OMC Layout Modification Plan v2

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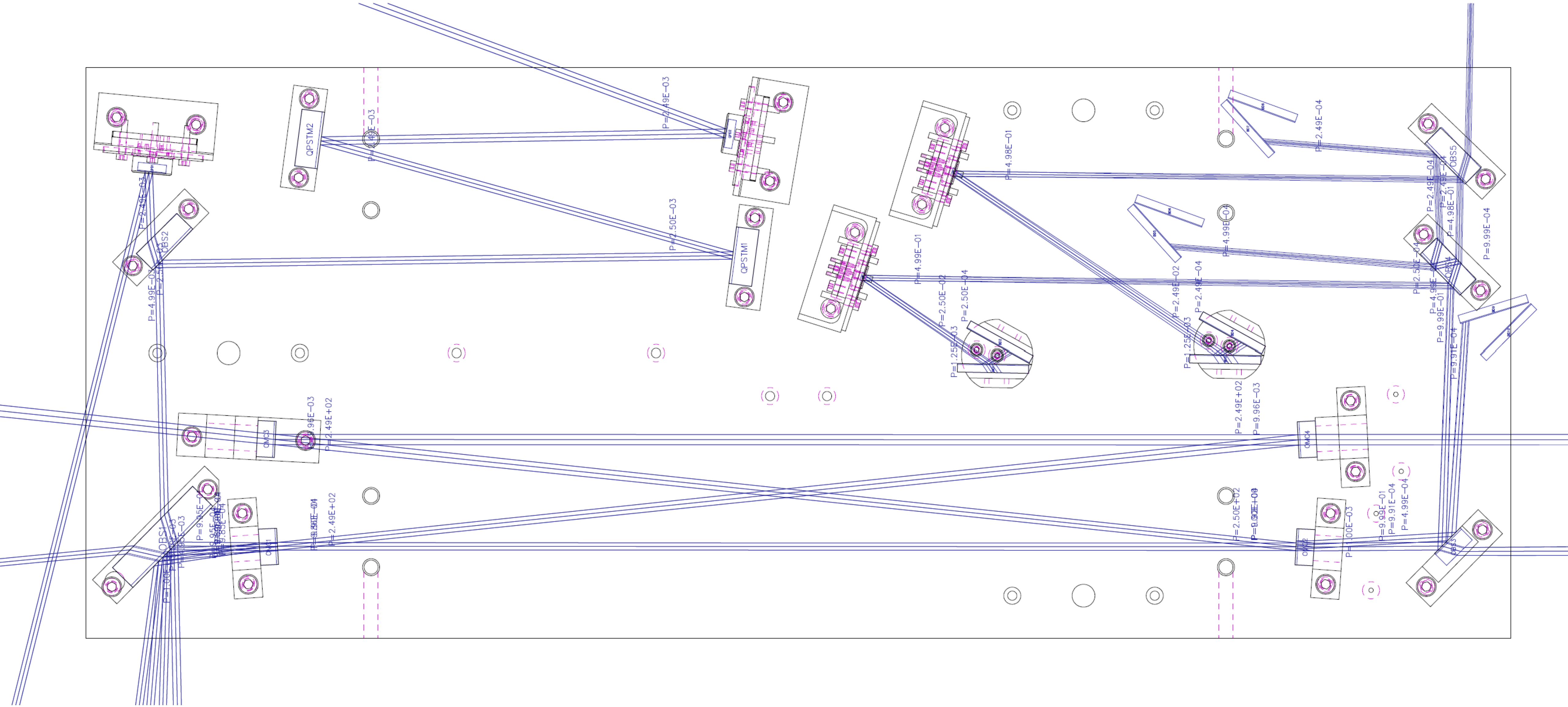
There are several problems with the current component layout of the OMC

- OMC cavity axis does not go through the center of the mirrors
- The beam spot size on the DC PDs is too large
  - The aperture size is about the same as the 2.7sigma diameter of the beam
- Ghost beams need to be dumped.

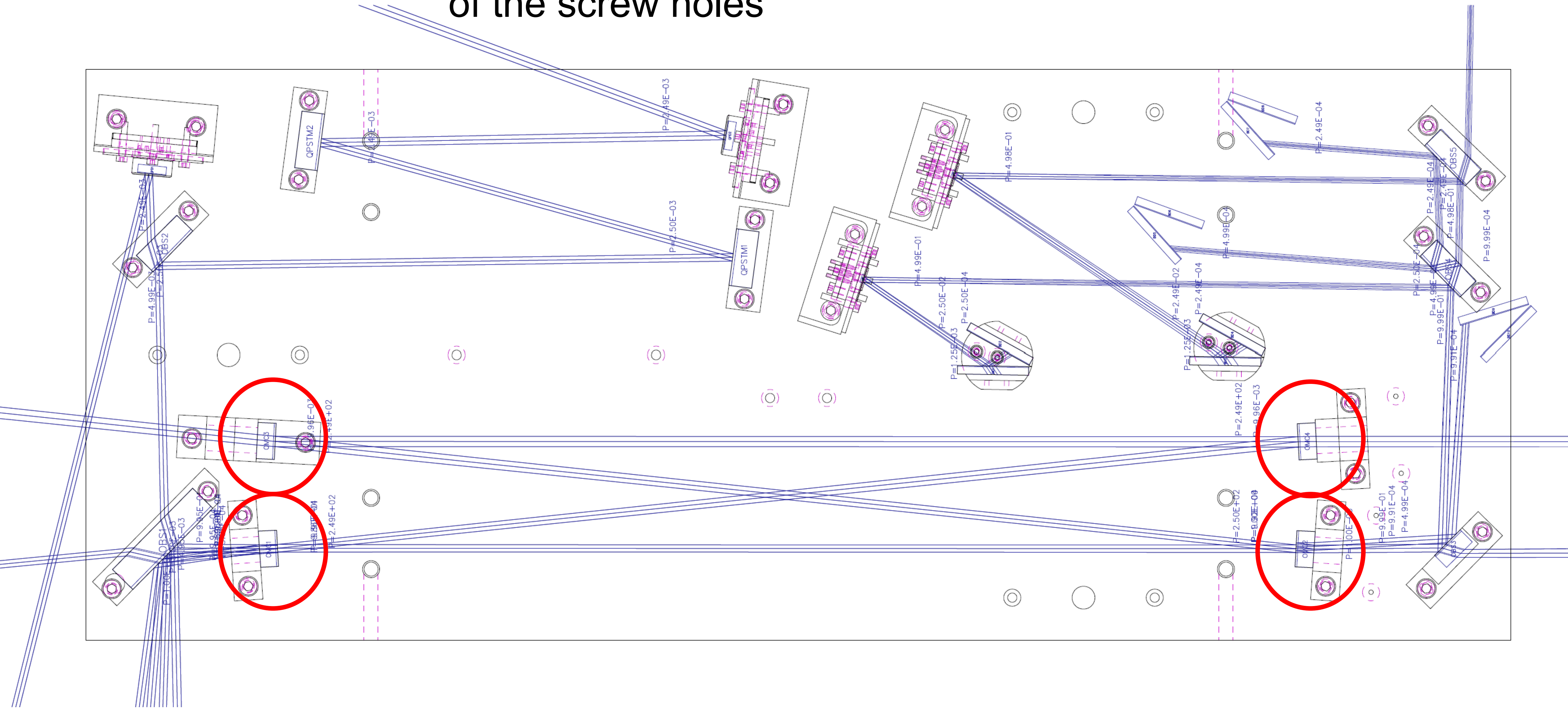
In order to cope with the above issues, I propose to modify the layout of the OMC as shown in the following pages.

Modified OMC layout with stray beam tracing

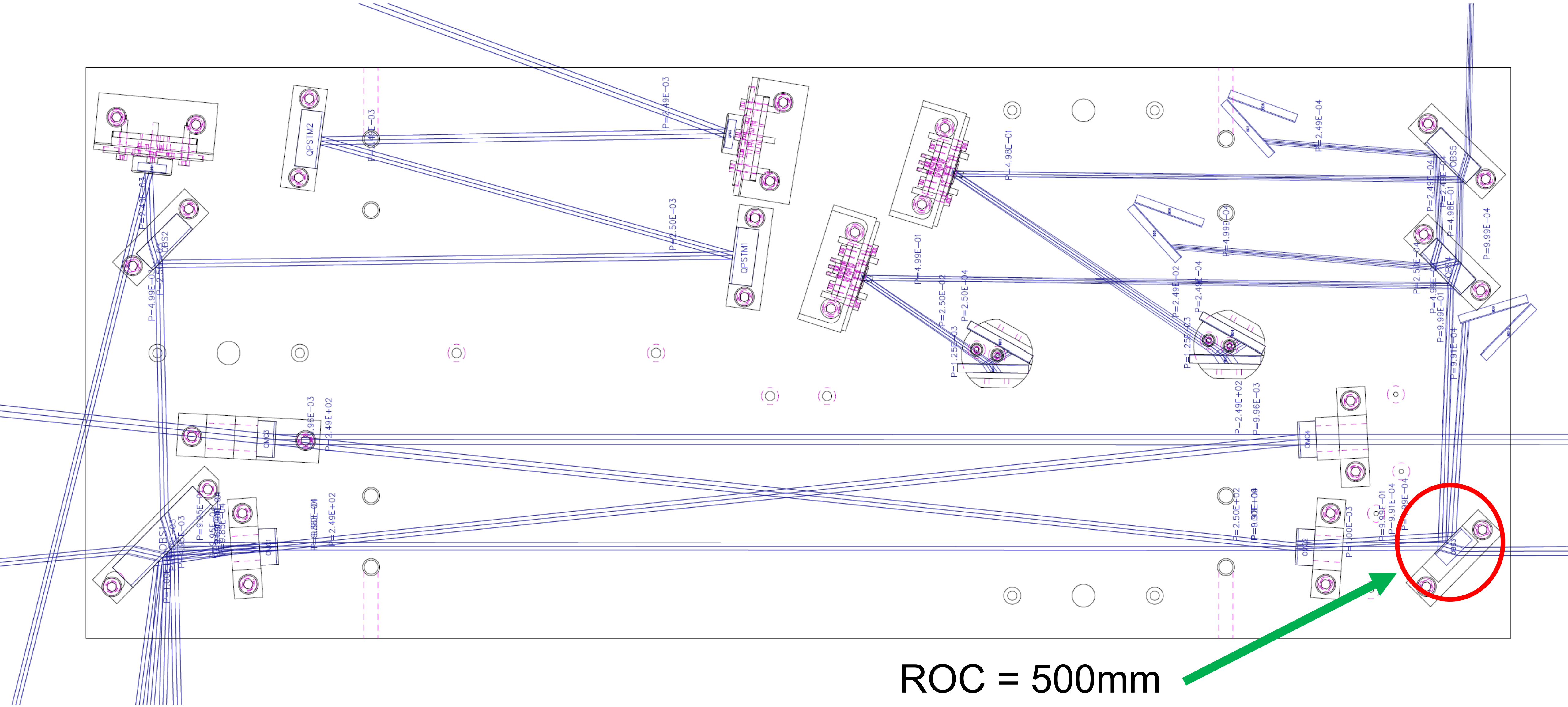


Stray beams with 1/10000 of the input power are shown

Modification point 1: Slightly tweak the OMC mirror orientations within the play of the screw holes



Modification point 2: Replace the OBS3 with a curved mirror



ROC = 500mm

A new mirror mount will be designed for this mirror

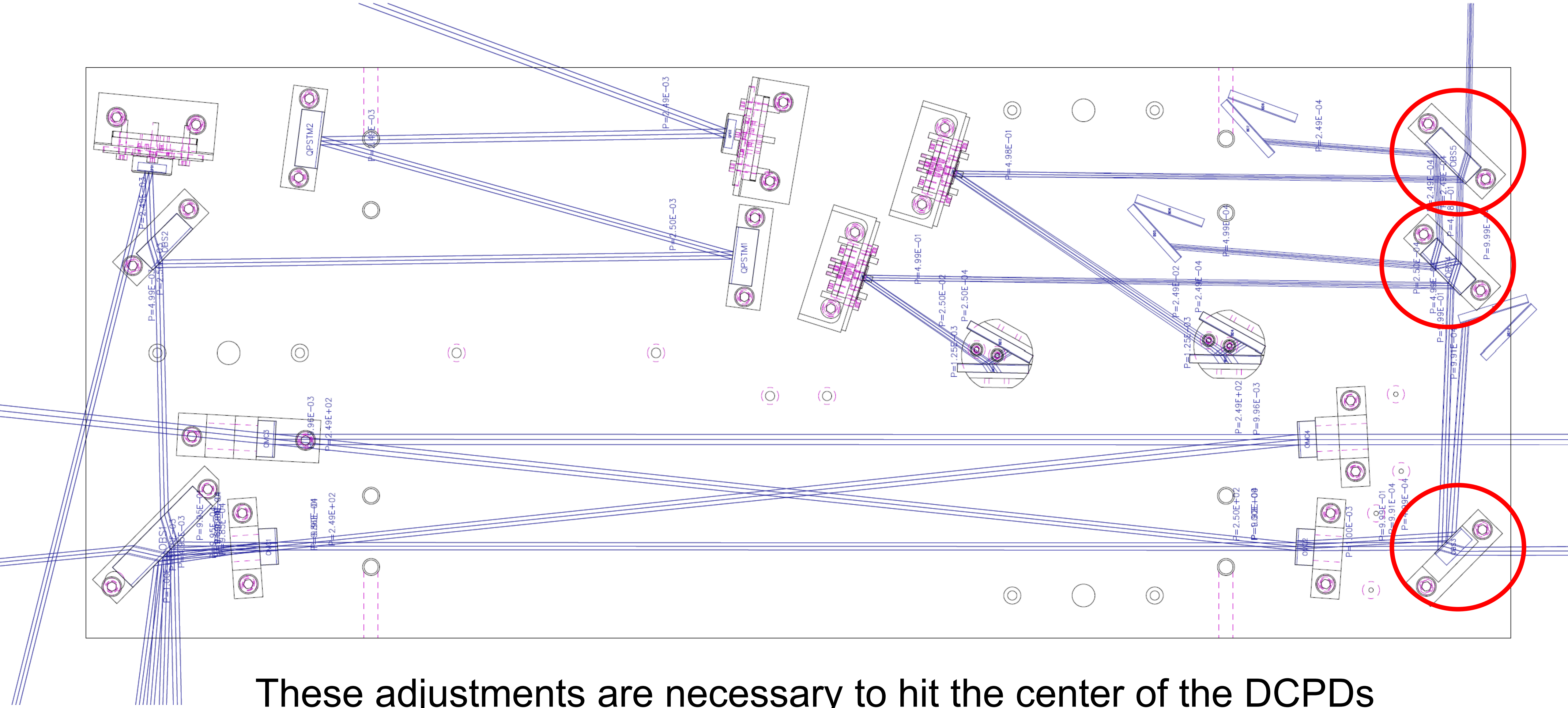
Explanation of the modification point 2

A curved OBS3 will make the beam spot size smaller at the DC PDs.
$\Rightarrow$ 3 sigma diameter will be about 1.9mm

The 45deg. AOI induces strong astigmatism. Still, with ROC=500mm, the beam becomes circular on the PDs.

Asking Layertec about the possibility of using a stock mirror for 0 deg. AOI with p-pol 45deg AOI.

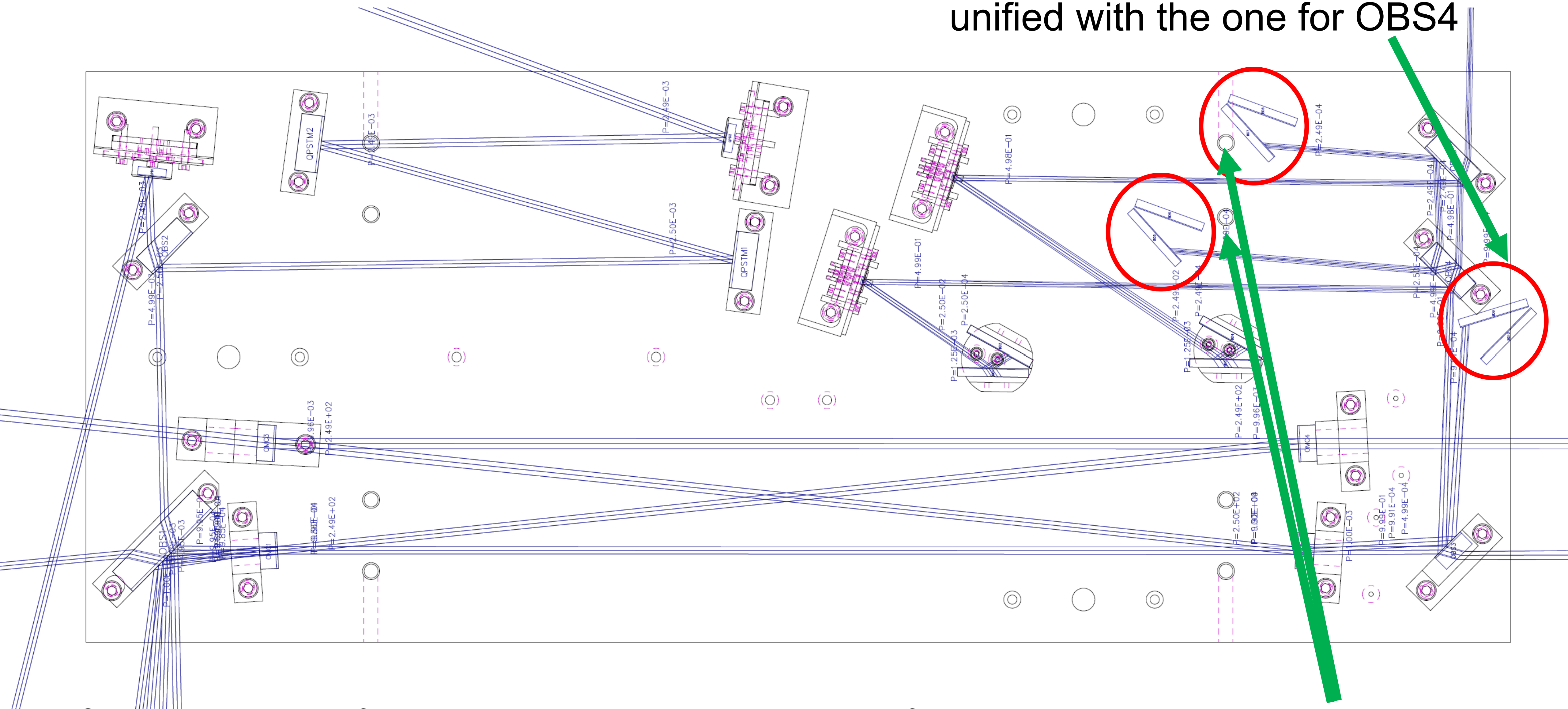
Modification point 3: Tweak the orientations of those mirrors



These adjustments are necessary to hit the center of the DCPDs as well as avoiding AR reflected beams hitting the barrel of OBS4

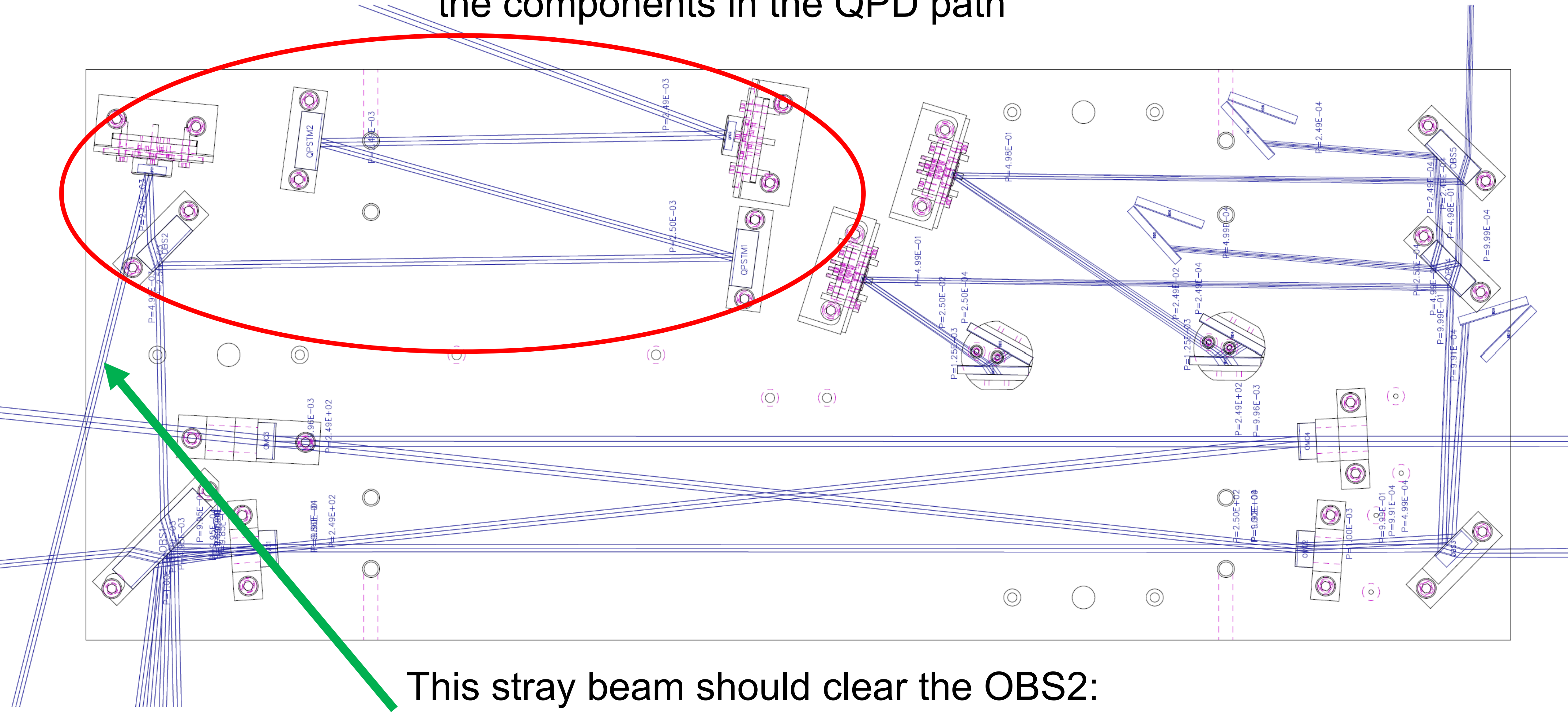
Modification point 4: Additional beam dumps

The mount for this BD should be unified with the one for OBS4



Special mounts for those BDs are necessary to fix them with the existing screw holes

Modification point 5: Tweaked the orientation and position of the components in the QPD path



This stray beam should clear the OBS2: rotated the QPD1

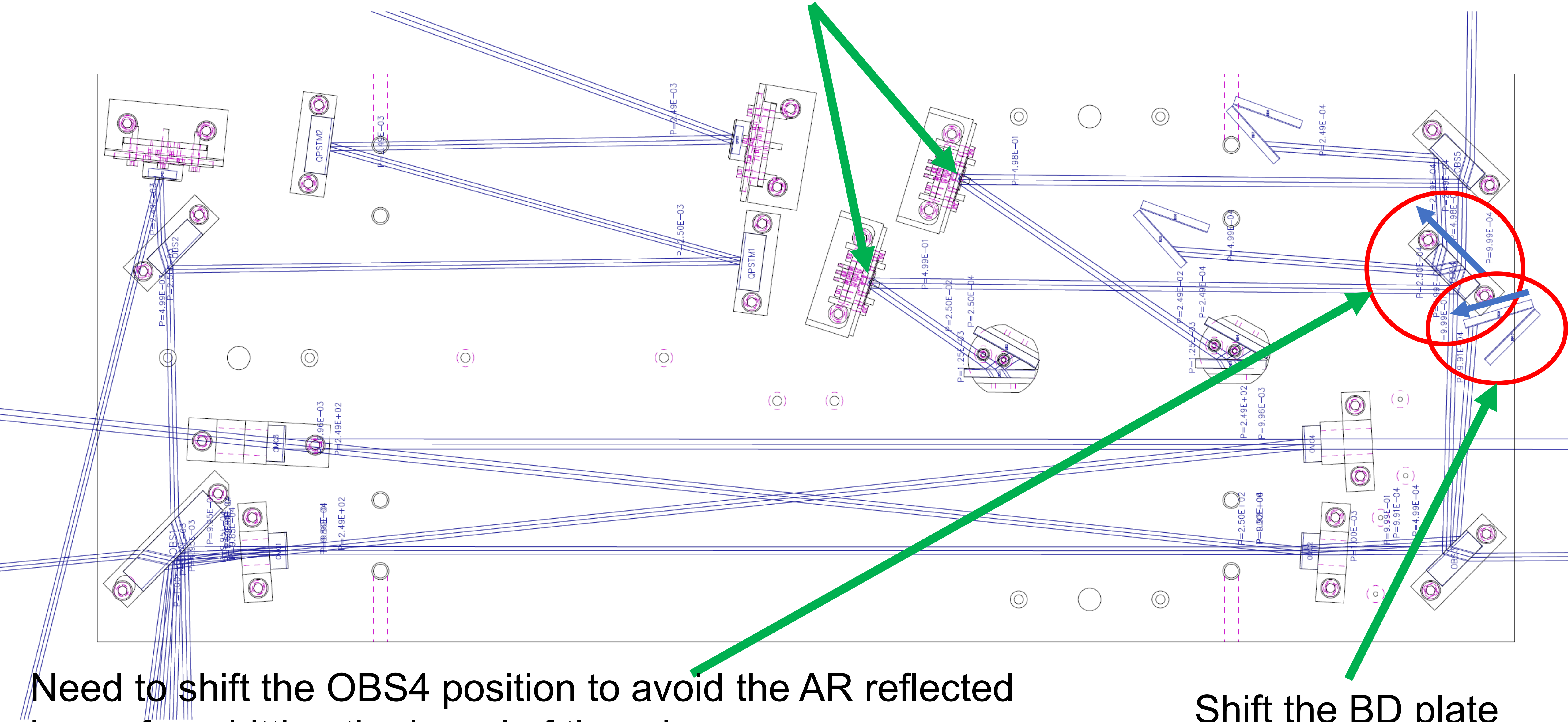
If the lead-time for the curved OBS3 is too long, we can fall back to the flat OBS3

In this case, the beam spot size on the DCPD becomes larger
(3 sigma diameter is 3.7mm)

Small adjustments to the OBS4 and the BD positions are necessary

OMC layout with a flat OBS3

Beam size is larger

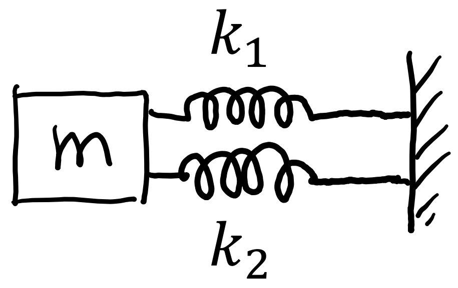


Need to shift the OBS4 position to avoid the AR reflected beam from hitting the barrel of the mirror

Shift the BD plate

Damping the 700Hz resonance

- Effectively damping a stiff mode requires a stiff lossy material
- Assume a spring-mass system shown on the right
  - k_1 represents a stiff resonant mode
  - We attach a lossy spring k_2 in parallel
- The overall spring constant is
  - $k = k_1 + k_2(1 + i\phi) = (k_1 + k_2)(1 + i\frac{k_2}{k_1+k_2}\phi)$
- Therefore, the effective loss angle will be smaller than the original loss angle of the lossy material by a factor of $\frac{k_2}{k_1+k_2}$.
- This means, the stiffness of the lossy material (k_2) needs to be comparable to k_1 to effectively damp the stiff resonant mode.
- Soft materials such as rubber may not be effective in our application.
- Damping metal M2052 is a potential candidate for killing the 700Hz resonance.



A possible configuration of attaching M2052 rods on the bottom of the OMC breadboard.

Red rods are M2052

We use existing screw holes and clamps (purple components) to attach the M2052 rods.

This is just an idea.
Details need to be worked out.

Takahashi-san will perform a test in Mitaka.
Aso ordered an M2052 rod for this test.