

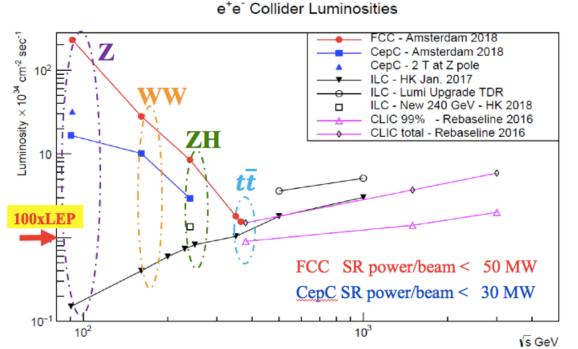
Top threshold physics

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Introduction

- CEPC is Higgs Factory (E_{cms}=240GeV, 10⁶ Higgs)
- CEPC is Z factory($E_{cms} \sim 91$ GeV), electroweak precision physics at Z pole.
 - baseline L=1.6 X 10^{35} cm⁻²s⁻¹, Solenoid =3T, 3X 10^{11} Z boson, two years
 - L= $3.2 \times 10^{35} \text{ cm}^{-2}\text{s}^{-1}$, Solenoid = 2T, $6\times 10^{11} \text{ Z boson}$
- WW threshold scan runs (~160GeV) are also expected.
 - One year, Total luminosity 2.6 ab⁻¹ 14M WW events



From F. Bedeschi

Top threshold scan

Review of the key electroweak constant

Fundamental constant	δx/x	measurements	
$\alpha = 1/137.035999139 (31)$	1×10 ⁻¹⁰	$\mathrm{e}^{\pm}g_2$	
$G_F = 1.1663787 (6) \times 10^{-5} \text{ GeV}^{-2}$	1×10 ⁻⁶	$\mu^{\pm} lifetime$	
$M_Z = 91.1876 \pm 0.0021 \text{ GeV}$	1×10 ⁻⁵	LEP	
$M_W = 80.379 \pm 0.012 \text{ GeV}$	1×10-4	LEP/Tevatron/LHC	
$sin^2\theta_W = \ 0.23152 \pm 0.00014$	6×10 ⁻⁴	LEP/SLD	
$m_{top} = 172.74 \pm 0.46 \text{ GeV}$	3×10 ⁻³	Tevatron/LHC	Top s
$M_H = 125.14 \pm 0.15 \text{ GeV}$	1×10 ⁻³	LHC	Runs

From PDG2018

Input from CEPC accelerator design

- Instant luminosity for CEPC at ttbar threshold is low for now.
 - 5~10 times lower than Fcc-ee design ,
 - Need ~2 years to get 200fb⁻¹



CEPC parameters (Tentative at tt)

 $\begin{array}{l} 30 MW \\ 0.38*10^{34} cm^{-2} s^{-1} @\ 350 GeV \\ 0.32*10^{34} cm^{-2} s^{-1} @\ 365 GeV \end{array}$

If 50MW 0.63*10³⁴cm⁻²s⁻¹@ 350GeV 0.53*10³⁴cm⁻²s⁻¹@ 365GeV

tt based on lattice fcp=0.3% and ϵx =1.2nm, if fcp=0.2% and ϵx =0.89nm or even lower, the luminosity at tt will be higher.

Number of IPs 2 2 2 2 2 Eaam energy (GeV) 120 120 175 182.5 Circumference (km) 100 100 100 100 Synchrotron radiation loss/turn (GeV) 1.68 1.73 7.61 9.0 Crossing angle at IP (mrad) 16.5×2 16.5×2 16.5 16.5 Piwinski angle 3.78 3.48 0.91 0.89 Number of particles/bunch N_c (10 ¹⁰) 17.0 15.0 24.15 26.7 Bunch number (bunch spacing) 218 (0.76µs) 242 (0.68µs) 34 26 Beam current (mA) 17.8 17.4 3.95 3.3 Synchrotron radiation power/beam (MW) 30 30 30 30 Synchrotron radiation power/beam (MW) 30 30 30 30 Synchrotron radiation power/beam (MW) 30 30 30 30 Beam ding radius (km) 10.7 10.7 10.9 10.9 Momentum compact (10 ¹⁶ s) 0.31			T W (GDD)	1	1
Beam energy (GeV) 120 120 175 182.5 Circumference (km) 100 100 100 100 Synchrotron radiation loss/turn (GeV) 1.68 1.73 7.61 9.0 Crossing angle at IP (mrad) 16.5×2 16.5×2 16.5 16.5 Piwinski angle 3.78 3.48 0.91 0.89 Number of particles/bunch N_x (10 ¹⁶) 17.0 15.0 24.15 26.7 Bunch number (bunch spacing) 218 (0.76µs) 242 (0.68µs) 34 26 Beam current (mA) 17.8 17.4 3.95 3.3 Synchrotron radiation power /beam (MW) 30 30 30 30 Synchrotron radiation power /beam (MW) 30 30 30 30 Momentum compact (10°5) 0.91 1.11 1.14 1.14 β function at IP β_x^{2} / β_y^{2} (m) 0.330.001 0.360.0015 1.20.0037 1.20.0037 Emittance $s_x^{2} s_y^{2}$ (mm) 0.890.0018 1.21/0.0024 2.24/0.0068 2.46/0.0074 <		Higgs (high)	Higgs (CDR)	tt	tt
Circumference (km) 100 100 100 100 Synchrotron radiation loss/turn (GeV) 1.68 1.73 7.61 9.0 Crossing angle at IP (mrad) 16.5×2 16.5×2 16.5 16.5 Piwinski angle 3.78 3.48 0.91 0.89 Number of particles/bunch N_c (10 ¹⁶) 17.0 15.0 24.15 26.7 Bunch number (bunch spacing) 218 (0.76µs) 242 (0.68µs) 34 26 Beam current (mA) 17.8 17.4 3.95 33 Synchrotron radiation power /beam (MW) 30 30 30 30 Synchrotron radiation power /beam (MW) 30 30 30 30 Beam current (mA) 10.7 10.7 10.9 10.9 Momentum compact (10.8) 0.91 1.11 1.14 1.14 Momentum compact (10.8) 0.91 1.11 1.14 1.14 β function at IP β_c / β_c (m) 0.33/0.001 0.360-0015 1.20.0037 1.20.0037 Emittance β_c (gm)	Number of IPs	2	2	2	2
Synchrotron radiation loss/turn (GeV) 1.68 1.73 7.61 90 Crossing angle at IP (mrad) 16.5×2 16.5×2 16.5 16.5 Piwinski angle 3.78 3.48 0.91 0.89 Number of particles/bunch N_c (10 ¹⁶) 17.0 15.0 24.15 26.7 Bunch number (bunch spacing) 218 (0.76µs) 242 (0.68µs) 34 26 Beam current (mA) 17.8 17.4 3.95 3.3 Synchrotron radiation power /beam (MW) 30 30 30 30 Bending radius (km) 10.7 10.7 10.9 10.9 Momentum compact (10 ⁵) 0.91 1.11 1.14 1.14 β function at IP $β_c^{**}/β_c^{**}$ (m) 0.33/0.001 0.36/0.0015 1.20.0037 1.20.0037 Emittance $ε_c/ℓ_c$ (mm) 0.33/0.001 0.36/0.0015 1.20.0037 1.20.0037 Emittance $ε_c/ℓ_c$ (mm) 0.89/0.0018 1.21/0.0024 2.24/0.0068 2.46/0.0074 Beam size at IP $σ_c/σ_c$ (µm) 17.10.042 20.90/0.6 51.8/0.	Beam energy (GeV)	120	120	175	182.5
Crossing angle at IP (mrad) 16.5×2 16.5×2 16.5 16.5 Piwinski angle 3.78 3.48 0.91 0.89 Number of particles/bunch N_e (10^{10}) 17.0 15.0 24.15 26.7 Bunch number (bunch spacing) 218 ($0.76 \mu s$) 242 ($0.68 \mu s$) 34 26 Beam current (mA) 17.8 17.4 3.95 3.3 Synchrotron radiation power /beam (MW) 30 30 30 30 Bending radius (km) 10.7 10.7 10.9 10.9 Momentum compact (10^{-5}) 0.91 1.11 1.14 1.14 β function at IP $\beta_s^{*}e^{*}(\beta_s^{*}e^{*}(m)$ $0.33/0.001$ $0.36/0.0015$ $1.20.0037$ $1.20.0037$ Emittance $s_s^{*}/s_s^{*}(m)$ $0.889/0.0018$ $1.21/0.0024$ $2.24/0.0068$ $2.460.0074$ Beam size at IP σ_s / σ_s (µm) $17.10.042$ $20.90.06$ $51.8/0.16$ $54.4/0.17$ Beam-beam parameters ξ_s / ξ_s $0.024/0.113$ $0.018/0.109$ $0.077/0.105$ 0	Circumference (km)	100	100	100	100
Piwinski angle 3.78 3.48 0.91 0.89 Number of particles/bunch N_e (1016) 17.0 15.0 24.15 26.7 Bunch number (bunch spacing) 218 (0.76µs) 242 (0.68µs) 34 26 Beam current (mA) 17.8 17.4 3.95 3.3 Synchrotron radiation power /beam (MW) 30 30 30 30 Bending radius (km) 10.7 10.7 10.9 10.9 Momentum compact (10°5) 0.91 1.11 1.14 1.14 β function at IP β_s^{α} / β_s^{α} (m) 0.33/0.001 0.36/0.0015 1.20.0037 1.20.0037 Emittance $\varepsilon_s/\varepsilon_s$ (nm) 0.89/0.0018 1.21/0.0024 2.24/0.0068 2.46/0.0074 Beam size at IP σ_s / σ_s (µm) 17.1/0.042 20.90.06 51.8/0.16 54.4/0.17 Beam-beam parameters ξ_s/ξ_s 0.024/0.113 0.018/0.109 0.077/0.105 0.076/0.103 RF voltage V_{RF} (GV) 2.4 2.17 8.93 10.3 RF frequency f_{RF} (MHz) (harmonic) 650 (216816) 650	Synchrotron radiation loss/turn (GeV)	1.68	1.73	7.61	9.0
Number of particles/bunch N_c (10 ¹⁶) 17.0 15.0 24.15 26.7 Bunch number (bunch spacing) 218 (0.76µs) 242 (0.68µs) 34 26 Beam current (mA) 17.8 17.4 3.95 3.3 Synchrotron radiation power /beam (MW) 30 30 30 30 30 30 30 Bending radius (km) 10.7 10.7 10.7 10.9 10.9 10.9 Momentum compact (10 ⁻⁵) 0.91 1.11 1.14 1.14 1.14 β function at $\Pi P \beta_c^{**} / \beta_f^{**}$ (m) 0.33/0.001 0.36/0.0015 1.20/0.037 1.20/0.037 Emittance $\varepsilon_c / \varepsilon_c$ (nm) 0.89/0.0018 1.21/0.0024 2.24/0.068 2.46/0.0074 Beam size at $\Pi P \sigma_c / \sigma_c$ (µm) 17.10.042 20.9/0.06 51.8/0.16 54.4/0.17 Beam-beam parameters ξ_c / ξ_f 0.024/0.113 0.018/0.109 0.077/0.105 0.076/0.103 RF voltage V_{RF} (GV) 2.4 2.17 8.93 10.3 RF frequency f_{RF} (MHz) (harmonic) 650 (216816) 650 (216816) 650 (217500) 650 (217500) Natural bunch length σ_c (mm) 2.2 2.72 2.54 2.62 Bunch length σ_c (mm) 3.93 4.4 2.87 2.93 HOM power/cavity (2 cell) (kw) 0.58 0.46 0.53 (Scell) 0.49 Energy spread (%) 0.19 0.134 0.14 0.15 Energy acceptance requirement (%) 1.7 1.35 1.57 1.7 Energy acceptance requirement (%) 1.7 1.35 1.57 1.7 Energy acceptance by RF (%) 3.0 2.06 2.67 2.48 Photon number due to beamstrahlung 0.104 0.082 0.19 0.15 Beamstruhlung lifetime /quantum lifetime* (min) 30/50 80/80 60 1.0 Lifetime (hour) 0.22 0.43 0.89 0.89 0.88	Crossing angle at IP (mrad)	16.5×2	16.5×2	16.5	16.5
Bunch number (bunch spacing) 218 (0.76µs) 242 (0.68µs) 34 26 Beam current (mA) 17.8 17.4 3.95 3.3 Synchrotron radiation power /beam (MW) 30 30 30 30 Bending radius (km) 10.7 10.7 10.9 10.9 Momentum compact (10°5) 0.91 1.11 1.14 1.14 β function at IP $β_s^* / β_r^*$ (m) 0.33/0.001 0.360.0015 1.20.0037 1.20.0037 Emittance $ε_r / ε_r$ (m) 0.89/0.0018 1.21/0.0024 2.24/0.0068 2.46/0.0074 Beam size at IP $α_s / α_r$ (µm) 17.1/0.042 20.9/0.06 51.8/0.16 54.4/0.17 Beam-beam parameters $ξ_s / ξ_r$ 0.024/0.113 0.018/0.109 0.077/0.105 0.076/0.103 RF voltage V_{RF} (MHz) (harmonic) 650 (216816) 650 (216816) 650 (217500) 650 (217500) Natural bunch length $α_s$ (mm) 2.2 2.72 2.54 2.62 Bunch length $α_s$ (mm) 3.93 4.4 2.87 2.93 HOM power/cavity (2 cell) (kw) 0	Piwinski angle	3.78	3.48	0.91	0.89
Beam current (mA) 17.8 17.4 3.95 3.3 Synchrotron radiation power /beam (MW) 30 30 30 30 Bending radius (km) 10.7 10.7 10.9 10.9 Momentum compact (10°5) 0.91 1.11 1.14 1.14 β function at IP $β_s^* / β_s^*$ (m) 0.330,001 0.360,0015 1.20,0037 1.20,0037 Emittance $ε/ε_s$ (mm) 0.890,0018 1.210,0024 2.240,0068 2.460,0074 Beam size at IP $σ_s/σ_s$ (μm) 17.10,042 20.90,06 51.8/0.16 54.4/0.17 Beam-beam parameters $ξ_s/ξ_s$ 0.024/0.113 0.018/0.109 0.077/0.105 0.076/0.103 RF voltage V_{RF} (GV) 2.4 2.17 8.93 10.3 RF frequency f_{RF} (MHz) (harmonic) 650 (216816) 650 (216816) 650 (217500) 650 (217500) Natural bunch length $σ_s$ (mm) 2.2 2.72 2.54 2.62 Bunch length $σ_s$ (mm) 3.93 4.4 2.87 2.93 HOM power/cavity (2 cell) (kw) 0.58 0.46 <td>Number of particles/bunch N_e (1010)</td> <td>17.0</td> <td>15.0</td> <td>24.15</td> <td>26.7</td>	Number of particles/bunch N_e (1010)	17.0	15.0	24.15	26.7
Synchrotron radiation power /beam (MW) 30 30 30 30 Bending radius (km) 10.7 10.7 10.9 10.9 Momentum compact (10-5) 0.91 1.11 1.14 1.14 β function at IP $β_x^* / β_y^*$ (m) 0.33/0.001 0.36/0.0015 1.2/0.0037 1.2/0.0037 Emittance $ε_x^* / ε_y$ (mm) 0.889/0.0018 1.21/0.0024 2.24/0.0068 2.46/0.0074 Beam size at IP $σ_x^* / σ_y$ (μm) 17.1/0.042 20.9/0.06 51.8/0.16 54.4/0.17 Beam-beam parameters $ξ_x^* / ξ_y$ 0.024/0.113 0.018/0.109 0.077/0.105 0.076/0.103 RF voltage V_{RF} (GV) 2.4 2.17 8.93 10.3 RF frequency f_{RF} (MHz) (harmonic) 650 (216816) 650 (216816) 650 (217500) 650 (217500) Natural bunch length $σ_x$ (mm) 2.2 2.72 2.54 2.62 Bunch length $σ_x$ (mm) 3.93 4.4 2.87 2.93 HOM power/cavity (2 cell) (kw) 0.58 0.46 0.53 (5cell) 0.49 Energy spread (%)	Bunch number (bunch spacing)	218 (0.76µs)	242 (0.68μs)	34	26
Bending radius (km) 10.7 10.7 10.9 10.9 Momentum compact (10^{-5}) 0.91 1.11 1.14 1.14 β function at IP $β_x^{**}/β_y^*$ (m) $0.330.001$ $0.360.0015$ $1.20.0037$ $1.20.0037$ Emittance s_x/s_y (nm) $0.890.0018$ $1.210.0024$ $2.240.0068$ $2.460.0074$ Beam size at IP $σ_x/σ_y$ (μm) $17.10.042$ $20.90.06$ $51.80.16$ $54.40.17$ Beam-beam parameters $\frac{f_y}{f_y}$ $0.0240.113$ $0.0180.109$ $0.0770.105$ $0.0760.103$ RF voltage V_{RF} (GV) 2.4 2.17 8.93 10.3 RF frequency f_{RF} (MHz) (harmonic) 650 (216816) 650 (216816) 650 (217500) 650 (217500) Natural bunch length $σ_z$ (mm) 2.2 2.72 2.54 2.62 Bunch length $σ_z$ (mm) 3.93 4.4 2.87 2.93 HOM power/cavity (2 cell) (kw) 0.58 0.46 0.53 (Scell) 0.49 Energy spread (%) 0.19 0.134 0.14 <td< td=""><td>Beam current (mA)</td><td>17.8</td><td>17.4</td><td>3.95</td><td>3.3</td></td<>	Beam current (mA)	17.8	17.4	3.95	3.3
Momentum compact (10^{-5}) 0.91 1.11 1.14 1.14 $β$ function at IP $β_x^* / β_y^*$ (m) 0.330.001 0.360.0015 1.20.0037 1.20.0037 1.20.0037 Emittance $ε_x / ε_y$ (mm) 0.89/0.0018 1.21/0.0024 2.24/0.0068 2.460.0074 Beam size at IP $σ_x / σ_y$ (μm) 17.1/0.042 20.9/0.06 51.8/0.16 54.4/0.17 Beam-beam parameters $ξ_x / ξ_y$ 0.024/0.113 0.018/0.109 0.077/0.105 0.076/0.103 RF voltage V_{RF} (GV) 2.4 2.17 8.93 10.3 RF frequency f_{RF} (MHz) (harmonic) 650 (216816) 650 (216816) 650 (217500) 650 (217500) Natural bunch length $σ_z$ (mm) 2.2 2.72 2.54 2.62 Bunch length $σ_z$ (mm) 3.93 4.4 2.87 2.93 HOM power/cavity (2 cell) (kw) 0.58 0.46 0.53 (5cell) 0.49 Energy spread (%) 0.19 0.134 0.14 0.15 Energy acceptance requirement (%) 1.7 1.35 1.57 1.7 Energy acceptance by RF (%) 3.0 2.06 2.67 2.48 Photon number due to beamstrahlung 0.104 0.082 0.19 0.15 Beamstruhlung lifetime /quantum lifetime* (min) 30/50 80/80 60 1.0 Lifetime (hour) 0.22 0.43 0.89 0.89 0.88	Synchrotron radiation power /beam (MW)	30	30	30	30
β function at IP $β_x^* / β_y^*$ (m) 0.33/0.001 0.36/0.0015 1.2/0.0037 1.2/0.0037 Emittance $ε_x / ε_y$ (m) 0.89/0.0018 1.21/0.0024 2.24/0.0068 2.46/0.0074 Beam size at IP $σ_x / σ_y$ (μm) 17.1/0.042 20.9/0.06 51.8/0.16 54.4/0.17 Beam-beam parameters $ξ_x / ξ_y$ 0.024/0.113 0.018/0.109 0.077/0.105 0.076/0.103 RF voltage V_{RF} (GV) 2.4 2.17 8.93 10.3 RF frequency f_{RF} (MHz) (harmonic) 650 (216816) 650 (216816) 650 (217500) 650 (217500) Natural bunch length $σ_x$ (mm) 2.2 2.72 2.54 2.62 Bunch length $σ_x$ (mm) 3.93 4.4 2.87 2.93 HOM power/cavity (2 cell) (kw) 0.58 0.46 0.53 (5cell) 0.49 Energy spread (%) 0.19 0.134 0.14 0.15 Energy acceptance requirement (%) 1.7 1.35 1.57 1.7 Energy acceptance by RF (%) 3.0 2.06 2.67 2.48 Photon number due to beamstrahlung </td <td>Bending radius (km)</td> <td>10.7</td> <td>10.7</td> <td>10.9</td> <td>10.9</td>	Bending radius (km)	10.7	10.7	10.9	10.9
Emittance $ε_i/ε_j$ (nm) 0.89/0.0018 1.21/0.0024 2.24/0.0068 2.46/0.0074 Beam size at IP $σ_i/σ_j$ (μm) 17.1/0.042 20.9/0.06 51.8/0.16 54.4/0.17 Beam-beam parameters $ξ_i/ξ_j$ 0.024/0.113 0.018/0.109 0.077/0.105 0.076/0.103 RF voltage V_{RF} (GV) 2.4 2.17 8.93 10.3 RF frequency f_{RF} (MHz) (harmonic) 650 (216816) 650 (216816) 650 (217500) 650 (217500) Natural bunch length $σ_i$ (mm) 2.2 2.72 2.54 2.62 Bunch length $σ_i$ (mm) 3.93 4.4 2.87 2.93 HOM power/cavity (2 cell) (kw) 0.58 0.46 0.53 (5cell) 0.49 Energy spread (%) 0.19 0.134 0.14 0.15 Energy acceptance requirement (%) 1.7 1.35 1.57 1.7 Energy acceptance by RF (%) 3.0 2.06 2.67 2.48 Photon number due to beamstrahlung 0.104 0.082 0.19 0.15 Beamstruhlung lifetime /quantum lifetime* (min) 3	Momentum compact (10 ⁻⁵)	0.91	1.11	1.14	1.14
Beam size at IP $σ_x/σ_y$ (µm) 17.1/0.042 20.9/0.06 51.8/0.16 54.4/0.17 Beam-beam parameters ξ/ξ_y 0.024/0.113 0.018/0.109 0.077/0.105 0.076/0.103 RF voltage V_{RF} (GV) 2.4 2.17 8.93 10.3 RF frequency f_{RF} (MHz) (harmonic) 650 (216816) 650 (216816) 650 (217500) 650 (217500) Natural bunch length $σ_x$ (mm) 2.2 2.72 2.54 2.62 Bunch length $σ_x$ (mm) 3.93 4.4 2.87 2.93 HOM power/cavity (2 cell) (kw) 0.58 0.46 0.53 (5cell) 0.49 Energy spread (%) 0.19 0.134 0.14 0.15 Energy acceptance requirement (%) 1.7 1.35 1.57 1.7 Energy acceptance by RF (%) 3.0 2.06 2.67 2.48 Photon number due to beamstrahlung 0.104 0.082 0.19 0.15 Beamstruhlung lifetime /quantum lifetime* (min) 30/50 80/80 60 1.0 Lifetime (hour) 0.85 0.89 <	$β$ function at IP $β_x^*/β_y^*$ (m)	0.33/0.001	0.36/0.0015	1.2/0.0037	1.2/0.0037
Beam-beam parameters ξ_i/ξ_j 0.024/0.113 0.018/0.109 0.077/0.105 0.076/0.103 RF voltage V_{RF} (GV) 2.4 2.17 8.93 10.3 RF frequency f_{RF} (MHz) (harmonic) 650 (216816) 650 (216816) 650 (217500) 650 (217500) Natural bunch length σ_c (mm) 2.2 2.72 2.54 2.62 Bunch length σ_c (mm) 3.93 4.4 2.87 2.93 HOM power/cavity (2 cell) (kw) 0.58 0.46 0.53 (5cell) 0.49 Energy spread (%) 0.19 0.134 0.14 0.15 Energy acceptance requirement (%) 1.7 1.35 1.57 1.7 Energy acceptance by RF (%) 3.0 2.06 2.67 2.48 Photon number due to beamstrahlung 0.104 0.082 0.19 0.15 Beamstruhlung lifetime /quantum lifetime* (min) 30/50 80/80 60 1.0 Lifetime (hour) 0.22 0.43 0.89 0.89 0.88	Emittance $\varepsilon_x/\varepsilon_y$ (nm)	0.89/0.0018	1.21/0.0024	2.24/0.0068	2.46/0.0074
RF voltage V_{RF} (GV) 2.4 2.17 8.93 10.3 RF frequency f_{RF} (MHz) (harmonic) 650 (216816) 650 (216816) 650 (217500) 650 (217500) Natural bunch length σ_c (mm) 2.2 2.72 2.54 2.62 Bunch length σ_c (mm) 3.93 4.4 2.87 2.93 HOM power/cavity (2 cell) (kw) 0.58 0.46 0.53 (5cell) 0.49 Energy spread (%) 0.19 0.134 0.14 0.15 Energy acceptance requirement (%) 1.7 1.35 1.57 1.7 Energy acceptance by RF (%) 3.0 2.06 2.67 2.48 Photon number due to beamstrahlung 0.104 0.082 0.19 0.15 Beamstruhlung lifetime /quantum lifetime* (min) 30/50 80/80 60 1.0 Lifetime (hour) 0.22 0.43 0.89 0.89 0.88	Beam size at IP σ_x/σ_y (µm)	17.1/0.042	20.9/0.06	51.8/0.16	54.4/0.17
RF frequency f_{RF} (MHz) (harmonic) 650 (216816) 650 (216816) 650 (217500) 650 (217500) Natural bunch length σ_{ζ} (mm) 2.2 2.72 2.54 2.62 Bunch length σ_{ζ} (mm) 3.93 4.4 2.87 2.93 HOM power/cavity (2 cell) (kw) 0.58 0.46 0.53 (5cell) 0.49 Energy spread (%) 0.19 0.134 0.14 0.15 Energy acceptance requirement (%) 1.7 1.35 1.57 1.7 Energy acceptance by RF (%) 3.0 2.06 2.67 2.48 Photon number due to beamstrahlung 0.104 0.082 0.19 0.15 Beamstruhlung lifetime /quantum lifetime* (min) 30/50 80/80 60 1.0 Lifetime (hour) 0.22 0.43 0.89 0.89 F (hour glass) 0.85 0.89 0.89 0.88	Beam-beam parameters ξ_x/ξ_y	0.024/0.113	0.018/0.109	0.077/0.105	0.076/0.103
Natural bunch length $σ_ε$ (mm) 2.2 2.72 2.54 2.62 Bunch length $σ_ε$ (mm) 3.93 4.4 2.87 2.93 HOM power/cavity (2 cell) (kw) 0.58 0.46 0.53 (5cell) 0.49 Energy spread (%) 0.19 0.134 0.14 0.15 Energy acceptance requirement (%) 1.7 1.35 1.57 1.7 Energy acceptance by RF (%) 3.0 2.06 2.67 2.48 Photon number due to beamstrahlung 0.104 0.082 0.19 0.15 Beamstruhlung lifetime /quantum lifetime* (min) 30/50 80/80 60 1.0 Lifetime (hour) 0.22 0.43 0.7 0.7 F (hour glass) 0.85 0.89 0.89 0.88	RF voltage V_{RF} (GV)	2.4	2.17	8.93	10.3
Bunch length σ_{c} (mm) 3.93 4.4 2.87 2.93 HOM power/cavity (2 cell) (kw) 0.58 0.46 0.53 (Scell) 0.49 Energy spread (%) 0.19 0.134 0.14 0.15 Energy acceptance requirement (%) 1.7 1.35 1.57 1.7 Energy acceptance by RF (%) 3.0 2.06 2.67 2.48 Photon number due to beamstrahlung 0.104 0.082 0.19 0.15 Beamstruhlung lifetime /quantum lifetime* (min) 30/50 80/80 60 1.0 Lifetime (hour) 0.22 0.43 0.7 0.7 F (hour glass) 0.85 0.89 0.89 0.88	RF frequency f_{RF} (MHz) (harmonic)	650 (216816)	650 (216816)	650 (217500)	650 (217500)
HOM power/cavity (2 cell) (kw) 0.58 0.46 0.53 (5cell) 0.49 Energy spread (%) 0.19 0.134 0.14 0.15 Energy acceptance requirement (%) 1.7 1.35 1.57 1.7 Energy acceptance by RF (%) 3.0 2.06 2.67 2.48 Photon number due to beamstrahlung 0.104 0.082 0.19 0.15 Beamstruhlung lifetime /quantum lifetime* (min) 30/50 80/80 60 1.0 Lifetime (hour) 0.22 0.43 0.7 F (hour glass) 0.85 0.89 0.89 0.88	Natural bunch length σ_{z} (mm)	2.2	2.72	2.54	2.62
Energy spread (%) 0.19 0.134 0.14 0.15 Energy acceptance requirement (%) 1.7 1.35 1.57 1.7 Energy acceptance by RF (%) 3.0 2.06 2.67 2.48 Photon number due to beamstrahlung 0.104 0.082 0.19 0.15 Beamstruhlung lifetime /quantum lifetime* (min) 30/50 80/80 60 1.0 Lifetime (hour) 0.22 0.43 0.7 F (hour glass) 0.89 0.89 0.88	Bunch length σ_z (mm)	3.93	4.4	2.87	2.93
Energy acceptance requirement (%) 1.7 1.35 1.57 1.7 Energy acceptance by RF (%) 3.0 2.06 2.67 2.48 Photon number due to beamstrahlung 0.104 0.082 0.19 0.15 Beamstruhlung lifetime /quantum lifetime* (min) 30/50 80/80 60 1.0 Lifetime (hour) 0.22 0.43 0.7 F (hour glass) 0.85 0.89 0.89 0.88	HOM power/cavity (2 cell) (kw)	0.58	0.46	0.53 (5cell)	0.49
Energy acceptance by RF (%) 3.0 2.06 2.67 2.48 Photon number due to beamstrahlung 0.104 0.082 0.19 0.15 Beamstruhlung lifetime /quantum lifetime* (min) 30/50 80/80 60 1.0 Lifetime (hour) 0.22 0.43 0.7 F (hour glass) 0.85 0.89 0.89 0.88	Energy spread (%)	0.19	0.134	0.14	0.15
Photon number due to beamstrahlung 0.104 0.082 0.19 0.15 Beamstruhlung lifetime / quantum lifetime* (min) 30/50 80/80 60 1.0 Lifetime (hour) 0.22 0.43 0.7 F (hour glass) 0.85 0.89 0.89 0.88	Energy acceptance requirement (%)	1.7	1.35	1.57	1.7
Beamstruhlung lifetime /quantum lifetime* (min) 30/50 80/80 60 1.0 Lifetime (hour) 0.22 0.43 0.7 F (hour glass) 0.85 0.89 0.89 0.88	Energy acceptance by RF (%)	3.0	2.06	2.67	2.48
Lifetime (hour) 0.22 0.43 0.7 F (hour glass) 0.85 0.89 0.89 0.88	Photon number due to beamstrahlung	0.104	0.082	0.19	0.15
F (hour glass) 0.85 0.89 0.89 0.88	Beamstruhlung lifetime /quantum lifetime* (min)	30/50	80/80	60	1.0
0.00	Lifetime (hour)	0.22	0.43		0.7
Luminosity/IP L (10 ³⁴ cm ⁻² s ⁻¹) 5.2 2.93 0.38 0.32	F (hour glass)	0.85	0.89	0.89	0.88
	Luminosity/IP L (10 ³⁴ cm ⁻² s ⁻¹)	5.2	2.93	0.38	0.32

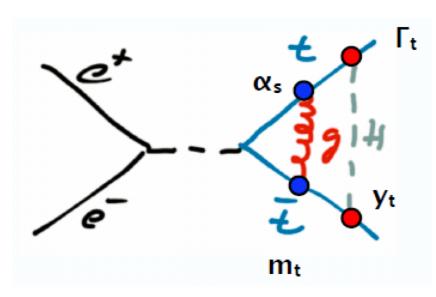


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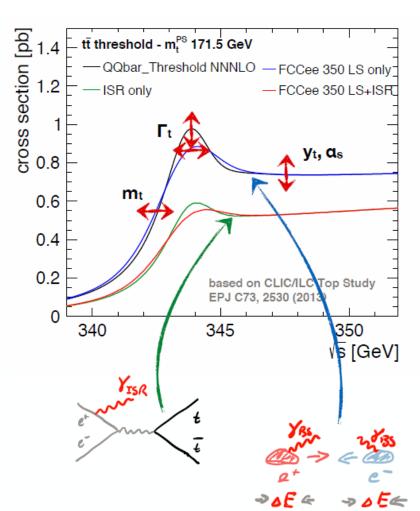
https://indico.ihep.ac.cn/event/11069/contribution/3/material/slides/0.pdf

top threshold scan

- Top threshold cross-section depends on:
 - top mass
 - top width (lifetime)
 - top-Higgs coupling
 - αQCD

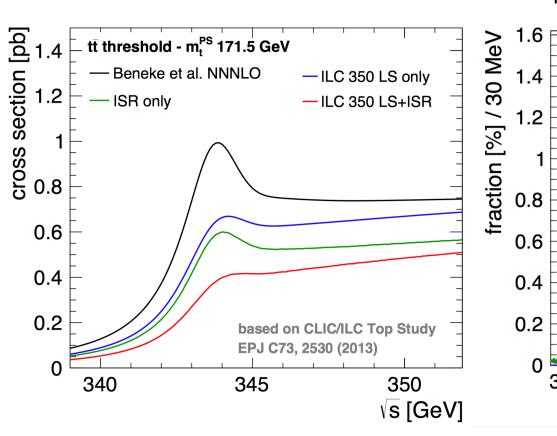


Thanks to discussion and slides from Alain Blondel Study by Frank Simon (CLIC/ILC study, EPJC 73,(2013)2530)

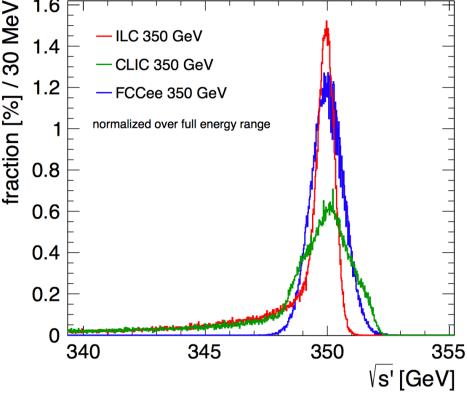


Theory prediction

- Impact due to luminosity spectrum and ISR is large
- Cross section to be re-calculated with CEPC luminosity spectrum



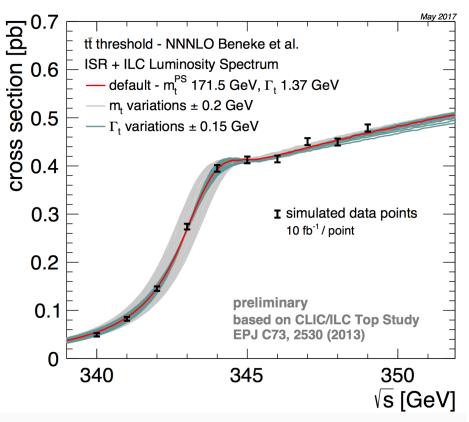
luminosity spectrum for ILC/CLIC/FCCee

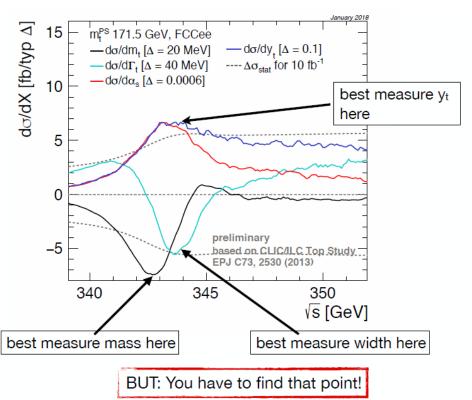


Top threshold scan

Strategy:

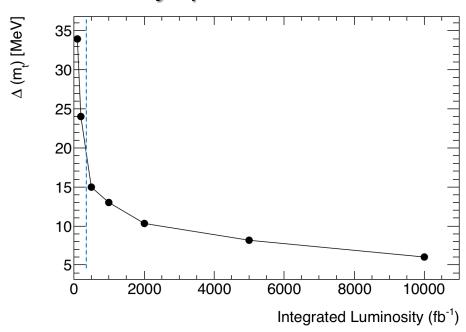
- Need a rough scan in step of 1GeV to measure the top mass (5 fb⁻¹)
- Fix the final scan points
- since there are four parameters to fix, need at least 4 scan points
 - Scanning range 342GeV ~350GeV
 - Focusing 342GeV ~345GeV





Top threshold scan

- If CEPC decided to have top threshold scan
 - Better to have integrated Lumosity larger than 200~400fb⁻¹
 - Need to re-calculated with CEPC lumiosity spectrum
 - Aim for 15MeV precision



ILC/CLIC estimation with 100 fb-1

m_t stat. error	34 MeV
m_t theory syst. (1 %/3 %)	5 MeV/8 MeV
α_s stat. error	0.0009
α_s theory syst. (1 %/3 %)	0.0008/0.0022

Summary

- Potential of electroweak measurement at CEPC
 - Possible target for top mass precision (15MeV) for CEPC
 - Propose 200~400 fb⁻¹ integrated Luminosity scanning
 - According to current CEPC design at ttbar threshold,
 - Need about two years to accurate 200~400 fb⁻¹
 - The instant luminosity is 5~10 times lower than Fcc-ee
 - Need to add more RF cavity if we need higher instant luminosity.
 - Scan range: 342GeV~345GeV
 - Energy points above 345GeV is not very useful for top mass measurement

Backup