

# PRad-II, X17 and TFF Tasks List

PRad Collaboration

PRad equipment	PRad-II	X17	pi0 TFF	Group responsible
Target chamber	No change	replace with large dia. pipe	replace with large dia. pipe +target fixture	JLab target group
Target pumps	No change	No change	No change	JLab target group
Target cell	No change	not used	not used	JLab target group
5m long Vacuum chamber	more pump ports	same as PRad-II	same as PRad-II	Hall -B engineering
HyCal modules	LG to PbWO <sub>4</sub>	inner PbWO <sub>4</sub> used	same as PRad-II	NCA&T and MSU
HyCal readout	fADC based readout	subset of PRad-II	same as PRad-II	JLab DAQ and MSU
Dynode based Trigger	FPGA based custom trigger	FPGA based custom trigger	FPGA based custom trigger	JLab Fast electronics
GEM chambers	two new chambers	same as PRad-II	same as PRad-II	UVa and JLab detector group
GEM readout	MPD-APV system	same as PRad-II	same as PRad-II	UVa and JLab fast electronics
2 mm vacuum window	No change	smaller 1 mm window	No change	Hall B engineering
solid target ladder	No change	used for target	Special fixture	Hall B engineering
W shield for inner blocks	No change	No change	New extended shields	UMass

Table 1: Changes in equipment relative to PRad

## List of Engineering Tasks

### Beamline

1. Additional halo blocking collimator which can re-use the existing HPS collimator setup as shown in Fig 1. Three different collimator holes, 1-inch diameter, 0.5 inch diameter and 0.25 inch diameter will be needed. We also need a radiator foil to produce real photons for the calibration of HyCal. This collimator should be placed either downstream of the 2C21 harp, or at the current location of the raster magnets. The additional halo blocker is essential for the PRad-II experiment.

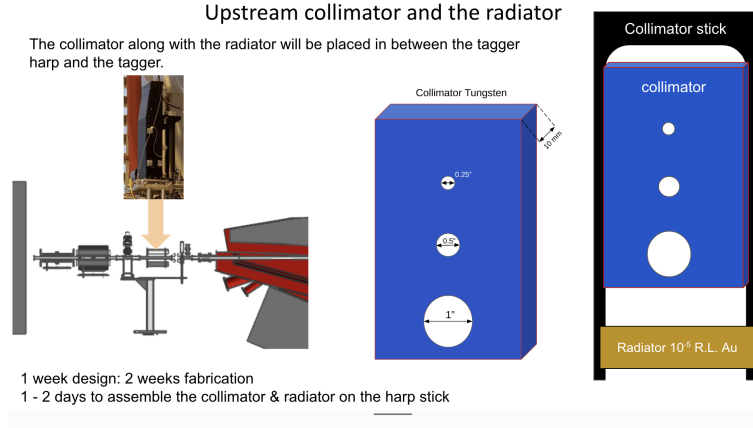


Figure 1: New collimator using the existing HPS collimator setup.

2. Harp modified to hold two Ta target foils as shown in Fig 2. The existing harp stick has to be modified to hold two thin Ta foils (  $1 \mu\text{m}$  thickness ). These Ta foils are to be used as the target for the X17 experiment.

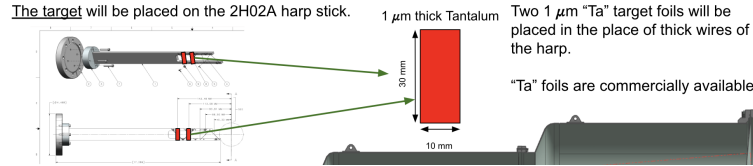
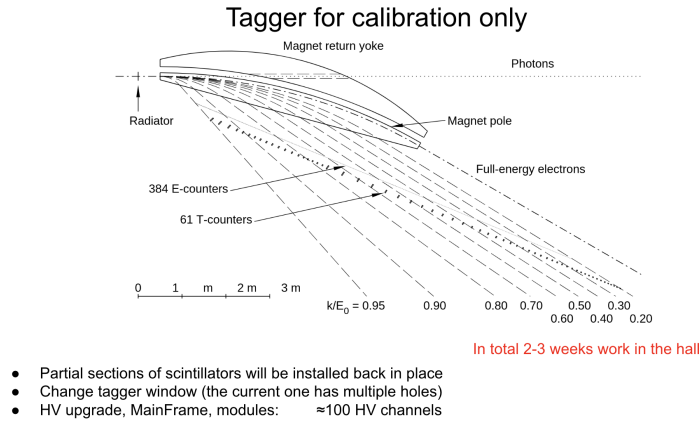


Figure 2: Harp stick modified to carry two Ta foils to be used as target for the X17 experiment.

3. New aluminum vacuum window for Tagger. A precise calibration of the HyCal calorimeter, especially for establishing the linearity of the HyCal response is critical for the ultra-high precision PRad-II experiment. A well tested and the best suited method is to use a tagged photon beam. Only a small fraction of the scintillator counters and associated HV supplies ( $\sim 100$  channels) will be used for this calibration. However, in order to use the Hall-B tagger, the large area tagger vacuum window (consisting of glued-on Kapton) will have to be replaced with a new Al window. This will also help reduce the beamline background that was observed during PRad, however, the quality of this beamline vacuum will be poorer compared to what can be achieved when bypassing the tagger with 2" diameter beam pipe.

As an alternative calibration scheme, un-tagged photons can be used to photoproduce neutral pions which decay into two photons. These decay photons can be used to calibrate the HyCal modules. This alternate method would forego using the tagger but it is somewhat deficient in establishing the linearity of the HyCal response.

4. HyCal transporter system. If the tagged photon beam is used for HyCal calibration, then the HyCal transporter needs to be installed to allow all detector modules to be put in the path of the photon beam.



10

Figure 3: Tagger vacuum window needs to be replaced.

- install PRad beamline from HyCal exit to dump as shown in Fig 4. This exit beamline requires the 2H01 girder and it must also include a harp in order to ensure a stable and locked beam on the target. This is needed for all three experiments.

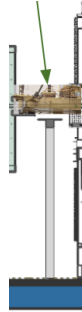


Figure 4: The 2H01 girder has to placed after HyCal

## Target

- Large diameter beam pipe from harp to entrance of 5m vacuum chamber as shown in Fig 5. The large diameter pipe also needs to have pumping port to help maintain good vacuum. This large diameter pipe is needed for both the X17 and TFF experiments. An additional motorized fixture is needed to hold the retractable solid target for the TFF experiment.

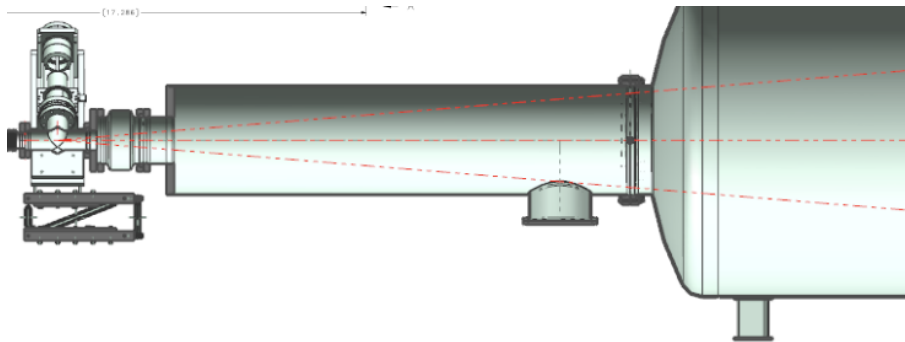


Figure 5: New large diameter beam pipe

2. Reinstall the PRad target as shown in Fig 6. For the PRad-II experiment the old PRad target will need to be installed. This work will be completed by the target group.



Figure 6: The PRad Target

3. X/Y linear stage for scintillator detector as shown in Fig. 7. The PRad-II experiment will use a scintillating cross detector to tag the Moller electrons that fall outside the HyCal acceptance. This will help separate the  $ep$  and  $ee$  events at the smallest angles. This detector must be mounted on a X/Y linear stage to allow it to be moved in and out of the acceptance for calibration. The target group has proposed an initial design shown in Fig. 7.

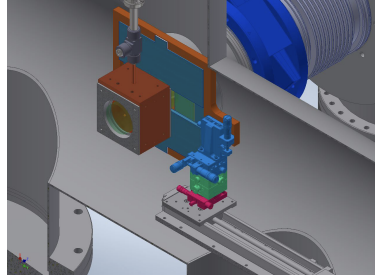


Figure 7: XY motion stage inside target chamber

4. new feedthroughs flanges for fibers from scintillator detector. The signal from the scintillating detector will be carried out of the target chamber using scintillating fibers which need feedthroughs. The side flanges of the target chamber has room to accomodate these feedthroughs. The target group will help redesign the flanges incorporating the feedthroughs.

#### 5 m vacuum chamber

1. 5 m vacuum chamber installation. All 3 experiments need the 5-m vacuum chamber to be installed in the Hall-B beamline.
2. Additional large pumping ports on the first section of 5-m vacuum chamber. During the PRad experiment, it was realized that additional pumping ports are needed to maintain good vacuum in the 5-m vacuum chamber. The first section has a small port which is not sufficient. A larger port which can accommodate a large turbo pump must be added. The target group will provide the pump and size of the port. All three experiments need this modification.
3. adapter flange for 1 m diameter,  $\leq 1$  mm thick Al. window as shown in Fig. 8. The X17 experiment will only use the inner  $\text{PbWO}_4$  part of HyCal, therefore the exit window of the 5-m vacuum chamber can be reduced in diameter and thickness. In order to hold the reduced diameter window an adaptor ring is needed.

4. Thinner Al, vacuum window with proper concave curvature as shown in Fig. 8. The smaller diameter window also implies that the window thickness can be reduced from the existing 2-mm thickness to the minimum that can hold under vacuum. This new thinner window will have to be constructed and tested. This is only needed for the X17 experiment.

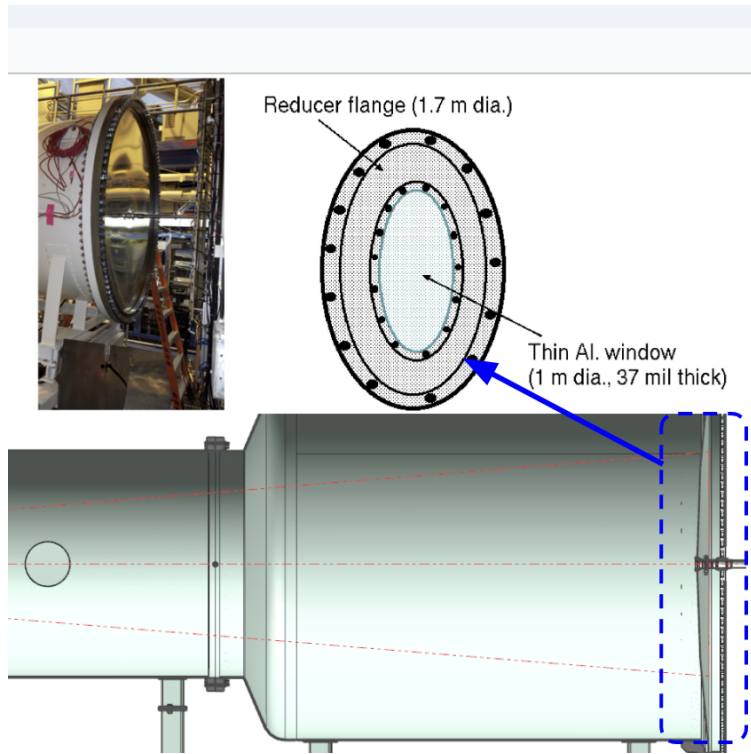


Figure 8: New adapter flange and window