

Doses from the LAr beam pipe

Here are given results of simulations of dose rate that results from activation of the beam pipe section placed inside the LAr End Cap Calorimeter ( $Z_{min}=365$  cm,  $Z_{max}=870$  cm).

All tubes and bellows removed between  $Z=365$  and  $449.5$ .

Table 1

Material zones of the LAr beam pipe section

##	$Z_{min}$ , cm	$Z_{max}$ , cm	$R_{min}$ , cm	$R_{max}$ , cm	Mass, kg <sup>(*)</sup>	Comment
1	365	366.4	2.9	4.3	0.346	Flange
2	397	397.08	2.98	8.3	0.118	Pump wall
3	397.08	402.6	8.23	8.3	0.156	Pump wall
4	402.6	402.68	2.98	8.3	0.118	Pump wall
5	398.6	401.8	4.5	4.7	0.144	Electrode
6	398.6	401.8	6.8	7	0.216	Electrode
7	449.5	855	2.9	2.98	4.672	Tube
8	855	863.2	2.9	3.04	0.167	Bellows
9	863.2	870	2.9	2.98	0.078	Tube
10	449.5	849	3.92	4	6.199	Tube
11	868.6	870	2.98	4.3	0.330	Flange
(*) - calculated as product of density by volume						

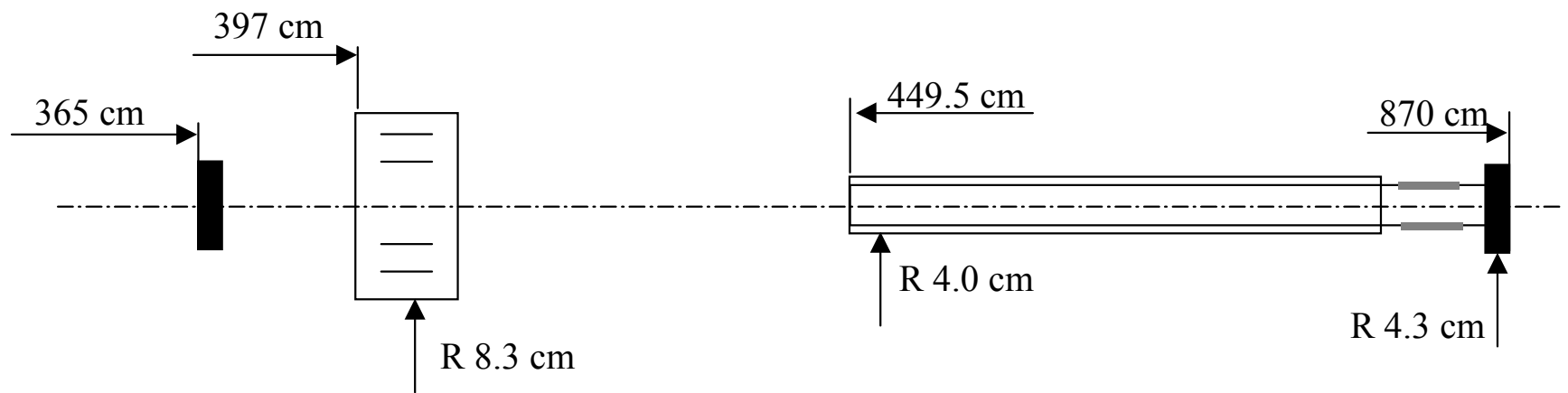


Fig. 1. Sketch of the LAr Beam pipe section.

Table 2

Equivalent dose rate induced by high-energy hadrons from LAr Beam Pipe for T= 100d, t=5d

R/Z, cm	350	365	370	385	415	450	500	600	700	750	800	850	870	880
0	179	2282	1060	329	325								2329	369
5	169	2488	805	312	312	1645	4886	3703	2846	2527	2505	1587	2293	337
7	161	928	590	297	300	1068	3073	2388	1844	1641	1608	1086	1025	312
10	148	436	378	270	279	743	1988	1593	1236	1101	1064	738	568	272
15	125	227	227	223	241	513	1223	1026	802	714	676	477	336	217
20	106	158	165	183	208	398	862	752	592	527	490	348	244	178
25	93	126	133	153	183	326	653	590	467	416	381	272	194	150
50	61	72	76	87	114	170	264	269	220	195	170	124	99	86
75	48	54	56	64	82	110	151	163	137	122	104	79	67	61
100	40	44	46	51	62	78	100	111	96	86	73	57	50	46
125	34	37	38	42	49	59	73	81	72	64	55	44	40	37
150	29	31	32	35	40	47	56	62	56	50	44	36	33	31
175	26	27	28	30	34	38	44	49	45	41	36	30	27	26
200	23	24	24	26	29	32	36	40	37	34	30	25	24	23
225	20	21	21	22	25	27	30	33	31	28	25	22	21	20

Table 2 (continuation)

Equivalent dose rate induced by high-energy hadrons from LAr Beam Pipe for T= 10y, t=5d

R/Z, cm	350	365	370	385	415	450	500	600	700	750	800	850	870	880
0	201	2562	1190	370	365								2620	415
5	191	2794	904	351	351	1856	5526	4173	3203	2844	2818	1785	2580	379
7	182	1042	663	334	338	1205	3475	2690	2075	1847	1809	1221	1153	351
10	166	490	425	304	314	839	2248	1795	1391	1239	1196	830	639	306
15	140	255	255	250	271	579	1383	1156	902	804	760	537	378	244
20	120	178	186	206	235	449	974	848	666	593	552	392	275	200
25	104	141	149	172	206	368	738	665	526	469	429	306	218	169
50	68	81	85	98	129	191	298	303	247	220	192	140	111	97
75	54	61	64	72	92	124	170	183	154	137	117	89	75	68
100	45	50	51	57	70	89	113	125	108	96	82	64	56	52
125	38	42	43	47	56	67	82	91	81	72	62	50	45	42
150	33	36	36	39	45	53	63	70	63	57	49	40	37	35
175	29	31	31	33	38	43	50	55	50	46	40	34	31	30
200	25	27	27	29	32	36	41	45	41	38	33	29	27	26
225	23	24	24	25	28	30	34	37	34	32	28	25	23	22

Table 2 (continuation)

Equivalent dose rate induced by high-energy hadrons from LAr Beam Pipe for T= 100d, t=100d

R/Z, cm	350	365	370	385	415	450	500	600	700	750	800	850	870	880
0	30	380	177	57	57								404	64
5	29	414	135	54	55	290	894	666	503	442	437	276	398	59
7	28	155	99	51	53	189	562	429	326	287	281	189	178	54
10	25	73	64	47	49	132	363	286	219	193	186	129	99	47
15	21	39	39	39	42	91	223	184	142	125	118	83	59	38
20	18	27	28	32	37	71	157	135	105	93	86	61	43	31
25	16	22	23	27	32	58	119	106	83	73	67	47	34	26
50	11	13	13	15	20	31	48	48	39	34	30	22	17	15
75	8	10	10	11	15	20	27	29	24	22	18	14	12	11
100	7	8	8	9	11	14	18	20	17	15	13	10	9	8
125	6	7	7	7	9	11	13	15	13	11	10	8	7	7
150	5	6	6	6	7	8	10	11	10	9	8	6	6	5
175	5	5	5	5	6	7	8	9	8	7	6	5	5	5
200	4	4	4	5	5	6	6	7	7	6	5	4	4	4
225	4	4	4	4	4	5	5	6	5	5	4	4	4	4

Table 2 (continuation)

Equivalent dose rate induced by high-energy hadrons from LAr Beam Pipe for T= 10y, t=100d

R/Z, cm	350	365	370	385	415	450	500	600	700	750	800	850	870	880
0	46	576	269	85	85								610	97
5	44	629	204	81	82	438	1340	993	754	665	658	416	600	88
7	42	235	150	77	79	285	842	640	488	432	422	285	268	82
10	38	111	97	70	74	199	544	427	327	290	279	194	149	71
15	32	58	58	58	64	138	335	275	212	188	178	125	88	57
20	28	41	43	48	55	107	235	202	157	139	129	91	64	47
25	24	33	35	40	49	88	178	158	124	110	100	71	51	40
50	16	19	20	23	31	46	72	72	58	52	45	33	26	23
75	13	14	15	17	22	30	41	44	36	32	28	21	18	16
100	11	12	12	14	17	21	27	30	26	23	19	15	13	12
125	9	10	10	11	13	16	20	22	19	17	15	12	10	10
150	8	8	9	9	11	13	15	17	15	13	12	9	9	8
175	7	7	7	8	9	10	12	13	12	11	9	8	7	7
200	6	6	7	7	8	9	10	11	10	9	8	7	6	6
225	5	6	6	6	7	7	8	9	8	8	7	6	5	5

Table 3

Equivalent dose rate induced by low-energy neutrons from LAr Beam Pipe for T= 100d, t=5d

R/Z, Cm	350	365	370	385	415	450	500	600	700	750	800	850	870	880
0	5.5	49.9	25.3	13.8	15.5								46.9	7.7
5	5.3	56.1	20.0	13.1	14.9	58.3	322.0	148.5	61.2	55.0	51.3	28.1	50.6	7.0
7	5.2	22.3	15.4	12.6	14.4	41.2	199.4	94.6	39.9	35.6	32.9	19.8	21.4	6.5
10	4.8	11.7	10.9	11.5	13.4	31.3	127.4	62.9	27.2	24.0	21.9	13.9	11.6	5.7
15	4.3	7.2	7.5	9.6	11.7	23.6	76.9	40.5	18.2	15.8	14.1	9.3	6.9	4.6
20	3.9	5.6	6.1	8.0	10.1	19.3	53.2	29.9	13.8	11.8	10.4	7.0	5.1	3.8
25	3.6	4.8	5.2	6.8	8.9	16.3	39.6	23.6	11.2	9.5	8.2	5.6	4.1	3.3
50	2.7	3.2	3.4	4.1	5.6	8.8	14.8	11.0	5.9	4.8	4.0	2.8	2.3	2.0
75	2.2	2.5	2.6	3.0	4.0	5.6	7.9	6.7	4.0	3.2	2.6	1.9	1.6	1.5
100	1.8	2.1	2.1	2.4	3.0	3.9	5.0	4.6	3.0	2.4	1.9	1.5	1.3	1.2
125	1.6	1.7	1.8	2.0	2.4	2.9	3.5	3.3	2.3	1.9	1.6	1.2	1.1	1.0
150	1.3	1.5	1.5	1.6	1.9	2.2	2.6	2.5	1.9	1.6	1.3	1.0	0.9	0.9
175	1.2	1.2	1.3	1.4	1.6	1.8	2.0	2.0	1.5	1.3	1.1	0.9	0.8	0.8
200	1.0	1.1	1.1	1.2	1.3	1.4	1.6	1.6	1.3	1.1	0.9	0.8	0.7	0.7
225	0.9	0.9	1.0	1.0	1.1	1.2	1.3	1.3	1.1	1.0	0.8	0.7	0.7	0.6

Table 3 (continuation)

Equivalent dose rate induced by low-energy neutrons from LAr Beam Pipe for T= 10y, t=5d

R/Z, cm	350	365	370	385	415	450	500	600	700	750	800	850	870	880
0	9.9	89.7	46.5	32.2	34.1								62.7	10.3
5	9.5	102.1	37.1	30.5	32.5	94.7	424.3	187.4	81.5	73.2	68.3	37.5	67.8	9.4
7	9.2	40.7	28.9	29.0	31.1	64.6	262.6	119.6	53.1	47.4	43.7	26.4	28.6	8.7
10	8.6	21.6	20.6	26.1	28.4	47.7	167.6	79.7	36.2	32.0	29.1	18.5	15.5	7.6
15	7.6	13.3	14.3	21.0	23.5	35.1	101.2	51.5	24.2	21.0	18.8	12.4	9.1	6.1
20	6.8	10.3	11.4	16.6	19.3	28.2	70.1	38.1	18.4	15.8	13.8	9.3	6.7	5.0
25	6.2	8.7	9.7	13.5	16.2	23.7	52.2	30.1	14.9	12.6	10.9	7.5	5.5	4.3
50	4.3	5.3	5.7	6.8	8.9	12.6	19.6	14.2	7.8	6.4	5.3	3.8	3.0	2.7
75	3.4	3.9	4.1	4.7	6.0	7.9	10.6	8.7	5.3	4.3	3.5	2.6	2.2	2.0
100	2.7	3.1	3.2	3.6	4.4	5.5	6.8	6.0	3.9	3.2	2.6	2.0	1.7	1.6
125	2.3	2.5	2.6	2.8	3.4	4.0	4.7	4.4	3.1	2.5	2.1	1.6	1.5	1.4
150	1.9	2.1	2.1	2.3	2.7	3.1	3.5	3.3	2.5	2.1	1.7	1.4	1.3	1.2
175	1.6	1.8	1.8	1.9	2.2	2.4	2.7	2.6	2.0	1.7	1.5	1.2	1.1	1.0
200	1.4	1.5	1.5	1.6	1.8	2.0	2.2	2.1	1.7	1.5	1.3	1.0	1.0	0.9
225	1.3	1.3	1.3	1.4	1.5	1.6	1.8	1.8	1.5	1.3	1.1	0.9	0.9	0.8



Table 3 (continuation)

Equivalent dose rate induced by low-energy neutrons from LAr Beam Pipe for T= 100d, t=100d

R/Z, cm	350	365	370	385	415	450	500	600	700	750	800	850	870	880
0	2.6	23.2	11.8	6.8	7.5								20.6	3.4
5	2.5	26.1	9.3	6.5	7.2	26.5	140.1	64.2	26.8	24.1	22.5	12.3	22.2	3.1
7	2.4	10.4	7.2	6.2	7.0	18.6	86.8	40.9	17.5	15.6	14.4	8.7	9.4	2.9
10	2.2	5.5	5.1	5.6	6.5	14.0	55.4	27.2	11.9	10.5	9.6	6.1	5.1	2.5
15	2.0	3.3	3.5	4.6	5.5	10.5	33.5	17.6	8.0	6.9	6.2	4.1	3.0	2.0
20	1.8	2.6	2.8	3.8	4.7	8.6	23.1	12.9	6.1	5.2	4.6	3.1	2.2	1.7
25	1.6	2.2	2.4	3.2	4.1	7.2	17.2	10.2	4.9	4.2	3.6	2.5	1.8	1.4
50	1.2	1.5	1.6	1.9	2.5	3.9	6.4	4.8	2.6	2.1	1.7	1.2	1.0	0.9
75	1.0	1.1	1.2	1.4	1.8	2.5	3.5	2.9	1.7	1.4	1.1	0.8	0.7	0.7
100	0.8	0.9	1.0	1.1	1.3	1.7	2.2	2.0	1.3	1.1	0.9	0.7	0.6	0.5
125	0.7	0.8	0.8	0.9	1.0	1.3	1.5	1.4	1.0	0.8	0.7	0.5	0.5	0.5
150	0.6	0.6	0.7	0.7	0.8	1.0	1.1	1.1	0.8	0.7	0.6	0.5	0.4	0.4
175	0.5	0.6	0.6	0.6	0.7	0.8	0.9	0.9	0.7	0.6	0.5	0.4	0.4	0.3
200	0.5	0.5	0.5	0.5	0.6	0.6	0.7	0.7	0.6	0.5	0.4	0.3	0.3	0.3
225	0.4	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.5	0.4	0.4	0.3	0.3	0.3

Table 3 (continuation)

Equivalent dose rate induced by low-energy neutrons from LAr Beam Pipe for T= 10y, t=100d

R/Z, cm	350	365	370	385	415	450	500	600	700	750	800	850	870	880
0	6.3	57.9	30.4	23.7	24.4								31.7	5.2
5	6.1	66.3	24.4	22.4	23.2	57.0	211.4	88.8	41.1	37.0	34.5	19.0	34.4	4.8
7	5.9	26.5	19.1	21.2	22.1	37.9	130.8	56.8	26.8	23.9	22.1	13.4	14.5	4.4
10	5.5	14.1	13.7	19.0	20.0	27.3	83.4	38.0	18.3	16.1	14.7	9.4	7.8	3.9
15	4.9	8.7	9.5	15.0	16.2	19.6	50.4	24.6	12.2	10.6	9.5	6.3	4.6	3.1
20	4.3	6.8	7.6	11.6	12.9	15.6	34.9	18.3	9.2	7.9	7.0	4.7	3.4	2.6
25	3.9	5.7	6.4	9.2	10.6	13.0	26.0	14.5	7.5	6.4	5.5	3.8	2.8	2.2
50	2.6	3.2	3.5	4.2	5.2	6.8	9.8	6.9	3.9	3.2	2.7	1.9	1.5	1.4
75	2.0	2.3	2.4	2.7	3.4	4.2	5.4	4.3	2.6	2.2	1.7	1.3	1.1	1.0
100	1.5	1.7	1.8	2.0	2.4	2.9	3.4	3.0	2.0	1.6	1.3	1.0	0.9	0.8
125	1.3	1.4	1.4	1.5	1.8	2.1	2.4	2.2	1.5	1.3	1.0	0.8	0.7	0.7
150	1.0	1.1	1.2	1.2	1.4	1.6	1.8	1.7	1.2	1.0	0.9	0.7	0.6	0.6
175	0.9	0.9	1.0	1.0	1.1	1.3	1.4	1.3	1.0	0.9	0.7	0.6	0.6	0.5
200	0.8	0.8	0.8	0.9	0.9	1.0	1.1	1.1	0.9	0.7	0.6	0.5	0.5	0.5
225	0.7	0.7	0.7	0.7	0.8	0.9	0.9	0.9	0.7	0.6	0.6	0.5	0.4	0.4