Update to 2D Synchrotron Radiation Profile Analysis for CesrTA Lattices

1) Fixed bug in photon rate calculation. Removes unphysical high-rate tails.

2) Protect against zero-divide.

3) Use wall segment length to get γ/m/s rather than Δ s.

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Cornell Laboratory for Accelerator-Based Sciences and Education

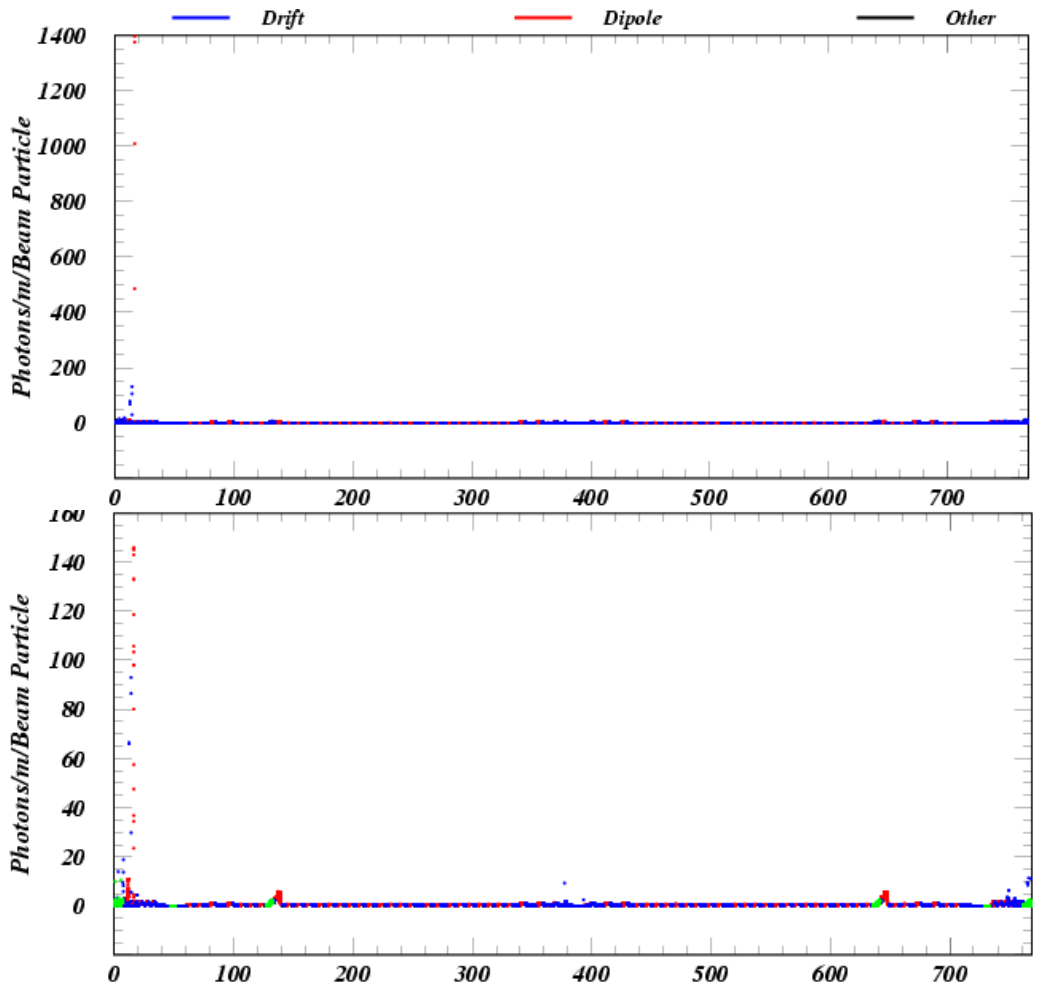
Electron Cloud Meeting

10 March 2010

CesrTA Lattice: cta_2085mev_20081107
Used for measurements in February 2009

SYNRAD 2009

SYNRAD 2010



There is a short "hot spot" at s=16.1 m in the dipole B04W due to the vacuum chamber wall profile. The radiation is from WIG2_02W.

Excerpt from
/home/critten/synrad/jobs/job65/synrad_job65_posx_0_768.table
These new files include source information.

```
Lattice:
/nfs/cesr/mnt/lattice/cesr/bmad/cta_2085nev_20081107.lat

I_beam     =  0.100000000000000       ! Amps/beam
Input eps_y =  9.99999999999999E-006  ! mm-mrad
Positron eps_x =  2.59719054015813E-003  ! mm-mrad
Positron eps_y =  1.19113280727943E-033  ! mm-mrad
Positron sig_z =  9.19169947790873E-003  ! m
Positron sigE/E =  8.12650409603148E-002  ! %
Electron eps_x =  0.00000000000000E+000  ! mm-mrad
Electron eps_y =  0.00000000000000E+000  ! mm-mrad
Electron sig_z =  0.00000000000000E+000  ! m
Electron sigE/E =  0.00000000000000E+000  ! %

Attribute values are G (bends), k1 (quads), k2 (sextupoles), ks (solenoids), B_max (wigglers)
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Segment Nr	S_seg (m)	L_seg (m)	X_seg (m)	P/len (W/m)	P/Area (W/mm^2)	P_tot (W)	Phot/sec (1/s)	A Beta (m)	B Beta (m)	A Eta (m)	Ele Type at s_mid	Attribute Value	Element Name	Source Ele Type	Primary Source	S_source (m)	Nr Sources
1565	16.1152	0.0095	2.195E-01	0.000E+00	0.0000E+00	0.0000E+00	0.0000E+00	4.777	33.107	0.217	SBEND	3.1591E-02	B04W	----------	----------	0.0000	0
1566	16.1154	0.0095	2.101E-01	5.075E+03	1.2150E+00	5.7571E+01	2.1760E+17	4.777	33.104	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	6.4226	9
1567	16.1156	0.0095	2.006E-01	1.731E+04	2.2252E+00	1.6402E+02	6.2765E+17	4.778	33.102	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	6.1942	46
1568	16.1158	0.0095	1.911E-01	1.690E+04	2.1497E+00	1.6015E+02	6.1441E+17	4.778	33.100	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	6.4130	38
1569	16.1161	0.0095	1.816E-01	1.577E+04	1.9799E+00	1.4948E+02	5.8103E+17	4.779	33.098	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	5.6101	217
1570	16.1163	0.0095	1.722E-01	1.549E+04	1.9415E+00	1.4680E+02	7.8971E+17	4.779	33.096	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	6.4059	238
1571	16.1165	0.0095	1.627E-01	1.527E+04	2.0374E+00	1.5418E+02	7.8987E+17	4.779	33.093	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	6.4023	69
1572	16.1167	0.0095	1.532E-01	1.869E+04	2.2429E+00	1.7712E+02	8.6212E+17	4.780	33.091	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	6.2116	76
1573	16.1169	0.0095	1.437E-01	1.892E+04	2.2685E+00	1.7931E+02	8.6349E+17	4.780	33.089	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	6.3951	74
1574	16.1171	0.0095	1.343E-01	1.900E+04	2.2739E+00	1.8001E+02	8.6472E+17	4.781	33.087	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	6.2186	69
1575	16.1173	0.0095	1.248E-01	1.896E+04	2.2630E+00	1.7962E+02	8.6629E+17	4.781	33.085	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	6.3879	61
1576	16.1175	0.0095	1.153E-01	1.829E+04	2.1963E+00	1.7328E+02	8.4918E+17	4.782	33.082	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	6.2257	68
1577	16.1177	0.0095	1.058E-01	1.448E+04	1.8752E+00	1.3722E+02	7.0427E+17	4.782	33.080	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	6.3807	60
1578	16.1179	0.0095	9.637E-02	1.103E+04	1.5289E+00	1.0450E+02	5.8236E+17	4.783	33.078	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG1_02W	4.6536	47
1579	16.1182	0.0095	8.689E-02	8.826E+03	1.2504E+00	8.3634E+01	4.7587E+17	4.783	33.076	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	6.3733	36
1580	16.1184	0.0095	7.742E-02	6.031E+03	9.0573E-01	5.7151E+01	3.4136E+17	4.783	33.074	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	5.9705	27
1581	16.1186	0.0095	6.795E-02	5.379E+03	8.1978E-01	5.0971E+01	2.8273E+17	4.784	33.071	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	6.3658	18
1582	16.1188	0.0095	5.847E-02	3.796E+03	6.0900E-01	3.5966E+01	2.0468E+17	4.784	33.069	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	6.3620	13
1583	16.1190	0.0095	4.900E-02	1.845E+03	3.2693E-01	1.7486E+01	1.3965E+17	4.785	33.067	0.217	SBEND	3.1591E-02	B04W	WIGGLER	WIG2_02W	6.2513	8
1584	16.1270	0.0082	4.700E-02	2.466E+01	1.1743E-02	2.0339E-01	1.8028E+16	4.794	33.024	0.218	SBEND	3.1591E-02	B04W	SBEND	B03BW	12.7058	1
1585	16.1350	0.0082	4.500E-02	2.500E+01	1.2084E-02	2.0614E-01	1.8272E+16	4.811	32.941	0.218	SBEND	3.1591E-02	B04W	SBEND	B03BW	12.7651	2
1586	16.1430	0.0082	4.300E-02	2.534E+01	1.2438E-02	2.0899E-01	1.8525E+16	4.828	32.858	0.219	SBEND	3.1591E-02	B04W	SBEND	B03BW	12.8251	2
1587	16.1490	0.0063	4.100E-02	3.254E+01	1.6258E-02	2.0581E-01	1.8243E+16	4.844	32.786	0.220	SBEND	3.1591E-02	B04W	SBEND	B03BW	12.8853	2
1588	16.1590	0.0100	4.100E-02	3.345E+00	1.6782E-03	3.3421E-02	2.9624E+15	4.861	32.703	0.220	SBEND	3.1591E-02	B04W	SBEND	B03BW	12.9197	1
1589	16.1690	0.0100	4.099E-02	3.364E+00	1.6885E-03	3.3610E-02	2.9792E+15	4.883	32.600	0.221	SBEND	3.1591E-02	B04W	SBEND	B03BW	12.9294	1
1590	16.1790	0.0100	4.099E-02	3.383E+00	1.6988E-03	3.3799E-02	2.9960E+15	4.905	32.497	0.222	SBEND	3.1591E-02	B04W	SBEND	B03BW	12.9392	1

Note the vacuum chamber wall angle.

CesrTA Lattice: cta_2085mev_20081107
Used for measurements in February 2009

SYNRAD 2009

Element	Nr Seg	<Length>	Tot Length	Fraction	<Beta X>	<Beta Y>	<Sig X>	<Sig Y>	<Phot/m/e>
Dipole	47446	0.010	474.2	61.8%	14.1	18.6	0.717	0.030	0.527
Drift	18013	0.010	178.7	23.3%	16.2	17.7	0.819	0.028	0.280
Wiggler	2452	0.010	24.5	3.2%	7.2	16.3	0.281	0.028	0.733
Quadrupole	6636	0.010	66.3	8.6%	17.4	20.0	0.728	0.029	0.382
Sextupole	2221	0.010	22.2	2.9%	17.5	20.2	0.816	0.030	0.334
Solenoid	0	0.000	0.0	0.0%	0.0	0.0	0.000	0.000	0.000
Octupole	154	0.010	1.5	0.2%	24.7	7.6	0.873	0.019	0.072
Non-dipole	29476	0.010	293.3	38.2%	15.8	18.2	0.754	0.029	0.344
Non-drift	58909	0.010	588.7	76.7%	14.3	18.7	0.705	0.029	0.511
Total	76922	0.010	767.5	100.0%	14.7	18.4	0.731	0.029	0.457

SYNRAD 2010

Element	Nr Seg	<Length>	Tot Length	Fraction	<Beta X>	<Beta Y>	<Sig X>	<Sig Y>	<Phot/m/e>
Dipole	47492	0.010	475.0	61.8%	14.1	18.6	0.717	0.030	0.554
Drift	18089	0.010	179.6	23.3%	16.1	17.7	0.817	0.028	0.280
Wiggler	2459	0.010	24.6	3.2%	7.2	16.4	0.280	0.028	0.697
Quadrupole	6635	0.010	66.3	8.6%	17.3	20.0	0.724	0.029	0.382
Sextupole	2193	0.010	21.9	2.9%	17.7	19.9	0.825	0.029	0.334
Solenoid	0	0.000	0.0	0.0%	0.0	0.0	0.000	0.000	0.000
Octupole	153	0.010	1.5	0.2%	24.6	7.6	0.878	0.019	0.072
Non-dipole	29529	0.010	293.9	38.2%	15.8	18.2	0.752	0.029	0.341
Non-drift	58932	0.010	589.5	76.6%	14.3	18.7	0.704	0.029	0.531
Total	77021	0.010	769.2	100.0%	14.7	18.4	0.730	0.029	0.472

POSINST simulations (DLK) have used photon rate values of 0.525 and 0.280, with beam size values of 702 / 30.4 μ (dipole) and 790 / 29.7 μ (drift). ECLOUD simulations until now have used β-weighted rate values (see next slide), with beam size values of 790 / 29.7 μ for both dipole and drift.

Photon Rates Weighted by the Beta Functions

SYNRAD 2009

Element	<F>=<Phot/m/e>	Max(F)	RMS(F)	<Bx*F>/<Bx>	Max(Bx*F/<Bx>)	RMS(Bx*F/<Bx>)	<By*F>/<By>	Max(By*F/<By>)	RMS(By*F/<By>)
Dipole	0.527	1395.225	3.339	0.500	473.659	1.310	0.486	2473.432	5.834
Drift	0.280	130.763	1.128	0.249	27.077	0.537	0.302	329.830	2.243
Wiggler	0.733	10.492	0.837	0.639	11.415	0.919	0.707	10.981	0.842
Quadrupole	0.382	9.069	0.383	0.356	10.336	0.482	0.358	5.030	0.413
Sextupole	0.334	3.101	0.271	0.328	2.492	0.371	0.314	3.075	0.290
Solenoid	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Octupole	0.072	0.172	0.053	0.064	0.140	0.040	0.058	0.102	0.033
Non-dipole	0.344	130.763	0.942	0.295	27.644	0.526	0.346	319.970	1.731
Non-drift	0.511	1395.225	3.006	0.473	465.569	1.180	0.471	2459.798	5.212
Total	0.457	1395.225	2.690	0.416	451.886	1.045	0.433	2489.917	4.737

SYNRAD 2010

Element	<F>=<Phot/m/e>	Max(F)	RMS(F)	<Bx*F>/<Bx>	Max(Bx*F/<Bx>)	RMS(Bx*F/<Bx>)	<By*F>/<By>	Max(By*F/<By>)	RMS(By*F/<By>)
Dipole	0.554	145.901	2.145	0.509	49.619	0.976	0.533	259.997	3.695
Drift	0.280	93.138	1.053	0.249	23.363	0.521	0.301	236.223	2.078
Wiggler	0.697	10.505	0.757	0.616	11.837	0.876	0.668	11.309	0.750
Quadrupole	0.382	2.644	0.363	0.355	3.034	0.464	0.357	2.672	0.406
Sextupole	0.334	2.061	0.265	0.328	2.204	0.367	0.314	2.061	0.289
Solenoid	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Octupole	0.072	0.172	0.054	0.064	0.141	0.040	0.058	0.101	0.033
Non-dipole	0.341	93.138	0.880	0.294	23.837	0.510	0.343	229.553	1.609
Non-drift	0.531	145.901	1.938	0.480	48.779	0.892	0.508	258.779	3.308
Total	0.472	145.901	1.774	0.421	47.363	0.811	0.461	261.924	3.087

Differences are less than 10%.

Don't expect big changes in the tune shift modelling, but will check it.