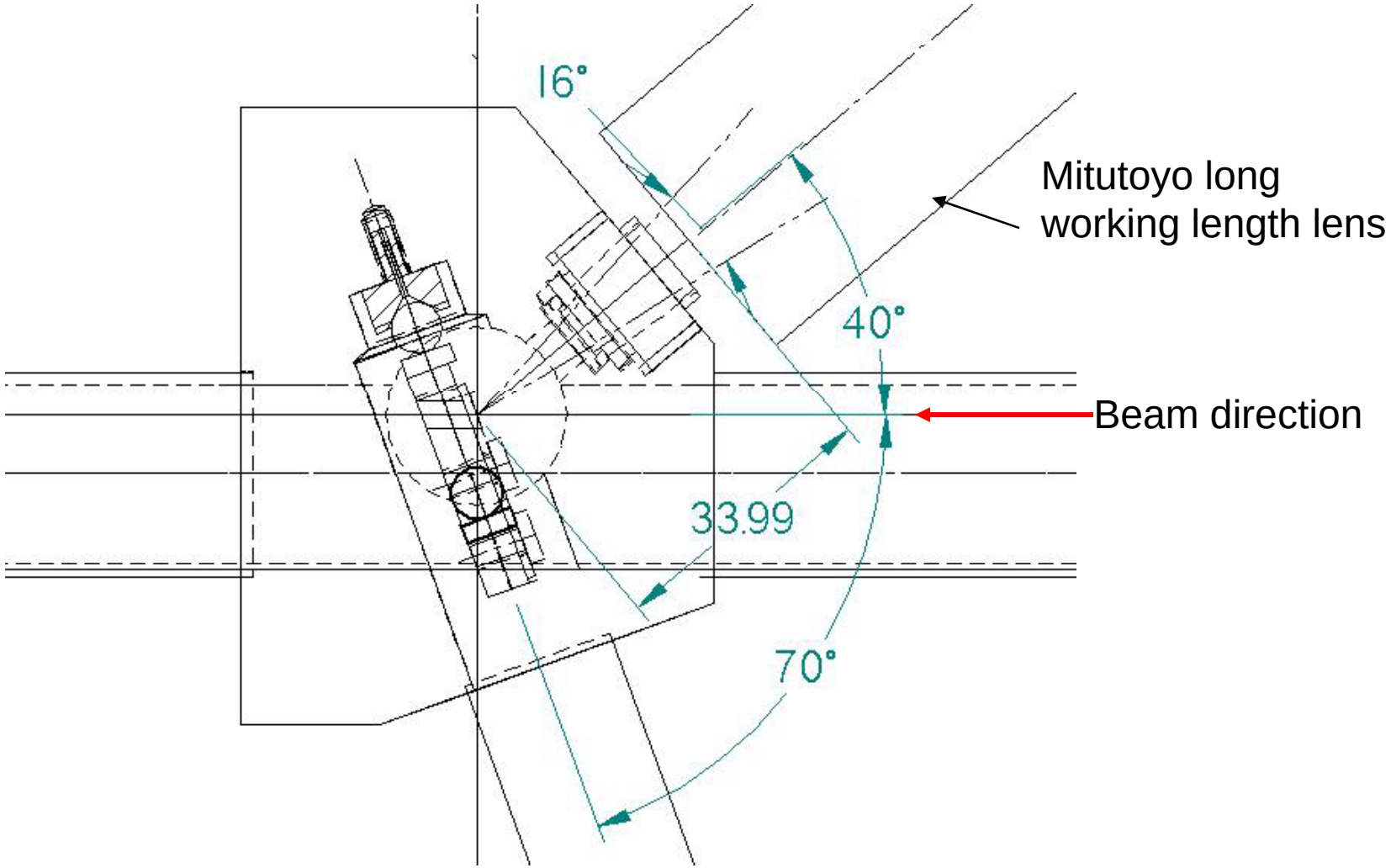
Four OTRs for ATF2

- OTR History
- Current OTR setup
- New OTR design

OTR History

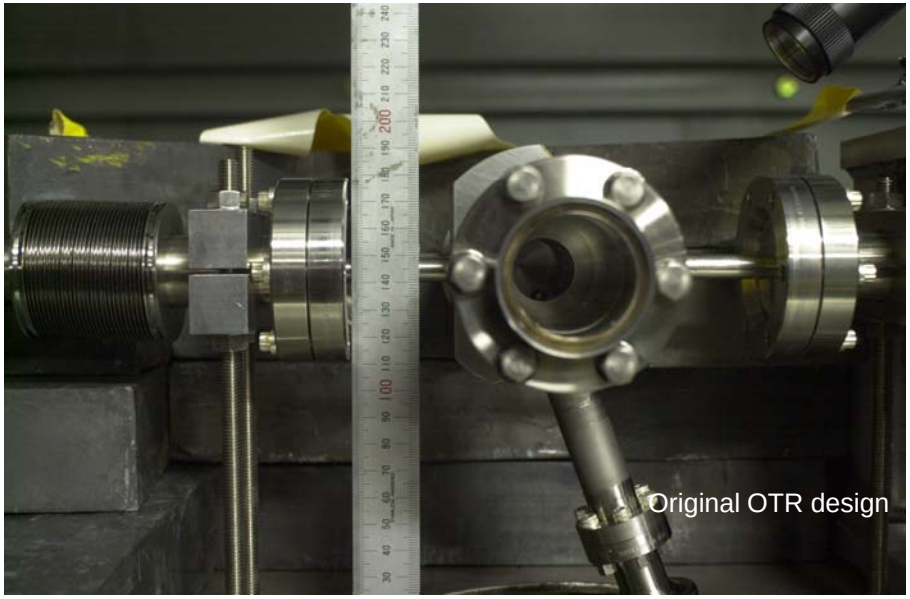
- 1st OTR was an evolved design rather than a optimized one.
  - New parts were added to the existing OTR to add functionality. Instead of making new design they were added bit by bit.
- As a result the 1st OTR is a patchwork of parts and takes up a lot of beam line space.
- Existing OTR targets were rather thick, about 0.5mm of copper, beryllium or glassy carbon. This caused radiation darkening of the glass lens and camera damage.
- The camera CCD was not parallel to the target. This meant that the beam spot was in focus on only a small portion of the target. If the beam moved, the image had to be refocused.

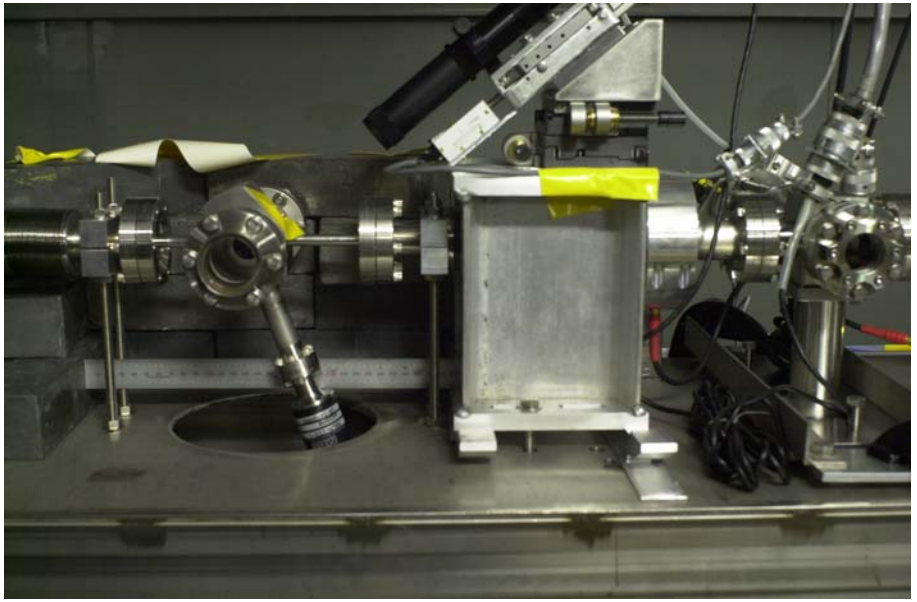
OTR Geometry



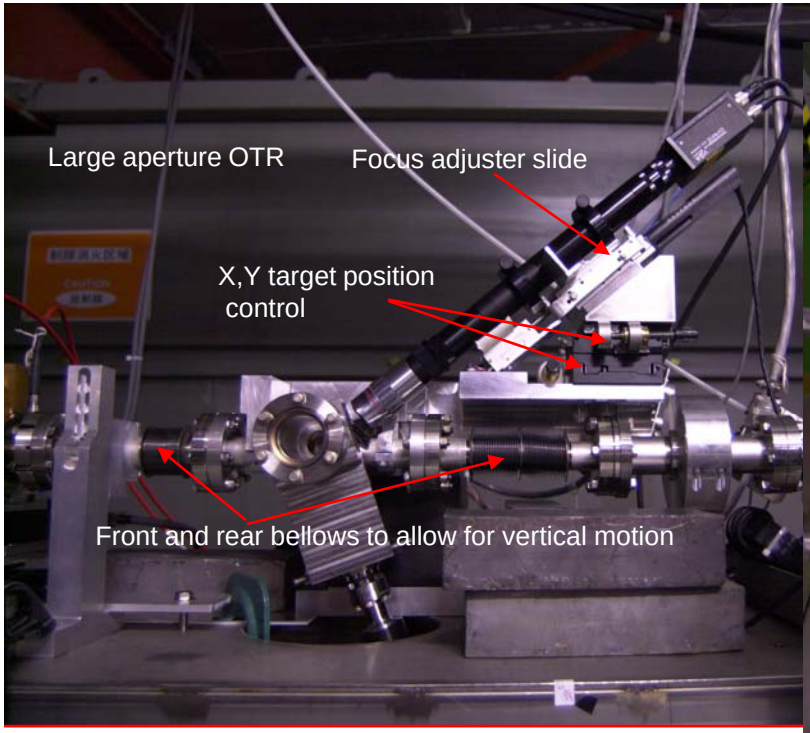
OTR Design Points

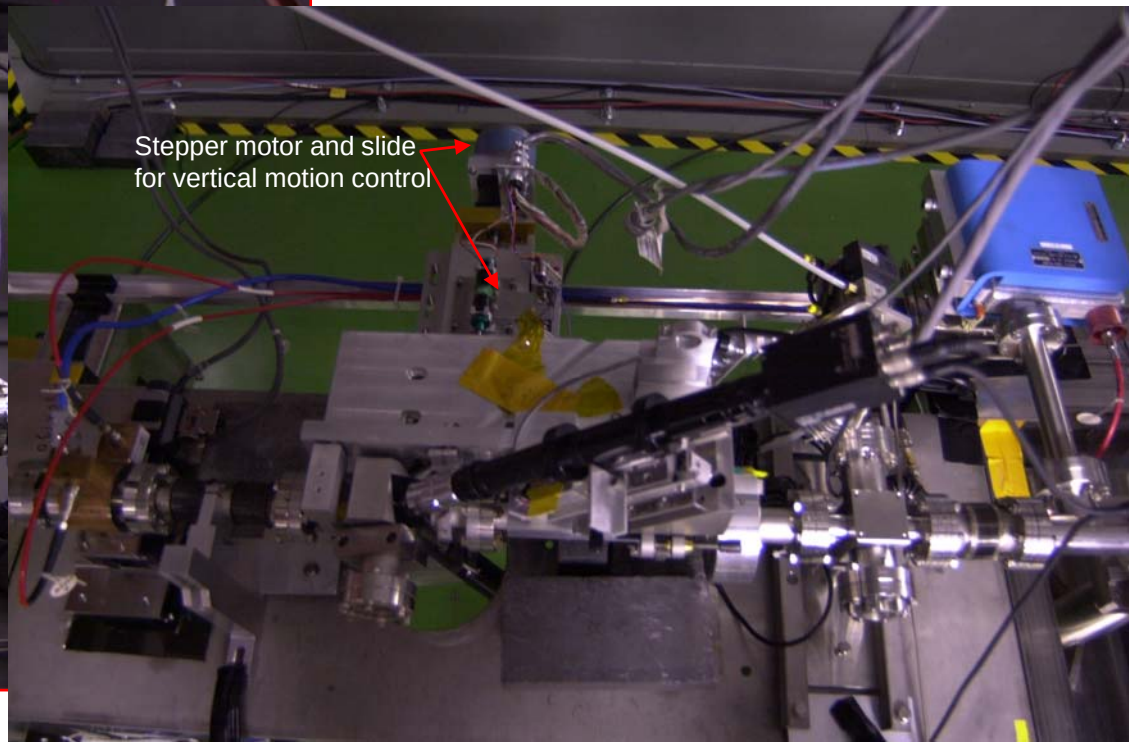
- The basic design was based on the working distance of the Mitutoyo 10x microscope lens (33mm) .
- This meant that during OTR operations the beam would be close (less than 5mm) to the beam pipe.
  - To accommodate the above geometry the original OTR had a 1cm beam pipe.
- Because of the possibility of target damage, the position of the camera and lens assembly was made adjustable with respect to the target, (used look at undamaged parts of the target)
- Depth of field with this lens was only a few microns, so a remote focus control was used.


Original OTR design

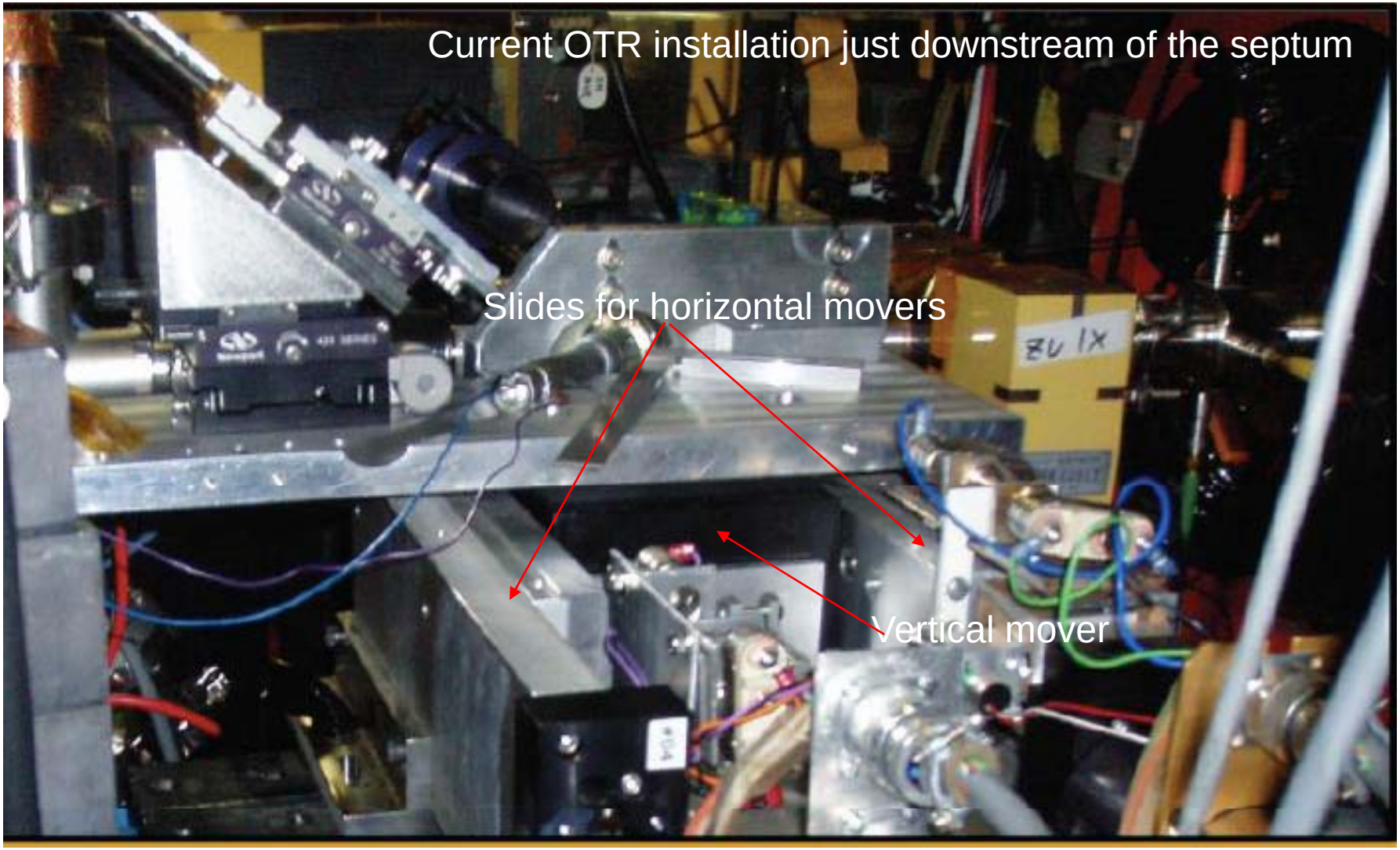


- However this design placed a permanent aperture in the beam line(which nobody liked) and had limited operational use as the beam had to be steered exactly to the correct spot on the target.
- To remove the aperture a 25mm beam pipe replaced the 10mm one and a vertical mover was installed. This allowed the OTR to move down to put the beam on the correct spot on the target and up to put the beam in the middle of the pipe.
- This provided a large aperture when the OTR wasn't in use and gave some vertical flexibility in the beam position. The OTR could now track vertical beam motion.

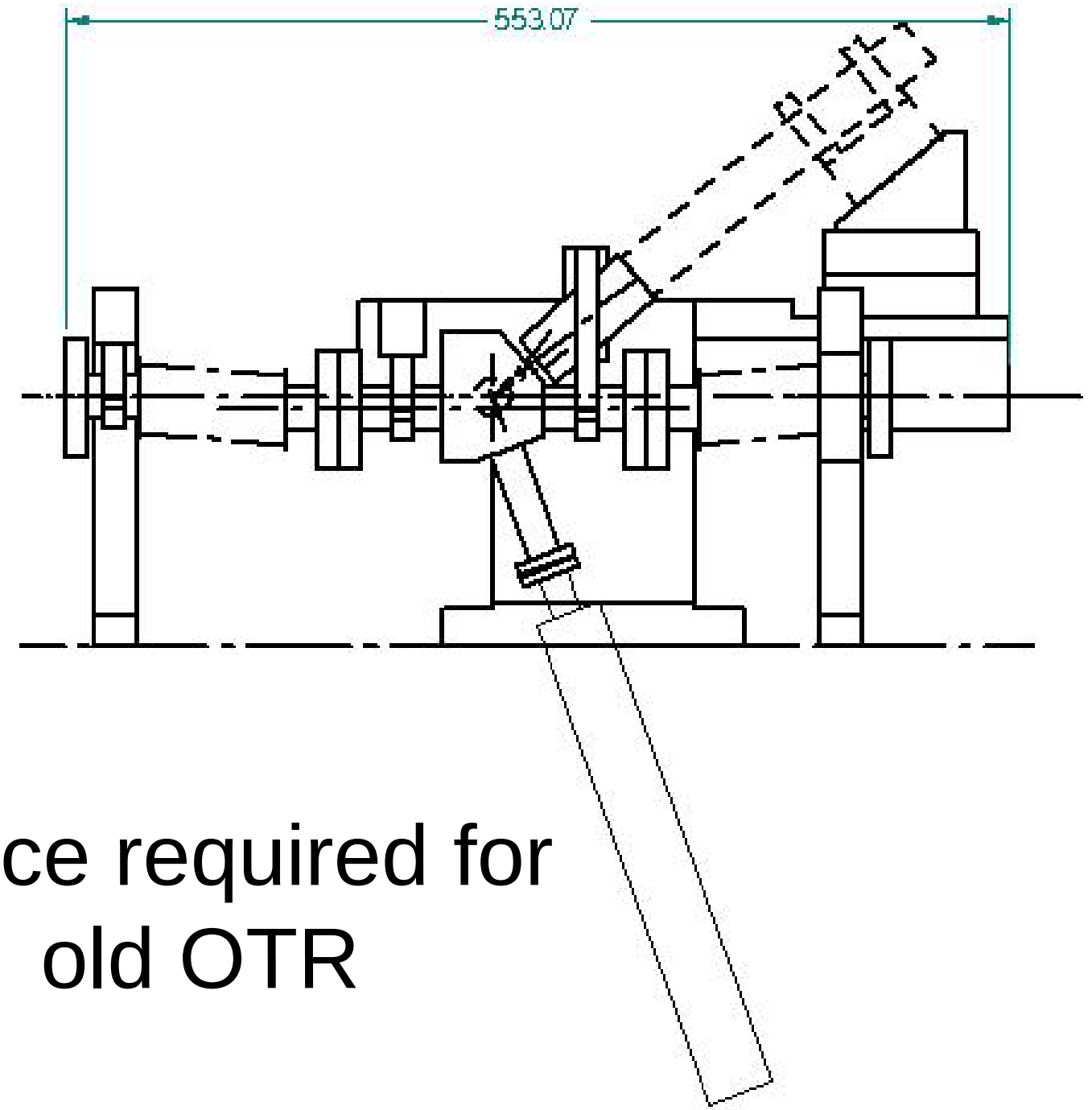




- This configuration was quite flexible and made operation fairly easy.
- The next change was to add a horizontal mover, and folded optics for a smaller installation foot print



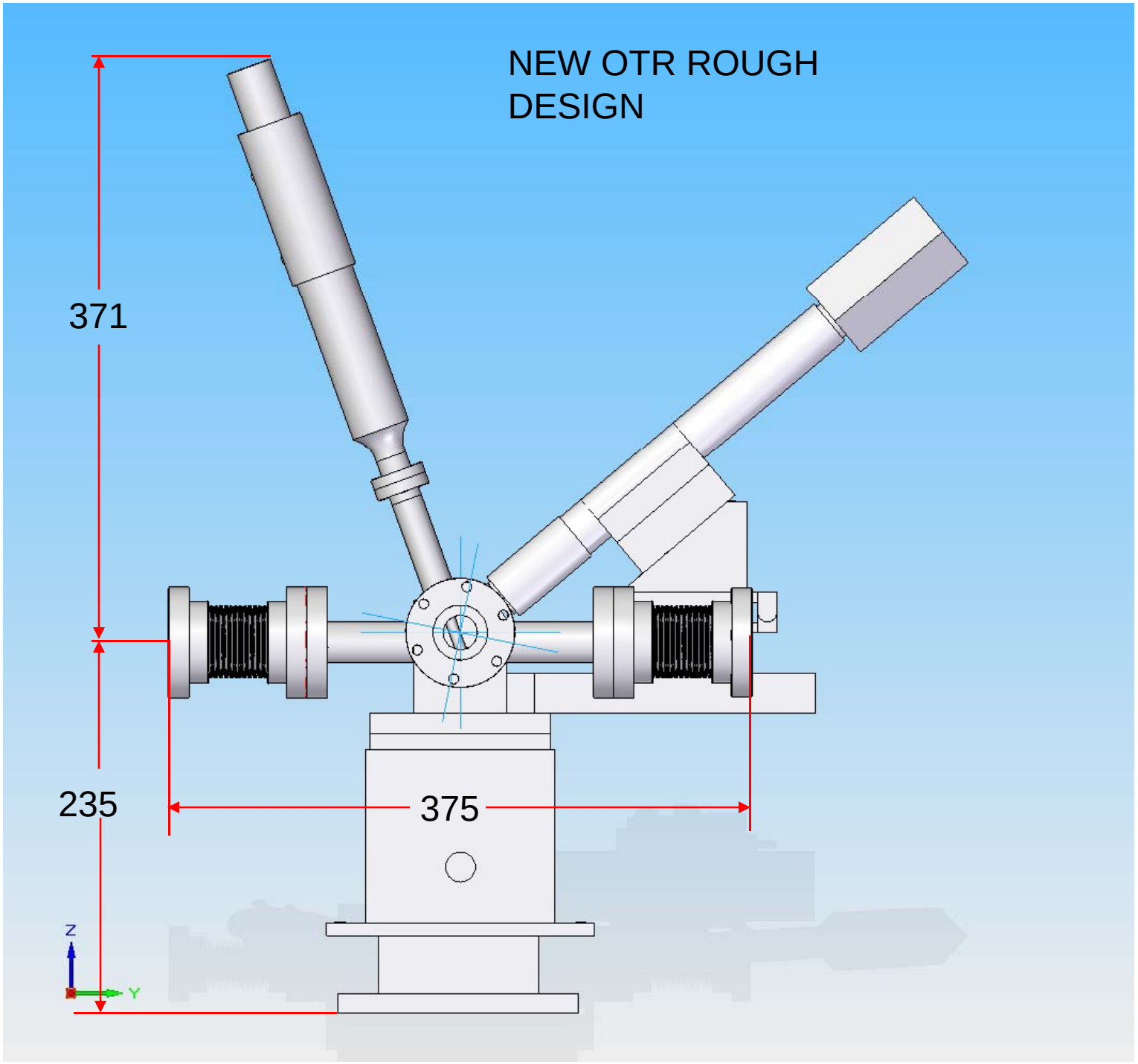
- With remote vertical motion already installed, remote horizontal motion was added to allow the OTR to track beam motion during quad scan emittance measurements.

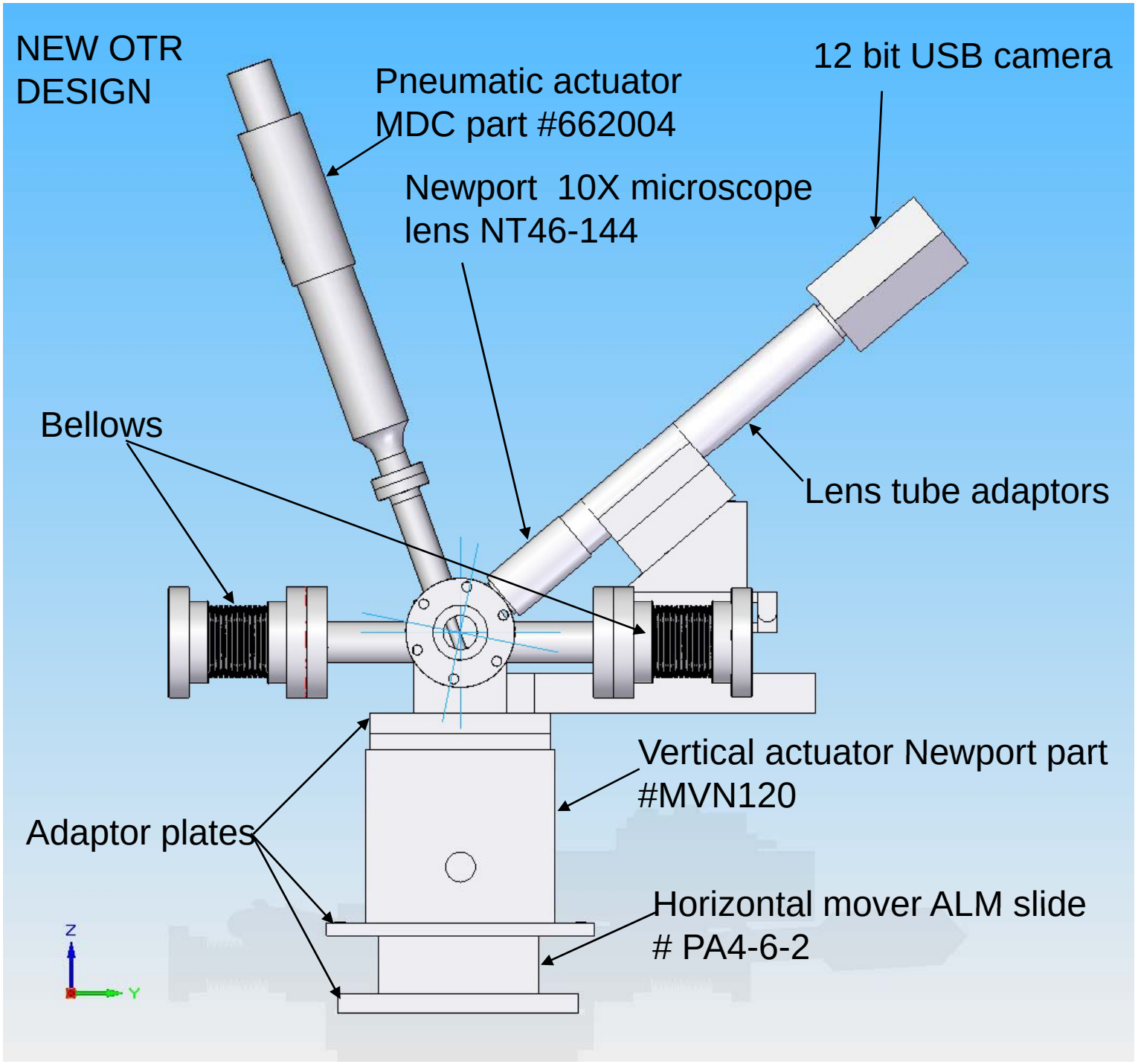


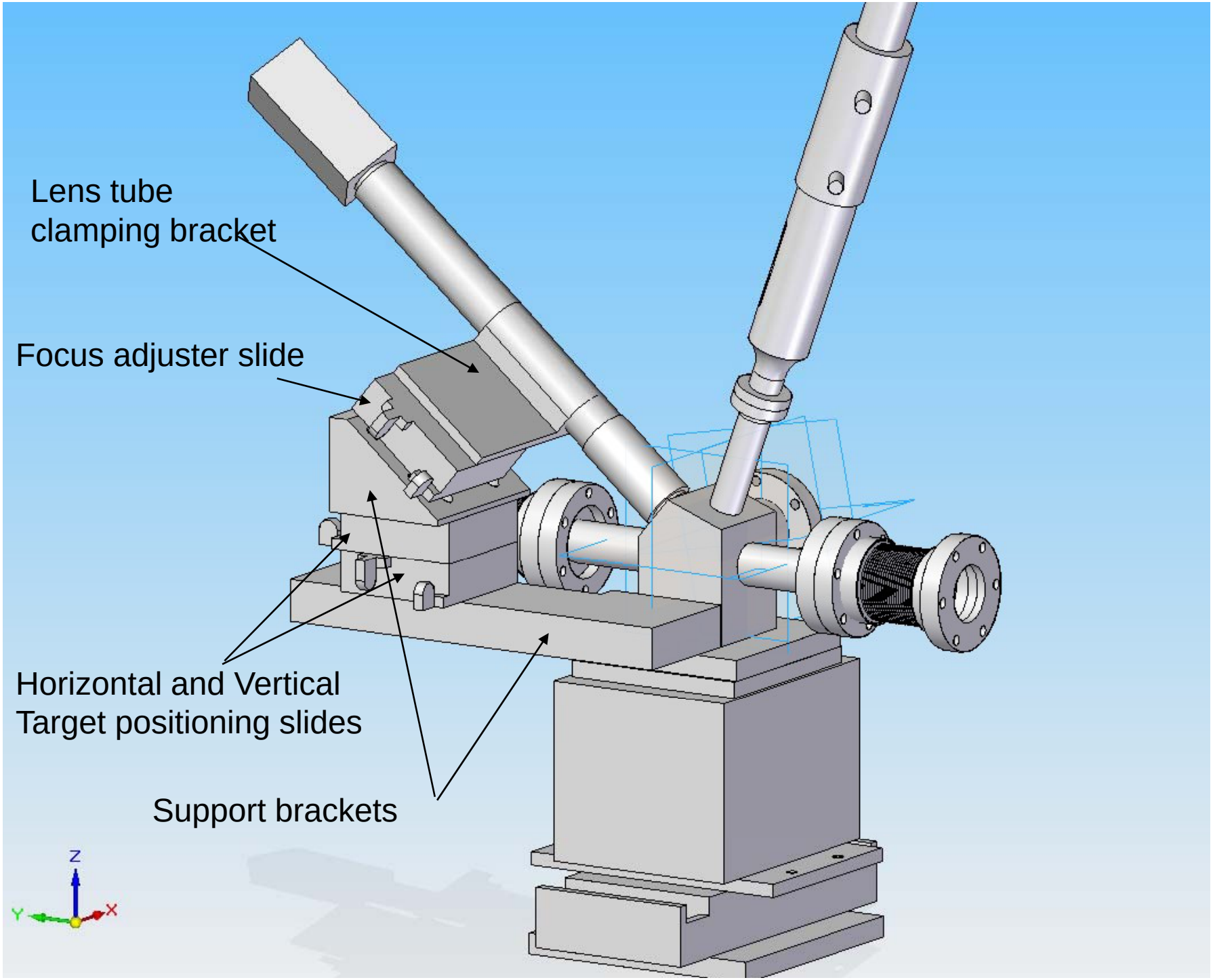
Space required for old OTR

New OTR

- Will optimize the design to reduce the footprint so it will fit in the smallest space possible yet still have the same capabilities.
- Target actuator used to be on the bottom of the old OTR. This created interference problems with the girder. It will be relocated to the top. This will allow greater flexibility in the OTR placement.
- Will try out new target material made of 5um thick nitrocellulose with 1200 angstroms of aluminum. This should reduce the radiation produced when the target is inserted. Will evaluate target light output and radiation levels during trip in May.
- Will “wedge” the camera so the CCD is parallel to the target. This should improve depth of field and make size measurements less sensitive to the position of the beam on the target. Test in May
- New 12 bit cameras have better dynamic range and about a factor of 2 smaller pixel sizes producing better resolution. Test in May.
- Aspect ratio of the beam of about 10 to 20 to one will require careful selection of camera CCD and lens magnification.


NEW OTR ROUGH DESIGN
371
235
375
Z
Y


NEW OTR DESIGN
Pneumatic actuator MDC part #662004
12 bit USB camera
Newport 10X microscope lens NT46-144
Bellows
Lens tube adaptors
Vertical actuator Newport part #MVN120
Adaptor plates
Horizontal mover ALM slide # PA4-6-2
Z
Y


Lens tube
clamping bracket
Focus adjuster slide
Horizontal and Vertical
Target positioning slides
Support brackets
Z
Y
X

Parts List for a single OTR

- OTR body
  - Body, 25mm beam tubes and flanges, target actuator sapphire window, indium seal, sealing plug, receiver for ball end of actuator shaft.
- Bellows
  - 25.4mm ID welded bellows 76mm long with 70mm flanges each end.
- Target actuator
  - MDC 50mm pneumatic actuator
  - Modifications to actuator shaft for ball end and target attachment.
  - Aluminum coated Mylar target.
- Lens and camera
  - Mitutoyo long range 10x microscope lens
  - 12 bit gigae camera.
  - Tube lens and tube extensions.
  - Software development for frame grabbing and spot size measurements.
- Movers
  - Newport MVN120 vertical mover
    - Linear stepper motor to actuate vertical mover.
    - Hardware for mounting linear stepper motor.
    - Read back pot.
    - Limit switches.
  - Cross roller slide with stepper motor control.
    - NEMA frame 23 stepper motor
    - Read back pot
    - Limit switches
  - Slide for focus control
    - Newport CMA stepper motor
    - Read back pot
    - Limit switches
  - 2 manual controlled slides for target position adjustment.
- Control system channels. VME based stepper motor control and position read back.
  - 3 channels stepper motor control
  - 3 channels mover position read back.
- Hardware
  - 2 Support brackets for optical system support
  - 3 Adaptor plates for mover and OTR mounting

Summary

- New OTRs will have same controls and motion capabilities as current OTR with the following improvements:
  - Reduced footprint along the beam line.
  - Reduced radiation damage from a thinner target.
  - 12 bit camera for more dynamic range with smaller pixel size for more resolution.
  - Camera CCD Placed parallel to the target to provide greater depth of field.