## Major modifications in 2008

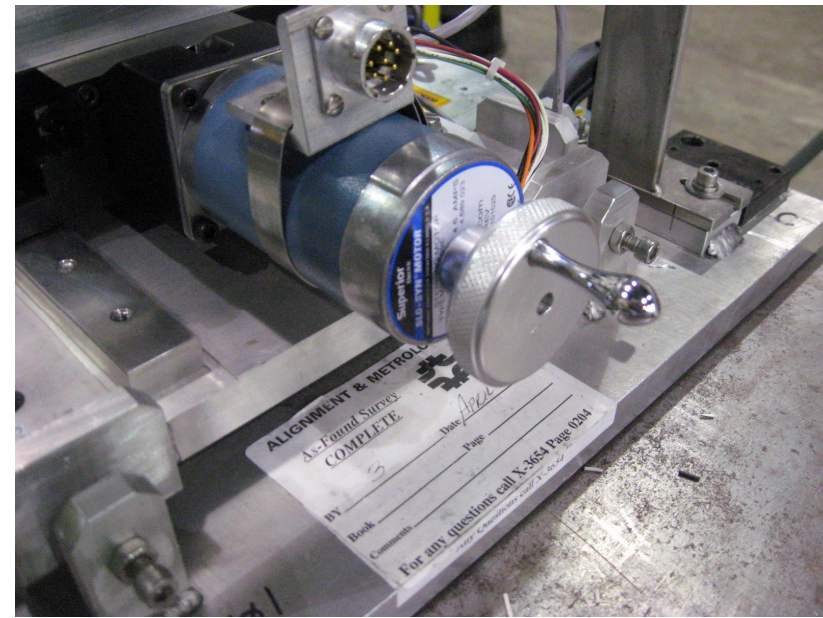
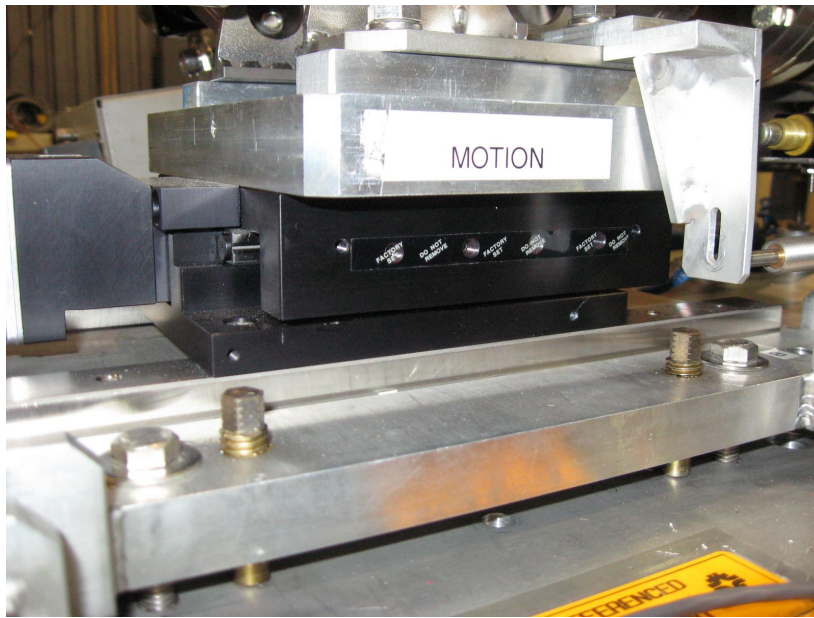
- Deleted angular swing motion inchworm motor and limit switches
- Deleted internal angular motion LVDT
- Deleted ball-screw type horizontal insertion drive slide
- Deleted electric brake on horizontal motion
- Removed strip crystal, installed original o-shaped RHIC crystal again
- New horizontal insertion drive slide is self-locking lead-screw type, not affected by vacuum load
- New horizontal insertion drive stepper motor with hand crank, in case of motor or controls failure the crystal can be cranked out of the beamline by hand
- New angular swing motion linear actuator vacuum feedthru with external stepper motor and limit switches, thumbwheel for hand operation
- New linear feedthru with external LVDT and visual position indicator for angular swing motion
- Glass viewport to observe angular swing motion

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## Major modifications in 2008

- New horizontal insertion drive slide is self-locking lead-screw type, not affected by vacuum load
- New horizontal insertion drive stepper motor with hand crank, in case of motor or controls failure the crystal can be extracted out of the beamline by hand cranking
- Linear motion .00005" per step



Rob Reilly - ADMSD

Crystal Collimator

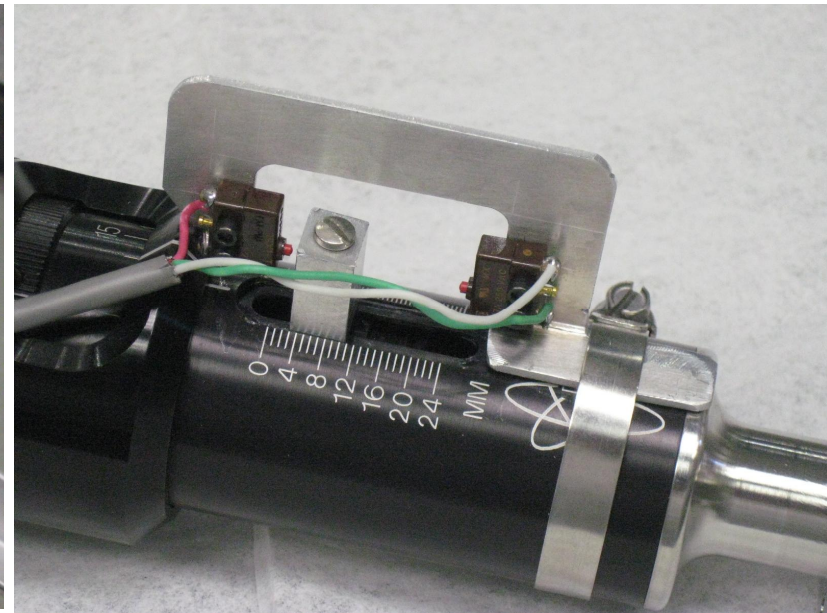
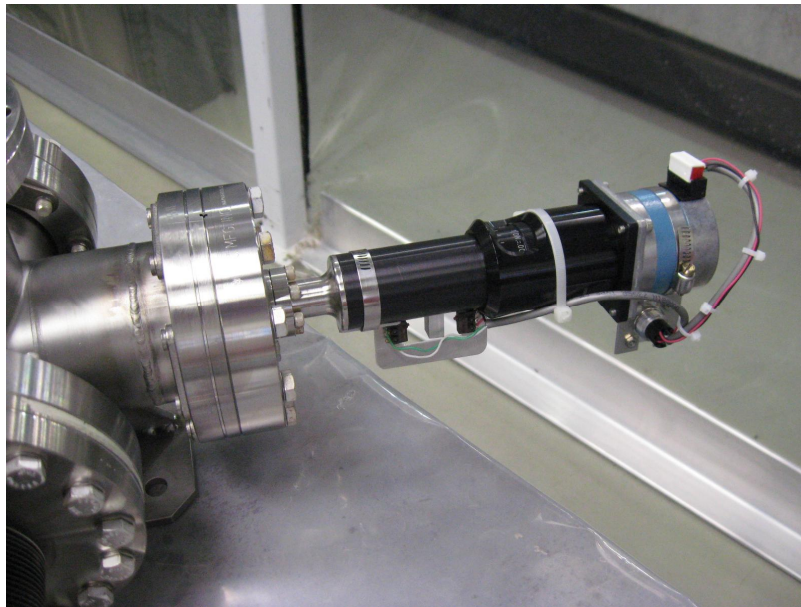


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Major modifications in 2008

- New angular swing motion linear actuator vacuum feedthru with external stepper motor and limit switches, thumbwheel for hand operation
- Angular positioning of the crystal in steps of 1.36 microradians

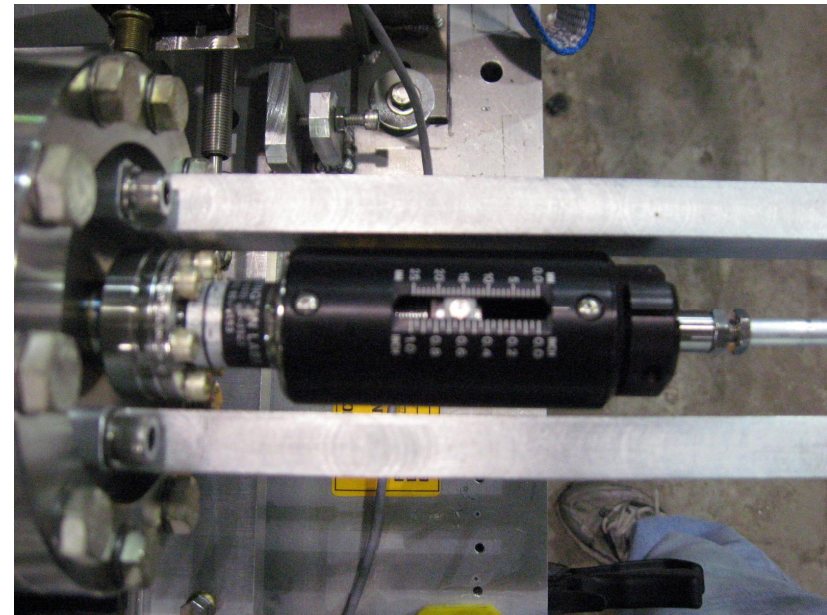
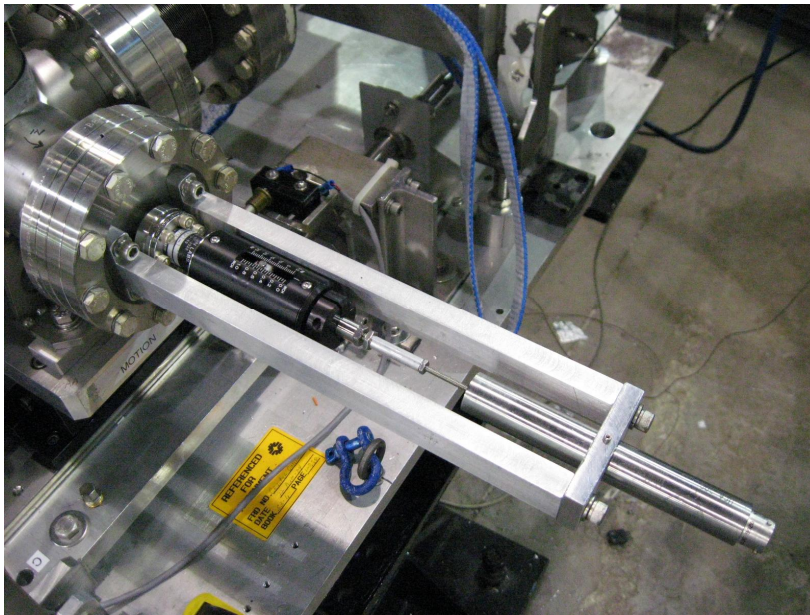


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Major modifications in 2008

- New linear feedthru with external LVDT and visual position indicator for angular swing motion
- Angular measurement 2.1 microradians



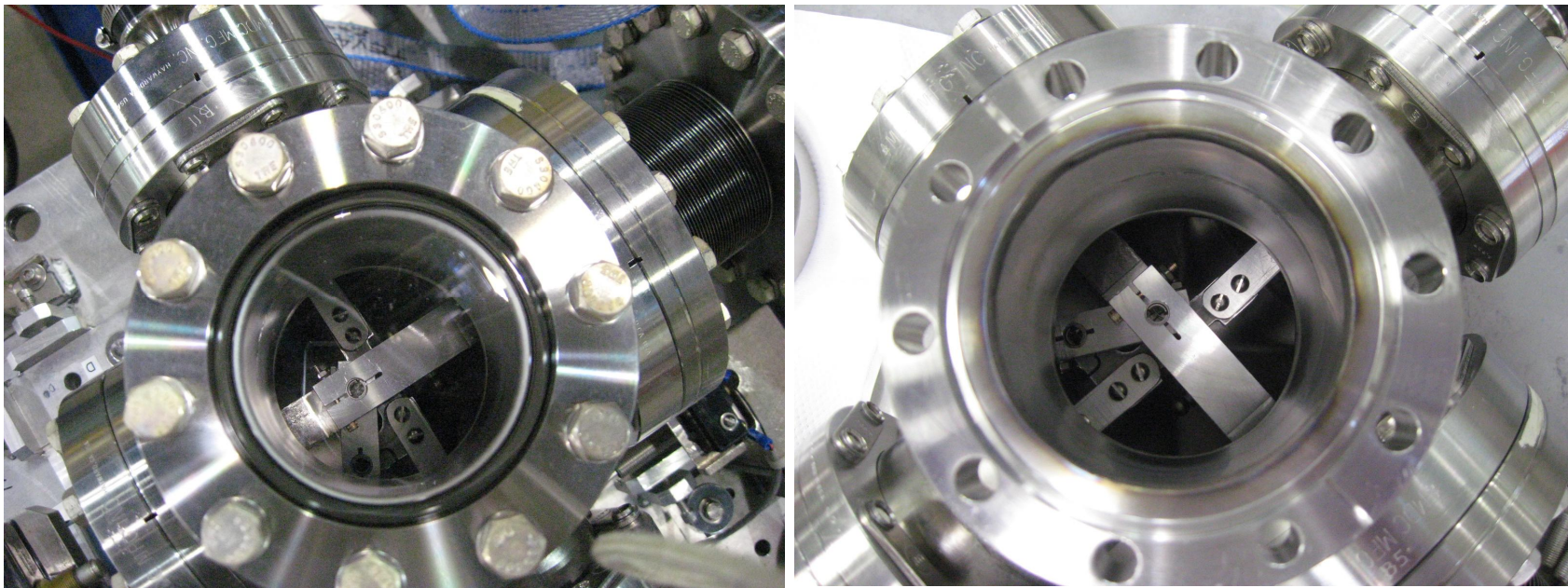


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Major modifications in 2008

- Glass viewport to observe angular swing motion

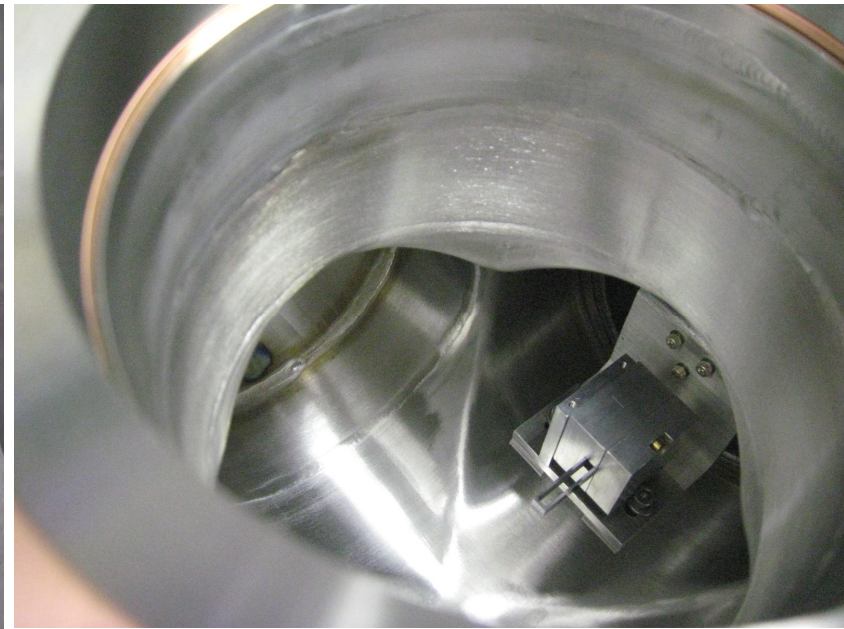
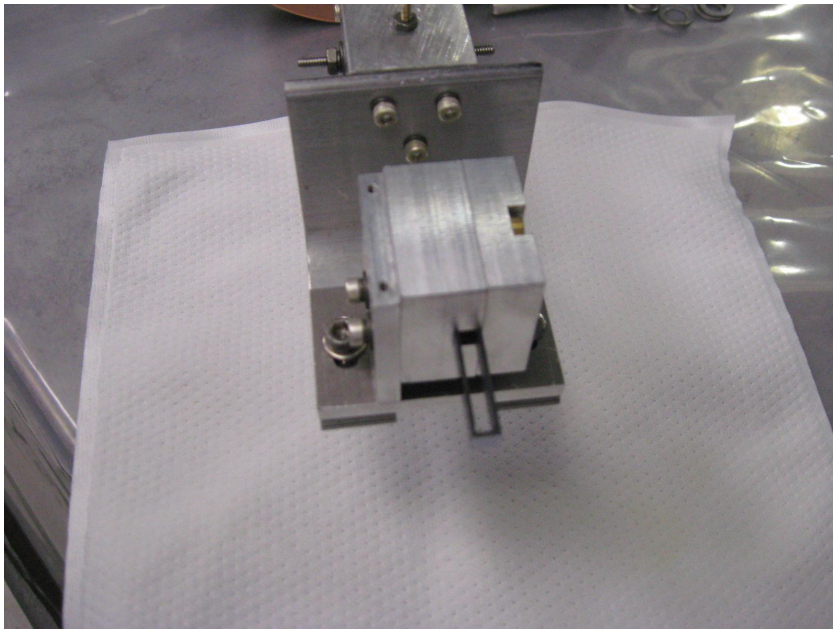


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7 August 2008

Major modifications in 2008

- Repaired vibration problem with crystal mounting bracket
- Repaired dragging arm problem with angular swing motion
- Original o-shaped RHIC crystal installed again



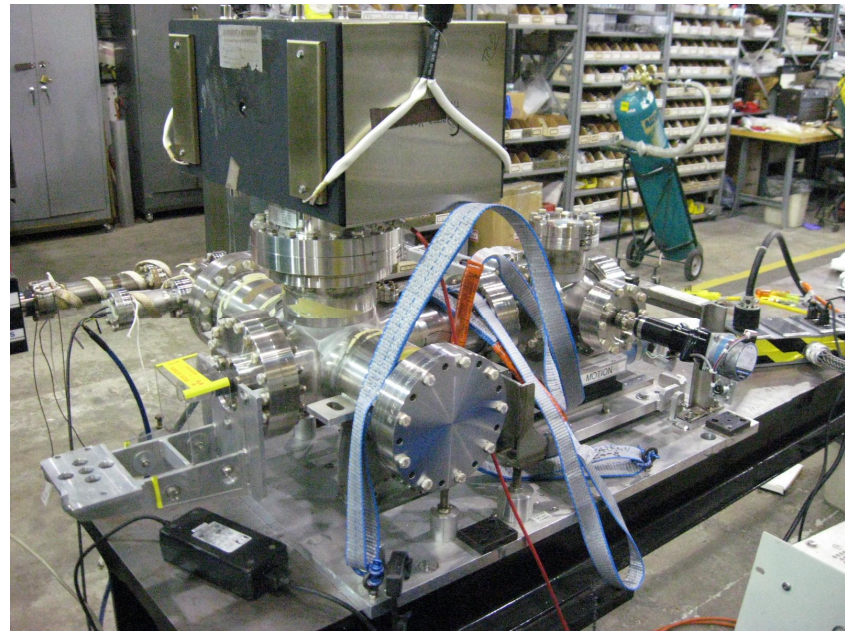
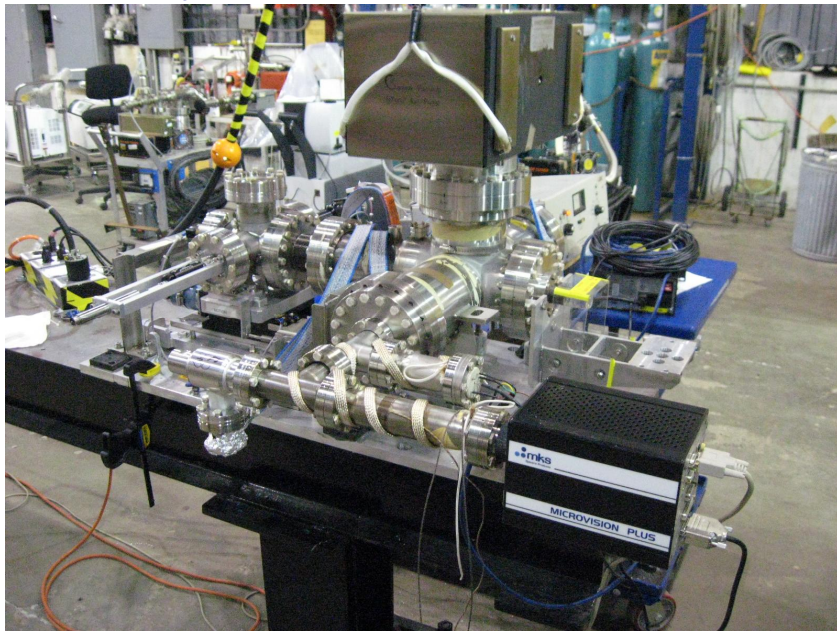
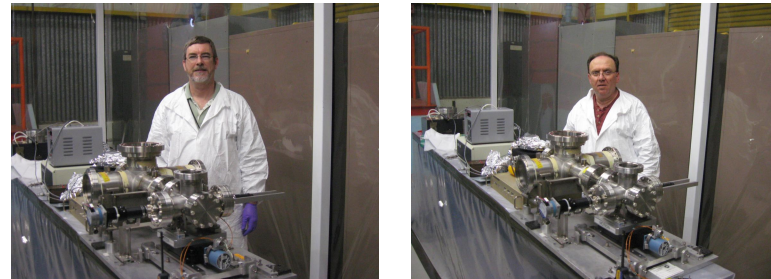


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Major modifications in 2008

- Operated under vacuum
- Vacuum chamber baked
- Vacuum certified
- Ready to install on 12 hr access



# FNAL Crystal Collimator Modifications

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- Crystal Collimator or Goniometer as installed at BNL in RHIC, 2003

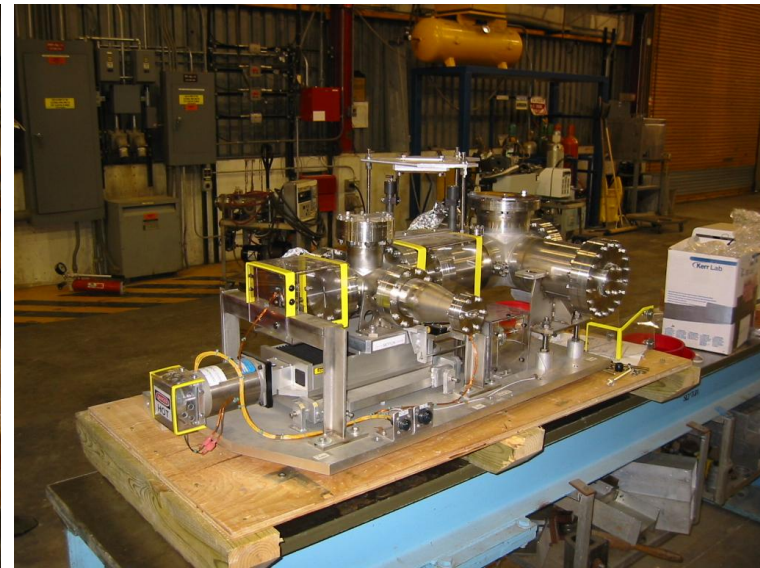
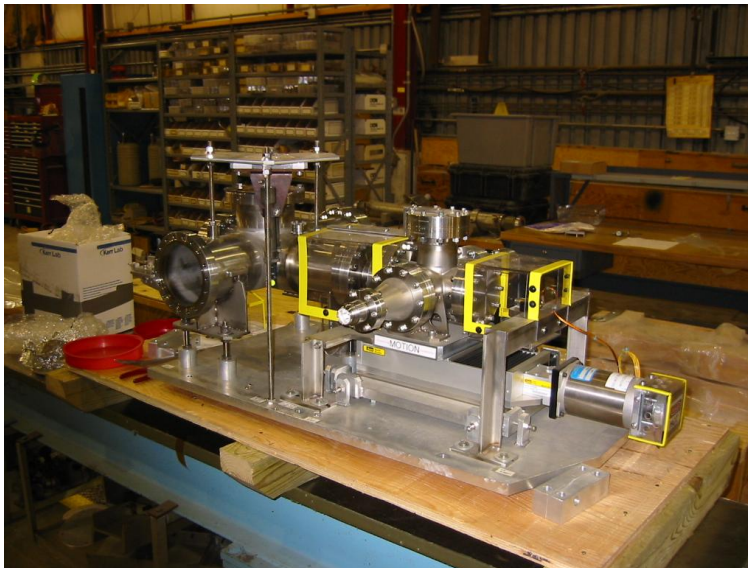




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7 August 2008

- Crystal Collimator or Goniometer as received from BNL, 2004
- Horizontal insertion drive stepper motor with electric brake

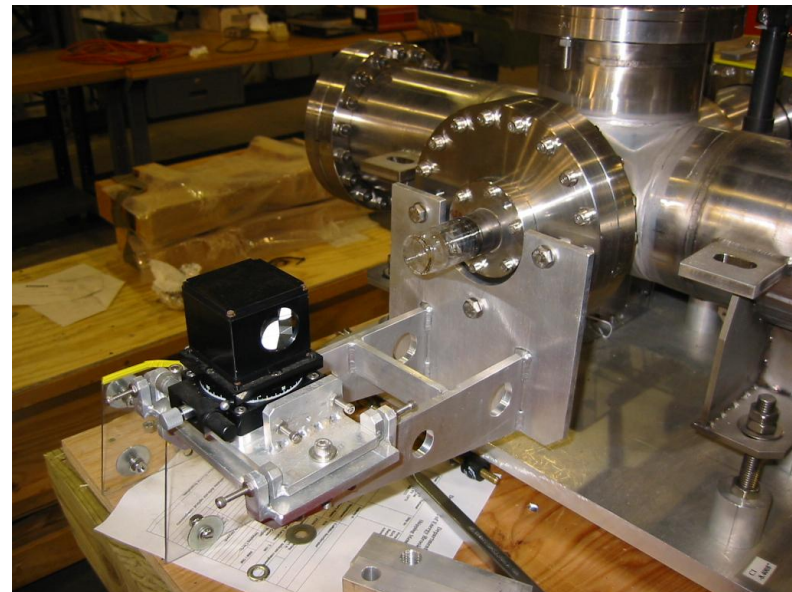
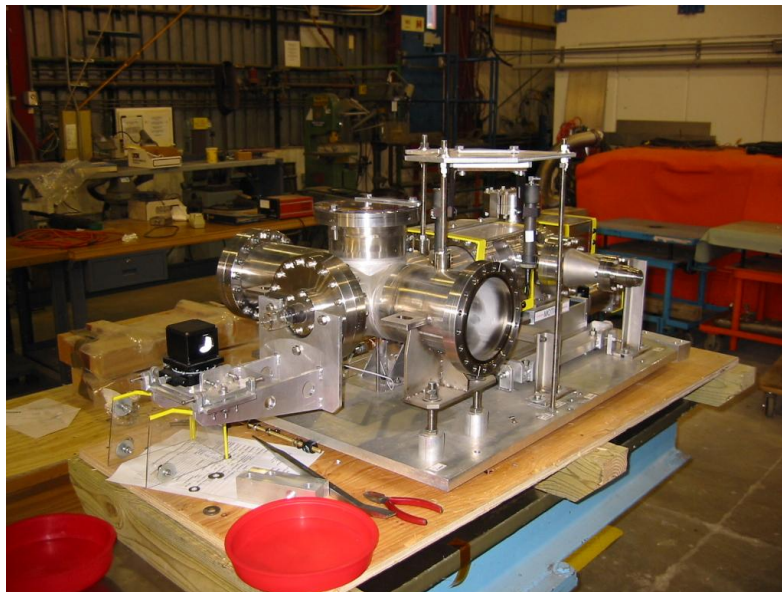




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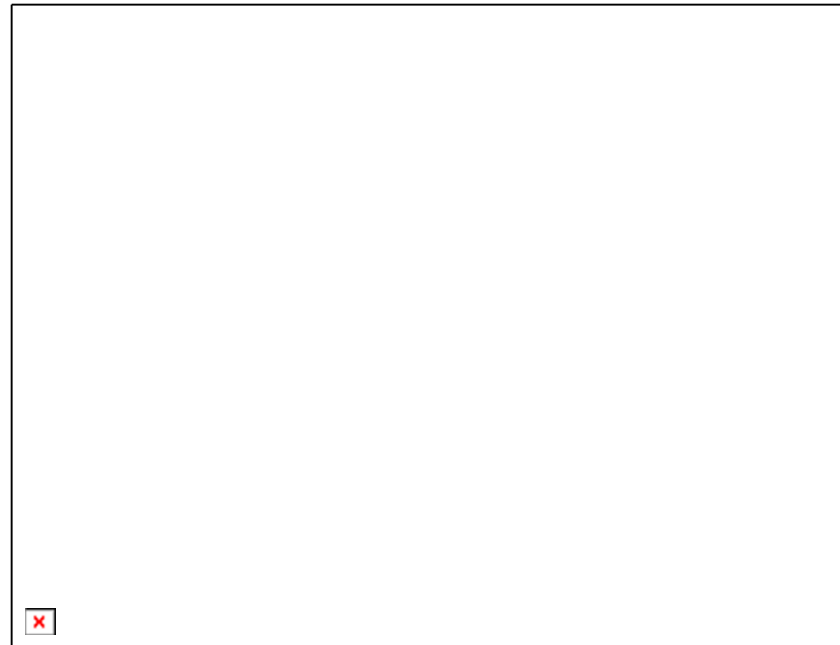
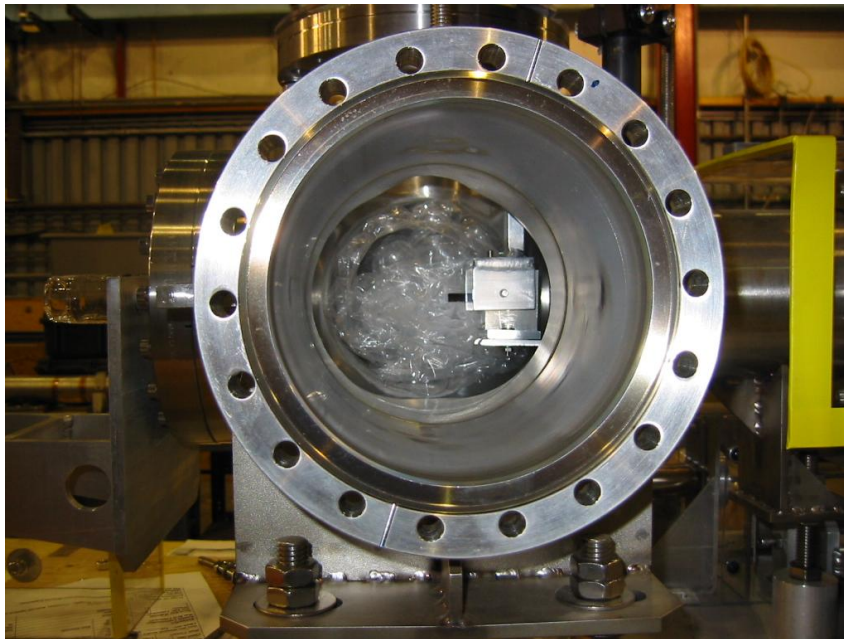
- Crystal Collimator or Goniometer as received from BNL, 2004
- Prism for alignment of crystal through glass viewport



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- Crystal Collimator or Goniometer as received from BNL, 2004
- BNL dwg of Crystal on swing arm with inchworm motor, internal LVDT, protective cover over crystal (removed before installation in beamline)



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2004 Choice of installation location; problems

- Tevatron E-0 straight
- Horizontal insertion drive motor protrudes into the aisle
- Beamline height 10.5" above the floor
- Need new support scheme
- Beam direction reversed from RHIC
- Need improved vacuum



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## Initial Changes and Modifications in 2004

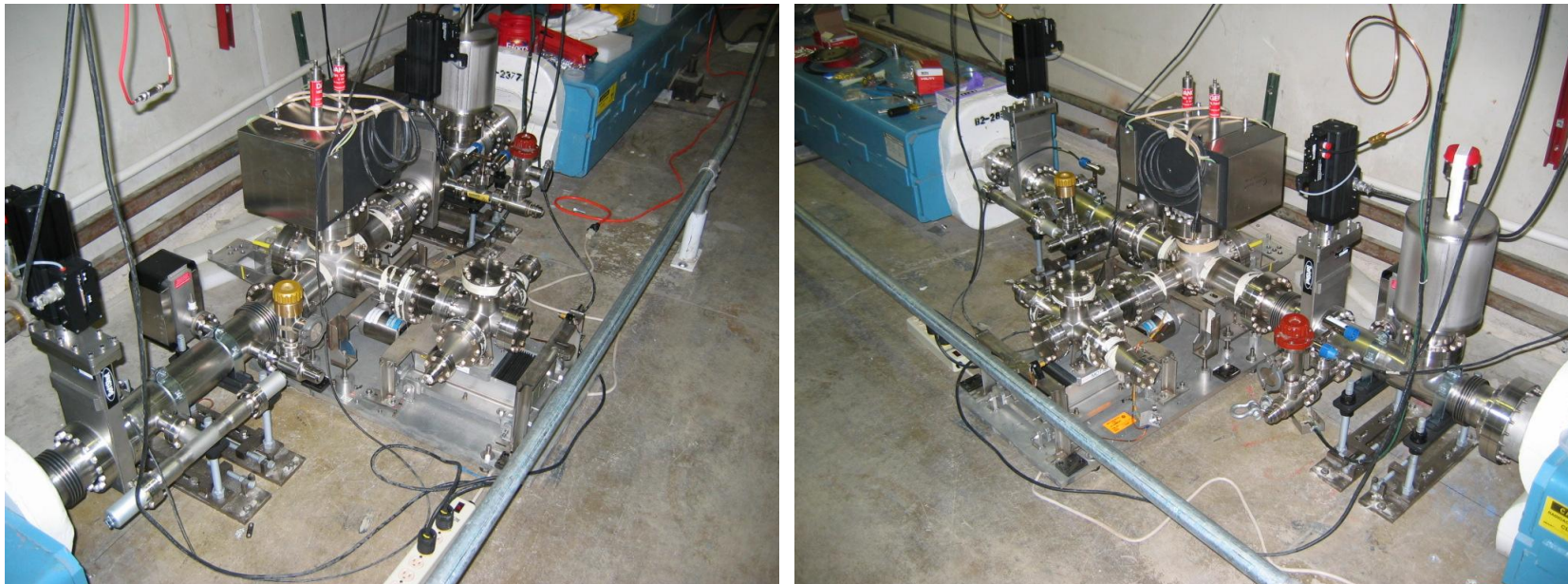
- Removed scintillators and covers
- Modified base plate for aisle clearance
- Modified mounting brackets of vacuum chamber for motor clearance
- Reversed position of horizontal drive motor for aisle clearance
- Added ion pump on top of vacuum chamber
- Turned crystal upside down for reversed beam direction
- Added standard tooling ball socket pads for alignment
- Designed and purchased heating blankets
- Repaired malfunctioning inchworm motor and internal LVDT

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Installation at E-0 in 2004

- Angular swing motion precision not satisfactory, internal LVDT problems
- Horizontal insertion drive motion not satisfactory, vacuum wants to pull the carriage in, horizontal drive slide is a ball screw, not self-locking, electric brake required



Rob Reilly - ADMSD

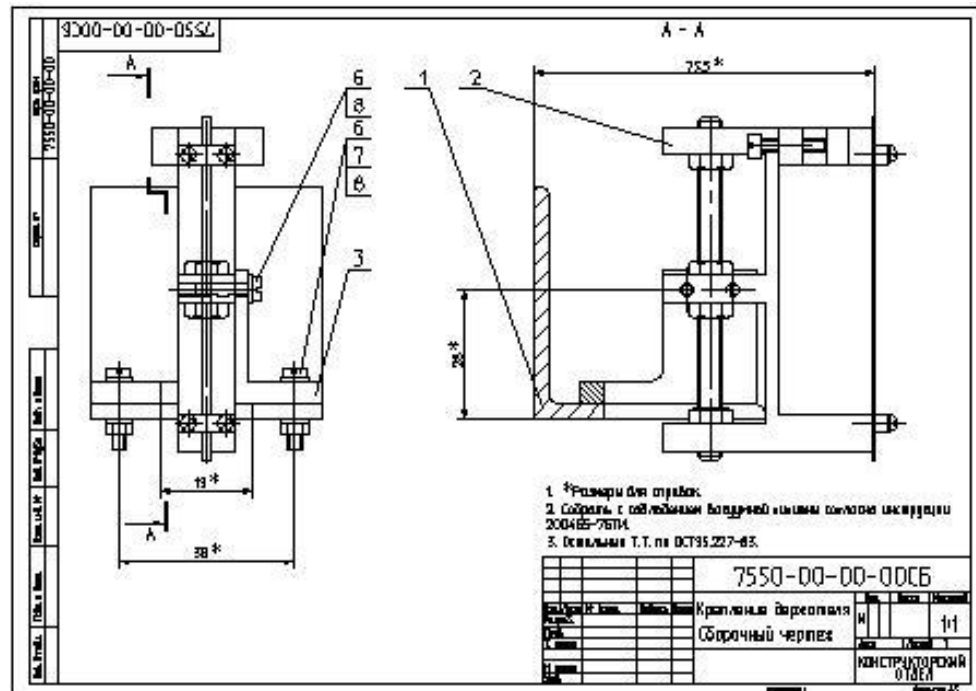
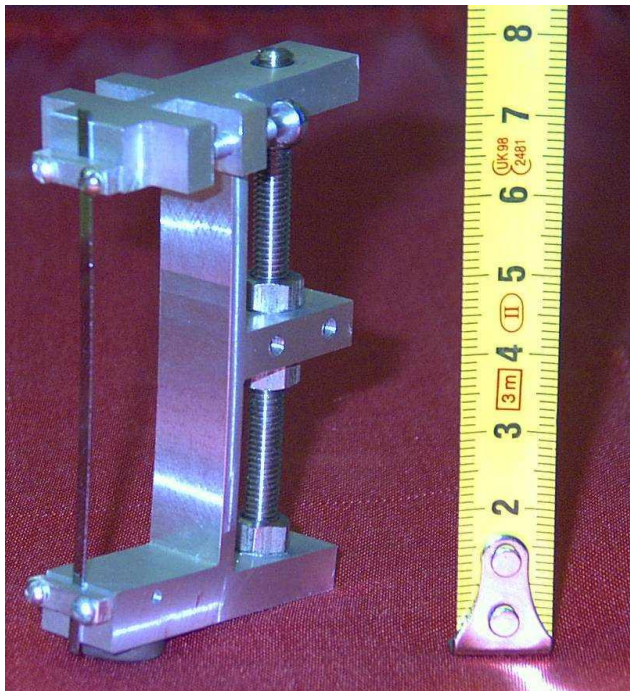
**Crystal Collimator**

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Changed to Russian strip crystal in 2005

- Made different holding bracket for end of swing arm





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Malfunctioning inchworm motor in 2006, 2007

- Made different wiring holding bracket
- Rewired inchworm
- Repaired inchworm limit switches several times
- Repaired burned out inchworm

