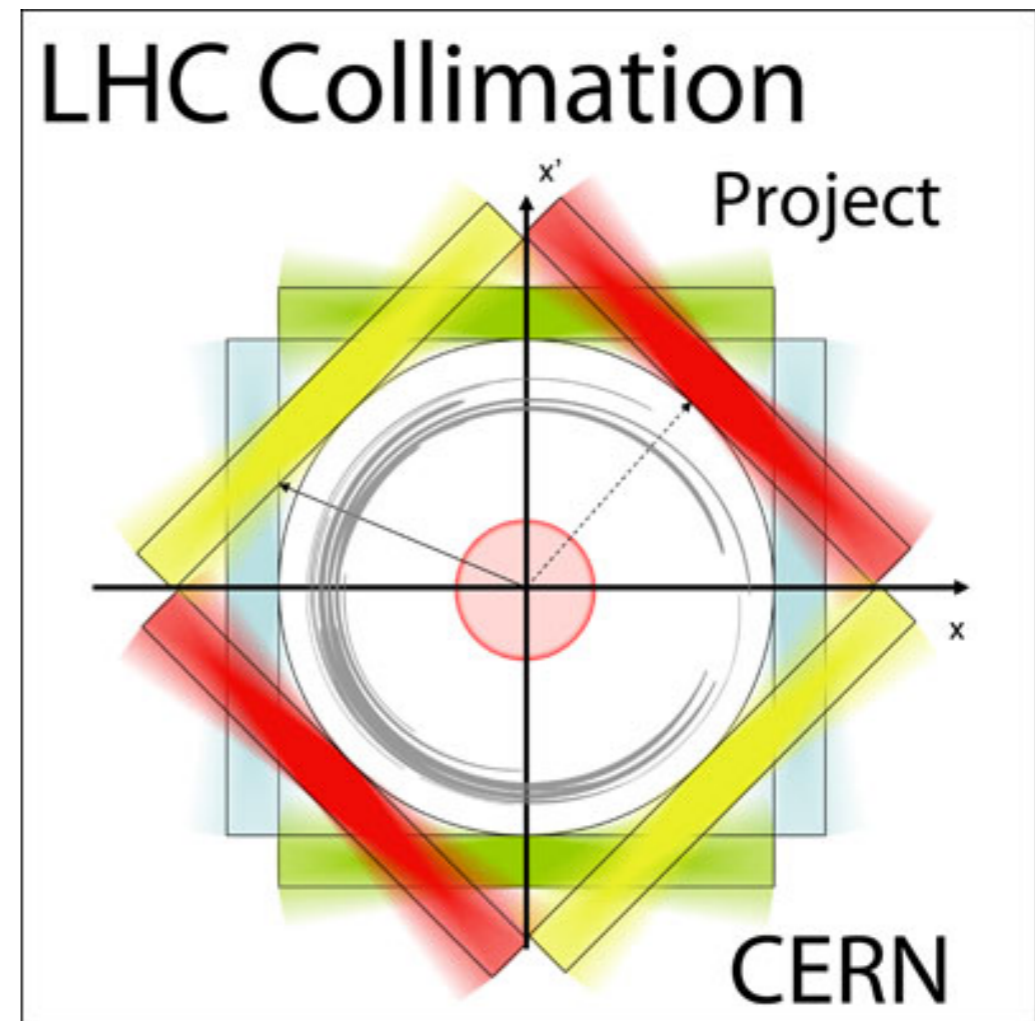# Roman Pot settings during low and high beta* runs in 2015
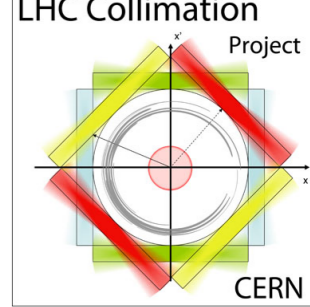

R.Bruce, S.Redaelli, **B.Salvachua**, G.Valentino
and discussions with
M.Deile, P.Fassnacht, S.Jakobsen, B.Salvant,
D.Wollmann, J.Wenninger, M.Zerlauth

Machine Protection Panel Meeting (MPP)

XRP settings Run 1

- **Roman Pot settings in 2012:**
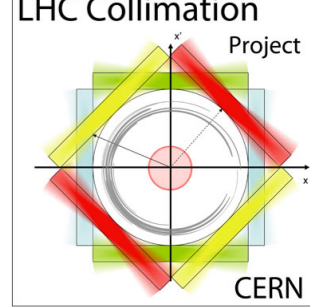
  - *EDMS No. 1225356*

  - Scenarios:

    ‣ Alignment: below SBF

    ‣ High luminosity: above SBF

      ✦ Low-β* optics 60cm standard physics

      ✦ High-β* optics 90m

      ✦ High-β* optics 500m or 1000m (not happened)

CERN
CH-1211 Geneva 23
Switzerland

the
Large
Hadron
Collider
project

LHC Project Document No.
LHC-MPP-00xx rev 0.3

CERN Div./Group or Supplier/Contractor Document No.
BE-ABP/TE-MPE

EDMS Document No.
1225356

Date: 2012-06-27

ROMAN POT SETTINGS IN 2012

Abstract

The movable Roman pots of the TOTEM and ATLAS-ALFA experiments will be used for data taking as part of the LHC physics programme in 2012. The operation of these devices is foreseen for different machine configurations and for different ranges of beam intensities. This document describes the operational settings of the Roman pots for all these conditions.

Prepared by:	Checked by:	Approved by:
Roderik Bruce **Stefano Redaelli** **Daniel Wollmann**	**rMPP members** **M. Deile, P. Fassnacht**	**M. Lamont** **R. Schmidt**

Distribution list:
LHC Machine Coordinators, LHC Engineers in Charge, LHC operators, TOTEM and ALFA team, H. Burkhardt.

XRP settings Run 1

Scenario	HORIZONTAL	VERTICAL
Alignment**	TCSG6 + 2σ = 5σ + 2σ = 7σ	TCP + 0.5σ = 4σ + 0.5σ = 4.5σ
60 cm above SBF	TCT + 5σ = 9σ + 5σ = 14σ	TCT + 3σ = 9σ + 3σ = 12σ
90 m above SBF*	TCSG6 + 3.9σ = 7.1σ + 3.9σ = 11σ	TCSG7 + 3.2σ = 6.3σ + 3.2σ = 9.5σ

* tight   ** Collimator settings could be tighter but XRP/Collimator retraction must be respected

β*=60cm

Horizontal: XRP stay at a retraction of 5σ that corresponds to less than 600μm.
Vertical: this margin is reduced in the vertical plane to 3σ because beam size is larger and the asynchronous dump failure scenario does not affect this plane.

β*=90 m:

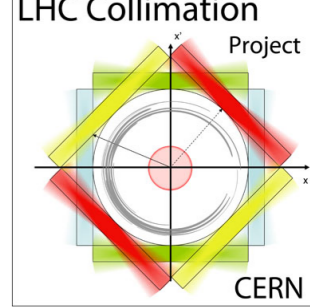Horizontal: XRP stay at a retraction of 3.9σ from the TCSP6
Vertical: XRP stay at a retraction of 3σ from the TCSP7 so that they do not become the bottleneck (TCTs are open with this configuration). There is a note that this could be reduced to 2σ.

2015 Small-β* High Luminosity

6.5TeV High luminosity run (above SBF) with small beta-star (β*=80cm)

- The margins of 3σ and 5σ for Vertical and Horizontal pots used in 2012 were established after a good understanding of the machine, this **retraction** corresponds to **less than 600µm in some cases**. We do not have the same experience for Run 2 yet.

- We propose to start with settings that **respect the same retraction XRP/TCT in [mm]** unless we have an immediate indication that that the IRs are less stable than in 2012, in that case we must add margins.

- Expressed in beam size (σ) this comes to:

  ‣ **Horizontal**: **7σ** retraction from the TCTH

  ‣ **Vertical**: **4.5σ** retraction from the TCTV

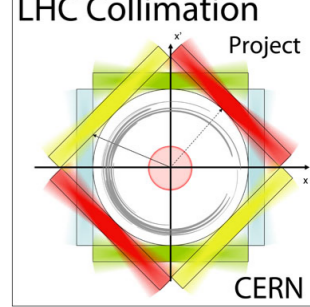| BEAM 1: IP1 and IP5 0.8 m beta star optics			TCT 9 sigma			TCT 11.5 sigma	Hor TCT + 7sig, Vert TCT + 4.5sig	Assuming same locations in Run 1	
Layout Name	Effective Sigma [um]		60 cm [sigma] Retraction from TCT	60 cm [um] Retraction from TCT	Run 1, 60 cm [um] Half-gap	Equivalent Run 1 retraction from TCT [sigma]	Run 2, 80cm [um] Half-gap	Diff	Run 2, 80cm, Final settings [sigma]
XRPV.A7R1.B1	281.92		3.0	1096.68	4386.73	3.9	4510.70	124.0	16.00
XRPV.B7R1.B1	232.74		3.0	901.24	3604.97	3.9	3723.89	118.9	16.00
XRPV.C6R5.B1	417.59		3.0	1781.28	7125.13	4.3	6681.42	-443.7	16.00
XRPH.C6R5.B1	164.72		5.0	1185.54	3319.50	7.2	3047.36	-272.1	18.50
XRPH.D6R5.B1	116.62		5.0	823.59	2306.05	7.1	2157.44	-148.6	18.50
XRPV.D6R5.B1	386.06		3.0	1600.17	6400.68	4.1	6176.94	-223.7	16.00
XRPV.A6R5.B1	380.76		3.0	1569.64	6278.56	4.1	6092.21	-186.4	16.00
XRPH.A6R5.B1	104.54		5.0	727.35	2036.59	7.0	1933.97	-102.6	18.50
XRPH.E6R5.B1	101.72		5.0	704.24	1971.87	6.9	1881.79	-90.1	18.50
XRPH.B6R5.B1	87.01		5.0	576.37	1613.84	6.6	1609.64	-4.2	18.50
XRPV.B6R5.B1	363.38		3.0	1469.18	5876.73	4.0	5814.03	-62.7	16.00

BEAM 2: IP1 and IP5 at 80cm beta-star optics			TCT 9 sigma			TCT 11.5 sigma	Hor TCT + 7sig, Vert TCT + 4.5sig	Assuming same locations in Run 1	
Layout Name	Effective Sigma [um]		60 cm [sigma] Retraction from TCT	60 cm [um] Retraction from TCT	Run 1, 60 cm [um] Half-gap	Equivalent Run 1 retraction from TCT [sigma]	Run 2, 80cm [um] Half-gap	Diff	Run 2, 80cm, Final settings [sigma]
XRPV.B6L5.B2	345.23		3.0	1518.71	6074.82	4.4	5523.64	-551.2	16.00
XRPH.B6L5.B2	91.19		5.0	584.13	1635.56	6.4	1687.10	51.5	18.50
XRPH.E6L5.B2	106.20		5.0	701.62	1964.55	6.6	1964.75	0.2	18.50
XRPH.A6L5.B2	109.02		5.0	723.02	2024.46	6.6	2016.91	-7.5	18.50
XRPV.A6L5.B2	365.44		3.0	1624.48	6497.94	4.4	5846.97	-651.0	16.00
XRPV.D6L5.B2	371.59		3.0	1656.62	6626.47	4.5	5945.45	-681.0	16.00
XRPH.D6L5.B2	121.00		5.0	812.50	2275.01	6.7	2238.57	-36.4	18.50
XRPH.C6L5.B2	168.15		5.0	1152.59	3227.24	6.9	3110.75	-116.5	18.50
XRPV.C6L5.B2	408.22		3.0	1847.15	7388.58	4.5	6531.56	-857.0	16.00
XRPV.B7L1.B2	221.10		3.0	947.94	3791.77	4.3	3537.64	-254.1	16.00
XRPV.A7L1.B2	265.01		3.0	1140.91	4563.65	4.3	4240.16	-323.5	16.00

Assuming TCTs at 11.5σ the smallest gap allowed at the pots is 1.6mm for Beam 1 and 1.9mm for Beam 2
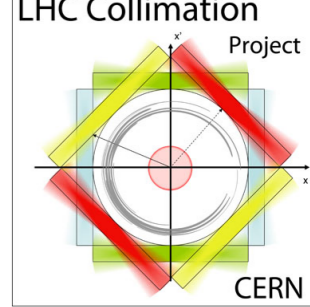
BEAM 1: IP1 and IP5 0.8 m beta star optics

Layout Name	Effective Sigma [um]		TCT 9 sigma 60 cm [sigma] Retraction from TCT	60 cm [um] Retraction from TCT	Run 1, 60 cm [um] Half-gap	TCT 11.5 sigma Equivalent Run 1 retraction from TCT [sigma]	Hor TCT + 7sig, Vert TCT + 4.5sig Run 2, 80cm [um] Half-gap	Assuming same locations in Run 1 Diff	Run 2, 80cm, Final settings [sigma]
XRPV.A7R1.B1	281.92		3.0	1096.68	4386.73	3.9	4510.70	124.0	16.00
XRPV.B7R1.B1	232.74		3.0	901.24	3604.97	3.9	3723.89	118.9	16.00
XRPV.C6R5.B1	417.59		3.0	1781.28	7125.13	4.3	6681.42	-443.7	16.00
XRPH.C6R5.B1	164.72		5.0	1185.54	3319.50	7.2	3047.36	-272.1	18.50
XRPH.D6R5.B1	116.62		5.0	823.59	2306.05	7.1	2157.44	-148.6	18.50
XRPV.D6R5.B1	386.06		3.0	1600.17	6400.68	4.1	6176.94	-223.7	16.00
XRPV.A6R5.B1	380.76		3.0	1569.64	6278.56	4.1	6092.21	-186.4	16.00
XRPH.A6R5.B1	104.54		5.0	727.35	2036.59	7.0	1933.97	-102.6	18.50
XRPH.E6R5.B1	101.72		5.0	704.24	1971.87	6.9	1881.79	-90.1	18.50
XRPH.B6R5.B1	87.01		5.0	576.37	1613.84	6.6	1609.64	-4.2	18.50
XRPV.B6R5.B1	363.38		3.0	1469.18	5876.73	4.0	5814.03	-62.7	16.00

BEAM 2: IP1 and IP5 at 80cm beta-star optics

Layout Name	Effective Sigma [um]		TCT 9 sigma 60 cm [sigma] Retraction from TCT	60 cm [um] Retraction from TCT	Run 1, 60 cm [um] Half-gap	TCT 11.5 sigma Equivalent Run 1 retraction from TCT [sigma]	Hor TCT + 7sig, Vert TCT + 4.5sig Run 2, 80cm [um] Half-gap	Assuming same locations in Run 1 Diff	Run 2, 80cm, Final settings [sigma]
XRPV.B6L5.B2	345.23		3.0	1518.71	6074.82	4.4	5523.64	-551.2	16.00
XRPH.B6L5.B2	91.19		5.0	584.13	1635.56	6.4	1687.10	51.5	18.50
XRPH.E6L5.B2	106.20		5.0	701.62	1964.55	6.6	1964.75	0.2	18.50
XRPH.A6L5.B2	109.02		5.0	723.02	2024.46	6.6	2016.91	-7.5	18.50
XRPV.A6L5.B2	365.44		3.0	1624.48	6497.94	4.4	5846.97	-651.0	16.00
XRPV.D6L5.B2	371.59		3.0	1656.62	6626.47	4.5	5945.45	-681.0	16.00
XRPH.D6L5.B2	121.00		5.0	812.50	2275.01	6.7	2238.57	-36.4	18.50
XRPH.C6L5.B2	168.15		5.0	1152.59	3227.24	6.9	3110.75	-116.5	18.50
XRPV.C6L5.B2	408.22		3.0	1847.15	7388.58	4.5	6531.56	-857.0	16.00
XRPV.B7L1.B2	221.10		3.0	947.94	3791.77	4.3	3537.64	-254.1	16.00
XRPV.A7L1.B2	265.01		3.0	1140.91	4563.65	4.3	4240.16	-323.5	16.00

Assuming TCTs at 11.5σ the smallest gap allowed at the pots is 1.6mm for Beam 1 and 1.9mm for Beam 2

BEAM 1: IP1 and IP5 0.8 m beta star optics			TCT 9 sigma			TCT 11.5 sigma	Hor TCT + 7sig, Vert TCT + 4.5sig	Assuming same locations in Run 1	
Layout Name	Effective Sigma [um]		60 cm [sigma] Retraction from TCT	60 cm [um] Retraction from TCT	Run 1, 60 cm [um] Half-gap	Equivalent Run 1 retraction from TCT [sigma]	Run 2, 80cm [um] Half-gap	Diff	Run 2, 80cm, Final settings [sigma]
XRPV.A7R1.B1	281.92		3.0	1096.68	4386.73	3.9	4510.70	124.0	16.00
XRPV.B7R1.B1	232.74		3.0	901.24	3604.97	3.9	3723.89	118.9	16.00
XRPV.C6R5.B1	417.59		3.0	1781.28	7125.13	4.3	6681.42	-443.7	16.00
XRPH.C6R5.B1	164.72		5.0	1185.54	3319.50	7.2	3047.3	-272.1	18.50
XRPH.D6R5.B1	116.62		5.0	823.59	2306.05	7.1	215.44	-148.6	18.50
XRPV.D6R5.B1	386.06						76.94	-223.7	16.00
XRPV.A6R5.B1	380.76						92.21	-186.4	16.00
XRPH.A6R5.B1	104.54						33.97	-102.6	18.50
XRPH.E6R5.B1	101.72						81.79	-90.1	18.50
XRPH.B6R5.B1	87.01						9.64	-4.2	18.50
XRPV.B6R5.B1	363.38						.03	-62.7	16.00

Smaller gaps than in Run 1 except for few stations

BEAM 2: IP1 and IP5 at 80cm beta-star optics			TCT 9 sigma			TCT 11.5 sigma	Hor TCT + 7sig, Vert TCT + 4.5sig	Assuming same locations in Run 1	
Layout Name	Effective Sigma [um]		60 cm [sigma] Retraction from TCT	60 cm [um] Retraction from TCT	Run 1, 60 cm [um] Half-gap	Equivalent Run 1 retraction from TCT [sigma]	Run 2, 80cm [um] Half-gap	Diff	Run 2, 80cm, Final settings [sigma]
XRPV.B6L5.B2	345.23		3.0	1518.71	6074.82	4.4	5523.64	-551.2	16.00
XRPH.B6L5.B2	91.19		5.0	584.13	1635.56	6.4	1687.10	51.5	18.50
XRPH.E6L5.B2	106.20		5.0	701.62	1964.55	6.6	1964.75	0.2	18.50
XRPH.A6L5.B2	109.02		5.0	723.02	2024.46	6.6	2016.91	-7.5	18.50
XRPV.A6L5.B2	365.44		3.0	1624.48	6497.94	4.4	5846.97	-651.0	16.00
XRPV.D6L5.B2	371.59		3.0	1656.62	6626.47	4.5	5945.45	-681.0	16.00
XRPH.D6L5.B2	121.00		5.0	812.50	2275.01	6.7	2238.57	-36.4	18.50
XRPH.C6L5.B2	168.15		5.0	1152.59	3227.24	6.9	3110.75	-116.5	18.50
XRPV.C6L5.B2	408.22		3.0	1847.15	7388.58	4.5	6531.56	-857.0	16.00
XRPV.B7L1.B2	221.10		3.0	947.94	3791.77	4.3	3537.64	-254.1	16.00
XRPV.A7L1.B2	265.01		3.0	1140.91	4563.65	4.3	4240.16	-323.5	16.00

Assuming TCTs at 11.5σ the smallest gap allowed at the pots is 1.6mm for Beam 1 and 1.9mm for Beam 2

2015 Large-β* High Luminosity
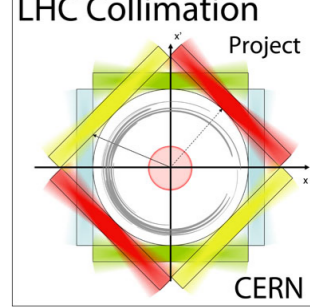
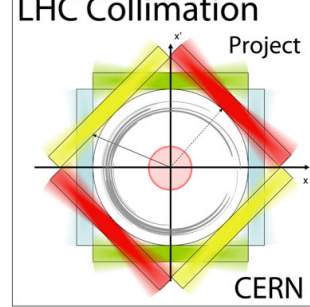**6.5TeV High luminosity run (above SBF) with large beta-star (β*=90m or other scenario like ~20m)**

- Same philosophy as in 2012 we should respect the full hierarchy IR3/IR6/IR7

- This comes to:

  ‣ TCTs will be open at ~20σ

  ‣ **Horizontal**: **4σ** retraction from the TCSG6 or larger than aperture

  ‣ **Vertical**: **3.5σ** retraction from the TCSG7

  ‣ We have not studied the aperture, but we assume to be 13.5σ

BEAM 1: IP1 and IP5 at 90m beta-star optics	Effective Sigma [um]		90 m [sigma] 4sig XRP-H from TCSG6 7.1, and 3sig XRP-V from TCSG7 6.3	Run 1, 90m [um] Half-gap	90 m [sigma] 4sig XRP-H from TCSG6 9.1 or larger than aperture 13.5, and 3.5sig XRP-V from TCSG7 8.3	Run 2, 90m [um] Half-gap	Diff
XRPV.A7R1.B1	666.87		9.5	8075.94	11.8	7869.09	-206.84
XRPV.B7R1.B1	604.34		9.5	7318.72	11.8	7131.27	-187.45
XRPV.C6R5.B1	437.33		9.5	5296.10	11.8	5160.45	-135.65
XRPH.C6R5.B1	588.87		11.0	8257.32	13.5	7949.75	-307.57
XRPH.D6R5.B1	485.45		11.0	6807.15	13.5	6553.60	-253.55
XRPV.D6R5.B1	545.36		9.5	6604.41	11.8	6435.25	-169.16
XRPV.A6R5.B1	563.65		9.5	6825.96	11.8	6651.13	-174.83
XRPH.A6R5.B1	455.54		11.0	6387.70	13.5	6149.77	-237.93
XRPH.E6R5.B1	448.04		11.0	6282.62	13.5	6048.61	-234.02
XRPH.B6R5.B1	402.60		11.0	5645.40	13.5	5435.12	-210.28
XRPV.B6R5.B1	624.05		9.5	7557.31	11.8	7363.75	-193.56

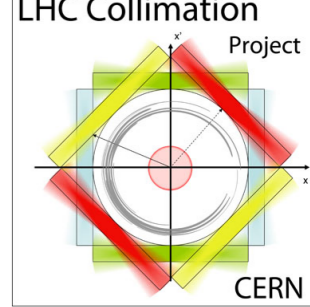- **Settings assumed:**

  - Horizontal: TCSG6 9.1σ + 4σ = 13.1σ This is smaller than the aperture at 13.5σ so we take the most conservative approach.

  - Vertical: TCSG7 8.3σ + 3.5σ = 11.8σ

- **With this collimator settings, for all XRP stations (TOTEM and ALFA) the pots are allowed smaller gaps in [mm] than in Run 1.**

- **Beam 2 is very similar (see backup-slides)**

Summary Table

Proposed XRP settings for 2015 in sigma for 6.5TeV

| *Scenario*	*HORIZONTAL*	*VERTICAL*
Alignment	TCSG6 + 2σ = 9.1σ + 2 = 11.1σ	TCP + 0.5σ = 5.5σ + 0.5σ = 6σ
80 cm above SBF	TCT + 7σ = 11.5σ + 7σ = 18.5σ	TCT + 4.5σ = 11.5σ + 4.5 = 16.0σ
90 m above SBF	(aperture) 13.5σ	TCSG7 + 3.5σ = 8.3σ + 3.5σ = 11.8σ
19-20 m above SBF	(aperture) 13.5σ	TCSG7 + 3.5σ = 8.3σ + 3.5σ = 11.8σ

Compared to Run 1 settings, **most of** the pots are same or closer position in absolute value *but NOTICE that the 2015 collimator settings are not yet approved by the LMC.*

EDMS note on preparation but is almost ready, it could be circulating next week if all the parts agree with this proposal.
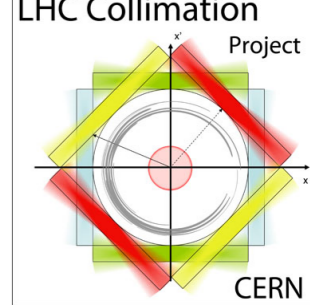
90 m

Layout Name	From IP	Marker	Position [m]	Beta-H [m]	Beta-V [m]	Sigma-H [um]	Sigma-V [um]	Effective Sigma [um]	Run 1, 90m [um] Half-gap	90 m [sigma] 4sig XRP-H from TCSG6 9.1 or larger than aperture 13.5, and 3.5sig XRP-V from TCSG7 8.3	Run 2, 90m [um] Half-gap	Diff
XRPV.A7R1.B1	237.40	0.000	237.40	137.77	880.24	263.82	666.87	666.87	8075.94	11.8	7869.09	-206.84
XRPV.B7R1.B1	245.66	0.000	245.66	109.60	722.91	235.32	604.34	604.34	7318.72	11.8	7131.27	-187.45
XRPV.C6R5.B1	203.38	13329.289	13532.67	698.84	378.55	594.20	437.33	437.33	5296.10	11.8	5160.45	-135.65
XRPH.C6R5.B1	203.83	13329.289	13533.12	686.37	387.32	588.87	442.36	588.87	8257.32	13.5	7949.75	-307.57
XRPH.D6R5.B1	212.55	13329.289	13541.84	466.45	577.85	485.45	540.32	485.45	6807.15	13.5	6553.60	-253.55
XRPV.D6R5.B1	213.00	13329.289	13542.29	456.29	588.69	480.13	545.36	545.36	6604.41	11.8	6435.25	-169.16
XRPV.A6R5.B1	214.63	13329.289	13543.92	420.38	628.84	460.85	563.65	563.65	6825.96	11.8	6651.13	-174.83
XRPH.A6R5.B1	215.08	13329.289	13544.37	410.74	640.15	455.54	568.70	455.54	6387.70	13.5	6149.77	-237.93
XRPH.E6R5.B1	215.71	13329.289	13545.00	397.34	656.27	448.04	575.82	448.04	6282.62	13.5	6048.61	-234.02
XRPH.B6R5.B1	219.55	13329.289	13548.84	320.82	758.39	402.60	619.00	402.60	5645.40	13.5	5435.12	-210.28
XRPV.B6R5.B1	220.00	13329.289	13549.29	312.42	770.82	397.29	624.05	624.05	7557.31	11.8	7363.75	-193.56

Layout Name	From IP	Marker	Position [m]	Beta-H [m]	Beta-V [m]	Sigma-H [um]	Sigma-V [um]	Effective Sigma [um]	Run 1, 90m [um] Half-gap	90 m [sigma] 4sig XRP-H from TCSG6 9.1 or larger than aperture 13.5, and 3.5sig XRP-V from TCSG7 8.3	Run 2, 90m [um] Half-gap	Diff
XRPV.B6L5.B2	-220.00	13329.594	13109.59	301.64	810.80	390.38	640.03	640.03	7750.85	11.8	7552.33	-198.52
XRPH.B6L5.B2	-219.55	13329.594	13110.04	309.70	797.72	395.56	634.84	395.56	5546.62	13.5	5340.02	-206.60
XRPH.E6L5.B2	-215.71	13329.594	13113.88	382.99	690.15	439.88	590.49	439.88	6168.11	13.5	5938.36	-229.75
XRPH.A6L5.B2	-215.08	13329.594	13114.52	395.82	673.18	447.19	583.18	447.19	6270.60	13.5	6037.03	-233.57
XRPV.A6L5.B2	-214.63	13329.594	13114.97	405.05	661.26	452.37	578.00	578.00	6999.70	11.8	6820.42	-179.28
XRPV.D6L5.B2	-213.00	13329.594	13116.59	439.42	618.97	471.18	559.21	559.21	6772.15	11.8	6598.70	-173.45
XRPH.D6L5.B2	-212.55	13329.594	13117.04	449.15	607.55	476.36	554.03	476.36	6679.72	13.5	6430.92	-248.81
XRPH.C6L5.B2	-203.83	13329.594	13125.77	659.53	406.92	577.25	453.41	577.25	8094.31	13.5	7792.81	-301.50
XRPV.C6L5.B2	-203.38	13329.594	13126.22	671.46	397.68	582.44	448.24	448.24	5428.26	11.8	5289.23	-139.03
XRPV.B7L1.B2	-245.66	26658.883	26413.23	110.37	719.67	236.14	602.99	602.99	7302.29	11.8	7115.26	-187.03
XRPV.A7L1.B2	-237.40	26658.883	26421.49	138.73	876.07	264.74	665.29	665.29	8056.78	11.8	7850.43	-206.35