Electroweak and Higgs Interplay at FCC-ee

P5 town hall

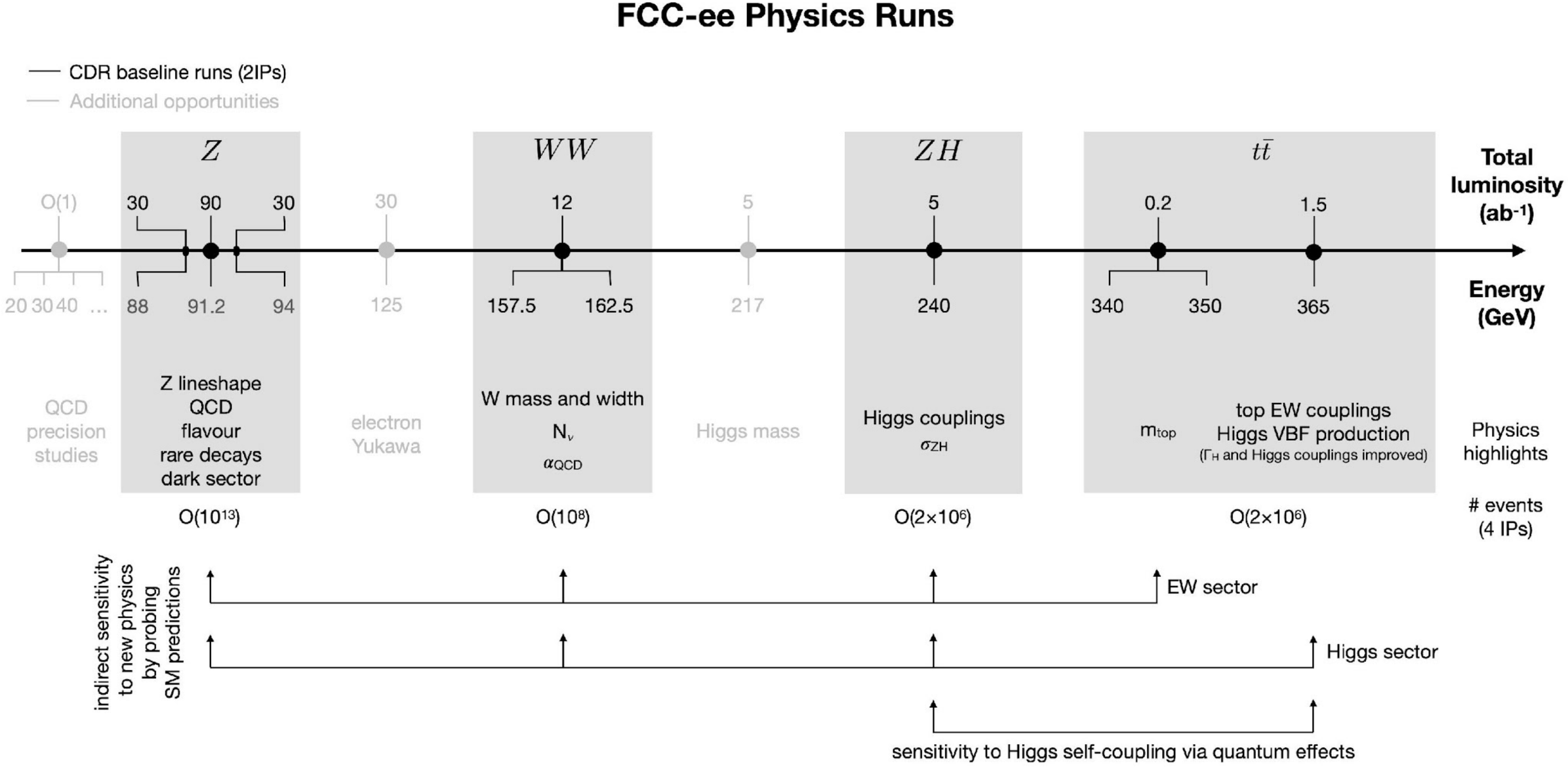
Saptaparna Bhattacharya[1], Christophe Grojean[2]

on behalf of FCC Feasibility Study Group

[1]Northwestern University and Humboldt Fellow,

[2]DESY and Humboldt University of Berlin

LEP data accumulated in first 3 minutes!
Exciting & diverse program with different priorities every few years



The order of the different stages still subject to discussion/optimization.

Event statistics (with 2 IPs, x1.7 for 4 IPs now official baseline)

Phase	Physics process	Center-of-mass energy √s (GeV)	Run duration (years)	Integrated luminosity (ab^{-1})	Number of particles accumulated	Improvement w.r.t LEP	√s uncertainty
FCC-ee-Z	Z-peak ($e^+e^- \rightarrow Z$)	88-95	4	150	5 X 10^{12}	LEP X 10^5	< 50 keV
FCC-ee-W	WW threshold ($e^+e^- \rightarrow W^+W^-$)	158-162	2	12	> 10^8	LEP X 10^3	< 200 keV
FCC-ee-H	ZH maximum ($e^+e^- \rightarrow ZH$)	240	3	5	> 10^6	Never done	2 MeV
FCC-ee-tt	tt threshold ($e^+e^- \rightarrow tt$)	345-365	5	1.5	> 10^6	Never done	5 MeV
s-channel H	($e^+e^- \rightarrow H_{125}$)	125	5?	30	~5000	Never done	100 keV

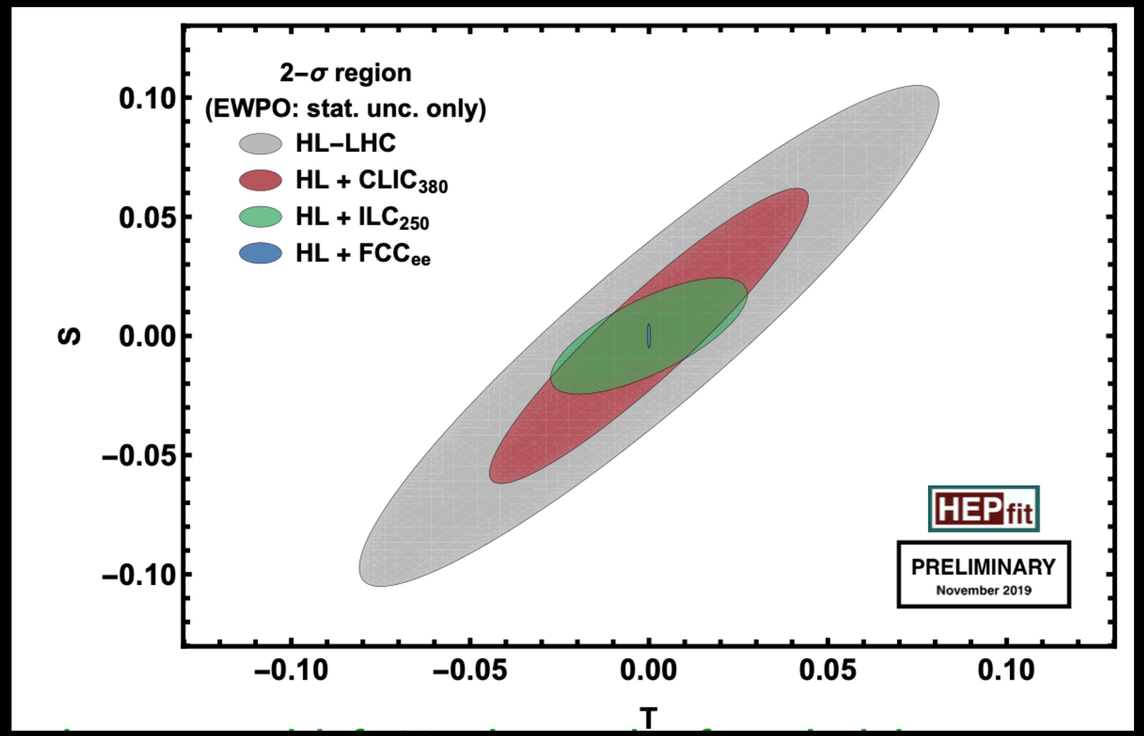
Event statistics (with 2 IPs, x1.7 for 4 IPs now official baseline)

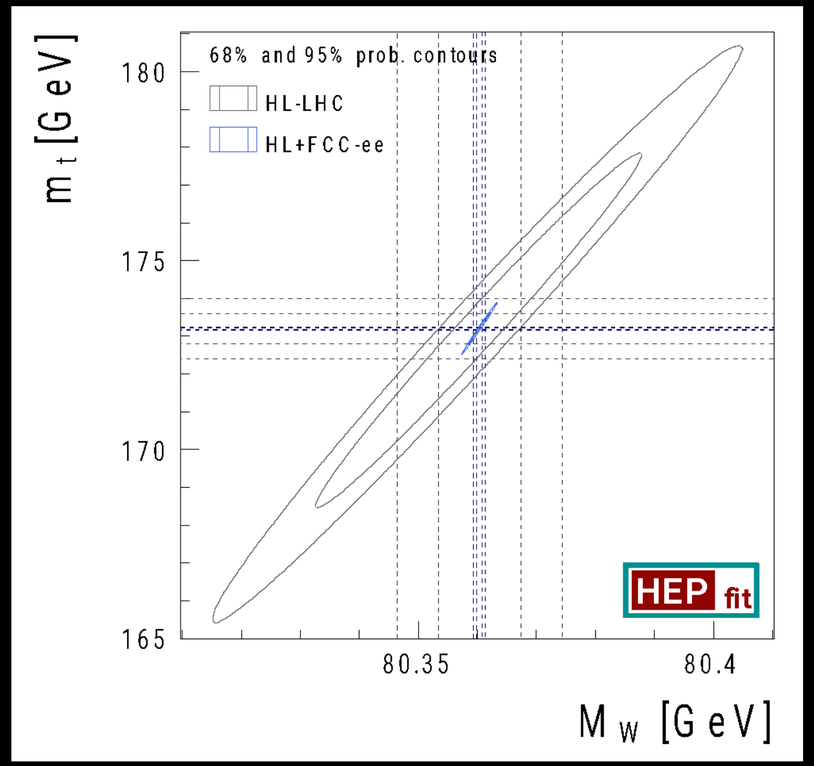
- Superb statistics achieved in only 15 years
- in each detector: 10^5 Z/sec, 10^4 W/hour, 1500 Higgs/day, 1500 top/day

Nailing the electro-weak sector

- Determination of electro-weak observables to unprecedented precision → indirect probe of new physics up to scale of order 70 TeV
- Study of heavy flavor mesons and tau leptons
- Reduction of degeneracies in global fits for Higgs couplings

stress-test of SM:
ΔM_W ~ 0.5 MeV (vs 8 MeV @ LHC)

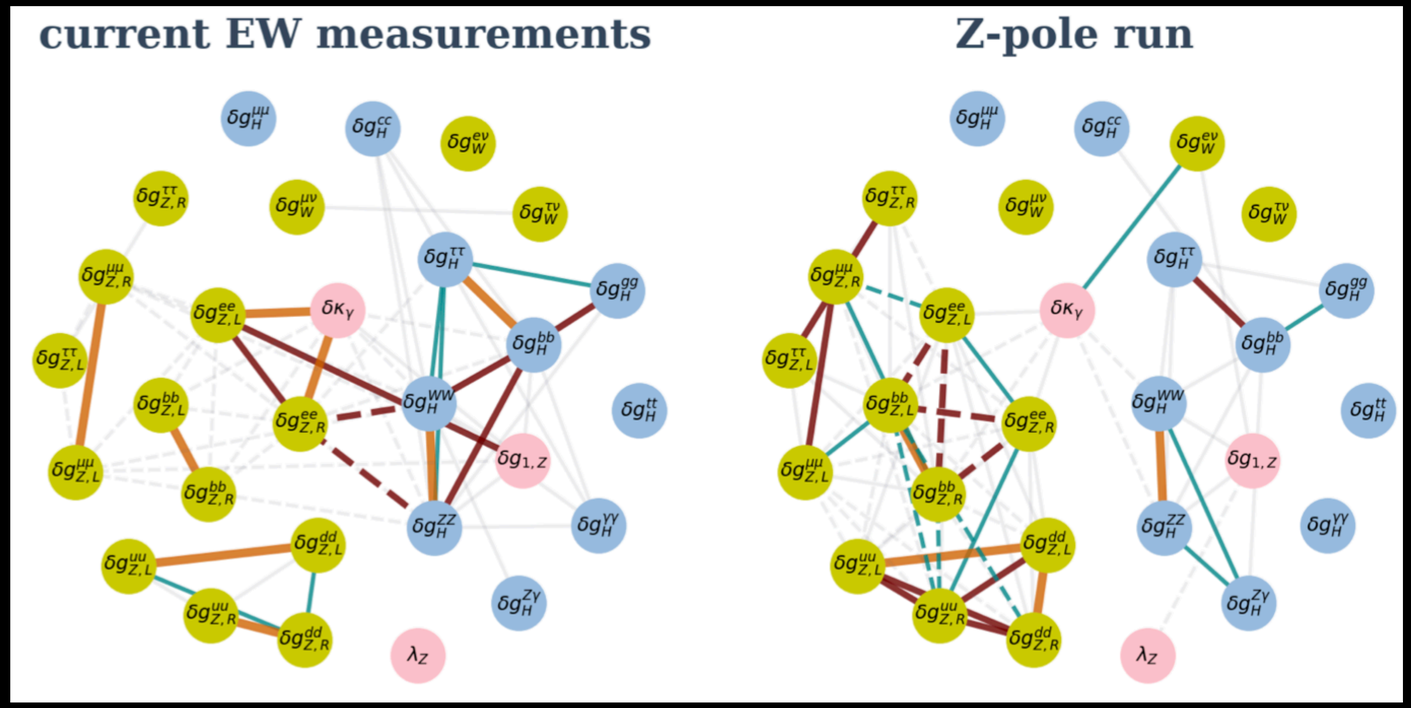




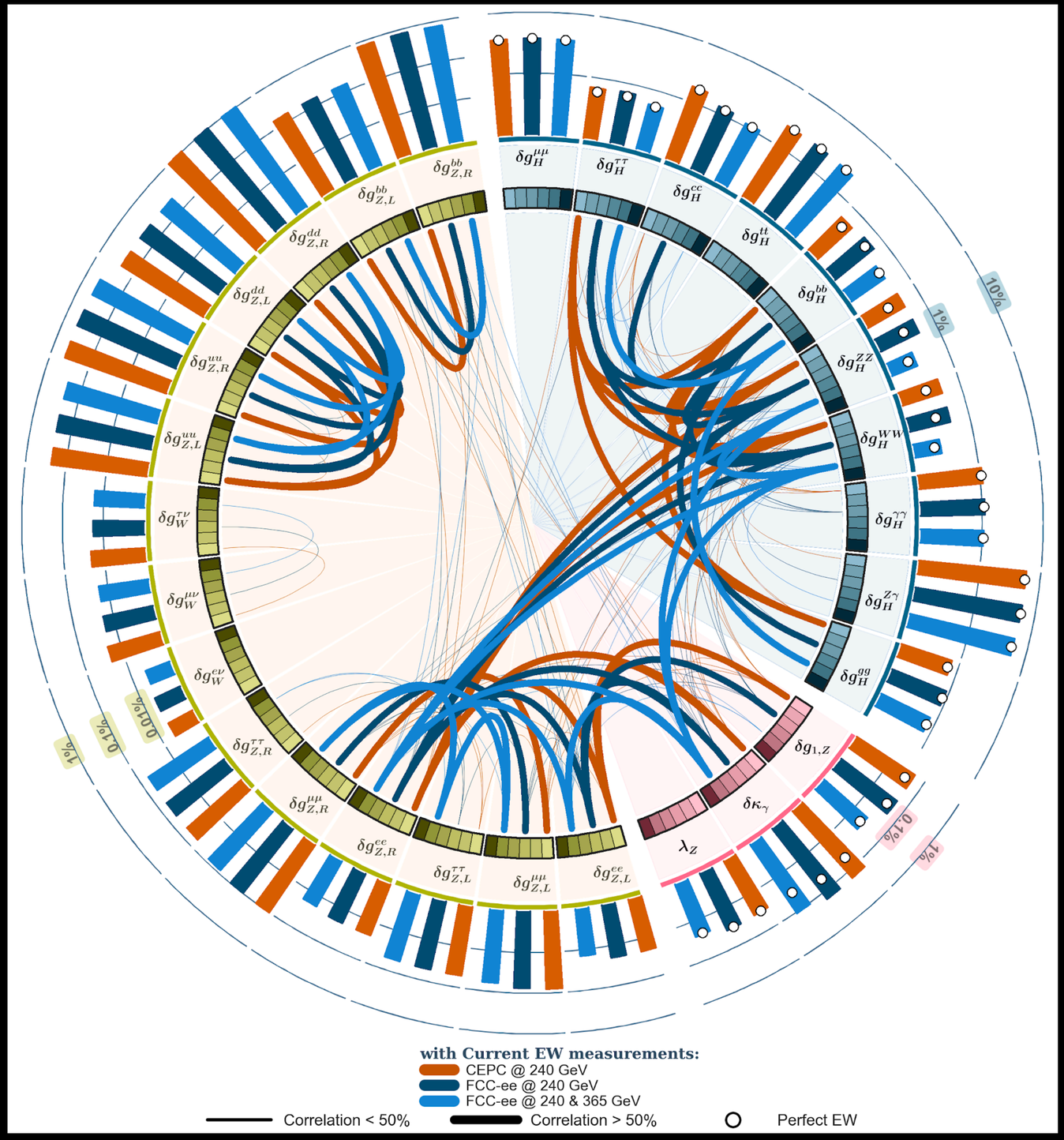
Electro-weak Measurements and Higgs Couplings

- At the LHC, electro-weak precision from LEP/SLC good enough → no interference with Higgs measurements
- Not true any longer at Future Higgs Factories → need refined electro-weak measurements to avoid contamination in Higgs coupling determination

- Without Z-pole runs, there are large correlations between electro-weak and Higgs
- With Z-pole runs, only correlations between electro-weak and trilinear gauge couplings remain



- LEP/LHC electro-weak measurements are a limiting factor to the Higgs precision program (at the 20-30% level)



- With Z-pole run, electro-weak uncertainties do not hinder Higgs coupling determination (effect below 5%)

Tera-Z program is a crucial feature of the FCC-ee