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THE COMPASS RICH-1 MIRROR WALL GEOMETRY

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Abstract

The mirror wall of the Compass Rich-1 detector is made of two parts. Each part has sixty sub-mirrors put together side by side to make a continuous spherical surface. This technical note presents the calculation of the positions of sub-mirror centres and their corresponding fixation points on the support structure relative to their spherical surface centres.

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1. INTRODUCTION

Compass is a fixed target experiment at CERN SPS designed to perform third generation polarised deep inelastic scattering measurements and hadron spectroscopy studies. The apparatus consists of two consecutive spectrometers, both equipped with a RICH (**R**ing **I**maging **C**herenkov **D**etector) detector. RICH-1 is one of these two detectors.

The mirror wall, located inside the RICH-1 vessel, consists of spherical mirrors radius 6.6 m, segmented into 120 hexagonal pieces covering a total area larger than 20 m² forming two spherical surfaces with different centres of curvature. The mirrors are fixed onto an aluminium space truss. Each of them is fixed to one of the node of the truss.

This note describes the details of the calculation made in order to compute the positions of the mirror centres and their fixations point on the support structure.

2. MIRROR WALL DESCRIPTION

Fig.1 shows the whole mirror wall from its rear face. Only the upper mirror sphere is represented with the space truss support mounted on the vessel rear frame. The two spherical mirror surfaces are identical and symmetrical with reference to the horizontal beam plane.

The arc length between two adjacent mirror centres, measured on the equator circle (or on all great circles), corresponds to an angle of 4 degrees.

The radius of both mirror spheres is 6.600 metres. The radius of the spherical surface of the space truss was fixed at 6.670 metres following the mechanical design.

The vertical distance between the two sphere centres is specified as 3.2 metres.

The support structure consists of a space truss which forms a spherical surface. It is made of aluminium and has a triangular mesh. The mesh members are made of 25/22 mm dia tubes connected together at the triangle vertices where the mirrors are fixed. This truss is connected at its edges on the mirror structure.

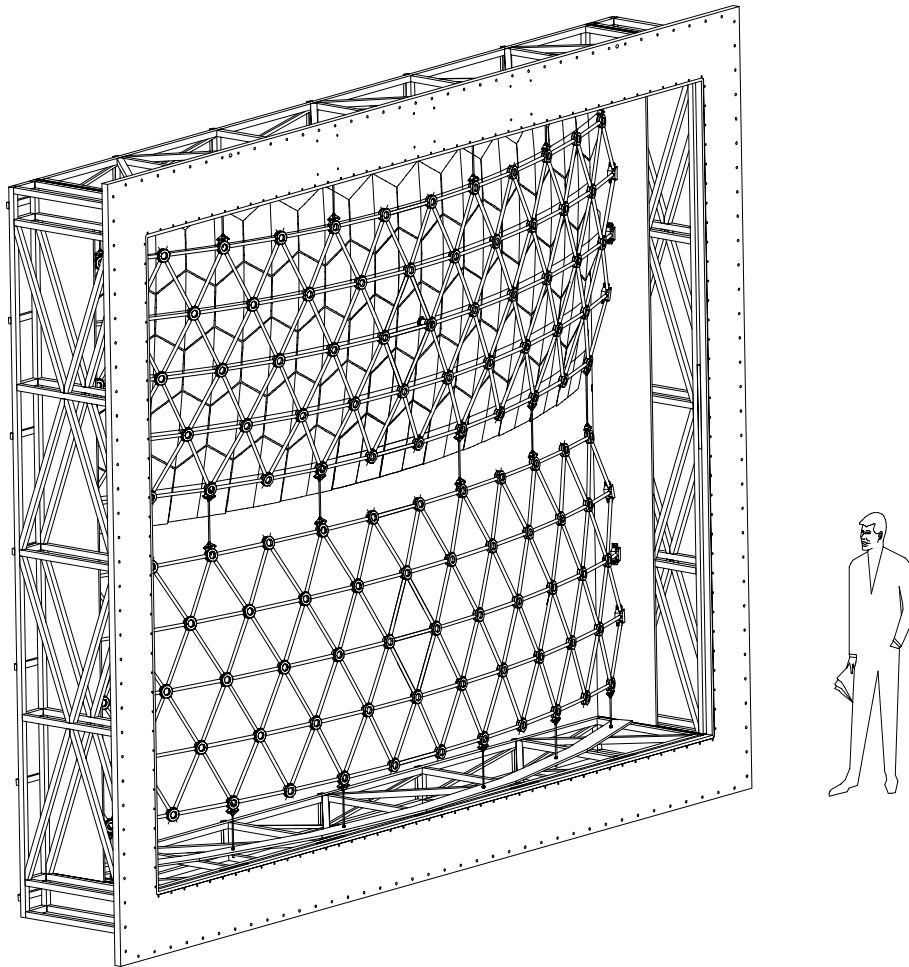


Figure 1: The Mirror wall

3. COORDINATE SYSTEMS

For each sphere, one coordinate system is defined as follows (see fig.2):

Origin at the sphere centre, Oz axis vertically upwards, Ox lies on the vertical symmetry plane of the spheres and Oy perpendicular to zOx plane.

For spherical coordinates, θ angle is measured from Oz axis towards the polar vector while φ angle is measured from Ox axis towards the projection of the polar vector onto the xOy plane.

The mirror surfaces will be put in their final place in two stages :

- 1st stage : the sphere equator circle is on xOy plane.

- 2nd stage : rotation of the upper mirror centres by 5.25° (downwards) about the Oy axis and -5.25° (upwards) for the lower ones. These angle values were selected to optimise the mirror coverage (see fig 3).

The mirror centre coordinates will be computed for both stages. The mirror centres have been numbered as shown in Fig. 2.

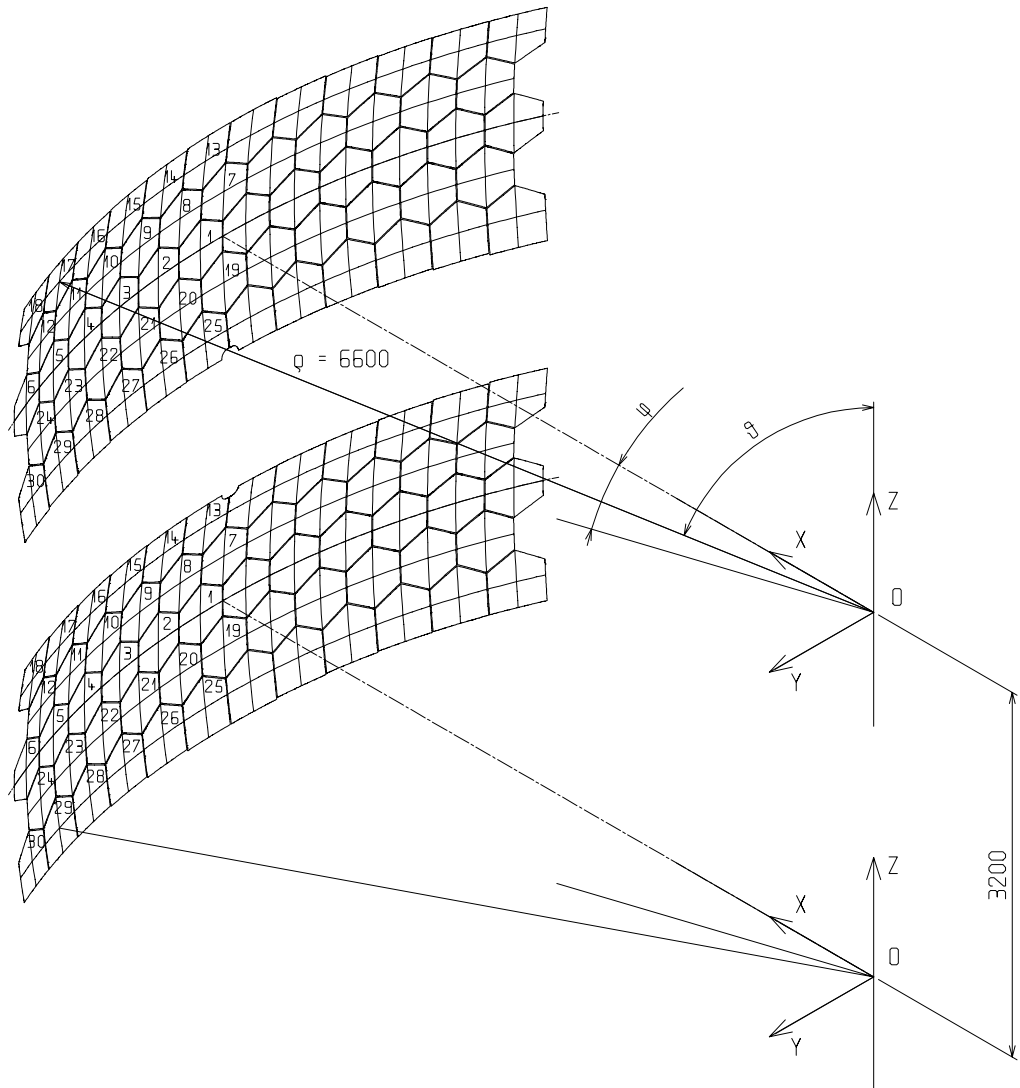


Figure 2: Initial mirror sphere positions : 1st stage.

4. THE MIRROR SPHERE COORDINATES

4.1 Spherical coordinates:

4.1.1 φ -coordinate

The φ -coordinate of any mirror centre belonging to the same row, can easily be found by applying the following relation :

$$\Phi_{(n+1)} = \Phi_{(n)} + 4^\circ$$

Note: this relation is only valid when the sphere equator circle is on the xOy plane.

The centre of the mirror no 1 is offset by two degrees from the symmetry plane, thus $\varphi_{(1)} = 2^\circ$.

4.1.2 θ -coordinate

Only the six mirror centres numbered from 1 to 6 located on the equator circle of each sphere are considered. They have the same θ -coordinate:

$$\theta_{(1 \rightarrow 6)} = 90^\circ$$

For the second row, (from number 7 to 12), only the angle at centre of the arc length between two mirror centres located on a great circle of the sphere is equal to $2\alpha = 4^\circ$. Considering the spherical right angled triangle with the points (R,0,0) and mirror centres $n^\circ 1$ and 7 as vertices (see Fig 2), the following relation is used to calculate the θ -coordinate of the mirror centre $n^\circ 7$; the value obtained is also the θ -coordinate of all the mirror centres of the row.

$$\theta_{(7 \rightarrow 12)} = \arccos(\tan \alpha \sqrt{4 \cos^2 \alpha - 1})$$

This formula can also be used for the third row provided that $2\alpha = 8^\circ$.

Once these values have been calculated for the three rows of the sphere, it is only necessary to apply the evident symmetry conditions on both θ and φ coordinates to find all the remaining mirror centres spherical coordinates.

Thus the first stage is finished. These values are listed in Table 1 and are valid for both spheres.

centre number	spherical coordinates					Cartesian coordinates		
	ρ [mm]	θ [deg]	θ [rad]	ϕ [deg]	ϕ [rad]	x	y	z
1	6600.000	90.00000	1.57080	2.00000	0.03491	6595.979	230.337	0.000
2	6600.000	90.00000	1.57080	6.00000	0.10472	6563.845	689.888	0.000
3	6600.000	90.00000	1.57080	10.00000	0.17453	6499.731	1146.078	0.000
4	6600.000	90.00000	1.57080	14.00000	0.24435	6403.952	1596.685	0.000
5	6600.000	90.00000	1.57080	18.00000	0.31416	6276.973	2039.512	0.000
6	6600.000	90.00000	1.57080	22.00000	0.38397	6119.413	2472.404	0.000
7	6600.000	86.53519	1.51032	0.00000	0.00000	6587.936	0.000	398.874
8	6600.000	86.53519	1.51032	4.00000	0.06981	6571.888	459.551	398.874
9	6600.000	86.53519	1.51032	8.00000	0.13963	6523.823	916.863	398.874
10	6600.000	86.53519	1.51032	12.00000	0.20944	6443.974	1369.709	398.874
11	6600.000	86.53519	1.51032	16.00000	0.27925	6332.730	1815.881	398.874
12	6600.000	86.53519	1.51032	20.00000	0.34907	6190.635	2253.207	398.874
13	6600.000	83.06615	1.44978	2.00000	0.03491	6547.738	228.652	796.773
14	6600.000	83.06615	1.44978	6.00000	0.10472	6515.838	684.842	796.773
15	6600.000	83.06615	1.44978	10.00000	0.17453	6452.193	1137.696	796.773
16	6600.000	83.06615	1.44978	14.00000	0.24435	6357.115	1585.007	796.773
17	6600.000	83.06615	1.44978	18.00000	0.31416	6231.064	2024.596	796.773
18	6600.000	83.06615	1.44978	22.00000	0.38397	6074.657	2454.321	796.773
19	6600.000	93.46481	1.63127	0.00000	0.00000	6587.936	0.000	-398.874
20	6600.000	93.46481	1.63127	4.00000	0.06981	6571.888	459.551	-398.874
21	6600.000	93.46481	1.63127	8.00000	0.13963	6523.823	916.863	-398.874
22	6600.000	93.46481	1.63127	12.00000	0.20944	6443.974	1369.709	-398.874
23	6600.000	93.46481	1.63127	16.00000	0.27925	6332.730	1815.881	-398.874
24	6600.000	93.46481	1.63127	20.00000	0.34907	6190.635	2253.207	-398.874
25	6600.000	96.93385	1.69181	2.00000	0.03491	6547.738	228.652	-796.773
26	6600.000	96.93385	1.69181	6.00000	0.10472	6515.838	684.842	-796.773
27	6600.000	96.93385	1.69181	10.00000	0.17453	6452.193	1137.696	-796.773
28	6600.000	96.93385	1.69181	14.00000	0.24435	6357.115	1585.007	-796.773
29	6600.000	96.93385	1.69181	18.00000	0.31416	6231.064	2024.596	-796.773
30	6600.000	96.93385	1.69181	22.00000	0.38397	6074.657	2454.321	-796.773

Table 1: Coordinates of mirror centres :1st stage

Now, it remains to put the mirrors in their final place; this will be executed in the second stage which consists of rotating the upper mirror centres by 5.25° around Oy , and by -5.25° for the lower ones (see fig.3).

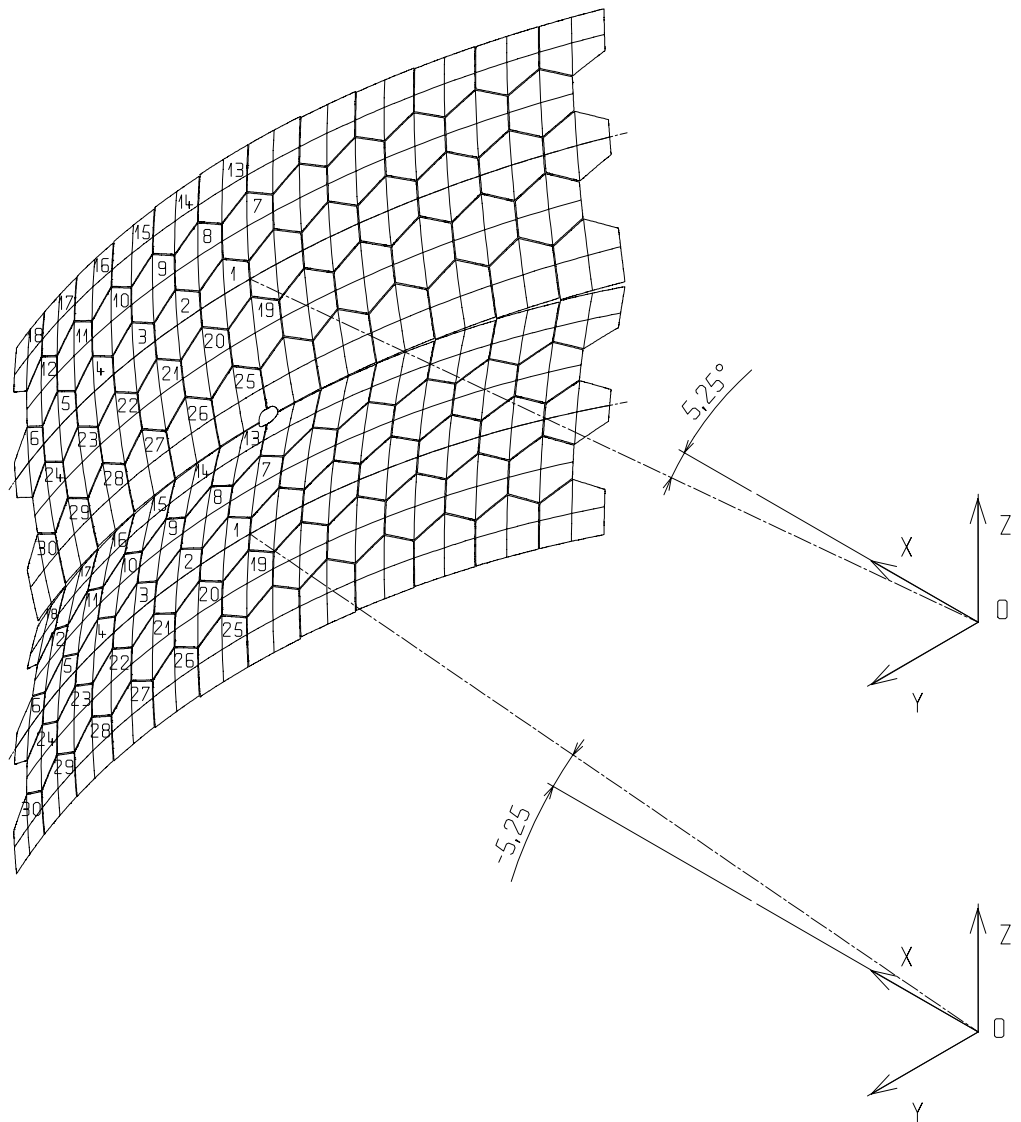


Figure 3: Final mirror sphere positions:2nd stage.

This operation will be applied to the Cartesian coordinates of the mirror centres.

4.2 Cartesian Coordinates

Once spherical coordinates $(\rho, \theta_{(n)}, \varphi_{(n)})$ the mirror (n) are known, Cartesian coordinates can be calculated from the following classical set of equations:

$$\mathbf{x}_{(n)} = \rho \sin \theta_{(n)} \cos \varphi_{(n)}$$

$$\mathbf{y}_{(n)} = \rho \sin \theta_{(n)} \sin \varphi_{(n)}$$

$$\mathbf{z}_{(n)} = \rho \cos \theta_{(n)}$$

These values have been computed and they are also listed in Table 1 for the 30 mirrors centres located on the sphere, remaining values can be easily found taking the opposite of either φ or y -coordinates.

5. FINAL COORDINATES OF THE MIRROR CENTRES IN THE RICH-1.

Once the Cartesian coordinates are known, a rotation operator can be applied in order to put the mirror spheres in their final position.

X, Y, Z the new coordinates, can be calculated from :

$$\begin{pmatrix} \mathbf{X} \\ \mathbf{Y} \\ \mathbf{Z} \end{pmatrix} = \begin{bmatrix} \cos \beta & 0 & \sin \beta \\ 0 & 1 & 0 \\ -\sin \beta & 0 & \cos \beta \end{bmatrix} \begin{pmatrix} \mathbf{x} \\ \mathbf{y} \\ \mathbf{z} \end{pmatrix}$$

with $\beta=5.25^\circ$ for the upper sphere and -5.25° for the lower one.

If we wish to know the corresponding spherical coordinates, the following formulas shall be applied :

$$\rho = \sqrt{\mathbf{X}^2 + \mathbf{Y}^2 + \mathbf{Z}^2}$$

$$\theta = \arccos \frac{\mathbf{Z}}{\sqrt{\mathbf{X}^2 + \mathbf{Y}^2 + \mathbf{Z}^2}}$$

$$\varphi = \arctan \frac{\mathbf{Y}}{\mathbf{X}}$$

These relations have been used for computing the coordinates of the final location of all the mirrors and are listed in Table 2 and 3.

centre number	Spherical coordinates					Cartesian coordinates		
	ρ [mm]	θ [deg]	θ [rad]	ϕ [deg]	ϕ [rad]	X	Y	Z
1	6600.000	95.24679	1.66237	2.00842	0.03505	6568.309	230.337	-603.543
2	6600.000	95.22116	1.66192	6.02509	0.10516	6536.309	689.888	-600.602
3	6600.000	95.17002	1.66103	10.04127	0.17525	6472.464	1146.078	-594.736
4	6600.000	95.09363	1.65970	14.05664	0.24533	6377.087	1596.685	-585.972
5	6600.000	94.99238	1.65793	18.07091	0.31540	6250.641	2039.512	-574.353
6	6600.000	94.86676	1.65574	22.08379	0.38543	6093.742	2472.404	-559.936
7	6600.000	91.78519	1.60195	0.00000	0.00000	6596.797	0.000	-205.606
8	6600.000	91.77244	1.60173	3.99459	0.06972	6580.816	459.551	-204.138
9	6600.000	91.73424	1.60106	7.98896	0.13943	6532.952	916.863	-199.740
10	6600.000	91.67079	1.59996	11.98291	0.20914	6453.438	1369.709	-192.434
11	6600.000	91.58239	1.59841	15.97623	0.27884	6342.662	1815.881	-182.255
12	6600.000	91.46947	1.59644	19.96873	0.34852	6201.162	2253.207	-169.253
13	6600.000	88.31298	1.54135	1.98623	0.03467	6593.176	228.652	194.302
14	6600.000	88.28763	1.54091	5.95863	0.10400	6561.410	684.842	197.221
15	6600.000	88.23705	1.54003	9.93087	0.17333	6498.032	1137.696	203.045
16	6600.000	88.16149	1.53871	13.90284	0.24265	6403.352	1585.007	211.745
17	6600.000	88.06131	1.53696	17.87447	0.31197	6277.831	2024.596	223.278
18	6600.000	87.93699	1.53479	21.84568	0.38128	6122.080	2454.321	237.590
19	6600.000	98.71481	1.72290	0.00000	0.00000	6523.801	0.000	-1000.007
20	6600.000	98.70191	1.72267	4.03925	0.07050	6507.821	459.551	-998.539
21	6600.000	98.66329	1.72200	8.07805	0.14099	6459.957	916.863	-994.141
22	6600.000	98.59913	1.72088	12.11597	0.21146	6380.443	1369.709	-986.834
23	6600.000	98.50977	1.71932	16.15258	0.28192	6269.667	1815.881	-976.656
24	6600.000	98.39566	1.71733	20.18748	0.35234	6128.167	2253.207	-963.654
25	6600.000	102.18060	1.78339	2.03111	0.03545	6447.364	228.652	-1392.560
26	6600.000	102.15468	1.78294	6.09305	0.10634	6415.597	684.842	-1389.641
27	6600.000	102.10297	1.78203	10.15413	0.17722	6352.220	1137.696	-1383.817
28	6600.000	102.02574	1.78069	14.21382	0.24808	6257.540	1585.007	-1375.117
29	6600.000	101.92339	1.77890	18.27156	0.31890	6132.019	2024.596	-1363.583
30	6600.000	101.79643	1.77668	22.32687	0.38968	5976.268	2454.321	-1349.272

Table 2: Final coordinates of upper mirror centres

centre number	Spherical coordinates					Cartesian coordinates		
	ρ [mm]	θ [deg]	θ [rad]	ϕ [deg]	ϕ [rad]	X	Y	Z
1	6600.000	84.75321	1.47922	2.00842	0.03505	6568.309	230.337	603.543
2	6600.000	84.77884	1.47967	6.02509	0.10516	6536.309	689.888	600.602
3	6600.000	84.82998	1.48056	10.04127	0.17525	6472.464	1146.078	594.736
4	6600.000	84.90637	1.48190	14.05664	0.24533	6377.087	1596.685	585.972
5	6600.000	85.00762	1.48366	18.07091	0.31540	6250.641	2039.512	574.353
6	6600.000	85.13324	1.48586	22.08379	0.38543	6093.742	2472.404	559.936
7	6600.000	81.28519	1.41869	0.00000	0.00000	6523.801	0.000	1000.007
8	6600.000	81.29809	1.41892	4.03925	0.07050	6507.821	459.551	998.539
9	6600.000	81.33671	1.41959	8.07805	0.14099	6459.957	916.863	994.141
10	6600.000	81.40087	1.42071	12.11597	0.21146	6380.443	1369.709	986.834
11	6600.000	81.49023	1.42227	16.15258	0.28192	6269.667	1815.881	976.656
12	6600.000	81.60434	1.42426	20.18748	0.35234	6128.167	2253.207	963.654
13	6600.000	77.81940	1.35820	2.03111	0.03545	6447.364	228.652	1392.560
14	6600.000	77.84532	1.35866	6.09305	0.10634	6415.597	684.842	1389.641
15	6600.000	77.89703	1.35956	10.15413	0.17722	6352.220	1137.696	1383.817
16	6600.000	77.97426	1.36091	14.21382	0.24808	6257.540	1585.007	1375.117
17	6600.000	78.07661	1.36269	18.27156	0.31890	6132.019	2024.596	1363.583
18	6600.000	78.20357	1.36491	22.32687	0.38968	5976.268	2454.321	1349.272
19	6600.000	88.21481	1.53964	0.00000	0.00000	6596.797	0.000	205.606
20	6600.000	88.22756	1.53986	3.99459	0.06972	6580.816	459.551	204.138
21	6600.000	88.26576	1.54053	7.98896	0.13943	6532.952	916.863	199.740
22	6600.000	88.32921	1.54164	11.98291	0.20914	6453.438	1369.709	192.434
23	6600.000	88.41761	1.54318	15.97623	0.27884	6342.662	1815.881	182.255
24	6600.000	88.53053	1.54515	19.96873	0.34852	6201.162	2253.207	169.253
25	6600.000	91.68702	1.60024	1.98623	0.03467	6593.176	228.652	-194.302
26	6600.000	91.71237	1.60068	5.95863	0.10400	6561.410	684.842	-197.221
27	6600.000	91.76295	1.60157	9.93087	0.17333	6498.032	1137.696	-203.045
28	6600.000	91.83851	1.60288	13.90284	0.24265	6403.352	1585.007	-211.745
29	6600.000	91.93869	1.60463	17.87447	0.31197	6277.831	2024.596	-223.278
30	6600.000	92.06301	1.60680	21.84568	0.38128	6122.080	2454.321	-237.590

Table 3: Final coordinates of lower mirror centres

6. CLEARANCE BETWEEN MIRROR SIDES

The clearance between mirrors can be calculated with the following relation by setting $2\alpha=4^\circ$:

$$d = 2\alpha R \sin \theta - w$$

As the mirror width has been set to $w=452$ mm, hence :

- At the equator level $d=8.76$ mm
- At the 1st row level $d=7.92$ mm
- At the 2nd row level $d=5.39$ mm

7. THE SPACE TRUSS NODE COORDINATES

The two following tables list the coordinates of the space truss nodes. They have been calculated in the same way as for mirrors except that the sphere radius has been set to 6.67 m. These values shall be used for the design of the jig needed for truss assembly.

centre number	spherical coordinates					Cartesian coordinates		
	ρ [mm]	θ [deg]	θ [rad]	ϕ [deg]	ϕ [rad]	x	y	z
1	6670.000	90.00000	1.57080	2.00000	0.03491	6665.937	232.780	0.000
2	6670.000	90.00000	1.57080	6.00000	0.10472	6633.461	697.205	0.000
3	6670.000	90.00000	1.57080	10.00000	0.17453	6568.668	1158.233	0.000
4	6670.000	90.00000	1.57080	14.00000	0.24435	6471.872	1613.619	0.000
5	6670.000	90.00000	1.57080	18.00000	0.31416	6343.547	2061.143	0.000
6	6670.000	90.00000	1.57080	22.00000	0.38397	6184.316	2498.626	0.000
7	6670.000	86.53519	1.51032	0.00000	0.00000	6657.808	0.000	403.104
8	6670.000	86.53519	1.51032	4.00000	0.06981	6641.590	464.425	403.104
9	6670.000	86.53519	1.51032	8.00000	0.13963	6593.015	926.588	403.104
10	6670.000	86.53519	1.51032	12.00000	0.20944	6512.319	1384.236	403.104
11	6670.000	86.53519	1.51032	16.00000	0.27925	6399.896	1835.141	403.104
12	6670.000	86.53519	1.51032	20.00000	0.34907	6256.293	2277.104	403.104
13	6670.000	83.06615	1.44978	2.00000	0.03491	6617.184	231.077	805.224
14	6670.000	83.06615	1.44978	6.00000	0.10472	6584.945	692.106	805.224
15	6670.000	83.06615	1.44978	10.00000	0.17453	6520.626	1149.762	805.224
16	6670.000	83.06615	1.44978	14.00000	0.24435	6424.539	1601.817	805.224
17	6670.000	83.06615	1.44978	18.00000	0.31416	6297.152	2046.069	805.224
18	6670.000	83.06615	1.44978	22.00000	0.38397	6139.085	2480.352	805.224
19	6670.000	93.46481	1.63127	0.00000	0.00000	6657.808	0.000	-403.104
20	6670.000	93.46481	1.63127	4.00000	0.06981	6641.590	464.425	-403.104
21	6670.000	93.46481	1.63127	8.00000	0.13963	6593.015	926.588	-403.104
22	6670.000	93.46481	1.63127	12.00000	0.20944	6512.319	1384.236	-403.104
23	6670.000	93.46481	1.63127	16.00000	0.27925	6399.896	1835.141	-403.104
24	6670.000	93.46481	1.63127	20.00000	0.34907	6256.293	2277.104	-403.104
25	6670.000	96.93385	1.69181	2.00000	0.03491	6617.184	231.077	-805.224
26	6670.000	96.93385	1.69181	6.00000	0.10472	6584.945	692.106	-805.224
27	6670.000	96.93385	1.69181	10.00000	0.17453	6520.626	1149.762	-805.224
28	6670.000	96.93385	1.69181	14.00000	0.24435	6424.539	1601.817	-805.224
29	6670.000	96.93385	1.69181	18.00000	0.31416	6297.152	2046.069	-805.224
30	6670.000	96.93385	1.69181	22.00000	0.38397	6139.085	2480.352	-805.224

Table 4: Space truss node coordinates 1st stage.

8. COORDINATES OF THE SPACE TRUSS NODES IN THE RICH-1

The two following tables give the coordinates of the truss nodes in the RICH-1 vessel. They will be useful for checking their real position after mounting and before fixing the mirrors.

centre number	Spherical coordinates					Cartesian coordinates		
	ρ [mm]	θ [deg]	θ [rad]	ϕ [deg]	ϕ [rad]	X	Y	Z
1	6670.000	95.24679	1.66237	2.00842	0.03505	6637.973	232.780	-609.944
2	6670.000	95.22116	1.66192	6.02509	0.10516	6605.633	697.205	-606.972
3	6670.000	95.17002	1.66103	10.04127	0.17525	6541.112	1158.233	-601.044
4	6670.000	95.09363	1.65970	14.05664	0.24533	6444.723	1613.619	-592.187
5	6670.000	94.99238	1.65793	18.07091	0.31540	6316.935	2061.143	-580.445
6	6670.000	94.86676	1.65574	22.08379	0.38543	6158.373	2498.626	-565.875
7	6670.000	91.78519	1.60195	0.00000	0.00000	6666.763	0.000	-207.787
8	6670.000	91.77244	1.60173	3.99459	0.06972	6650.613	464.425	-206.303
9	6670.000	91.73424	1.60106	7.98896	0.13943	6602.241	926.588	-201.858
10	6670.000	91.67079	1.59996	11.98291	0.20914	6521.884	1384.236	-194.475
11	6670.000	91.58239	1.59841	15.97623	0.27884	6409.932	1835.141	-184.188
12	6670.000	91.46947	1.59644	19.96873	0.34852	6266.932	2277.104	-171.048
13	6670.000	88.31298	1.54135	1.98623	0.03467	6663.103	231.077	196.363
14	6670.000	88.28763	1.54091	5.95863	0.10400	6631.000	692.106	199.313
15	6670.000	88.23705	1.54003	9.93087	0.17333	6566.951	1149.762	205.198
16	6670.000	88.16149	1.53871	13.90284	0.24265	6471.266	1601.817	213.990
17	6670.000	88.06131	1.53696	17.87447	0.31197	6344.414	2046.069	225.647
18	6670.000	87.93699	1.53479	21.84568	0.38128	6187.011	2480.352	240.110
19	6670.000	98.71481	1.72290	0.00000	0.00000	6592.993	0.000	-1010.613
20	6670.000	98.70191	1.72267	4.03925	0.07050	6576.843	464.425	-1009.129
21	6670.000	98.66329	1.72200	8.07805	0.14099	6528.472	926.588	-1004.685
22	6670.000	98.59913	1.72088	12.11597	0.21146	6448.115	1384.236	-997.301
23	6670.000	98.50977	1.71932	16.15258	0.28192	6336.163	1835.141	-987.014
24	6670.000	98.39566	1.71733	20.18748	0.35234	6193.163	2277.104	-973.874
25	6670.000	102.18060	1.78339	2.03111	0.03545	6515.745	231.077	-1407.329
26	6670.000	102.15468	1.78294	6.09305	0.10634	6483.642	692.106	-1404.379
27	6670.000	102.10297	1.78203	10.15413	0.17722	6419.592	1149.762	-1398.494
28	6670.000	102.02574	1.78069	14.21382	0.24808	6323.908	1601.817	-1389.702
29	6670.000	101.92339	1.77890	18.27156	0.31890	6197.055	2046.069	-1378.046
30	6670.000	101.79643	1.77668	22.32687	0.38968	6039.652	2480.352	-1363.582

Table 5: Final coordinates of the upper truss nodes

centre number	Spherical coordinates					Cartesian coordinates		
	ρ [mm]	θ [deg]	θ [rad]	ϕ [deg]	ϕ [rad]	X	Y	Z
1	6670.000	84.75321	1.47922	2.00842	0.03505	6637.973	232.780	609.944
2	6670.000	84.77884	1.47967	6.02509	0.10516	6605.633	697.205	606.972
3	6670.000	84.82998	1.48056	10.04127	0.17525	6541.112	1158.233	601.044
4	6670.000	84.90637	1.48190	14.05664	0.24533	6444.723	1613.619	592.187
5	6670.000	85.00762	1.48366	18.07091	0.31540	6316.935	2061.143	580.445
6	6670.000	85.13324	1.48586	22.08379	0.38543	6158.373	2498.626	565.875
7	6670.000	81.28519	1.41869	0.00000	0.00000	6592.993	0.000	1010.613
8	6670.000	81.29809	1.41892	4.03925	0.07050	6576.843	464.425	1009.129
9	6670.000	81.33671	1.41959	8.07805	0.14099	6528.472	926.588	1004.685
10	6670.000	81.40087	1.42071	12.11597	0.21146	6448.115	1384.236	997.301
11	6670.000	81.49023	1.42227	16.15258	0.28192	6336.163	1835.141	987.014
12	6670.000	81.60434	1.42426	20.18748	0.35234	6193.163	2277.104	973.874
13	6670.000	77.81940	1.35820	2.03111	0.03545	6515.745	231.077	1407.329
14	6670.000	77.84532	1.35866	6.09305	0.10634	6483.642	692.106	1404.379
15	6670.000	77.89703	1.35956	10.15413	0.17722	6419.592	1149.762	1398.494
16	6670.000	77.97426	1.36091	14.21382	0.24808	6323.908	1601.817	1389.702
17	6670.000	78.07661	1.36269	18.27156	0.31890	6197.055	2046.069	1378.046
18	6670.000	78.20357	1.36491	22.32687	0.38968	6039.652	2480.352	1363.582
19	6670.000	88.21481	1.53964	0.00000	0.00000	6666.763	0.000	207.787
20	6670.000	88.22756	1.53986	3.99459	0.06972	6650.613	464.425	206.303
21	6670.000	88.26576	1.54053	7.98896	0.13943	6602.241	926.588	201.858
22	6670.000	88.32921	1.54164	11.98291	0.20914	6521.884	1384.236	194.475
23	6670.000	88.41761	1.54318	15.97623	0.27884	6409.932	1835.141	184.188
24	6670.000	88.53053	1.54515	19.96873	0.34852	6266.932	2277.104	171.048
25	6670.000	91.68702	1.60024	1.98623	0.03467	6663.103	231.077	-196.363
26	6670.000	91.71237	1.60068	5.95863	0.10400	6631.000	692.106	-199.313
27	6670.000	91.76295	1.60157	9.93087	0.17333	6566.951	1149.762	-205.198
28	6670.000	91.83851	1.60288	13.90284	0.24265	6471.266	1601.817	-213.990
29	6670.000	91.93869	1.60463	17.87447	0.31197	6344.414	2046.069	-225.647
30	6670.000	92.06301	1.60680	21.84568	0.38128	6187.011	2480.352	-240.110

Table 6: Final coordinates of the lower truss nodes.

9. CONCLUSION

Mirror and truss node positions have been listed for two different configurations.

Values from Tables 1 and 4 shall be used for the design and manufacturing of the jig needed to insure a good geometry for the space truss structure, as for the pre-assembling of the mirror wall.

Values from Tables 3, 4, 5 and 6 will help for dimensional checks in the vessel once the assembly is completed.