

HiLum Exposures Work Sheet v7

This excel worksheet contains 1) parameters of the EMEC, HEC, and FCalchik modules, 2) Andrei Kiryunin's Monte Carlo predictions for the energy deposit per proton in various parts of the setup (in yellow), and 3) predictions for the behavior of the modules and cryostats at various beam intensities.

HiLum Exposures Work Sheet v7

25-Nov-07

		Fcal	Fcal	EMEC	HEC
Module Geometry					
Absorber					
Material		Cu	Cu	Pb	Cu
Thickness	LAbs (mm)	45.68	48.04	7.5	100
Density (g/mm ³)		8.96	8.96	11.35	8.96
dE/dxmin Abs (MeV/g/cm ²)		1.403	1.403	1.123	1.403
LAr Gap					
Area covered by electrodes	A (mm ²)	779.4	779.4	3600	3600
Effective radius sqrt(A/pi)	Reff (mm)	15.8	15.8	33.9	33.9
Effective thickness	LLAr (mm)	4.32	1.96	12.6	34.0
Gap	g (mm)	0.269	0.119	2.1	1.97
dE/dxmip Sampling Fraction	fS (%)	1.57	0.68	21.8	5.42
Sampling Fraction from AK data				13.8	4.5
dP/dV cal at worst location in ATLAS at sLHC (GeV/mm ³ /s)					
		1.5E+05	1.5E+05	1.8E+03	5.5E+02
Critical ionization rate eDc (C/mm ³ /s)					
		8.9E-08	7.5E-07	3.3E-09	1.9E-09

Energy Deposits from A. Kiryunin 05 and 14 Nov 2007 ppt presentations. All energies are per incident proton. Using simulated set-up D

		Cryostat	1left	1right	2	3
In the cryostat						
Warm wall	hW (GeV)		0.48		0.40	0.47
Cold wall	hC (GeV)		0.092		0.075	0.090
Inner volume of LAr	hA (GeV)		0.72		0.68	0.87
In the module						
Whole module	hM (GeV)		1.15		0.16	1.88
dE/dS on cL (GeV/mm ²)			7.5E-04		8.0E-05	1.8E-03
dE/dV on cL (GeV/mm ³)			1.5E-05		3.5E-06	1.3E-05
Cumulative Sum out to Reff	hS (GeV)		0.43		0.15	1.75
LAr in gaps	hg (GeV)		0.0056	0.0027	0.022	0.085
LAr in gaps from fS (GeV)			0.0068	0.0029	0.035	0.102

Derived quantities

Charge deposit in LAr gaps	Qg (fC)	38	18	149	577
Initial current on triangle from all channels summed ii (uA)		0.64	0.69	0.32	0.66

HiLum Exposures Work Sheet v7

Protons/spill	RA	1.E+07	1.E+08	1.E+09	1.E+10	1.E+11	1.E+12
Protons/r.f.bunch	RB	14	1.4E+02	1.4E+03	1.4E+04	1.4E+05	1.4E+06
Protons/sec during spill	RI	1.4E+07	1.4E+08	1.4E+09	1.4E+10	1.4E+11	1.4E+12
Protons/sec average	RV	1.0E+06	1.0E+07	1.0E+08	1.0E+09	1.0E+10	1.0E+11
FCalchik in Set-up A							
<dE/dx> heating (W)		3.1E-04	3.1E-03	3.1E-02	0.31	3.1	31
Rate relative to sLHC rate (for worst case location)		1.4E-03	1.4E-02	1.4E-01	1.43	14.3	143
sLHC run year equivalent (hours)							278
initial current on triangle for all channels summed (uA)		9.0	90	899	8994	89936	899365
For side with 269 um gaps							
HV current draw (4 channels summed) during spill (uA)		0.54	5.4	54	543	5431	54305
<Ohmic> heating (W)		9.5E-06	9.5E-05	9.5E-04	0.010	0.10	1.0
relative ionization rate r during spill		0.0030	0.030	0.30	3.0	30	297
< ΔT > from rod to tube (mK)		0.006	0.06	0.6	6	64	639
Pulse Peak in ADC counts (4 channels summed together)		264	2635	26351	263514	2635139	26351391
For side with 119 um gaps							
HV current draw (4 channels summed) during spill (uA)		0.26	2.6	26	262	2618	26183
<Ohmic> heating (W)		1.8E-06	1.8E-05	1.8E-04	1.8E-03	0.018	0.18
relative ionization rate r during spill		0.00034	0.0034	0.034	0.34	3.4	34
< ΔT > from rod to tube (mK)		0.0029	0.029	0.29	2.9	29	291
Pulse Peak in ADC counts (4 channels summed together)		135	1349	13490	134905	1349047	13490473
EMEC in Set-up A							
<dE/dx> heating (W)		1.5E-04	1.5E-03	1.5E-02	0.147	1.47	14.7
Rate relative to sLHC rate (for worst case location)		0.0281	0.281	2.81	28.1	281	2809
sLHC run year equivalent (hours)							14
initial current on triangle for all channels summed (uA)		4.53	45.3	453	4526	45259	452589
HV current draw (4 channels summed) during spill (uA)		2.13	21.3	213	2133	21334	213341
<Ohmic> heating (W)		3.0E-04	3.0E-03	3.0E-02	0.299	2.99	29.9
relative ionization rate r during spill		0.0228	0.228	2.28	22.8	228	2282
Pulse Peak in ADC counts (4 channels summed together)		207.3	2073	20729	207286	2072856	20728556
HEC in Set-up A							
<dE/dx> heating (W)		4.5E-04	4.5E-03	4.5E-02	0.45	4.5	45
Rate relative to sLHC rate (for worst case location)		0.349	3.49	34.9	349	3489	34890
sLHC run year equivalent (hours)						11	1.1
initial current on triangle for all channels summed (uA)		9.3	93	932	9320	93201	932015
HV current draw (4 channels summed) during spill (uA)		8.2	82	824	8243	82427	824274
<Ohmic> heating (W)		1.2E-03	1.2E-02	1.2E-01	1.2	11.5	115
relative ionization rate r during spill		0.122	1.22	12.2	122	1222	12217
Pulse Peak in ADC counts (4 channels summed together)		400.8	4008	40077	400766	4007664	40076643

HiLum Exposures Work Sheet v7

Charge on electron e (Coulombs/e-)	1.602E-19
LAr Ionization Potential W (eV)	23.6
Electron drift velocity in LAr (mm/us)	4.5
$dE/dx _{\text{LAr}}$ (MeV/g/cm ²)	1.519
Density of LAr	1.396
Thermal conductivity of LAr k_{Ar} (W/cm/K)	0.00126
FCal tube ID (mm)	5.250
π	3.141593
Time between RF bunches whether filled or not (s)	1.65E-07
Number of filled bunches in ring	5
Spill Length (s)	0.7
Spill Cycle Time (s)	10