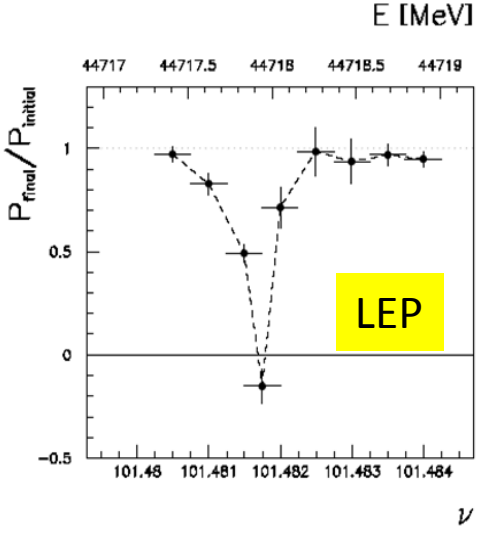
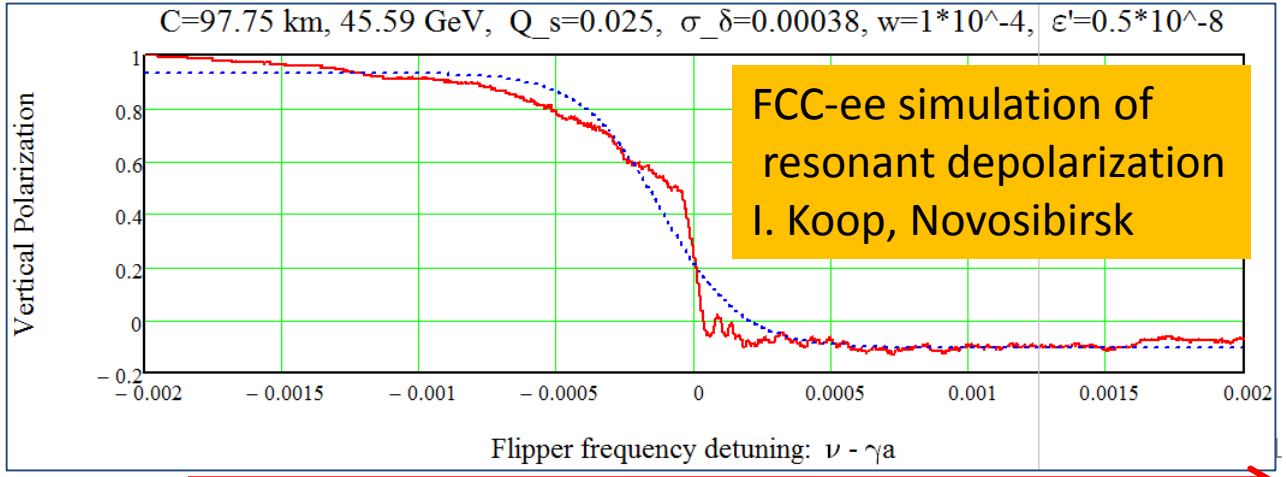
FCC-ee Beam Polarization and Energy Calibration (I)

1. **Priority from Physics** : $\Delta E/E$ ~O(10^{-6}) around Z pole and WW threshold →**Z,W mass&width**
2. Exploit natural transverse beam polarization present at Z and W (E.Gianfelice, S.Aumon)
   - **2.1 This is a unique capability of e+e- circular colliders**
   - 2.2 Sufficient level is obtained if machine alignment is good enough for luminosity
   - 2.2 Resonant depolarization has intrinsic stat. precision of ~10^{-6} on spin tune (I.Koop)
   - 2.3 Required hardware (polarimeter, wigglers depolarizer) is defined & integrated (K.Oide)
   - 2.4 Running mode with 1% non-colliding bunches and wigglers defined (Koratzinos)





260 seconds sweep of depolarizer frequency

FCC-ee Beam Polarization and Energy Calibration (II)

3. **From spin tune measurement to center-of-mass determination** $\nu_s = \frac{g-2}{2}\frac{E_b}{m_e} = \frac{E_b}{0.4406486(1)}$

3.1 Synchrotron Radiation energy loss (9 MeV @Z in 4 'arcs') calculable to < permil accuracy

3.3. Beamstrahlung energy loss (0.62 MeV per beam at Z pole), compensated by RF (Shatilov)

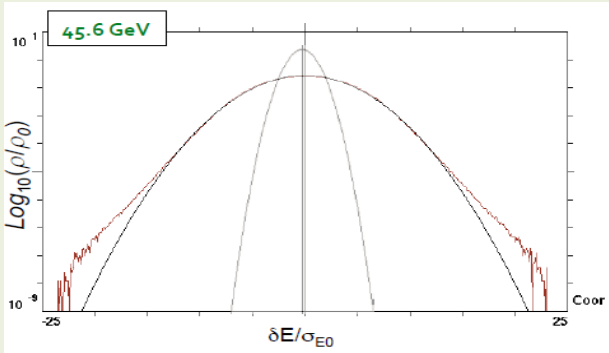
3.4 layout of accelerator with IPs between two arcs well separated from RF

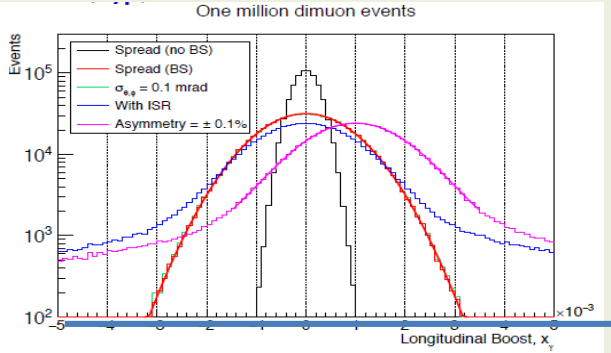
➔ $0.5\,(E_{CM}{}^{A} + E_{CM}{}^{G}) = (E_b{}^{+} + E_b{}^{-})\cos(\alpha_{crossing}/2)$

3.5 $E_b{}^{+}$ vs $E_b{}^{-}$ asymmetries and energy spread can be measured/monitored in expt:

e+e- → μ+ μ- longitudinal momentum shift and spread (Janot)

D. Shatilov: beam energy spectrum without/with beamstrahlung





P. Janot: 2 min @Z = 10^6 μ+ μ- /expt. → 50 keV meast!

z boost

4. work in progress: errors from betatron motion in non-planar orbits, transverse impedance, RF asymmetries, optimum depolarizer set-up vs Q_s at W, opp. sign vertical dispersion.

➔ On track to match goal of 100 (300) keV errors on E_{CM} at Z (WW) energies.