# Spin tracking vs Integration and dependence on $\beta$−amplitude

D. Rubin

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E field correction

*3 ways to compute E-field contribution to* $\omega_a$

1. Spin tracking (BMT equation)
2. Integration

$$\vec{C}_e(T) \sim 2\frac{\Delta p}{p}\frac{1}{T}\int_0^T \frac{\vec{\beta}\times\vec{E}}{Bc}dt$$

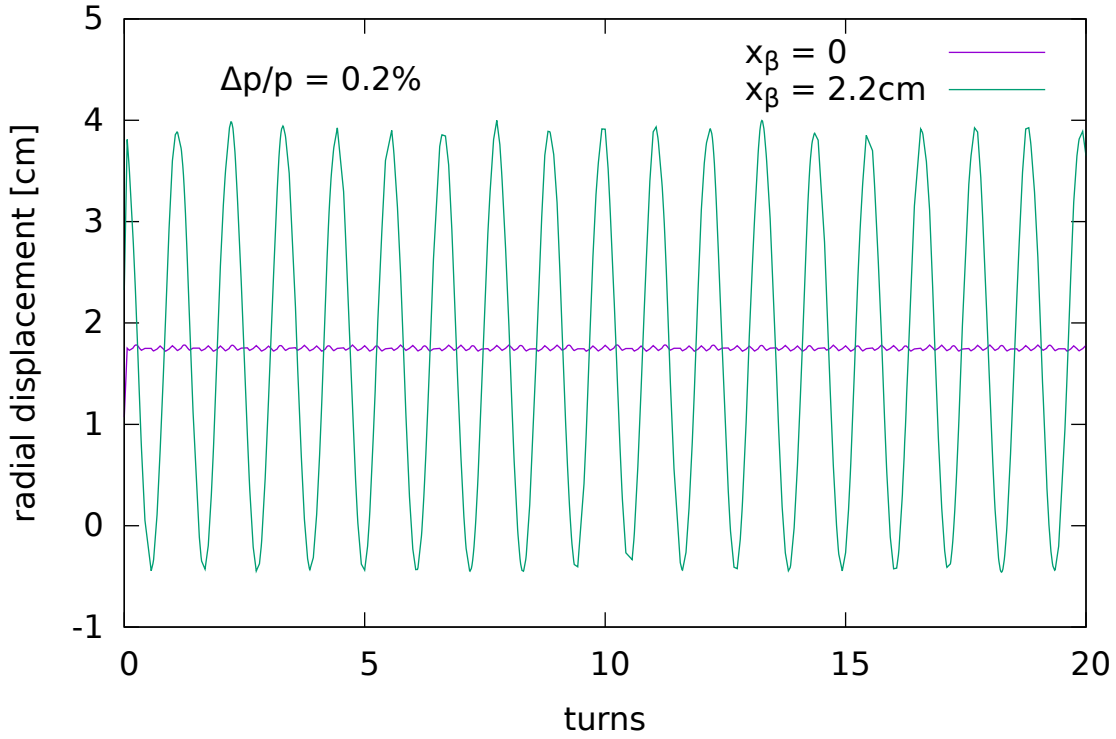
   a) Integration along trajectory (includes betatron oscillations)
   b) Integration along closed orbit ($x = \eta\delta$)

Note that method 2b) is most nearly equivalent to the 'classic' method, namely

$$C_E = -2\beta^2 n(1-n)\frac{\left\langle x_e^2 \right\rangle}{r_0^2}$$

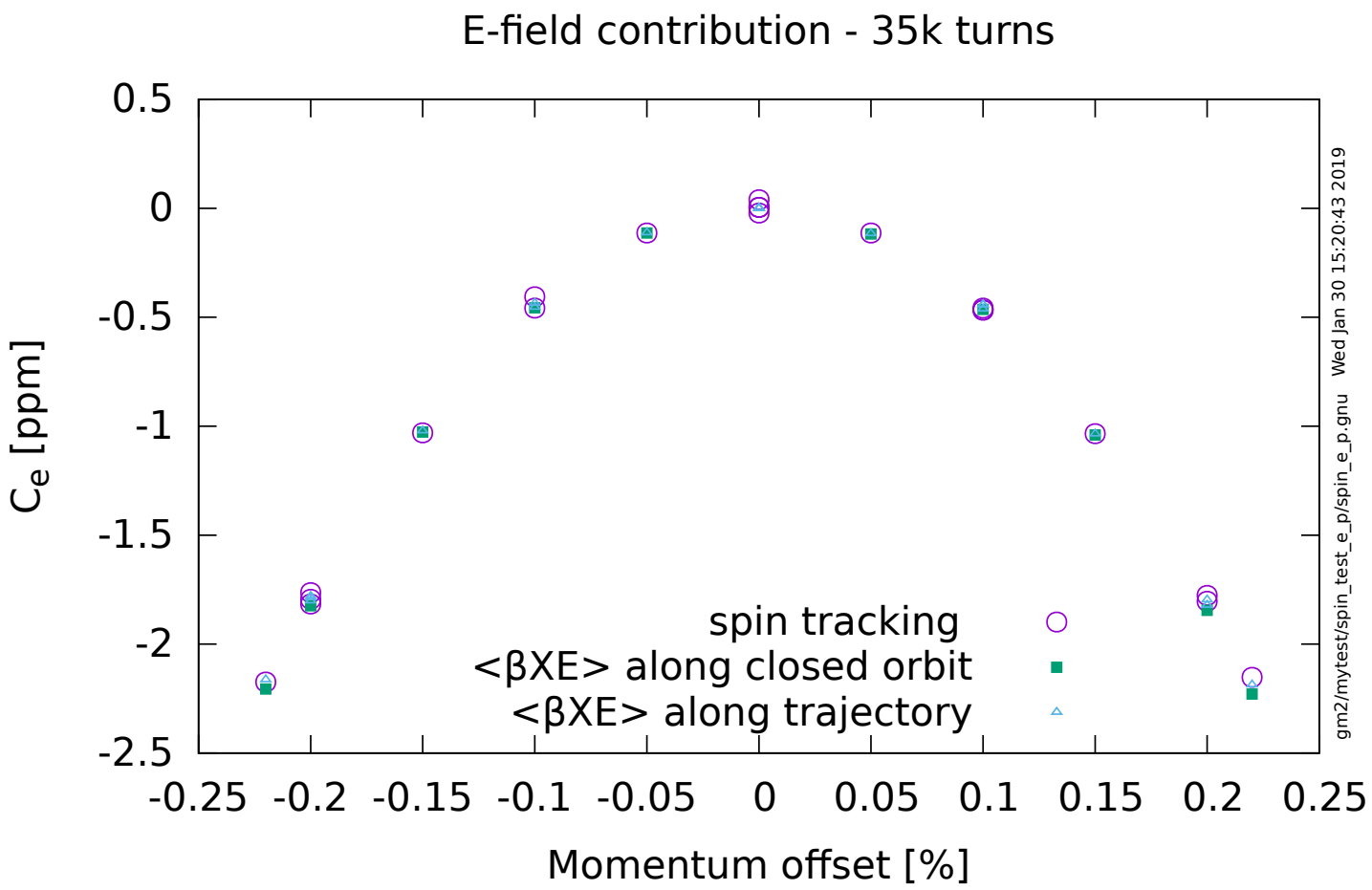
Compare the 3 methods in simulation to determine

1. If integration is a reliable proxy for spin tracking
2. The size of the contribution from finite betatron oscillation amplitude



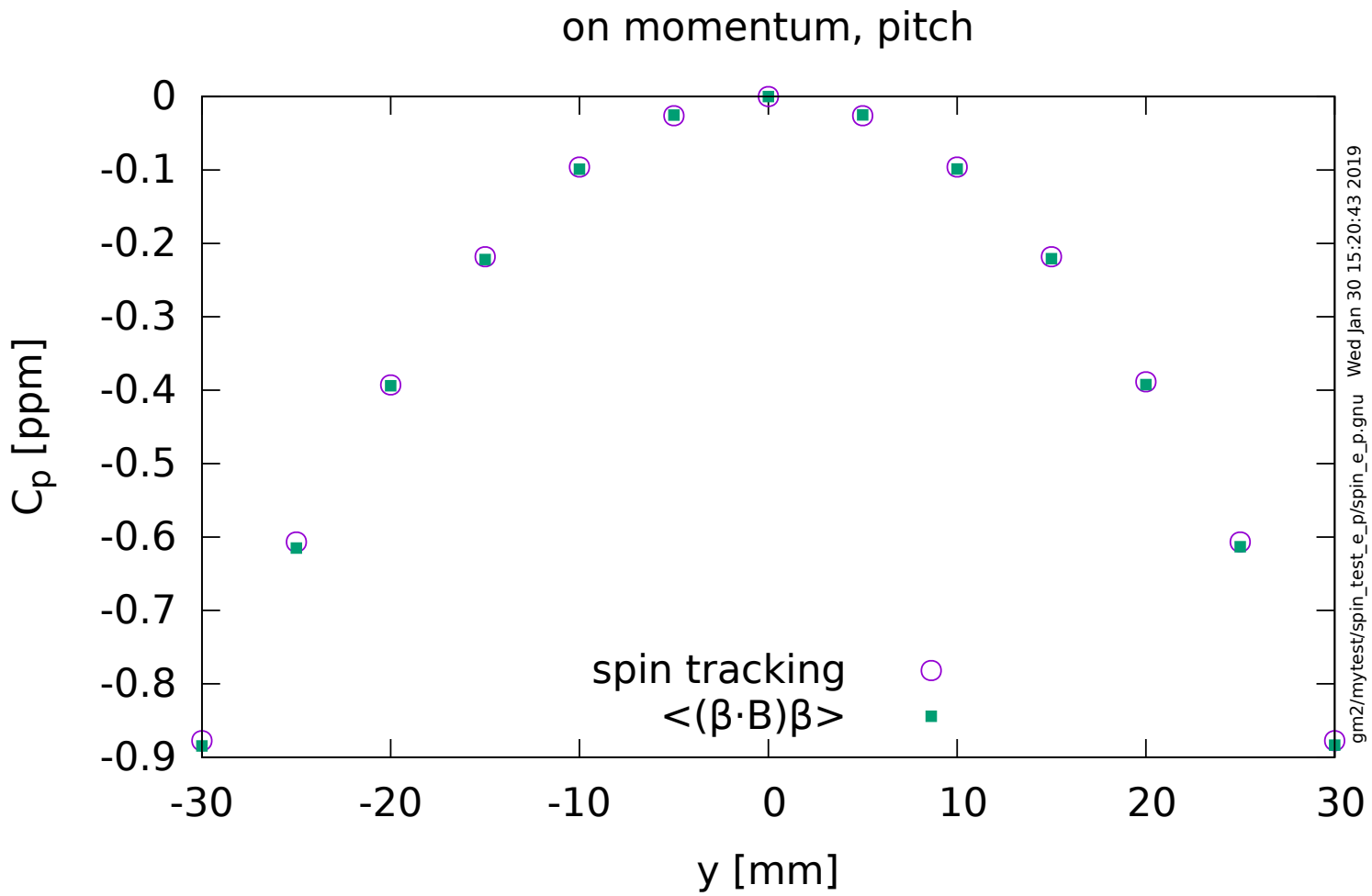

Distinct trajectories with common momentum offset

- For trajectory compute $\omega_a$ by spin tracking and by integration




Multiple trajectories at each momentum with minimum and maximum betatron amplitude
Conclusion

- Integration is equivalent to spin tracking
- Amplitude dependence is < 50 ppb




Conclusion

- Spin tracking is equivalent to integration

Next - compare spin tracking and integration

- With Misaligned quads
- Vs Quad voltage
- During/after scraping