I PREX COLLIMATOR ALIGNMENT PROCEDURE

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This document explains the desired alignment of the PREX collimator. Issues for discussion are: how feasible is this and what the final accuracies will be.

For Parity experiments it is highly desirable to have symmetry in the apparatus as "seen" by electrons coming from the target. The collimator should select angles that are identical on the left and on the right. Also there should be good up/down symmetry. If this is achieved it will reduce systematic errors.

Figures 1 and 2 show the PREX collimator. One HRS has the Beryllium plug up and the other down (it doesn't matter which). Figure 2 shows the concept for the alignment. The first step is to make the apparatus as symmetric as possible, both left/right and up/down. The equivalent placement tolerance is ± 1 millimeter for the location of the center of the collimator. The absolute location is *not* important; what matters is that the symmetry is good, i.e. whatever the angle to the left is, the angle to the right is the *same*.

Of course the absolute location does matter somewhat because we want to fit the septum magnet which was engineered to select 5° scattering angle. The point is we want to make small adjustments to the collimator position to account for the reality that the HRS are not perfectly symmetric.

It is not very important that the quads Q1 on left and right are symmetric, nor that their optic axis points exactly to the target center – although we should try to get these things reasonably close. The reason it's not important is that we will anyway use procedures for determining the central scattering angles and the track reconstruction at the target; these involve sieve slit measurements and a water cell calibration which will not be discussed here.

As a side point, we'll need to make sure the tungsten actuator works under vacuum and that we know in a definite way whether the tungsten is in or not (Be blocked/ unblocked).

Here is a possible alignment procedure, put here for discussion purposes.

1. Put the HRS in the nominally correct position with no septum magnet in place.
2. Using survey support, place the collimators in the bore of Q1 so that they are symmetric left/right and up/down with an equivalent 1 mm placement tolerance. After adjustment, the collimators should be rigidly locked (shimmed) in position so they will not subsequently move.

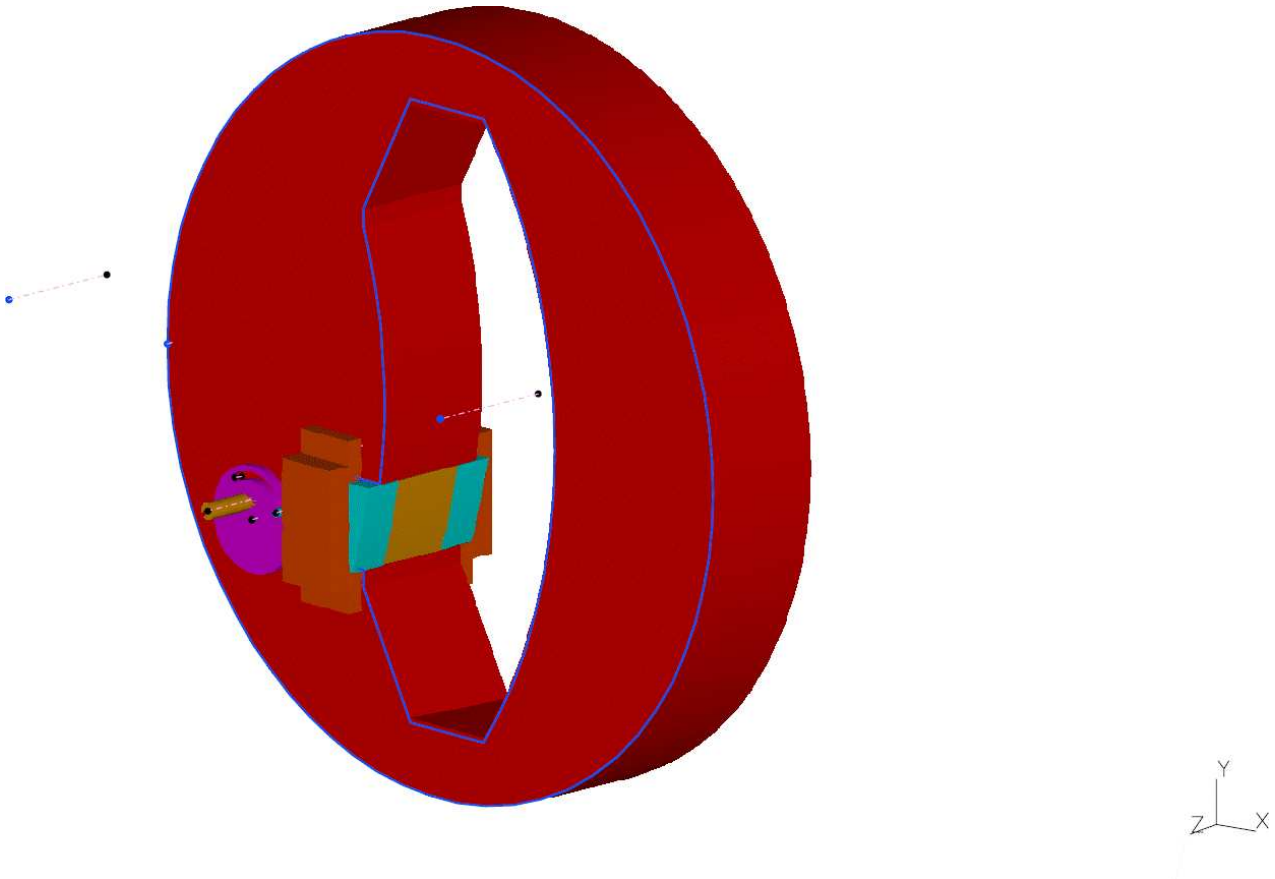

FIGURE 1. 3D view of the PREX collimator. The Be plug is shown near the bottom of the aperture. It can be blocked by a remotely actuated tungsten plug.

3. At this point it might be necessary to move the HRS for further construction. If so, one should survey external points on the HRS such that the reproducibility of their positions is known.

4. Build the septum magnet in such a way as to preserve the symmetry as much as possible. It's difficult to give a spec on this because it also depends on magnetic field quality. Assuming the field is a perfect dipole, the septum should be built with good left/right and up/down symmetry at the level of 2 mm, if possible. A more practical advice is to just do the best you can.

5. If the HRS had been moved, then we should check after-wards, using a survey of external fiducials, how well they've been relocated. Hopefully the 1 mm position accuracy can be maintained.

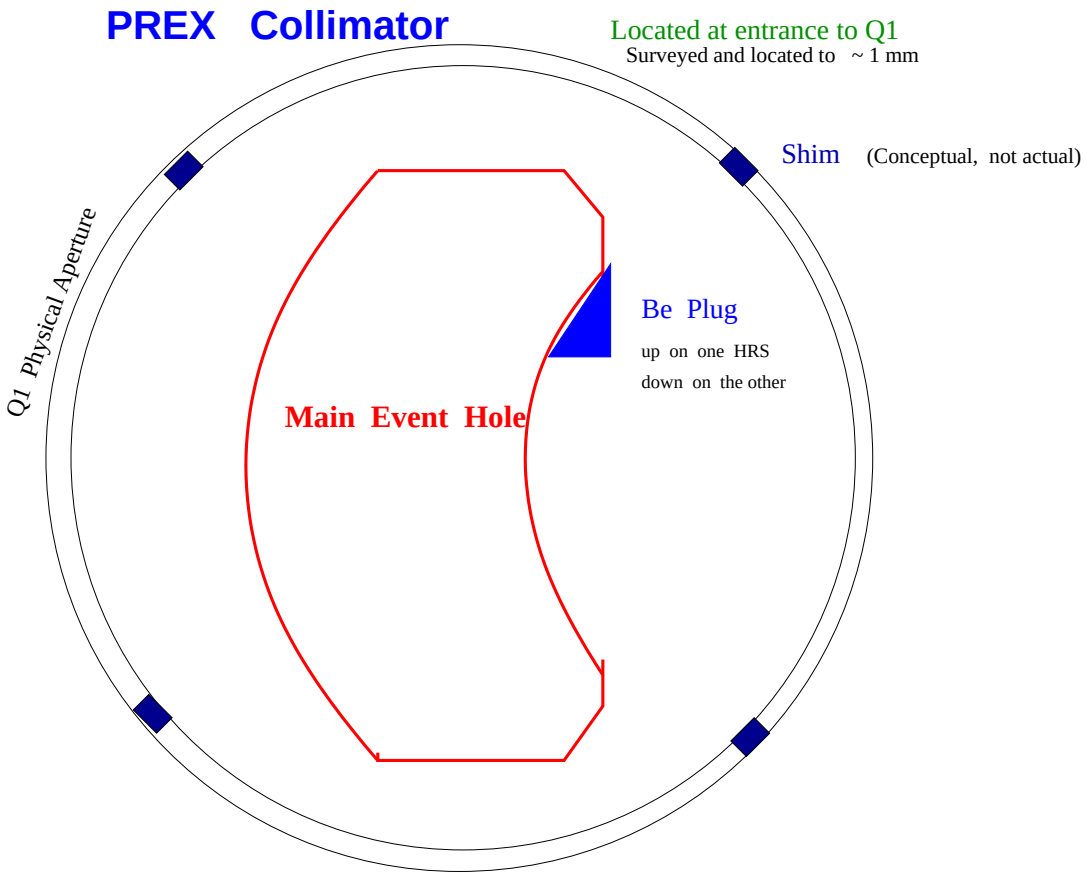

FIGURE 2. Conceptual drawing of the PREX collimator.

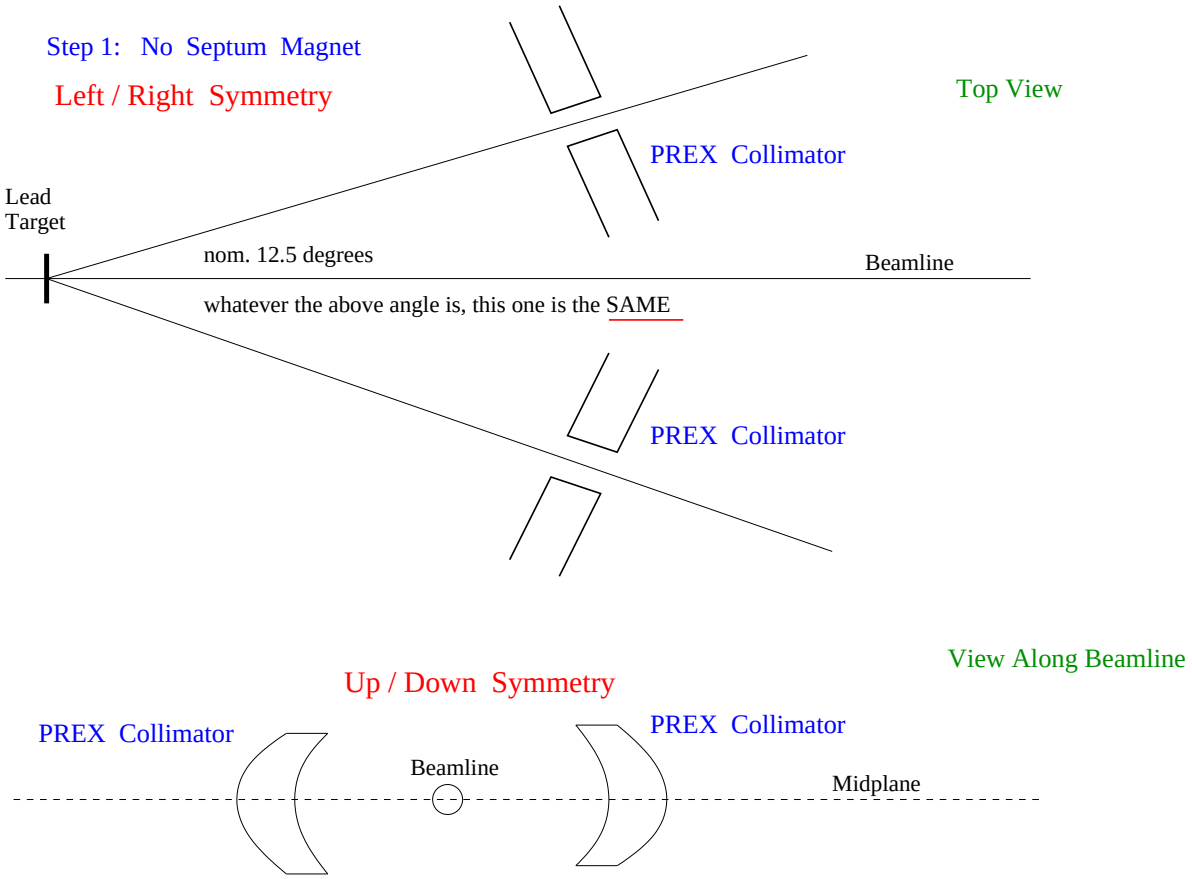

FIGURE 3. Concept of the collimator alignment requirements for PREX. Perfect symmetry is desired for left-right and up-down for electrons coming from the target in the absence of a septum magnet. When the septum magnet is built it should be done in such a way to preserve this symmetry. The pointing accuracy of the HRS optic axis is of less importance.