Evaluation of aperture for crab cavity*

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1 Discussion

Mail from Nikolai Solyak:

1. I looked again your data for photon loss in crab cavity for different configurations of collimation system (Table 1,2,3). Which one is baseline configuration?

2. For proposed design of the crab-cavity we have aperture radius 15mm, but the antenna is deeper inside cavity with $\sim$ 11mm from the center of cavity. The thickness of the antenna is about 4mm, so it cover area only $\sim$ 3% of the ring area (R(in)=11mm, R(out)=15mm). It means that losses should be reduced by factor of $\sim$ 15.

3. Angular orientation of the antenna is not fixed yet. If angular distribution of photons not uniform, we can put antenna in position (x or y or any other angle), when the density of the losses is smaller.

4. If with all above assumptions the final losses looks bad, then we will try to redesign antenna to reduce penetration to cavity, but we should have some requirements. For example, if we move 2mm out of center what the minimum aperture is acceptable.

Sasha Drozhdin:

I performed simulations with 4mm thick antenna at 11mm from the center of cavity for collimation system with enlarged aperture of SPEX to $1 \times 0.8\ mm^2$, PCs to $3 \times 3\ mm^2$ and aperture of absorbers to $2 \times 2\ mm^2$ (Table 4). Aperture of PC7 is $60 \times 5\ mm^2$, ABE, AB10, SB9 and AB7 are as in the Table 1. Results are presented in Fig. 3, 4 and Tables 7, 8. Radius of Crab Cavity is 0.5 mm bigger than radius of Crab Cavity mask. Photons are lost at the Crab cavity mask in a range of $\pm 2.5\ mm$ in a vertical plane from one side of aperture in the horizontal plane. There are no photon loss at the Crab cavity and antenna (for antenna position Y=11 mm) if Crab cavity mask aperture is 0.5 mm less compared to the aperture of Crab cavity itself. There are no photon loss from beam halo at Crab cavity mask with $R \geq 14.5\ mm$, and at Crab cavity mask with $R \geq 12.5\ mm$ for photons from beam core.

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name	thickness		material	aperture					σ beam size	
				code	hor.	ver.	hor.	ver.	hor.	ver.
	mm	rad.len.			mm	mm	σ_x	σ_y	mm	mm
collim.at $8\sigma_x$ X $57\sigma_y$										
AB2	429.0	30	Copper	17	1.7	1.3	15	169	0.1119	0.0077
SP2	8.6	0.6	Copper	18	0.9	0.5	8	65	0.1119	0.0077
PC1	214.5	15	Copper	20	1.3	0.7	20	438	0.0655	0.0016
AB3	429.0	30	Copper	28	0.7	0.7	35	583	0.0202	0.0012
PC2	214.5	15	Copper	10	1.1	0.7	18	467	0.0617	0.0015
PC3	214.5	15	Copper	22	2.8	1.5	20	273	0.1419	0.0055
AB4	429.0	30	Copper	24	1.9	1.3	17	169	0.1123	0.0077
SP4	8.6	0.6	Copper	25	0.9	0.5	8	65	0.1123	0.0077
PC4	214.5	15	Copper	23	2.8	1.5	20	246	0.1373	0.0061
PC5	214.5	15	Copper	11	1.8	0.7	20	233	0.0923	0.0030
AB5	429.0	30	Copper	12	1.0	0.7	23	778	0.0426	0.0009
PC6	214.5	15	Copper	27	1.8	0.7	20	304	0.0893	0.0023
PDUMP	214.5	15	Copper	56	1.8	1.5	27	246	0.0677	0.0061
PC7	214.5	15	Copper	55	5.0	3.5	143	202	0.0349	0.0173
SPEX	35.6	1	Titanium	33	0.5	0.8	10	62	0.0516	0.0130
PC8	214.5	15	Copper	19	0.7	1.7	19	100	0.0367	0.0170
PC9	214.5	15	Copper	26	0.7	1.2	19	98	0.0378	0.0123
PC10	214.5	15	Copper	13	1.2	1.0	20	137	0.0606	0.0073
ABE	105.0	30	Tungsten	37	1.8	0.5	20	208	0.0902	0.0024
PC11	214.5	15	Copper	14	0.8	0.7	20	636	0.0400	0.0011
AB10	105.0	30	Tungsten	39	7.0	7.0	18	139	0.3801	0.0502
AB9	105.0	30	Tungsten	40	10	4.5	16	147	0.6449	0.0307
AB7	105.0	30	Tungsten	41	4.4	1.6	171	1230	0.0257	0.0013
MSK1	105.0	30	Tungsten	42	7.8	4.0	16	178	0.4875	0.0225
MSK2	105.0	30	Tungsten	43	7.4	4.5	12	151	0.6076	0.0298

Table 1: ILC collimator aperture, length and material. CP - spoiler, AB - absorber, MSK - photon mask, PC - electron mask. Version ILCFF9.

name	thickness		material	aperture					σ beam size	
				code	hor.	ver.	hor.	ver.	hor.	ver.
	mm	rad.len.			mm	mm	σ_x	σ_y	mm	mm
collim.at $8\sigma_x$ X $57\sigma_y$										
AB2	429.0	30	Copper	17	2.0	2.0	18	260	0.1119	0.0077
SP2	8.6	0.6	Copper	18	0.9	0.5	8	65	0.1119	0.0077
PC1	214.5	15	Copper	20	2.0	2.0	30	1250	0.0655	0.0016
AB3	429.0	30	Copper	28	2.0	2.0	99	1670	0.0202	0.0012
PC2	214.5	15	Copper	10	2.0	2.0	32	1330	0.0617	0.0015
PC3	214.5	15	Copper	22	2.8	2.0	20	364	0.1419	0.0055
AB4	429.0	30	Copper	24	2.0	2.0	18	260	0.1123	0.0077
SP4	8.6	0.6	Copper	25	0.9	0.5	8	65	0.1123	0.0077
PC4	214.5	15	Copper	23	2.8	2.0	20	328	0.1373	0.0061
PC5	214.5	15	Copper	11	2.0	2.0	21	667	0.0923	0.0030
AB5	429.0	30	Copper	12	2.0	2.0	47	2220	0.0426	0.0009
PC6	214.5	15	Copper	27	2.0	2.0	22	870	0.0893	0.0023
PDUMP	214.5	15	Copper	56	2.0	2.0	29	328	0.0677	0.0061
PC7	214.5	15	Copper	55	60.0	4.0	1719	231	0.0349	0.0173
SPEX	35.6	1	Titanium	33	2.3	0.8	44	62	0.0516	0.0130
PC8	214.5	15	Copper	19	2.0	2.0	54	117	0.0367	0.0170
PC9	214.5	15	Copper	26	2.0	2.0	53	162	0.0378	0.0123
PC10	214.5	15	Copper	13	2.0	2.0	33	274	0.0606	0.0073
ABE	105.0	30	Tungsten	37	2.0	2.0	22	830	0.0902	0.0024
PC11	214.5	15	Copper	14	2.0	2.0	50	1820	0.0400	0.0011
AB10	105.0	30	Tungsten	39	7.0	9.1	18	180	0.3801	0.0502
AB9	105.0	30	Tungsten	40	11.3	5.5	18	180	0.6449	0.0307
AB7	105.0	30	Tungsten	41	4.4	2.0	171	1540	0.0257	0.0013
MSK1	105.0	30	Tungsten	42	8.8	4.0	18	180	0.4875	0.0225
MSK2	105.0	30	Tungsten	43	11.1	5.4	18	180	0.6076	0.0298

Table 2: ILC collimator aperture, length and material. CP - spoiler, AB - absorber, MSK - photon mask, PC - electron mask. Version ILCFF9 with enlarged aperture of PCs and absorbers to 2 mm, and AB10, AB9, MSK1, MSK2 to $18\sigma_x$ X $180\sigma_y$.

name	thickness		material	aperture					σ beam size	
				code	hor.	ver.	hor.	ver.	hor.	ver.
	mm	rad.len.			mm	mm	σ_x	σ_y	mm	mm
collim.at $8\sigma_x$ X $57\sigma_y$										
AB2	429.0	30	Copper	17	2.0	2.0	18	260	0.1119	0.0077
SP2	8.6	0.6	Copper	18	1.5	0.8	8	65	0.1119	0.0077
PC1	214.5	15	Copper	20	2.0	2.0	30	1250	0.0655	0.0016
AB3	429.0	30	Copper	28	2.0	2.0	99	1670	0.0202	0.0012
PC2	214.5	15	Copper	10	2.0	2.0	32	1330	0.0617	0.0015
PC3	214.5	15	Copper	22	2.8	2.0	20	364	0.1419	0.0055
AB4	429.0	30	Copper	24	2.0	2.0	18	260	0.1123	0.0077
SP4	8.6	0.6	Copper	25	1.5	0.8	8	65	0.1123	0.0077
PC4	214.5	15	Copper	23	2.8	2.0	20	328	0.1373	0.0061
PC5	214.5	15	Copper	11	2.0	2.0	21	667	0.0923	0.0030
AB5	429.0	30	Copper	12	2.0	2.0	47	2220	0.0426	0.0009
PC6	214.5	15	Copper	27	2.0	2.0	22	870	0.0893	0.0023
PDUMP	214.5	15	Copper	56	2.0	2.0	29	328	0.0677	0.0061
PC7	214.5	15	Copper	55	60.0	4.0	1719	231	0.0349	0.0173
SPEX	35.6	1	Titanium	33	2.3	0.8	44	62	0.0516	0.0130
PC8	214.5	15	Copper	19	2.0	2.0	54	117	0.0367	0.0170
PC9	214.5	15	Copper	26	2.0	2.0	53	162	0.0378	0.0123
PC10	214.5	15	Copper	13	2.0	2.0	33	274	0.0606	0.0073
ABE	105.0	30	Tungsten	37	2.0	2.0	22	830	0.0902	0.0024
PC11	214.5	15	Copper	14	2.0	2.0	50	1820	0.0400	0.0011
AB10	105.0	30	Tungsten	39	7.0	9.1	18	180	0.3801	0.0502
AB9	105.0	30	Tungsten	40	11.3	5.5	18	180	0.6449	0.0307
AB7	105.0	30	Tungsten	41	4.4	2.0	171	1540	0.0257	0.0013
MSK1	105.0	30	Tungsten	42	8.8	4.0	18	180	0.4875	0.0225
MSK2	105.0	30	Tungsten	43	11.1	5.4	18	180	0.6076	0.0298

Table 3: ILC collimator aperture, length and material. CP - spoiler, AB - absorber, MSK - photon mask, PC - electron mask. Version ILCFF9 with enlarged aperture of SP2, SP4 to 1.5×0.8 mm, PCs and absorbers to 2 mm, and AB10, AB9, MSK1, MSK2 to $18\sigma_x$ X $180\sigma_y$.

name	thickness		material	aperture					σ beam size	
				code	hor.	ver.	hor.	ver.	hor.	ver.
	mm	rad.len.			mm	mm	σ_x	σ_y	mm	mm
collim.at $8\sigma_x$ X $57\sigma_y$										
AB2	429.0	30	Copper	17	2.0	2.0	18	260	0.1119	0.0077
SP2	8.6	0.6	Copper	18	0.9	0.5	8	65	0.1119	0.0077
PC1	214.5	15	Copper	20	3.0	3.0	-	-	0.0655	0.0016
AB3	429.0	30	Copper	28	2.0	2.0	99	1670	0.0202	0.0012
PC2	214.5	15	Copper	10	3.0	3.0	-	-	0.0617	0.0015
PC3	214.5	15	Copper	22	3.0	3.0	-	-	0.1419	0.0055
AB4	429.0	30	Copper	24	2.0	2.0	18	260	0.1123	0.0077
SP4	8.6	0.6	Copper	25	0.7	0.5	6.2	65	0.1123	0.0077
PC4	214.5	15	Copper	23	3.0	3.0	-	-	0.1373	0.0061
PC5	214.5	15	Copper	11	3.0	3.0	-	-	0.0923	0.0030
AB5	429.0	30	Copper	12	2.0	2.0	47	2200	0.0426	0.0009
PC6	214.5	15	Copper	27	3.0	3.0	-	-	0.0893	0.0023
PDUMP	214.5	15	Copper	56	2.0	2.0	29	328	0.0677	0.0061
PC7	214.5	15	Copper	55	60.0	5.0	1700	289	0.0349	0.0173
SPEX	35.6	1	Titanium	33	1.0	0.8	19	62	0.0516	0.0130
PC8	214.5	15	Copper	19	3.0	3.0	-	-	0.0367	0.0170
PC9	214.5	15	Copper	26	3.0	3.0	-	-	0.0378	0.0123
PC10	214.5	15	Copper	13	3.0	3.0	-	-	0.0606	0.0073
ABE	105.0	30	Tungsten	37	2.0	2.0	22	833	0.0902	0.0024
PC11	214.5	15	Copper	14	3.0	3.0	-	-	0.0400	0.0011
AB10	105.0	30	Tungsten	39	7.0	7.0	18	139	0.3801	0.0502
AB9	105.0	30	Tungsten	40	10	4.5	16	147	0.6449	0.0307
AB7	105.0	30	Tungsten	41	4.4	1.6	171	1230	0.0257	0.0013
MSK1	105.0	30	Tungsten	42	7.8	4.0	16	178	0.4875	0.0225
MSK2	105.0	30	Tungsten	43	7.4	4.5	12	151	0.6076	0.0298

Table 4: ILC collimator aperture, length and material. SP - spoiler, AB - absorber, MSK - photon mask, PC - protection collimator (mask). Version ILCFF9 with enlarged aperture of SPEX to $1 \times 0.8\ mm^2$, PCs to $3 \times 3\ mm^2$ and aperture of absorbers to $2 \times 2\ mm^2$. Aperture of PC7 is $60 \times 5\ mm^2$, ABE, AB10, SB9 and AB7 are as in the Table 1 for "tight" collimation. There is a way for collimation with SPEX at X=1 mm. To do this, it is necessary to decrease aperture of SP4 from $0.9\ X\ 0.5\ mm^2$ to $0.7\ X\ 0.5\ mm^2$. Fig. 1 shows all halo particles and particles passed behind the collimation requirement window. Fig. 2 presents these particles at the SP2, SP4, SPEX and FD entrance. As it is seen from this figures, there is a way to reduce beam size at FD by moving SP4 close to the beam.

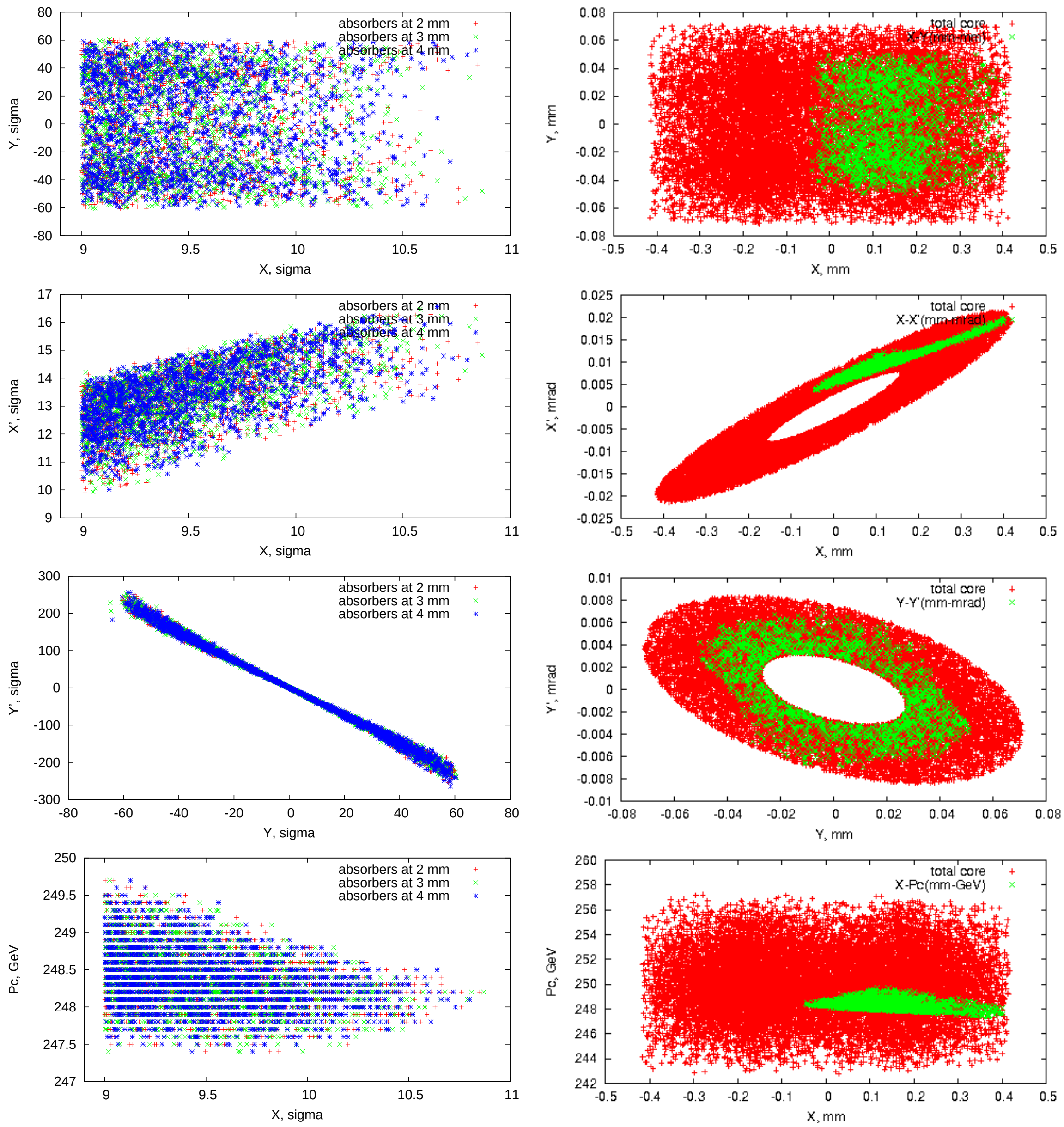

Figure 1: Beam halo particles passed through the final doublet behind the collimation depth shown at the FD entrance (left) and the entrance to the BDS in 2374.061 m upstream of IP (right).

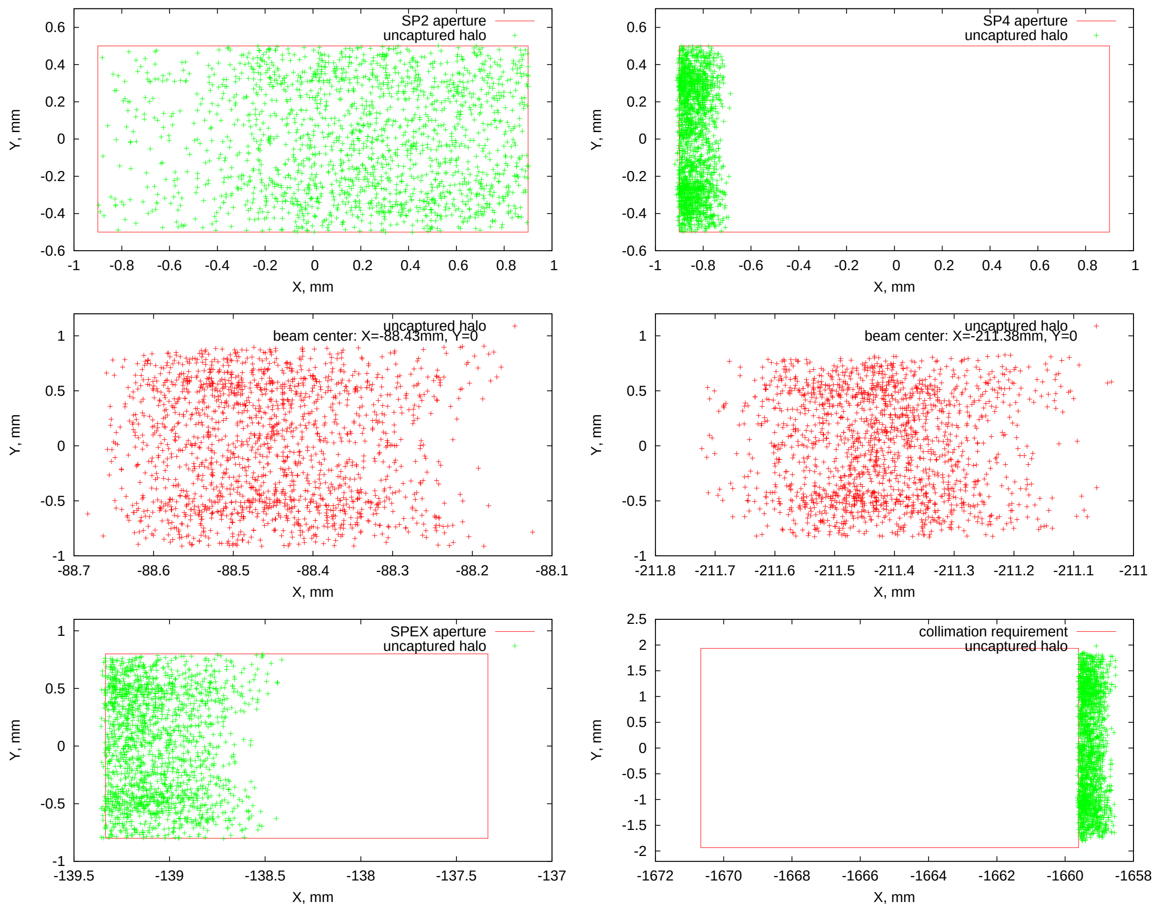

Figure 2: Beam halo particles passed through the final doublet behind the collimation depth shown at SP2 and SP4 entrance (top), in ~ 50 m upstream and downstream of SPEX (middle), at SPEX and FD entrance (bottom). There is a way for collimation with SPEX at X=1 mm. To do this, it is necessary to decrease aperture of SP4 from 0.9 X 0.5 mm^2 to 0.7 X 0.5 mm^2 (Table 4). Fig. 1 shows all halo particles and particles passed behind the collimation requirement window. Fig. 2 presents these particles at the SP2, SP4, SPEX and FD entrance. As it is seen from this figures, there is a way to reduce beam size at FD by moving SP4 close to the beam.

Crab Cavity radius mm	Mean energy GeV			Photons number per bunch			Photon energy per bunch GeV/bunch		
	Tab.1	Tab.2	Tab.3	Tab.1	Tab.2	Tab.3	Tab.1	Tab.2	Tab.3
lost at MSK1									
10.0	0.159E-03	0.178E-03	0.304E-03	0.279E+07	0.952E+07	0.205E+08	0.443E+03	0.170E+04	0.622E+04
12.5	0.159E-03	0.178E-03	0.304E-03	0.279E+07	0.952E+07	0.205E+08	0.443E+03	0.170E+04	0.622E+04
15.0	0.159E-03	0.178E-03	0.304E-03	0.279E+07	0.952E+07	0.205E+08	0.443E+03	0.170E+04	0.622E+04
17.5	0.159E-03	0.178E-03	0.304E-03	0.279E+07	0.952E+07	0.205E+08	0.443E+03	0.170E+04	0.622E+04
lost at Crab Cavity									
10.0	0.312E-04	0.317E-04	0.623E-04	0.192E+06	0.985E+06	0.286E+07	0.598E+01	0.313E+02	0.178E+03
12.5	0.298E-04	0.314E-04	0.810E-04	0.247E+05	0.386E+06	0.164E+07	0.735E+00	0.121E+02	0.133E+03
15.0	0	0.365E-04	0.175E-03	0	0.113E+05	0.501E+06	0	0.411E+00	0.874E+02
17.5	0	0.363E-02	0.106E-02	0	0.200E+02	0.414E+05	0	0.727E-01	0.439E+02
lost at MSK2									
10.0	0.312E-04	0	0	0.186E+06	0	0	0.582E+01	0	0
12.5	0.312E-04	0	0	0.186E+06	0	0	0.582E+01	0	0
15.0	0.312E-04	0	0	0.186E+06	0	0	0.582E+01	0	0
17.5	0.312E-04	0	0	0.186E+06	0	0	0.582E+01	0	0

Table 5: Photon loss at MSK1, Crab cavity and MSK2 from beam halo for different position of collimation system elements and Crab Cavity aperture.

Crab Cavity radius mm	Mean energy GeV			Photons number per bunch			Photon energy per bunch GeV/bunch		
	Tab.1	Tab.2	Tab.3	Tab.1	Tab.2	Tab.3	Tab.1	Tab.2	Tab.3
lost at MSK1									
10.0	0.692E-04	0.710E-04	0.733E-04	0.230E+11	0.220E+11	0.209E+11	0.159E+07	0.156E+07	0.153E+07
12.5	0.692E-04	0.710E-04	0.733E-04	0.230E+11	0.220E+11	0.209E+11	0.159E+07	0.156E+07	0.153E+07
15.0	0.692E-04	0.710E-04	0.733E-04	0.230E+11	0.220E+11	0.209E+11	0.159E+07	0.156E+07	0.153E+07
17.5	0.692E-04	0.710E-04	0.733E-04	0.230E+11	0.220E+11	0.209E+11	0.159E+07	0.156E+07	0.153E+07
lost at Crab Cavity									
10.0	0.340E-04	0.321E-04	0.312E-04	0.166E+10	0.266E+10	0.382E+10	0.565E+05	0.855E+05	0.119E+06
12.5	0.463E-05	0.286E-04	0.288E-04	0.400E+07	0.898E+09	0.205E+10	0.185E+02	0.257E+05	0.591E+05
15.0	0	0	0.276E-04	0	0	0.305E+09	0	0	0.843E+04
17.5	0	0	0	0	0	0	0	0	0
lost at MSK2									
10.0	0.305E-04	0	0	0.206E+10	0	0	0.628E+05	0	0
12.5	0.305E-04	0	0	0.206E+10	0	0	0.628E+05	0	0
15.0	0.305E-04	0	0	0.206E+10	0	0	0.628E+05	0	0
17.5	0.305E-04	0	0	0.206E+10	0	0	0.628E+05	0	0

Table 6: Photon loss at MSK1, Crab cavity and MSK2 from beam core for different position of collimation system elements and Crab Cavity aperture.

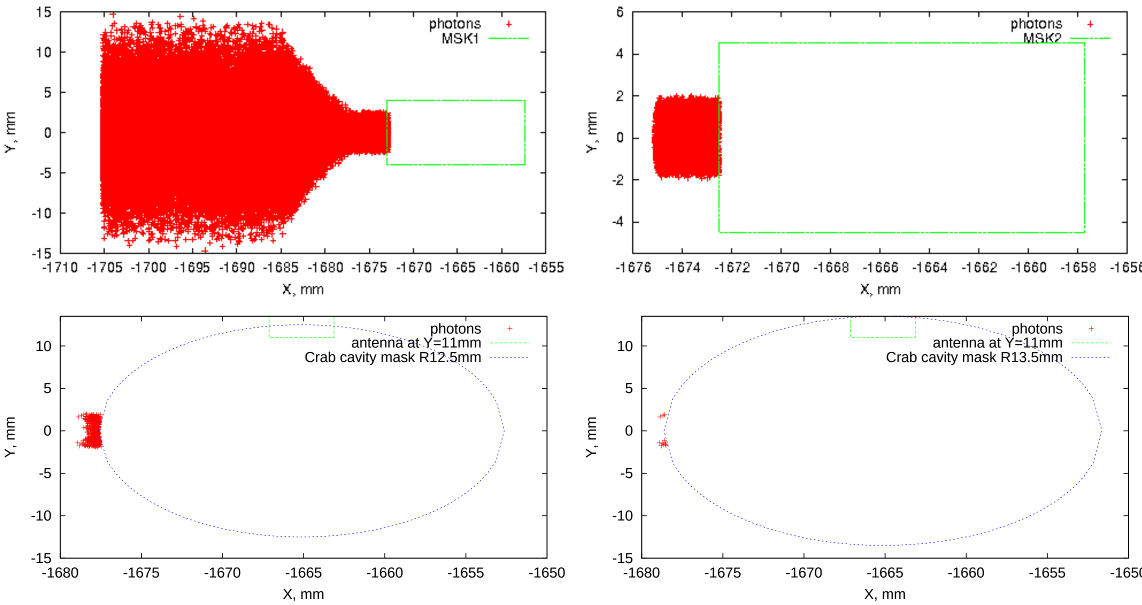

Figure 3: Position of synchrotron radiation photons from beam halo at the MSK1 (top, left) and MSK2 (top, right) for collimation system with enlarged aperture of SPEX to $1 \times 0.8\ mm^2$, PCs to $3 \times 3\ mm^2$ and aperture of absorbers to $2 \times 2\ mm^2$ (Tab. 4). Photons position at the Crab Cavity mask for different aperture of Crab Cavity (bottom). Radius of Crab Cavity is 0.5 mm bigger than radius of mask. There is no direct photon loss on the Crab Cavity itself in this case.

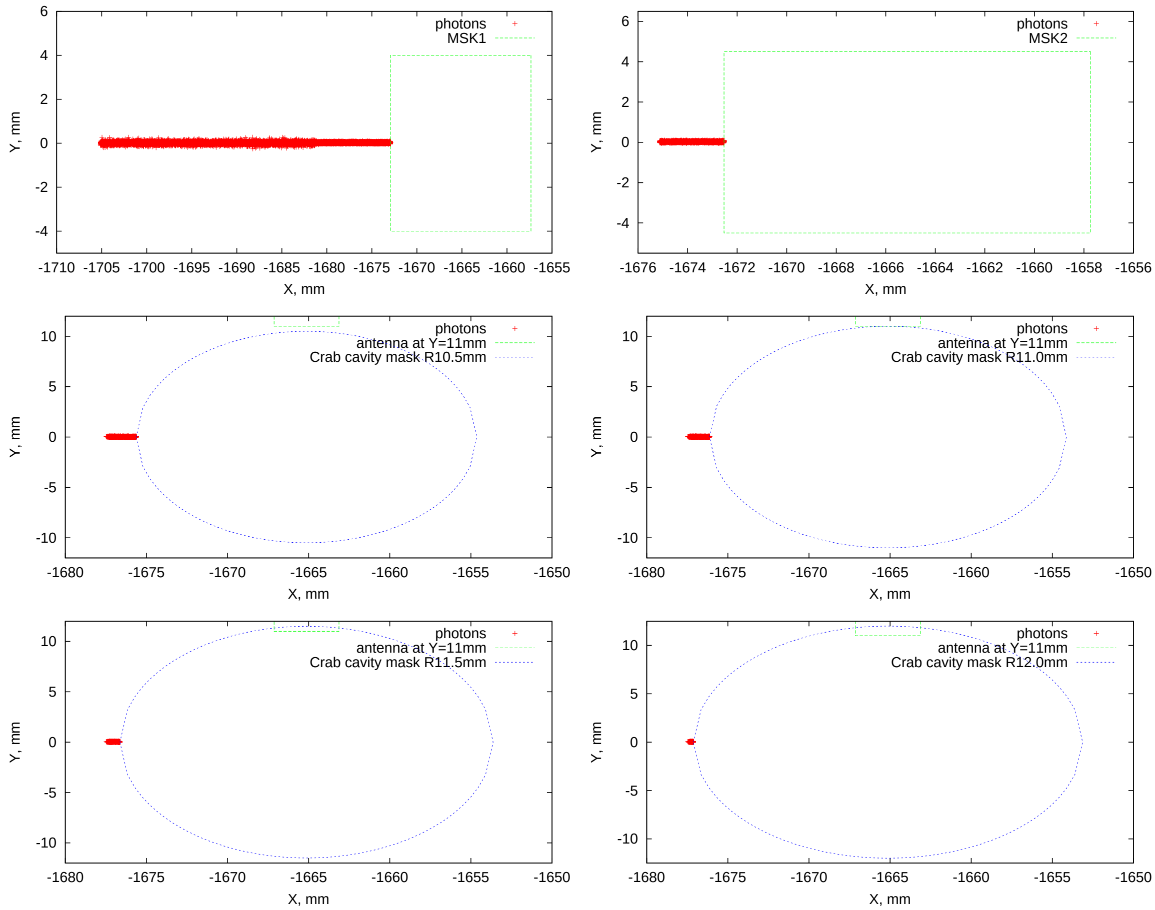

Figure 4: Position of synchrotron radiation photons from beam core at the MSK1 (top, left) and MSK2 (top, right) for collimation system with enlarged aperture of SPEX to $1 \times 0.8\ mm^2$, PCs to $3 \times 3\ mm^2$ and aperture of absorbers to $2 \times 2\ mm^2$ (Tab. 4). Photons position at the Crab Cavity mask for different aperture of Crab Cavity (middle and bottom). Radius of Crab Cavity is 0.5 mm bigger than radius of mask. There is no direct photon loss on the Crab Cavity itself in this case.

Crab Cavity mask radius	Antenna position	Mean energy	Photons number per bunch	Photon energy	
mm	mm	GeV		GeV/bunch	W
lost at MSK1					
11.5	11.0	0.122E-03	0.384E+07	0.467E+03	0.105E-02
12.5	11.0	0.122E-03	0.384E+07	0.467E+03	0.105E-02
13.5	11.0	0.122E-03	0.384E+07	0.467E+03	0.105E-02
14.5	11.0	0.122E-03	0.384E+07	0.467E+03	0.105E-02
15.5	11.0	0.122E-03	0.384E+07	0.467E+03	0.105E-02
lost at Crab Cavity mask					
11.5	11.0	0.305E-04	0.998E+05	0.305E+01	0.687E-05
12.5	11.0	0.278E-04	0.196E+05	0.544E+00	0.123E-05
13.5	11.0	0.599E-04	0.440E+03	0.264E-01	0.595E-07
14.5	11.0	0.0	0.0	0.0	0.0
15.5	11.0	0.0	0.0	0.0	0.0
lost at Crab Cavity antenna					
11.5	11.0	0.0	0.0	0.0	0.0
12.5	11.0	0.0	0.0	0.0	0.0
13.5	11.0	0.0	0.0	0.0	0.0
14.5	11.0	0.0	0.0	0.0	0.0
15.5	11.0	0.0	0.0	0.0	0.0
lost at MSK2					
11.5	11.0	0.319E-04	0.273E+06	0.871E+01	0.196E-04
12.5	11.0	0.319E-04	0.273E+06	0.871E+01	0.196E-04
13.5	11.0	0.319E-04	0.273E+06	0.871E+01	0.196E-04
14.5	11.0	0.319E-04	0.273E+06	0.871E+01	0.196E-04
15.5	11.0	0.319E-04	0.273E+06	0.871E+01	0.196E-04

Table 7: Photon loss at MSK1, Crab cavity mask, antenna and MSK2 from beam halo for different Crab Cavity mask aperture and antenna position with respect to cavity center. Radius of Crab Cavity is 0.5 mm bigger than radius of Crab Cavity mask. There is no direct photon loss on the Crab Cavity itself in this case. Calculations are done for parameters of collimation system presented in Table 4. Antenna is located on the top of cavity aperture and simulated as a bar with horizontal size of 4 mm and vertical size of 20 mm. Position of the bottom edge of antenna with respect to aperture center is shown in the table.

Crab Cavity mask radius	Antenna position	Mean energy	Photons number per bunch	Photon energy	
mm	mm	GeV		GeV/bunch	W
lost at MSK1					
10.5	11.0	0.688E-04	0.229E+11	0.157E+07	0.355E+01
11.0	11.0	0.688E-04	0.229E+11	0.157E+07	0.355E+01
11.5	11.0	0.688E-04	0.229E+11	0.157E+07	0.355E+01
12.0	11.0	0.688E-04	0.229E+11	0.157E+07	0.355E+01
12.5	11.0	0.688E-04	0.229E+11	0.157E+07	0.355E+01
13.5	11.0	0.688E-04	0.229E+11	0.157E+07	0.355E+01
lost at Crab Cavity mask					
10.5	11.0	0.339E-04	0.121E+10	0.412E+05	0.929E-01
11.0	11.0	0.349E-04	0.825E+09	0.288E+05	0.650E-01
11.5	11.0	0.342E-04	0.497E+09	0.170E+05	0.383E-01
12.0	11.0	0.269E-04	0.160E+09	0.431E+04	0.972E-02
12.5	11.0	0.0	0.0	0.0	0.0
13.5	11.0	0.0	0.0	0.0	0.0
lost at Crab Cavity antenna					
10.5	11.0	0.0	0.0	0.0	0.0
11.0	11.0	0.0	0.0	0.0	0.0
11.5	11.0	0.0	0.0	0.0	0.0
12.0	11.0	0.0	0.0	0.0	0.0
12.5	11.0	0.0	0.0	0.0	0.0
13.5	11.0	0.0	0.0	0.0	0.0
lost at MSK2					
10.5	11.0	0.318E-04	0.203E+10	0.644E+05	0.145E+00
11.0	11.0	0.318E-04	0.203E+10	0.644E+05	0.145E+00
11.5	11.0	0.318E-04	0.203E+10	0.644E+05	0.145E+00
12.0	11.0	0.318E-04	0.203E+10	0.644E+05	0.145E+00
12.5	11.0	0.318E-04	0.203E+10	0.644E+05	0.145E+00
13.5	11.0	0.318E-04	0.203E+10	0.644E+05	0.145E+00

Table 8: Photon loss at MSK1, Crab cavity mask, antenna and MSK2 from beam core for different Crab Cavity mask aperture and antenna position with respect to cavity center. Radius of Crab Cavity is 0.5 mm bigger than radius of Crab Cavity mask. There is no direct photon loss on the Crab Cavity itself in this case. Calculations are done for parameters of collimation system presented in Table 4. Antenna is located on the top of cavity aperture and simulated as a bar with horizontal size of 4 mm and vertical size of 20 mm. Position of the bottom edge of antenna with respect to aperture center is shown in the table.