PhD 2nd half plan

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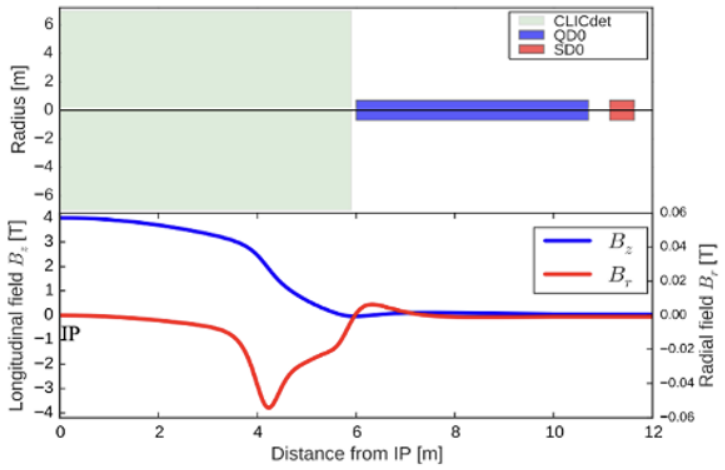
Shorter Collimation and Longer FFS

- BDS length = 6 km
- Luminosity = $10^{35}\mathrm{cm}^{-2}\mathrm{s}^{-1}$
- Shorter Betatron Collimation (not started)
  - Max length reduction = 555 m
- Longer FFS
  - FFS length = 1016 m
  - FFS max length = 1571 m for a 6 km BDS
  - Last updates:
    - $\mathrm{L}_{\mathrm{FFS}} = 1117$ m, 1219 m (MAD-X + MAD-NG)
    - $\mathrm{L}_{\mathrm{FFS}} = 1321$ m (MAD-NG) – it does not optimize well
    - No luminosity improvement
    - Possibility to scale down the angles

$\mathrm{L}_{\mathrm{BDS}}$ [m]	3474	6000
Full Collimation length [m]	2569	4437
Energy Collimation length [m]	1805	3118
Betatron Collimation length [m]	764	1319

Solenoid



[0] direct tracking

IP

[1] forward tracking
SR off, solenoid off

[2] backward tracking
SR off, solenoid on

[3] forward tracking
SR on, solenoid on

- Using Vera's file to implement the solenoid at the IP.
- Same solenoid and crossing angle as the 3 TeV design (20 mrad).
- From Vera's thesis, the luminosity loss with the solenoid is about 4%
  - $\mathcal{L}_{\text{sol}} \approx 10^{35}\text{cm}^{-2}\text{s}^{-1} \rightarrow \mathcal{L}_{\text{sol}} \approx 9.6 \cdot 10^{34}\text{cm}^{-2}\text{s}^{-1}$

CLIC 3 TeV								
	σ_x^* [nm]		σ_y^* [nm]		$\mathscr{L}_{TOT}$ $[10^{34}\,\text{cm}^{-2}\text{s}^{-1}]$			
	ideal	w/ SR	ideal	w/ SR	ideal	w/ SR	w/ sol.	w/ sol.+SR
baseline	41.4	50.3	1.06	1.69	9.40	6.50	8.65	6.22

[Cilento, Vera, *Optics Design of a novel Beam Delivery System for CLIC: the case of two Interaction Regions. First experiments for the validation of the ultra-low β_y^* nanometer beam size at ATF2*, 2021, https://cds.cern.ch/record/2834916]

ATF2 and Cool Copper Collider

- **ATF2**
  - Operations start from May 29
  - December 2023

- **Cool Copper Collider**
  - Use the 380 GeV BDS to down (up) scale the length for a 250 GeV (550 GeV) C^3

Collider	NLC [28]	CLIC [29]	ILC [5]	C^3	C^3
CM Energy [GeV]	500	380	250 (500)	250	550
σ_z [μm]	150	70	300	100	100
β_x [mm]	10	8.0	8.0	12	12
β_y [mm]	0.2	0.1	0.41	0.12	0.12
ϵ_x [nm-rad]	4000	900	500	900	900
ϵ_y [nm-rad]	110	20	35	20	20
Num. Bunches per Train	90	352	1312	133	75
Train Rep. Rate [Hz]	180	50	5	120	120
Bunch Spacing [ns]	1.4	0.5	369	5.26	3.5
Bunch Charge [nC]	1.36	0.83	3.2	1	1
Beam Power [MW]	5.5	2.8	2.63	2	2.45
Crossing Angle [rad]	0.020	0.0165	0.014	0.014	0.014
Crab Angle	0.020/2	0.0165/2	0.014/2	0.014/2	0.014/2
Luminosity [x10^{34}]	0.6 (w/ IP dil.)	1.5 (max is 4)	1.35	1.3	2.4
Gradient [MeV/m]	37	72	31.5	70	120
Effective Gradient [MeV/m]	29	57	21	63	108
Shunt Impedance [MΩ/m]	98	95		300	300
Effective Shunt Impedance [MΩ/m]	50	39		300	300
Site Power [MW]	121	168	125	~150	~175
Length [km]	23.8	11.4	20.5 (31)	8	8
L* [m]	2	6	4.1	4.3	4.3

[Mei Bai, et al., *C^3 : A "Cool" Route to the Higgs Boson and Beyond*, 2021]