# On possible low efficiency of RD technique at large storage rings like FCCee and CEPC

(remarks stimulated by Koop's simulations)

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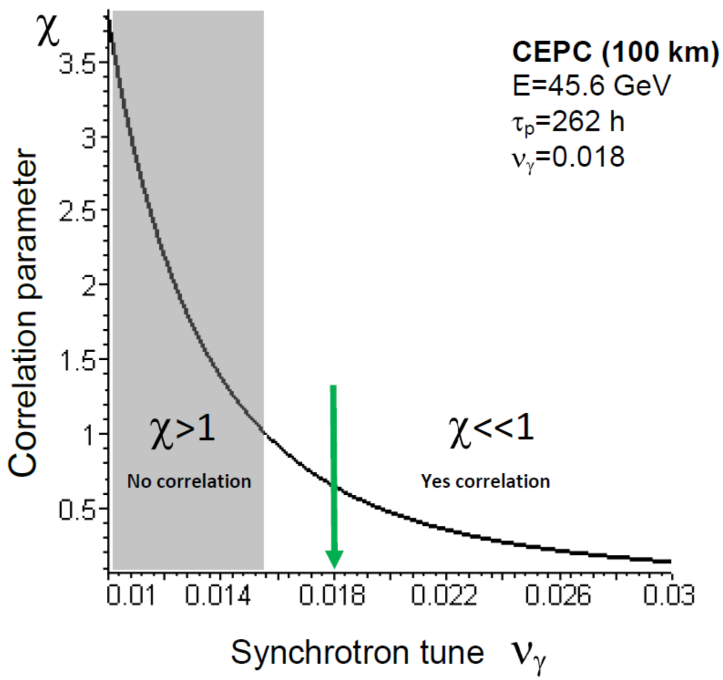
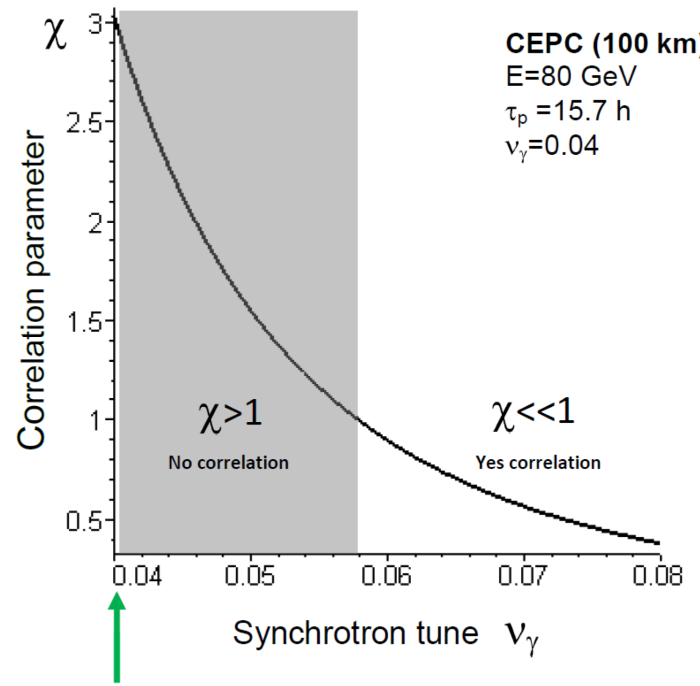
# Two cases of modulation resonance manifestation

Non-correlation in modulation resonance crossing due to synchrotron oscillations: $\chi = \dfrac{\nu^2}{\nu_\gamma^3 \tau_p f_0} \geq 1$
Diffusion of precession phase ≥1 per period of modulation.
$\nu$ is spin tune; $\nu_\gamma$ is synchrotron tune; $\tau_p$ is polarization time; $f_0$ is revolution frequency.




In accordance with spin resonant diffusion theory by Ya.S. Derbenev and A.M. Kondratenko:
**Yes correlation ($\chi$<<1)** $\rightarrow$ scanning depolarizer with spectrum line width $\delta\omega_d / \omega_0 < \nu_y$ 'sees' every modulation resonance as isolated one.
**No correlation ($\chi$>>1)** $\rightarrow$ modulation resonances are not isolated. Spin diffusion rate depends on total effect of set of modulation resonances overlapped by spin tune spread.

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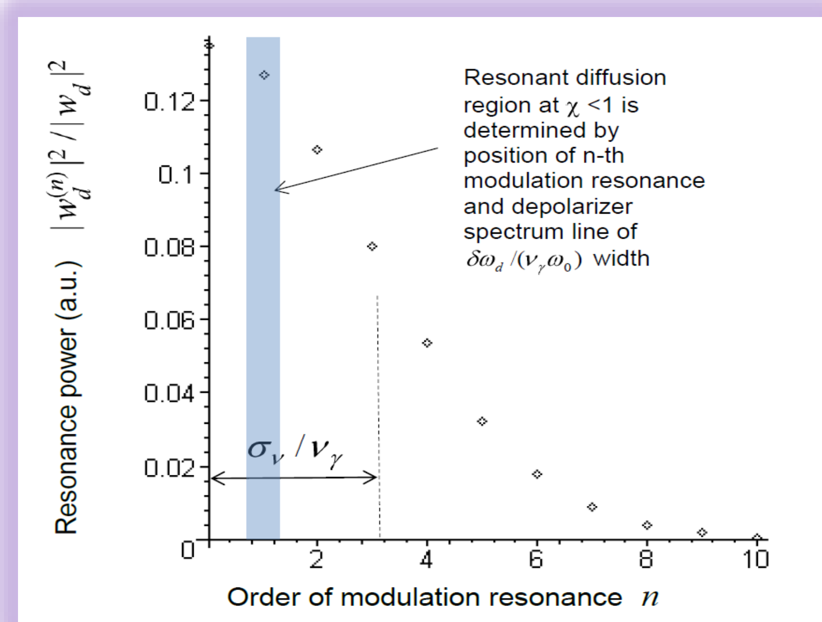
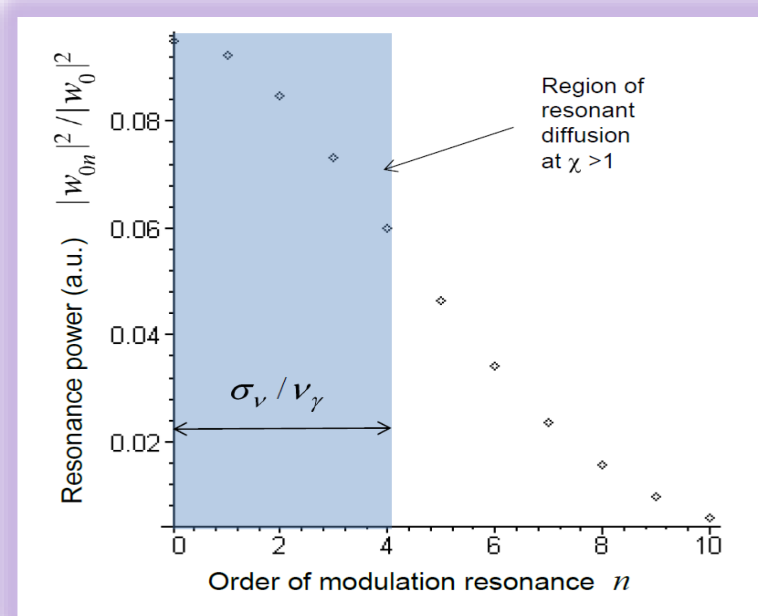
# Depolarizer efficiency in presence of synchrotron modulation of spin motion




Rate of depolarization by RF flipper as applied to isolated spin resonance:

$$\tau_d^{-1} \approx \frac{(\omega_0|w_d|)^2}{\delta\omega_d}$$

$|w_d|^2$ is power of spin perturbation due to RF flipper.

At large spin tune spread $\sigma_\nu = \sqrt{2}\nu\sigma_E >> \nu_\gamma$ (neglecting synchrotron tune as a distance between neighboring resonances):

$$\tau_d^{-1} \sim \frac{\omega_0|w_d|^2}{\sigma_\nu} I_0\left(\frac{\sigma_\nu^2}{\nu_\gamma^2}\right)\cdot\exp\left(-\frac{\sigma_\nu^2}{\nu_\gamma^2}\right) << \frac{(\omega_0|w_d|)^2}{\delta\omega_d}$$

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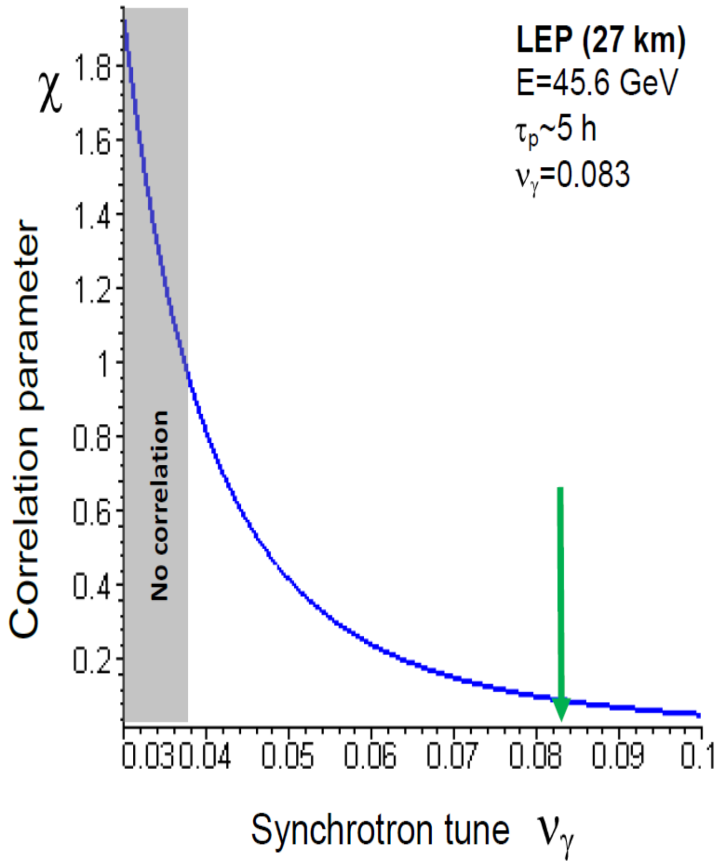
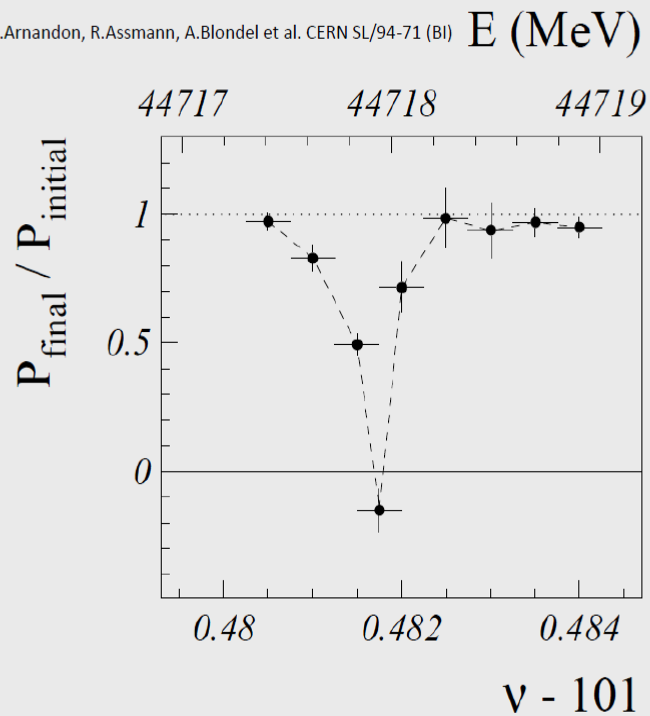
# LEP fortunate case




L.Arnandon, R.Assmann, A.Blondel et al. CERN SL/94-71 (BI)




LEP measurement of artificially excited spin resonance at the rate of spin tune change like in standard RD energy calibrations:

$\Delta\nu_{scan}/\Delta t = 1.67 \cdot 10^{-4} s^{-1}$

Resolution is better $5{\cdot}10^{-6}$.

Owing to large value of synchrotron tune the modulation resonances at LEP were 'isolated'. It enabled the RD technique to be sufficiently effective.

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