Update to the CESR Vacuum Chamber Model for Synrad and Synrad3D

The 2011 model by S. Milashuk used for all the Synrad3D simulations until now did not have the PEP-II chicane vacuum chamber, even though it was installed in February, 2009.

Rather than the present continuous 3.5” ID (89-mm diameter) chamber between Q48W and Q48E, the 2011 model used pipe sections with radii varying between 88 and 110 mm with a number of steep angle transitions.

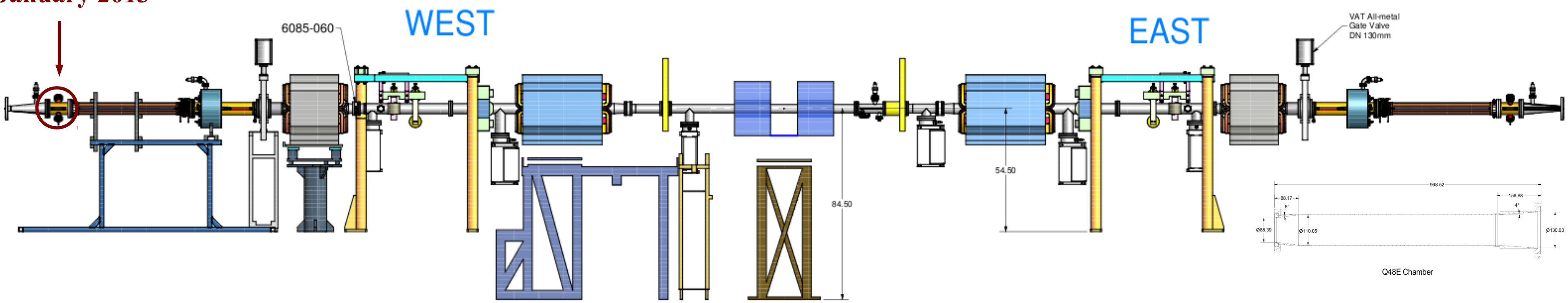
In addition to the correction for the chicane, I have now also modified the model to conform to the Q48W vacuum chamber with the QSPU installed in January, 2013.

Jim Crittenden

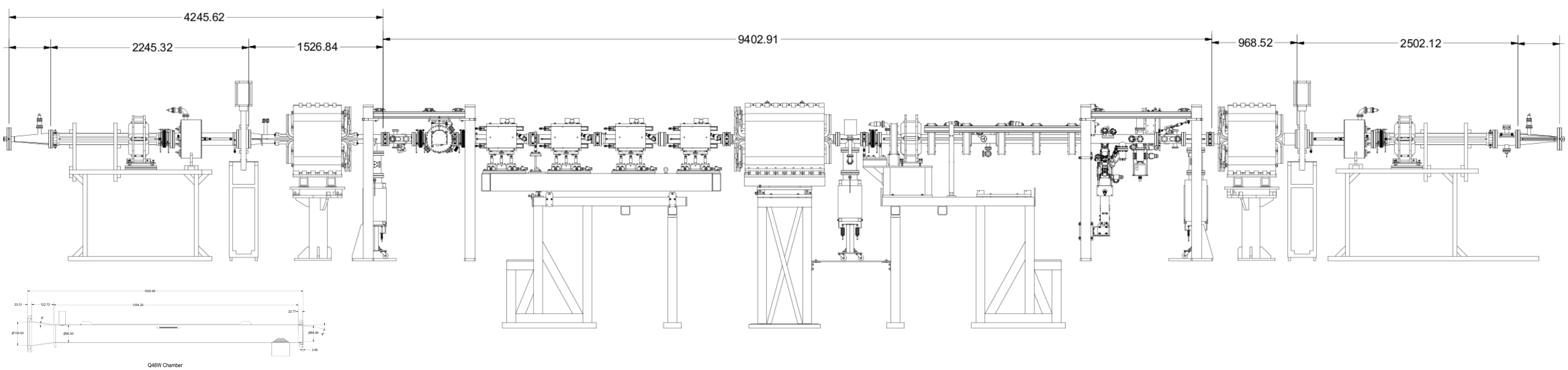
Electron Cloud Meeting

8 January 2014

Removed January 2013



Fall 2008 L3 Master drawing cited by Serozhah provided by Yulin



Installed January 2013

Present L3 dimensions from Joe

SVN Repository /trunk/src/cesr_survey/vac_pipe

Program PROFILER_SYNRAD input files

vac_pipe.measured excerpt

```
! B48W ---------------------------------------------------------------------------------
beampipe_SB48E        332.1  +    393.7   Q47AW                  +  "           " +    ! Revised April 30, 2011 from the drawing
pump_lumped             0     0     228.6   Q47AW               +  "VACUUM PUMPS 128"  +   !revised - M2 October 5 CESR survey;
pump_lumped             0     0     294.7   Q47AW               +  "VACUUM PUMPS 128"  +   !revised - M2 October 5 CESR survey;
pump_lumped             0     0     358.2   Q47AW               +  "VACUUM PUMPS 128"  +   !revised - M2 October 5 CESR survey;
flange_circular_large   0     0     393.7   Q47AW               +  "           " +  ! revised - M2 October 5 CESR survey
                                                                                  !  May 7 Inventor drawings of L3 region start here
gauge_cc                0     0    -285.9  Q48W                 -  "CSR VAC GAGE  71"  +    ! June 8 CESR survey
flange_circular_large   0     +    -272.6  Q48W                 -  "           " +  ! from CESR survey
flange_circular_large   0     +    -270.6  Q48W                 -  "           " +  ! from CESR survey)
flange_circular_large   0     -    -138.8  Q48W                 -  "           " +  ! Measured 1/6/2014 (JAC)
pump_TiSP               0     -    -126.7  Q48W                 -  "           " +  ! Measured 1/6/2014 (JAC)
flange_circular         0     0     -63.7  Q48W                 -  "           " +  ! Measured 1/6/2014 (JAC)
valve_gate_VAT          0     0     -57.2  Q48W                 -  "           " +  ! Measured 1/6/2014 (JAC)
flange_circular_large   0     0     -51.2  Q48W                 -  "           " +  ! Measured 1/6/2014 (JAC)
! Q48W ---------------------------------------------------------------------------------
pump_lumped             0     0      40.0   Q48W                +  "VACUUM PUMPS 131"  +   ! Measured 1/6/2014 (JAC)
flange_circular         0     0      45.4   Q48W                +  "           " +  ! Measured 1/6/2014 (JAC)
gauge_cc                0     0      54.0   Q48W                +  "CSR VAC GAGE  75"  +   ! Measured 1/6/2014 (JAC)
synch_light_monitor     0     0      73.2   Q48W                +  "           " +  ! May 7 Inventor drawings
flange_circular         0     0      84.3   Q48W                +  "           " +  ! May 7 Inventor drawings
flange_circular         0     0     120.1   Q48W                +  "           " +  ! May 7 Inventor drawings
flange_circular         0     0     135.5   Q48W                +  "           " +  ! May 7 Inventor drawings
flange_circular         0     0     212.9   Q48W                +  "           " +  ! May 7 Inventor drawings
flange_circular         0     0     219.3   Q48W                +  "           " +  ! May 7 Inventor drawings
beampipe_L3_center     1753.9  -     0.01   BEAMPIPE_SB48E   +  "     " -  ! from Inventor !added Sep. 10 Revised Oct21 2010
```

vac_pipe.outline excerpts

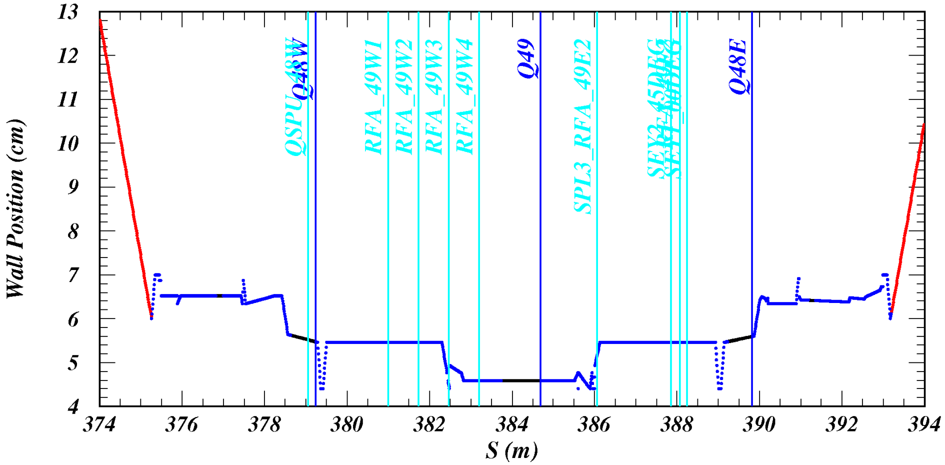
```
!--------------------------------------------------------
! resolution = 3.0mm
! Added - November 6, 2010 - Serozhah Milashuk

&element
   name = 'beampipe_L3_center'
   drawing = 'CESR-TA_L3 Master Layout'
   units = 'SI'

   cross(1)%s = 0.0
   cross(1)%pt(1) = 0.067282, 0.0
   cross(1)%pt(2) = 0.066612, 0.00880885
   cross(1)%pt(3) = 0.0632299, 0.0158559
   cross(1)%pt(4) = 0.0585436, 0.022903
   cross(1)%pt(5) = 0.0501576, 0.0264266
   cross(1)%pt(6) = -0.0495234, 0.0264266
   cross(1)%pt(7) = -0.0585789, 0.022903
   cross(1)%pt(8) = -0.0636175, 0.0158559
   cross(1)%pt(9) = -0.066582, 0.00880885
   cross(1)%pt(10) = -0.067282, 0.0

   cross(2)%s = 0.030232
   cross(2)%pt(1) = 0.067282, 0.0
   cross(2)%pt(2) = 0.066612, 0.00880885
   cross(2)%pt(3) = 0.0632299, 0.0158559
   cross(2)%pt(4) = 0.0585436, 0.022903
   cross(2)%pt(5) = 0.0501576, 0.0264266
   cross(2)%pt(6) = -0.0495234, 0.0264266
   cross(2)%pt(7) = -0.0585789, 0.022903
   cross(2)%pt(8) = -0.0636175, 0.0158559
   cross(2)%pt(9) = -0.066582, 0.00880885
   cross(2)%pt(10) = -0.067282, 0.0
```

```
cross(22)%s = 3.92241
cross(22)%pt(1) = 0.04445, 0.0
cross(22)%pt(2) = 0.0, 0.04445, 0.04445

cross(23)%s = 13.3258
cross(23)%pt(1) = 0.04445, 0.0
cross(23)%pt(2) = 0.0, 0.04445, 0.04445

cross(24)%s = 13.3297
cross(24)%pt(1) = 0.04445, 0.0
cross(24)%pt(2) = 0.0, 0.04445, 0.04445

cross(25)%s = 13.3525
cross(25)%pt(1) = 0.04775, 0.0
cross(25)%pt(2) = 0.0, 0.04775, 0.07745

cross(26)%s = 14.7067
cross(26)%pt(1) = 0.04775, 0.0
cross(26)%pt(2) = 0.0, 0.04775, 0.07745

cross(27)%s = 14.8294
cross(27)%pt(1) = 0.065, 0.0
cross(27)%pt(2) = 0.0, 0.065, 0.065

cross(28)%s = 14.8527
cross(28)%pt(1) = 0.065, 0.0
cross(28)%pt(2) = 0.0, 0.065, 0.065

cross(29)%s = 15.0463
cross(29)%pt(1) = 0.065, 0.0
cross(29)%pt(2) = 0.0, 0.065, 0.065
```

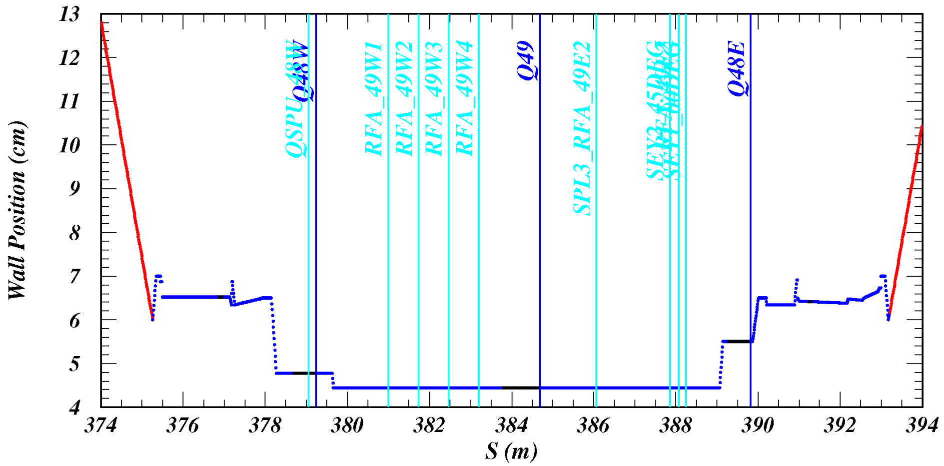
PROFILER_SYNRAD output files (also in repository)

vac_pipe.s_positions
synrad.wall for Synrad
synrad3d.wall for Synrad3D

Outer wall positions in horizontal mid-plane (SYNRAD.WALL used as input to Synrad)



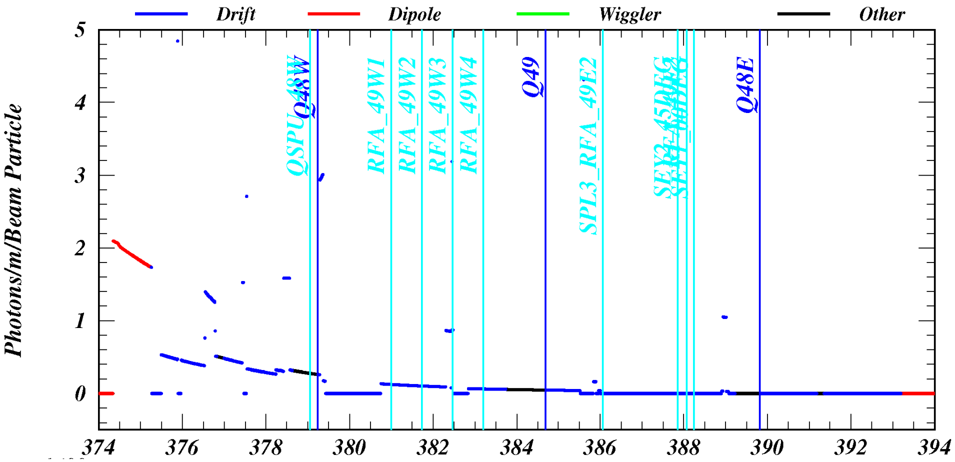
Synrad3D until now



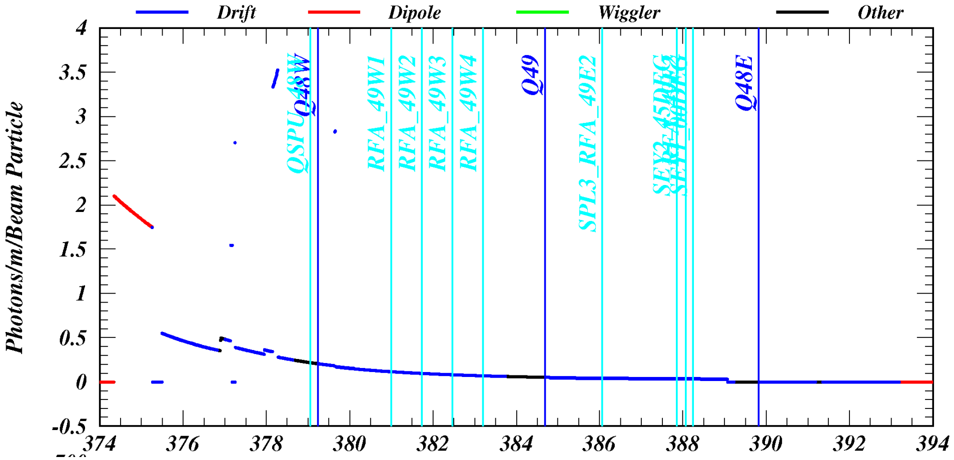
After updates of 6 January 2014

**The Synrad3D simulations were run with an incorrect complicated vacuum chamber geometry in the chicane.
In particular, RFA 3 is located at an incorrectly steeply angled wall.
Location 4 was used for the IPAC13 simulation.**

Synrad photon rate calculations for e+ beam before and after



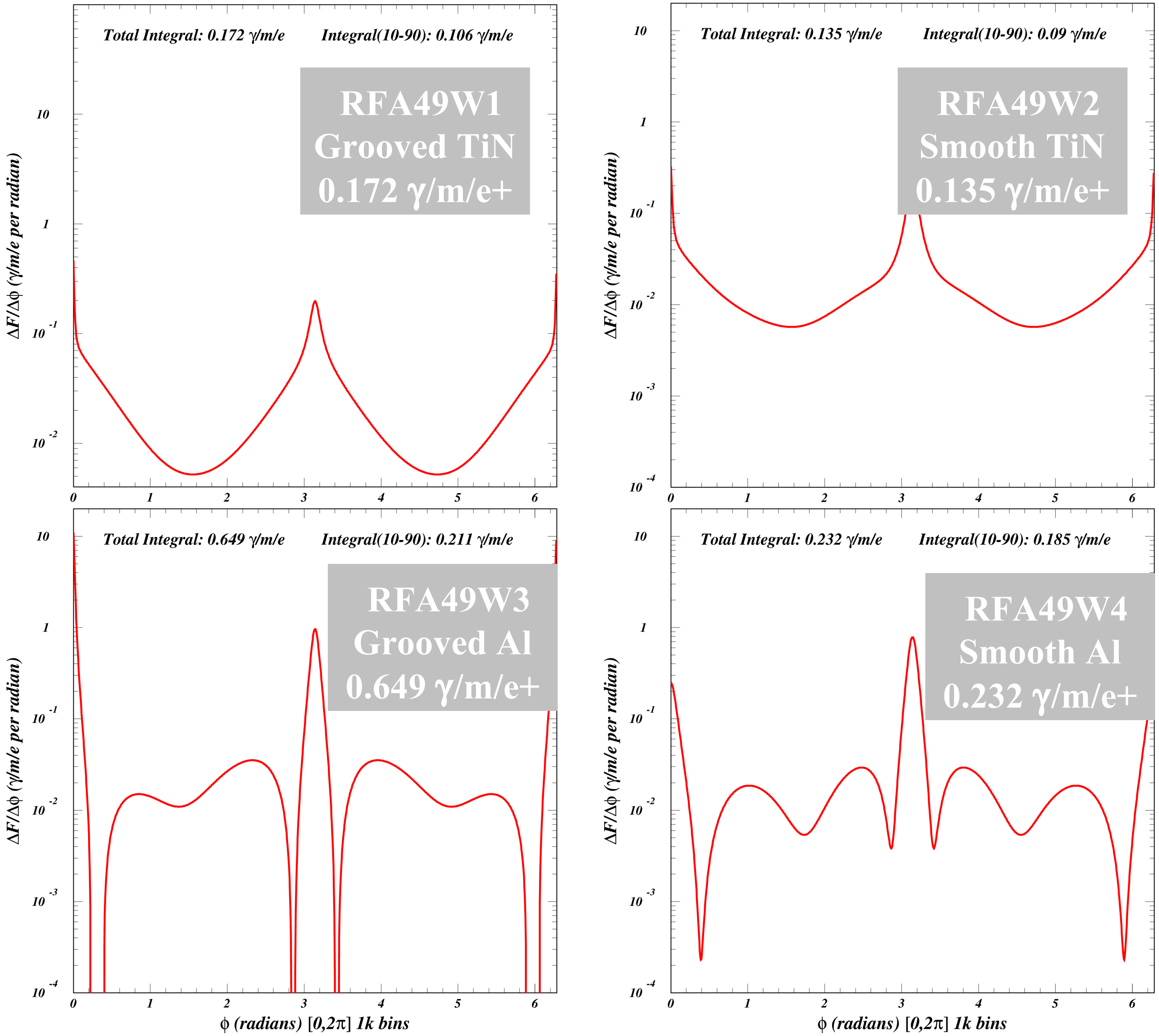
Synrad3D until now



After updates of 6 January 2014

The hot spot at RFA location 3 is gone.

Reprise of slide 6 of 24 April 2013 talk
Synrad3D photon rates in L3 RFA 1-4



Synrad3D calculated quite different photon rates and distributions in the four TR-RFA chambers.

Summary and comments

I have discovered PROFILER_SYNRAD.
I know how to modify its input files to produce wall files for Synrad and Synrad3D.
Much more detailed wall files for Synrad are now available (!)
Wall files with updated Q48W vacuum chamber and L3 chicane region are now available.

I can run Synrad3D, but remain unfamiliar with PreSynrad3D, which makes the dozens of RFA input files for Synrad3D.
I also remain unfamiliar with Gerry's automated Mathematica-based analysis of the Synrad3D output files.
Both of these are necessary to produce ring-wide and comprehensive RFA output files for use by POSINST and ECLOUD.
I can run Synrad3D for individual RFAs, but I don't yet know how to analyse the results.

Now there are two major outstanding improvements for the simulations of the time-resolving RFA measurements:
1) Walter's magnetic field acceptance function and 2) the improved Synrad3D.

Certain characteristics of other regions of the CESR vacuum chamber model are disquieting.
For example, there appear to be many conical regions which are likely to be cylindrical.