Spin Flipper @ Injection

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Summary from APEX 14 Workshop

- The elimination of the mirror resonance works (within the accuracy of the measurement). Bump closure works and may be improved with better instrumentation
- No spin flip has been demonstrated with RHIC spin flipper in current machine setup
  - Spin flipping is quite sensitive to the spin tune chromaticity due to the unbalance dispersion slope at the two snakes
  - Spin flipping also requires excellent spin tune stability from store to store
- Due to the limit of physical aperture at injection, all tests were carried out at store, this however creates time constrains
  - Develop a sequence to bring up DC dipoles and countering bump to offset the beam to work at injection
- The strategy for future spin flipper commissioning is still to first establish spin tune meter capability by measuring driven coherent spin precession

(Presented by P. Oddo)

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Procedure

- We tested the DC magnet without orbit bump. There was not enough time to build a closed orbit bump. So we decided to set the DC magnet current to 600A. The beam loss is small for DC magnet current up to 600A. Then we turned off spin flipper and fill the RHIC with 28 bunches.
- Polarization did not change with spin flipper on and tune at 0.5. Sweep spin flipper tune between 0.49-0.51in 3 sec depolarized beam.
- We then take polarization measurements after spin flipper tune set at constant value for 3 sec then off.
- The orbit bump is reasonably closed, so that there was not much polarization loss at $1\text{-}Q_{spin}$, but it gave us some hint on the location of spin tune on the opposite side.
- We ran out time to do smaller steps near the spin tune to get spin tune spread information.
- Due to limited physical aperture, all spin flipper exercises were done at store. This is the first time we could do it at injection.

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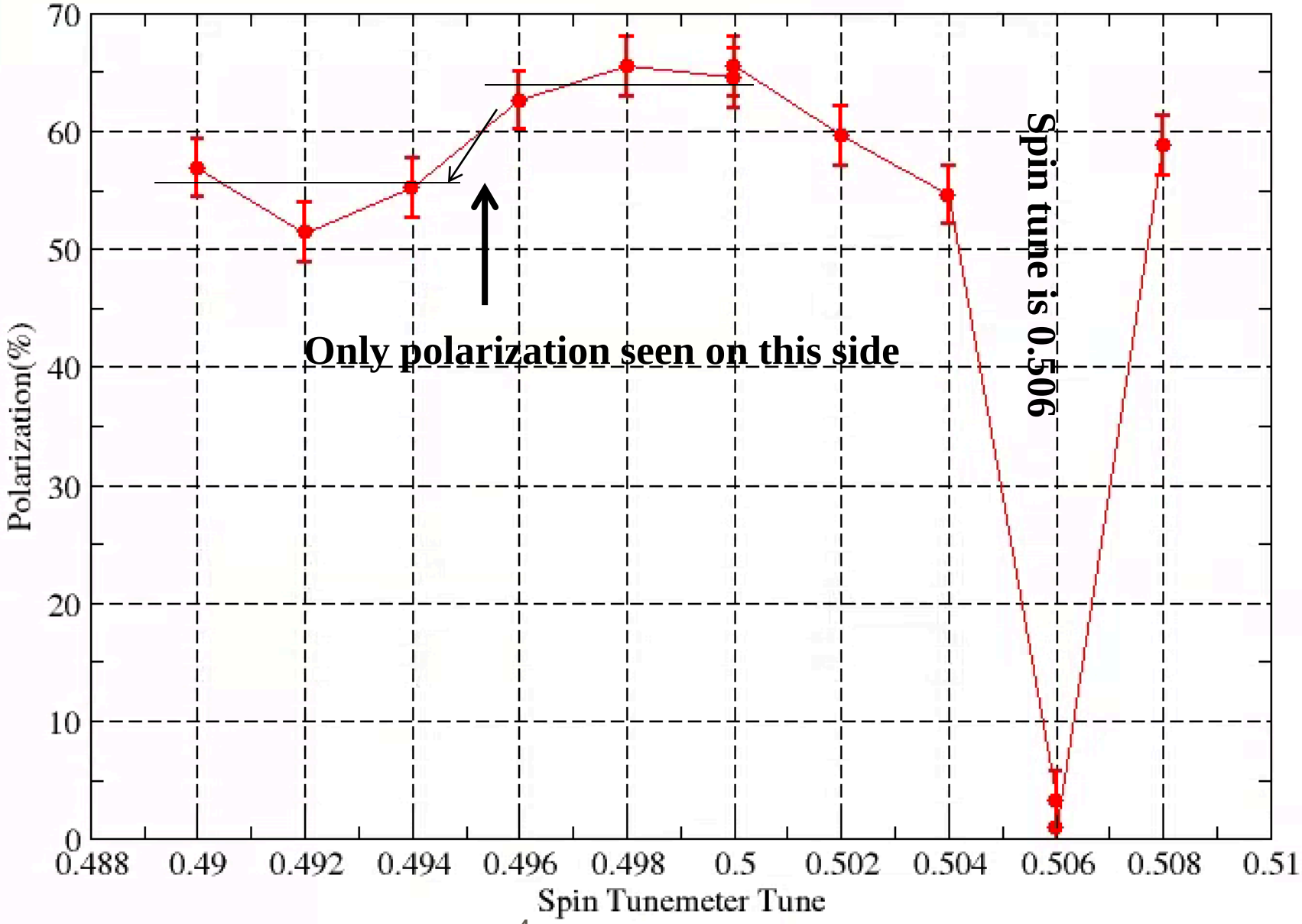
Spin Tune Measurement at Injection



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Next Time

- We want to take smaller step around the spin tune at injection.
- The expected spin tune spread at the injection (according to on-line model values of D' in Snake locations) is about 7E-4. We could make quick measurement of dispersion function to verify what is D' in real machine, as compared with the model.
- The width of the depolarization dip is defined by both spin tune spread and flipper resonance strength (whatever is larger). The flipper resonance strength should be on the level ~ E-4 (although it would be good also to measure the flipper strength, in terms of related orbit distortion, next time to verify its value). Thus, expected width of the resonance dip should be defined by spin tune spread and be at ~E-3 level. With our fine step flipper frequency scan we should see how the width of depolarizing area agrees with predictions.
- Also, if the spin tune spread is larger than synchrotron frequency (in our case synchrotron frequency is about 1E-4), one may expect the synchrotron resonance sidebands around central spin tune value. Thus, our fine flipper frequency scan could show whether these sidebands are present. That would be very interesting to see!

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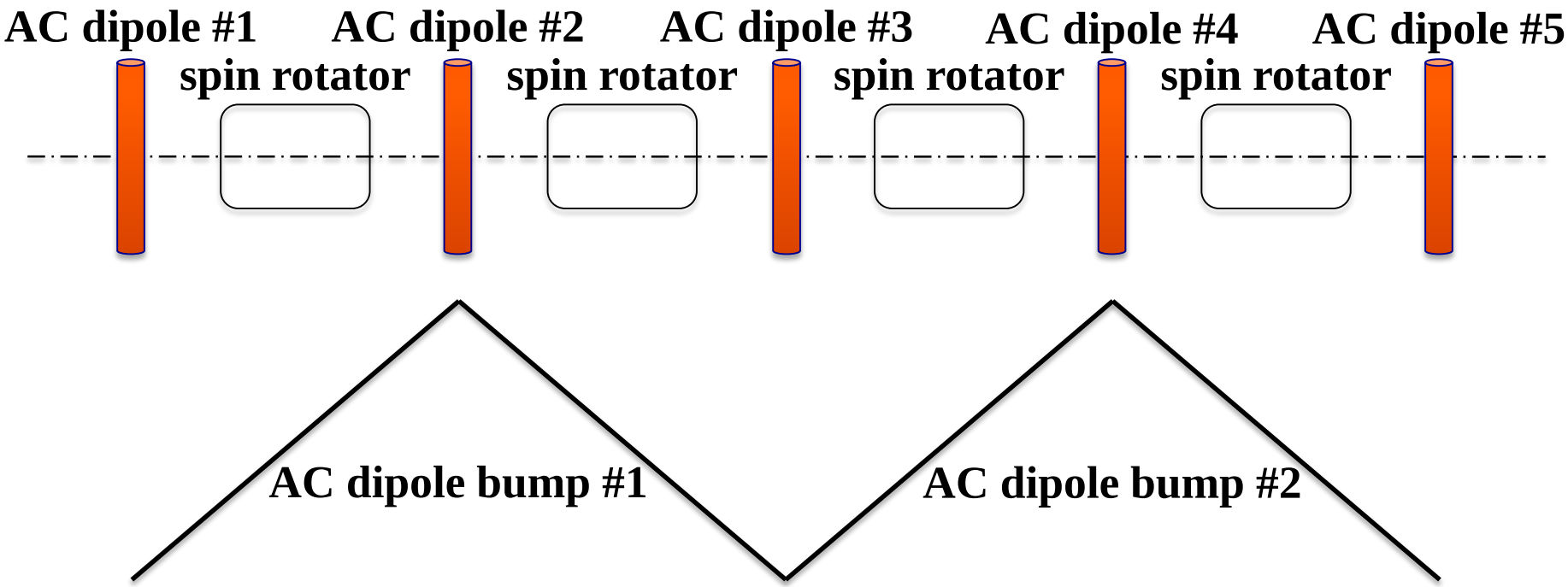
Spin Flipper Layout



The spin flipper system consists of four DC dipole magnets (spin rotators) and five AC dipole magnets. The aim of this configuration is to produce a rotating field which eliminates the mirror resonance. Multiple AC dipoles are needed to localize the driven coherent betatron oscillation inside the spin flipper.

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