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. November 26, 2001

RICH-1 SURVEYING IN 2001

S. Dalla Torre

1 Introduction

The results of the RICH-1 surveying in 2001 have been analysed with the purpose of (i) comparing the information from mechanical drawings and surveying and (ii) check/modify the RICH section of the "detector.dat" files, which describe the geometry of the COMPASS set-up for the 2001 run. The mirror alignment data are not included in this analysis.

2 Surveying data

Several surveying exercises concerning RICH-1 have been performed in 2001.

- At the beginning of March 2001, RICH-1 has been moved to its location for 2001 run and surveyed [1].
- The two detector frames housing the Photon Detectors (PD) have been surveyed in the Clean Area before mounting them onto RICH-1 [2], [3].
- The same detector frames have been surveyed after mounting them onto RICH-1 [4].

The surveying accuracy quoted in the surveying reports is 0.3 mm for all 3 coordinates.

3 Reference frame and units

The reference frame is the same used in CORAL, i.e. the origin is the centre of the target as in the original set-up design, the x-axis is horizontal, from Saleve to Jura, the y-axis is vertical, pointing up and the z-axis is along the undeflected beam line, pointing downstream.

All lengths are given in mm and all angles in mrad.

4 RICH-1 location in the hall

RICH-1 has been positioned with the following prescriptions:

- coordinates of the centre of the downstream RICH-1 window, internal face:

  P: (0., 0., 9185.)

- face of the window orthogonal to beam axis, edges horizontal and vertical.

From the surveying in March 2001, after positioning the RICH, we get [1]:

- using the 4 surveyed points on the external surface of the mirror flange:

  P: (1.1, -2.95, 9186.5)

- using the 4 surveyed points on the most downstream portion of the vessel:

  P: (1.45, -2.63, 9186.5)

One more measurement can be obtained from the measured coordinates of 32 points on the PD frame if the z-distance between the detectors and the downstream window is assumed from RICH-1 mechanical drawings [4] (see below):

P: (1.56, -2.54, 9187.5).
The 3 sets of coordinates are in good agreement and compatible with assumed accuracy (the slightly larger discrepancy for the z-coordinate can be due to the geometrical assumption).

These measurements allow also to have some indications about a possible rotation of the RICH-1 axes respect to reference frame.

- angle between the "RICH z-axis" and the reference frame z-axis: from P-coordinates x and y as measured at the downstream RICH-1 surface [1] and upstream (at PDs) [4] the estimated value for this angle is 0.2 mrad

- rotation in the plane perpendicular to the z-axis, i.e. (x,y) plane: informations come from both the downstream measurements [1] and the PD surveying [4]
  - both measurements on vessel and on mirror flange indicate a rotation of -0.13 mrad and, in both cases, measured x and y coordinates give consistent estimations
  - the measurements of the PDs mounted on RICH, indicate
    from measured x-coordinates: -0.6 mrad
    from measured y-coordinates: -1.3 mard;
    these values could indicate a slight deviation (deformation ?) of the upstream RICH shape from the mechanical drawings.

5 PD surveying in Clean Area

Both detector frames (4 PDs each) have been surveyed in Clean Area [2], [3]; 4 points per PD are surveyed (total: 16 points per detector frame). From the measured coordinates and from construction symmetries, the accuracy of the measured coordinates is obtained:

- $\sigma_x = 0.13$ mm
- $\sigma_y = 0.21$ mm .
- $\sigma_z = 0.26$ mm

Of course, these values include mechanical accuracy.

6 PD surveying on RICH-1

Four points per PD are surveyed (total: 16 points per detector frame, 15 for upper detector frame as 1 point was not visible). From measured coordinates and construction symmetries, the accuracy of the measured coordinates is obtained:

- $\sigma_x = 0.13$ mm
- $\sigma_y = 0.24$ mm .
- $\sigma_z = 0.40$ mm

These values for the accuracy have to be compared with those for the measurements in Clean Area: in spite of the much less easy access to optical target points, the accuracy is very similar.

7 Comparison of PD surveying in Clean Area and on the RICH

The coordinates measured in Clean Area have been transformed according to the following algorithm:

- translation as from detector frame centres (each detector frame independently)
- rotation according to vessel design ($\pm$ 8.6^0).

The differences between measured coordinates on RICH and measured coordinates in Clean Area transformed as above is always $<$ 0.2 mm for x and z, 0.6 for y.

8 Comparison of surveying results and RICH design

	drawings (mm)	surveying (mm)	δ (mm)
y-distance of detector frames	3862.	3864.4	-2.4
z-distance between detector frames and RICH downstream window	3244.	3243.0	1.

9 Comparison of surveyed cathode positions and RICH design

The photocathode positions according to RICH design are those implemented, for example, in "detector.dat.2001_11_15" file (please note that in "detector.dat" files the COMGEANT reference frame is used and that units are cm).

If a general translation of
(2., -2.5, 2.5)
is applied and no rotation, the differences between the measured cathode coordinates and the calculated ones are all within 2 mm.

If individual translations are applied to the 2 PD frames:
upper set: (3.1, -1.1, 2.6)
lower set: (0.9, -3.9, 2.4)
they are all within 1 mm.

10 Conclusions

The description of RICH-1 obtained from the mechanical drawings is correct. In particular, the photocathode offsets in "detector.dat" files are correct. The calculated position of RICH-1 elements from drawings and positioning prescription must be corrected for:

- a general offset (2., -2.5, 2.5) (to be applied also to mirror geometry!)
- no correction for angular miss-alignments are needed.

. A slightly better agreement between surveying and detector description can be obtained applying independent offsets for each PD frame, but the difference is small and not justified on the base of mechanical drawings.

References

[1] A. Froton and J.-Ch. Gayde,

COMPASS-RICH1, Position du RICH dans le hall 888 apres déplacement Mars 2001, March 9, 2001

[2] A. Froton and J.-F. Fuchs, *COMPASS-RICH1, Calibration Geometrique dela plaque détecteur amont bas*, July 25, 2001

[3] A. Froton and M. Gourragne, *COMPASS-RICH1, Calibration Geometrique dela plaque détecteur amont haut*, July 20, 2001

[4] A. Froton and M. Gourragne, *COMPASS-RICH1, Contrôle de position des photomultiplicateurs inférieurs and supérieurs situés en amont du détecteur RICH*, August 6, 2001