

Spin Flipper @ Injection

H. Huang, P. Oddo, C. Liu, A. Marusic, F. Meot, V. Ranjbar

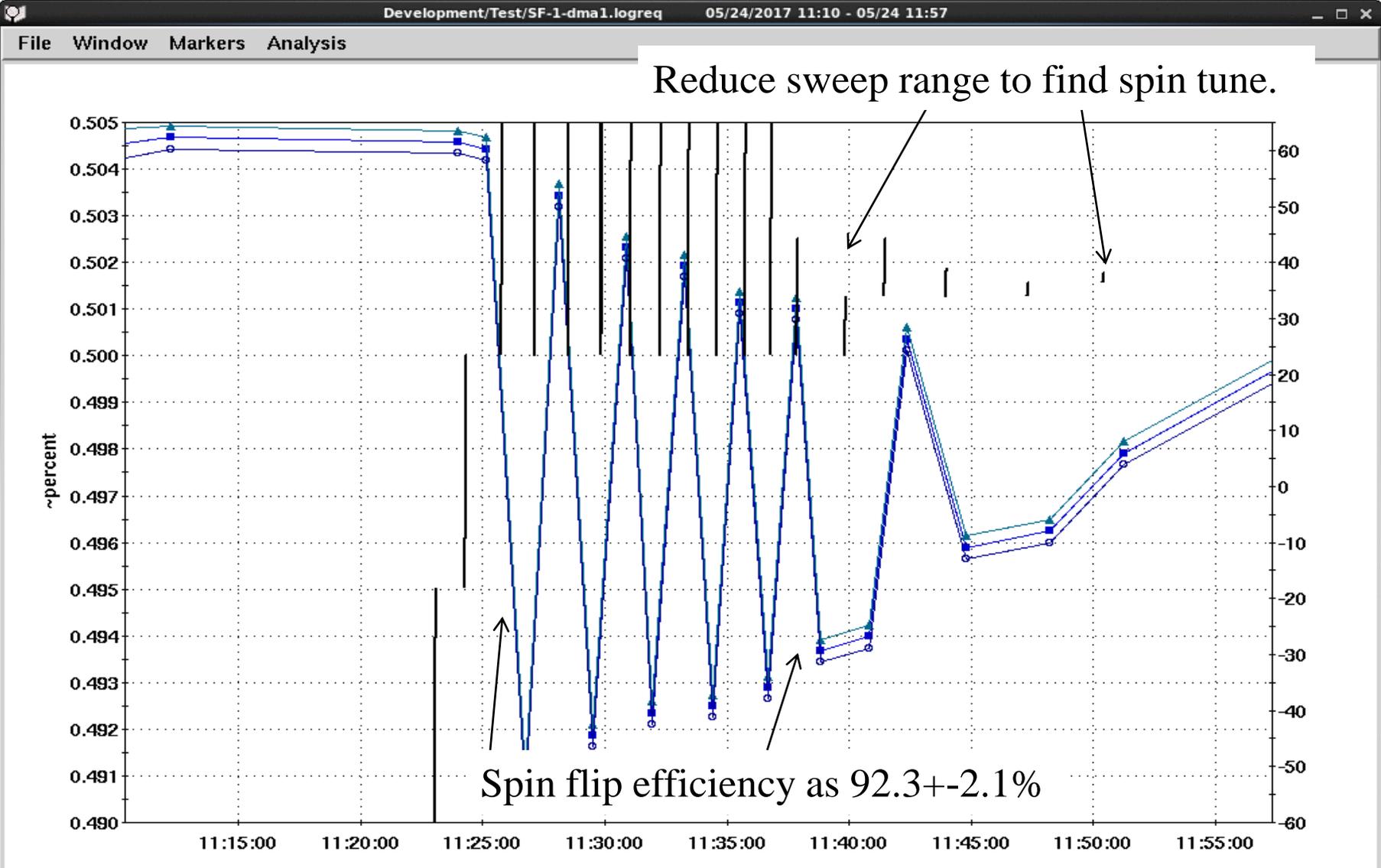
May 26, 2017

APEX Meeting

Experiment Procedure

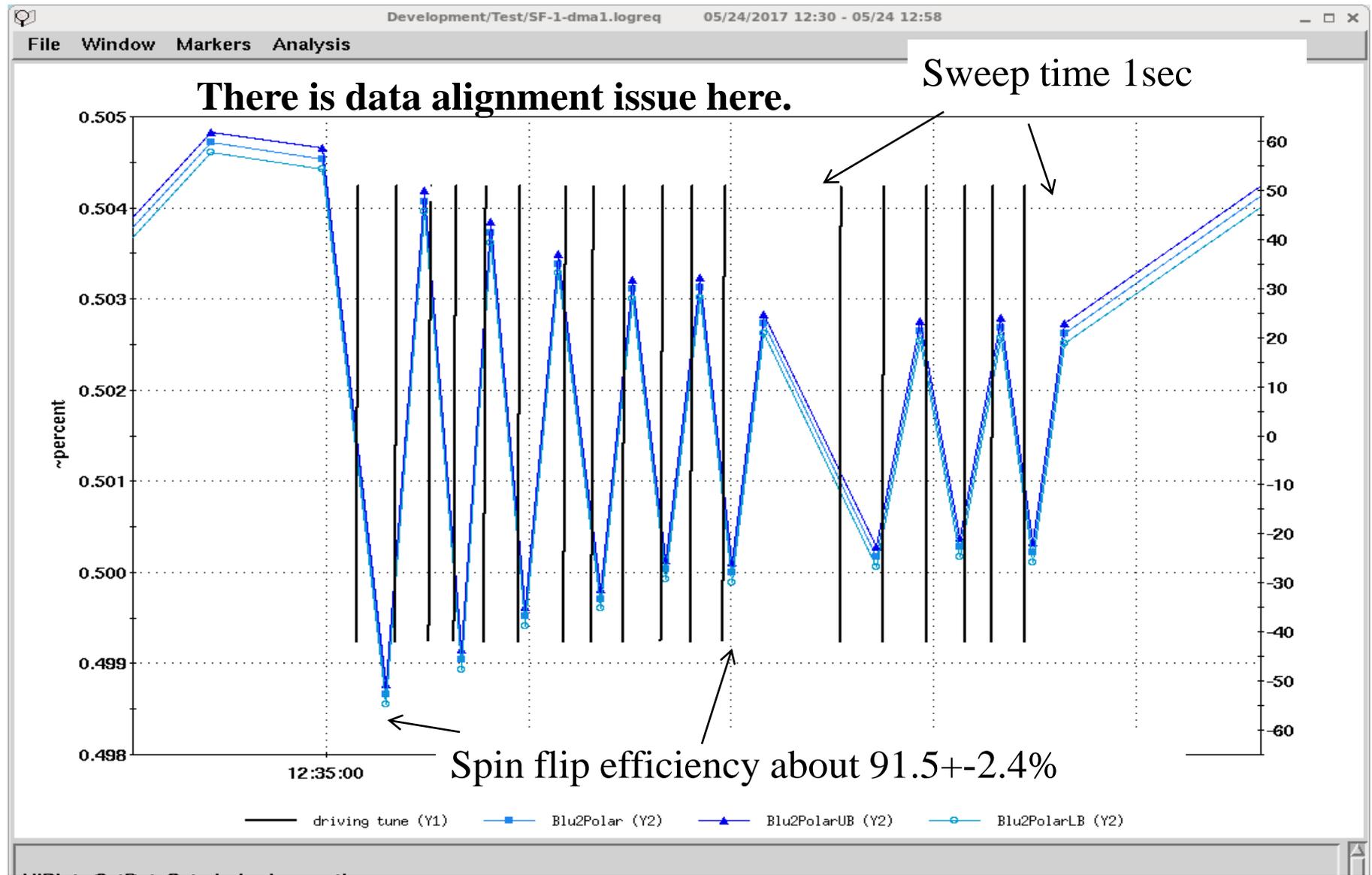
- We started late by about 2.5 hours due to source and Booster issues. We took total near 3 hours beam time.
- The dispersion and chromaticity were measured at injection. Two settings were used : $\xi_y=4.95$ at first, then $\xi_y=3.15$.
- The -26mm orbit bump at spin flipper was improved by using orbit feedback. If set it at -26mm with one step, overshooting in orbit will happen and large beam loss will be the result.
- PA #1 tripped once during the 3s ramp. About half polarization was gone.
- The DC dipole current was set at 900A. Polarization was measured after sweep the driving tune. For each condition, spin was flipped 11-12 times to get average efficiency. The driving tune sweep range was 0.005. The sweep time was set as 3s, 1s and 0.5s.
- The spin tune was located by narrowing down the sweep range. Last, the driving tune was fixed and depolarization confirmed the spin tune at 0.5017.

Polarization and Driving Tune Sweep (3sec)



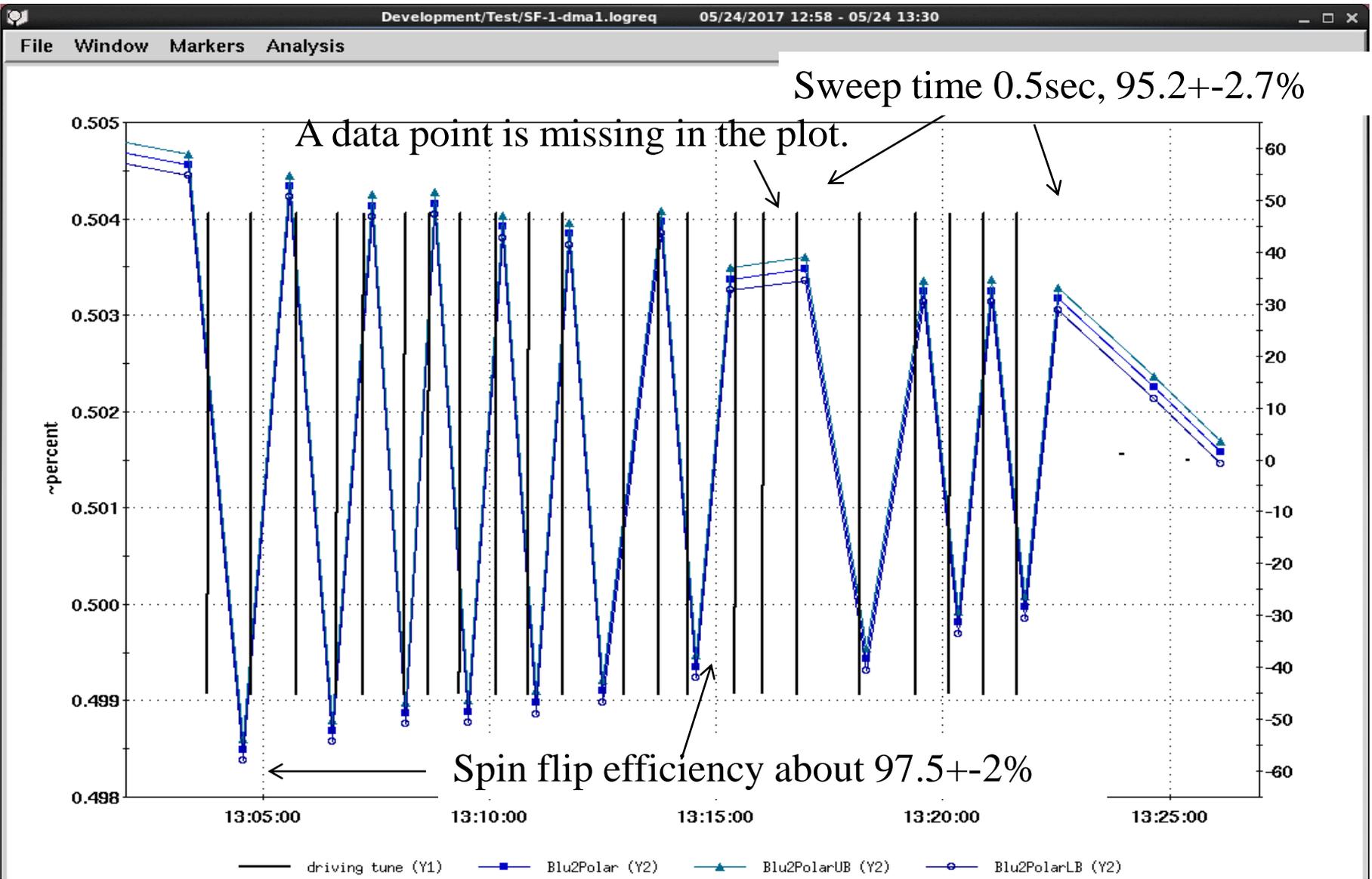
the vertical black bars show the driving tune sweep range.

Polarization and Driving Tune Sweep (3sec & 1 sec)



From this point, $\xi_y = 3.15$.

Polarization and Driving Tune Sweep (1sec & 0.5 sec)



The last two points are with fixed driving tune, which confirmed spin tune is near 0.5017.

Spin Flipper Test at Injection

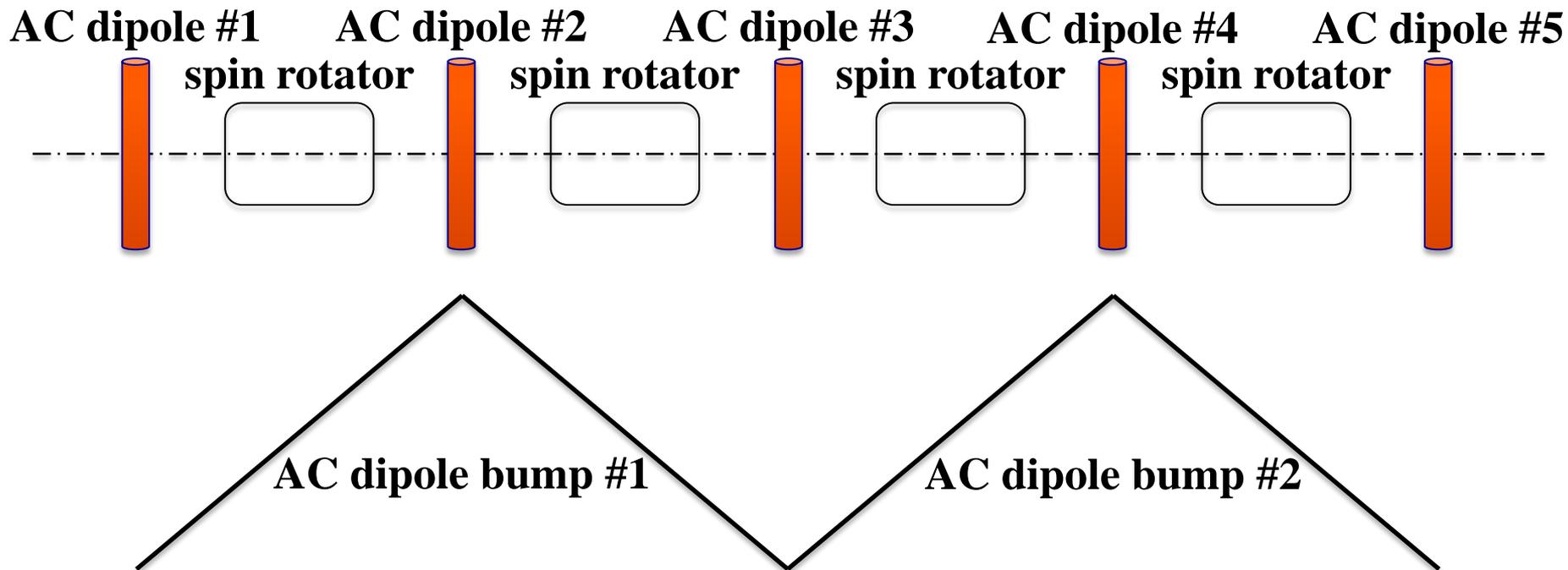
| Start | End | Chrom | Range | Time (sec) | Ratio |
|---------|---------|-------|-------|------------|---------------|
| 0.5 | 0.505 | 4.95 | 0.005 | 3. | -0.923+-0.021 |
| 0.49917 | 0.50417 | 3.15 | 0.005 | 3. | -0.915+-0.024 |
| 0.49917 | 0.50417 | 3.15 | 0.005 | 1. | -0.975+-0.019 |
| 0.49917 | 0.50417 | 3.15 | 0.005 | 0.5 | -0.952+-0.027 |

- The weak dependence on sweep speed: maybe there are more than one resonance (in addition to the strong driving one, probably there are high order, or sideband weak ones), such that the slower crossing speed may not result in better flip efficiency.

Spin Flipper Test at Injection

- We have done spin flipper study in four sessions so far. April 6, April 19, May 3 and May 24. Measured $\Delta D'$ was 0.0036 for the first case and 0.0033 for the rest cases on May 3. As comparison, $\Delta D'$ was 0.007 on April 6, and 0.009 on May 3 (with poor flip efficiency), but was not measured on April 19 (first 90+% flip efficiency).
- The difference among April 19, May 3 and May 24: D' and sextupole settings are the same. When we had worse efficiency (May 3), e-lens was on. If the two solenoids are not fully canceled, there could be some coupling resonances. Should we repeat the measurements with e-lens on at injection?
- Move on to store to check spin flipper efficiency there. Need some thinking on why we lose polarization even though the tune sweep range does not cover the spin tune. Can this be explained by coupling effect?

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.