Monday Morning Plenary Q&A

Please put your name in parentheses at the start of your questions so that speakers can follow up directly.

1. Shinichiro Michizono, 08:40-09:00, “ILC Technology Network”
    a. (name) Question 1
    b. (Maxim) Cavity processing question
        i. Answer: 10-year timescale would include Nb3Sn but WP1 only includes Nb.
2. Sergey Belomestnykh, 09:00-09:20, “Overview of accelerator technology development relevant to ILC and other future lepton linear collider options”
    a. (name) Question 1
    b. (Maxim) SW Cavity. Will it be tested? What is cost?
        i. Answer: Yes, 3-cell cavity test in preparation. 30% saving for going to TW cavity for ILC main linac.
3. Steinar Stapnes, 09:20-09:40, “Status and Plans for CLIC Studies”
    a. (name) Question 1
    b. (Dasu) Tunneling question: What is CO2 and costing impact of CLIC tunnel?
        i. Answer: CO2 impact similar for blasting and TBM. Size of tunnel is most important (bore and length). Need to consider entire lifespan of machine. Include new and replacement machine parts.
4. Brian Foster, 09:40-10:00, “A hybrid, asymmetric, linear Higgs factory based on plasma-wakefield and radio-frequency acceleration”
    a. (name) Question 1
    b. () Why do you assume L-band acceleration for positrons? Why not x-band?
        i. Answer: Heavily loaded L-band linac less likely to melt. Need help from linac experts.
    c. (Marty) What is experimental demonstration of multiple stages?
        i. Answer: Need a “real” experimental demo.
    d. (Eric Esarey) This is a mid-term goal and a demonstrator of many core technologies. More upgrades possible.
        i. Answer: Helps focus plasma accelerator people on HEP challenges.

Coffee break

5. Caterina Vernieri, 10:45-11:05, “C3”
    a. (Gudrid Moortgat-Pick) ‘Impact of simultaneously polarized beams is more involved: With both beams polarized you really can get insights on the interaction structure at the vertex, so, that’s the ‘new physics’. In the higgs physics sector it is, for instance, access to CP-violating couplings. Such options can not be compensated by polarized electrons only. In addition you can enhance the effective luminosity with both beams polarized, as well only by both beams polarized.’
        i. Answer (CV): Absolutely, thanks for making this point more clear. Electron polarization at 250 GeV already takes us to effectively use the integrated luminosity and 2/ab become ~ equivalent to 5/ab w/o polarization. See table below from one of the backup-slides in my talk (arXiv:1908.11299, arXiv:1506.07830). The positron polarization and e-_Le+_R becomes really relevant >> 500 GeV operations and as you pointed out would help at lower energy with better control over systematic errors and dedicated CP sensitive observables.

Collider Luminosity Polarization	HL-LHC 3 ab^{-1} in 10 yrs -	C^3 /ILC 250 GeV 2 ab^{-1} in 10 yrs $\mathcal{P}_{e^+} = 30\%$ (0%)	C^3 /ILC 500 GeV + 4 ab^{-1} in 10 yrs $\mathcal{P}_{e^+} = 30\%$ (0%)
g_{HZZ} (%)	3.2	0.38 (0.40)	0.20 (0.21)
g_{HWW} (%)	2.9	0.38 (0.40)	0.20 (0.20)
g_{Hbb} (%)	4.9	0.80 (0.85)	0.43 (0.44)
g_{Hcc} (%)	-	1.8 (1.8)	1.1 (1.1)
g_{Hgg} (%)	2.3	1.6 (1.7)	0.92 (0.93)
$g_{H\tau\tau}$ (%)	3.1	0.95 (1.0)	0.64 (0.65)
$g_{H\mu\mu}$ (%)	3.1	4.0 (4.0)	3.8 (3.8)
$g_{H\gamma\gamma}$ (%)	3.3	1.1 (1.1)	0.97 (0.97)
$g_{HZ\gamma}$ (%)	11.	8.9 (8.9)	6.5 (6.8)
g_{Htt} (%)	3.5	–	3.0 (3.0)*
g_{HHH} (%)	50	49 (49)	22 (22)
Γ_H (%)	5	1.3 (1.4)	0.70 (0.70)

        ii. (Gudi again) Yes, thanks a lot, but I also mean the effective luminosity, that’s proportional to Pe-Pe+ and can only be enhanced by both beams polarized. ….Just for completeness. (Please, just compare with 1801.02840 if convenient and for more details *Phys.Rept.* 460 (2008)).

iii. (Michael Peskin) Whereas the advantage of having electron beam polarization at an e+e- collider is completely obvious, the advantage of adding positron polarization is more subtle. The table posted by Caterina is correct but somewhat understates the advantage. On the other hand, Gudi is somewhat overstating the advantage; for example, it is possible to access CP violating Higgs observables with electron polarization only. For a more nuanced version of the case for positron polarization, please see Section 5.3 of the ILC Snowmass Report, arXiv:2203.07622.

Caterina emphasized the role of positron polarization in Higgs precision. If you just look at the projected numbers, the effect seems to be quite small. However, positron polarization allows many more quantities to be measured, and this offers cross-checks on estimates of systematic errors. If a deviation from the Standard Model is observed (and this is the whole point of a Higgs factory), the observation will be controversial, and all possible explanations will need to be explored. Observables depending on positron polarization will be an important tool.

Another important question is : Is positron polarization needed on day 1? I think that the C^3 group is more concerned that there should be a robust positron source on day 1 to tune up the machine. Positron polarization would be added later as an upgrade. Whether this would be done at the 250 or the 550 GeV stages would depend on the physics results.

b. () How to account for factor of 2 energy gain if less than a factor of 2 gradient enhancement?
    i. Answer: Not all cryomodules used at 250 stage. Spare capacity in main linac as risk mitigation for 250.
c. (Sergey) Why CEPC so much higher for CO2?
    i. Answer: Higher luminosity machine.
    ii. (Daniel Jeans) maybe also the assumed energy mix?

6. Jinlong Zhang, 11:05-11:25, “Recent Developments in Detector Concept Studies”
    a. (Maxim) MAPS timestamping resolution
        i. Answer: Tests underway at DESY
    b. () Too optimistic about magnet. Need field with minimal material to establish desired field.

7. Adrian Irles, 11:25-11:45, “Calorimetry for Higgs Factory Detectors”
    a. (Jinlong) What is most challenging technique to reach 10x granularity with nobel liquid.
        i. Answer: Electronics
8. Ariel Schwartzman, 11:45-12:05, “Fast Timing in Higgs Factory Detectors”
    a. (name) Question 1
    b. (Jenny List) Question: Is PID simulation or analytic? How well can you measure length of track?
    c. (Marty) Question: Control systematics? How to calibrate? How stable is calibration?
        i. Answer: Many timescales. Data-based calibration. Self-calibrating TPCs. More R&D needed.
    d. () Question: How much do we have to pay for better timing?
        i. Answer: More R&D needed.