Spin TuneMeter @ Injection

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

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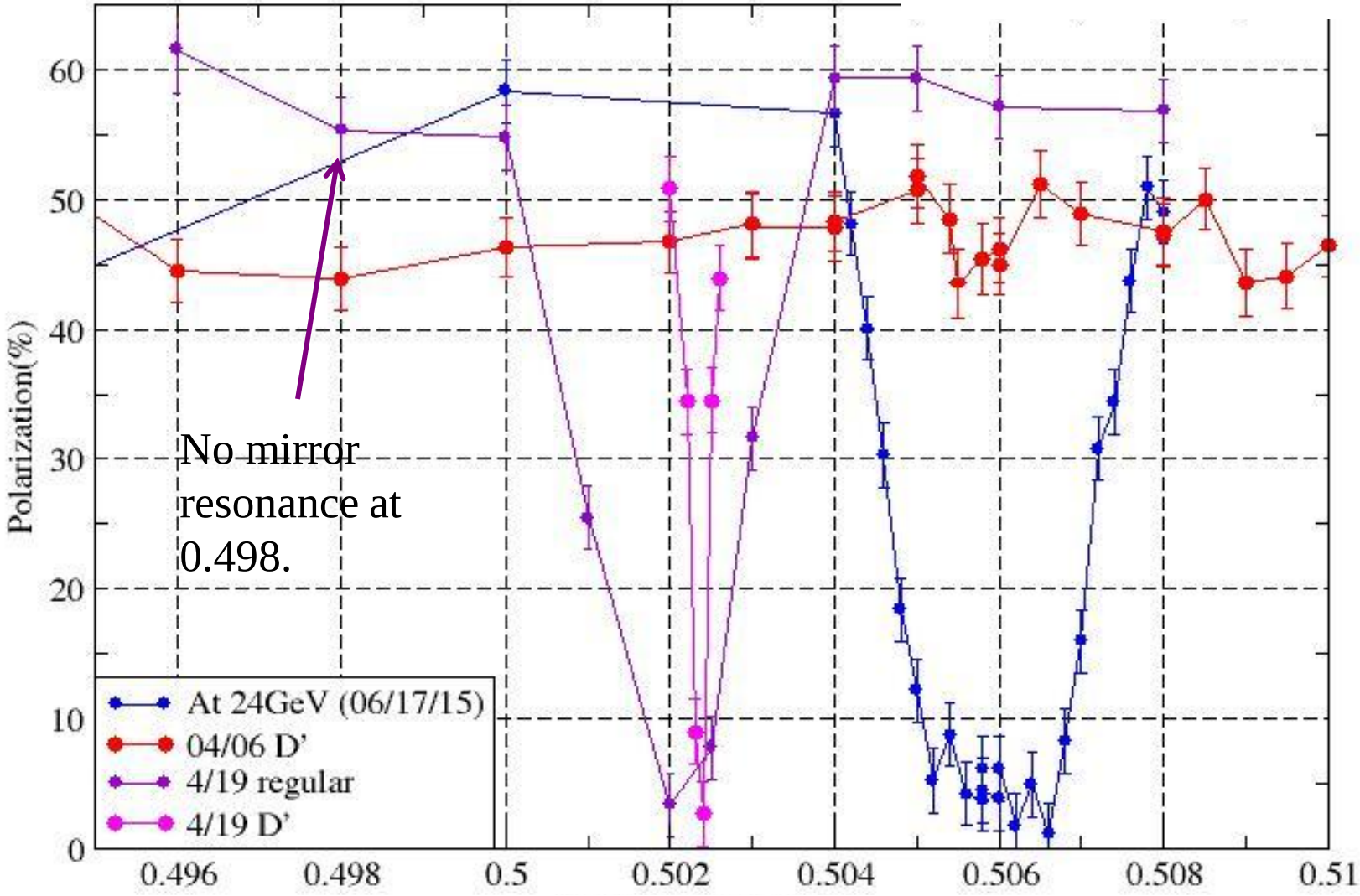
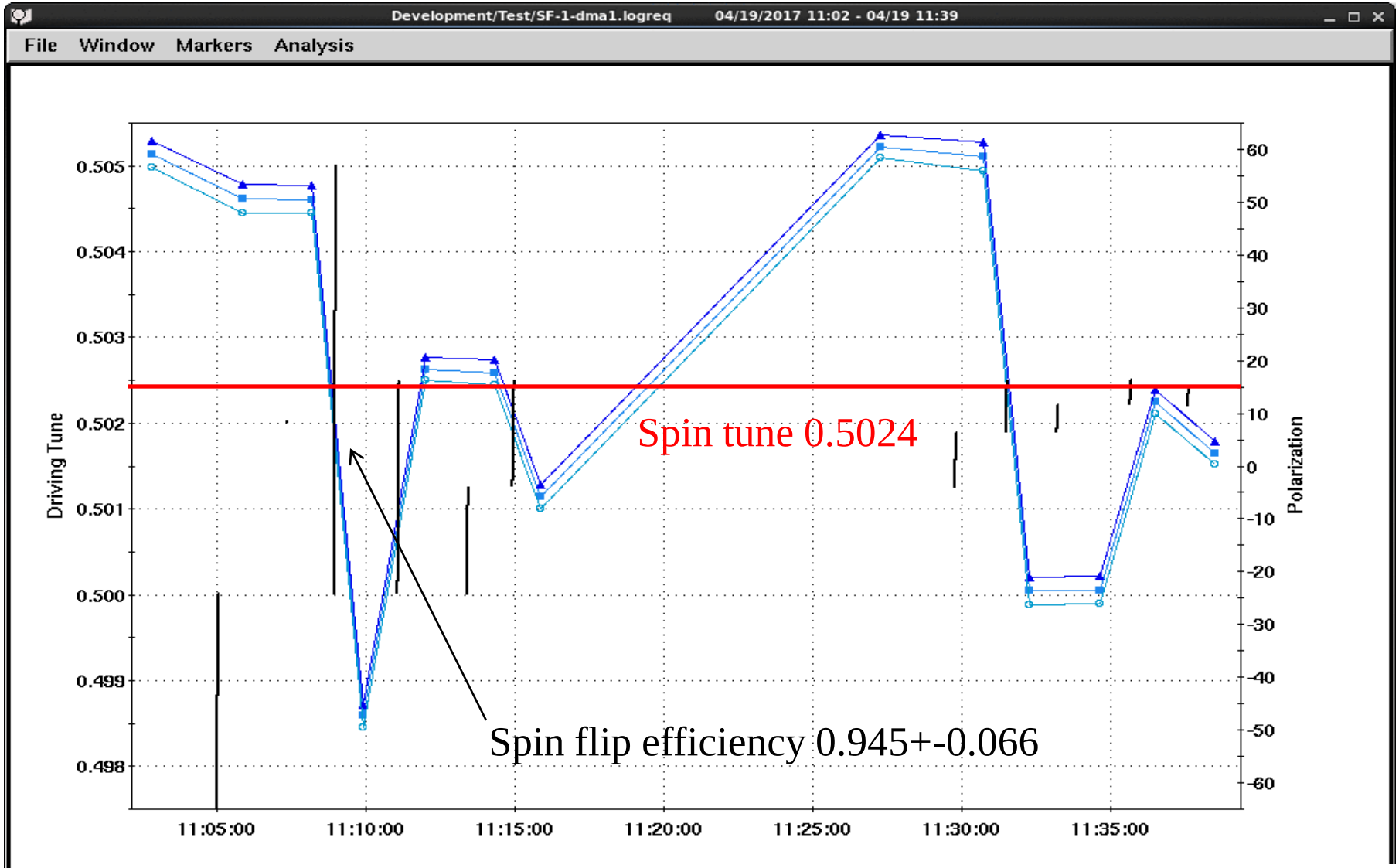
Scan Driving Tune Results

$$\delta Q_s = \frac{G\gamma}{\pi}\Delta D'\frac{\Delta p}{p},$$



Very narrow spin tune spread with D' lattice (~5 times smaller). Some small difference of spin tune between regular and D' lattices. The spin tune spread is similar to two years ago, 0.004.

Sweep Driving Tune Results (D' Lattice)



the vertical black bars show the driving tune sweep range. Most of driving tune sweep ranges are too close to the spin tune 0.5024. So no good spin flip efficiency is expected from them.

Procedure

- We first set the AC dipole and DC dipole on with zero current. We thought this would not affect the beam but we got very poor beam lifetime (beam decay ~600%/hr). We tried to find the source, such as coupling, e-lens (quenched during this process), tunes. Finally we realized that the parameters in the spin flipper magnets had to be adjusted to avoid the feedback loop to pick up noise. This took us more than one hour.
- We get beam injected first then applied -26.5mm local bump at 1225m. The spin tunemeter current was then ramped to 900A.
- For the regular lattice we scanned the spin tunemeter driving tune from 0.496-.508.
- For the D' lattice, we swept driving tune in small range to pinpoint the spin tune. After we located the spin tune is between 0.5022-0.5024, we then fixed the driving tune.
- Last, we took two sets of driven spin coherent precession measurement. The first set (420 million events) was taken with driving tune at 0.5004, or 0.002 away from spin tune. The next one was 300 million events with driving tune at 0.5009, or 0.0015 away. Polarimeter group will analyze these data offline to determine spin tune.
- We run one hour longer mainly to compensate the time lost at beginning of setup.

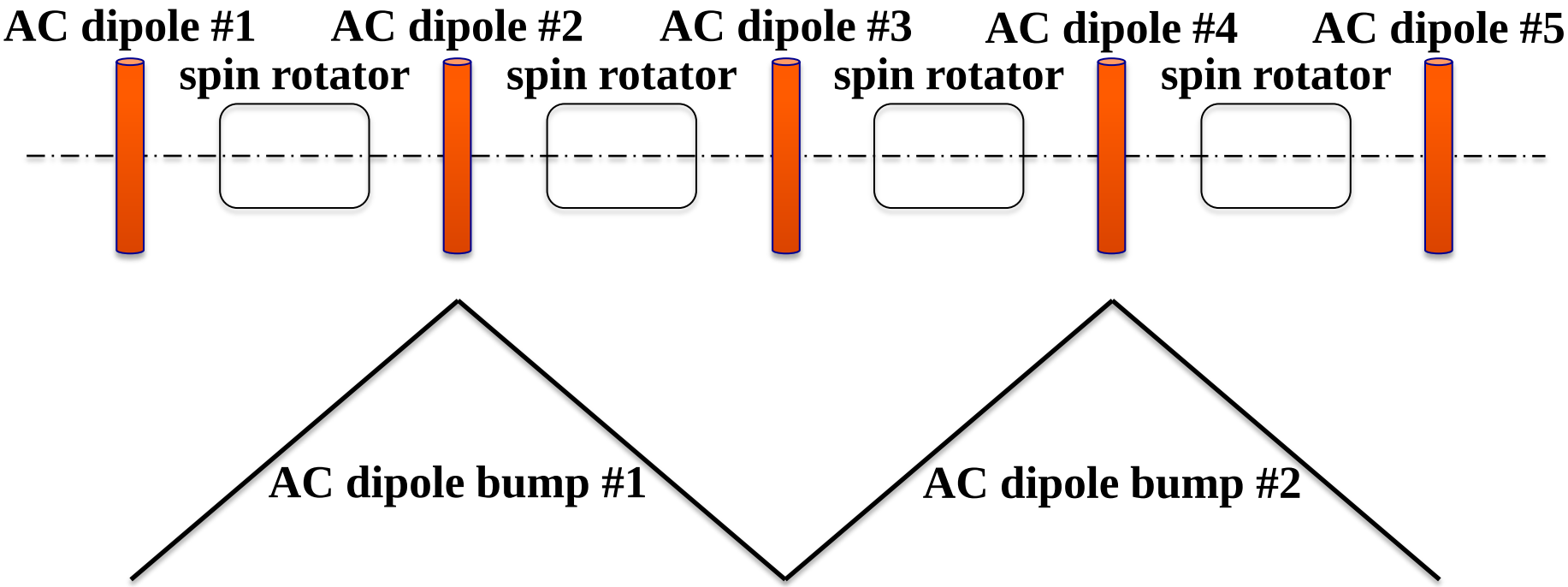
Measurements Taken

- We scanned the spin tunemeter driving tune from 0.496-.508. The spin tune was found at 0.502, which is outside the window 0.4975-0.500 two weeks ago. The spin tune spread is similar to two years ago, 0.004.
- Then we changed lattice to equal D' lattice. We swept driving tune in small range to pinpoint the spin tune. We can depolarize beam with driving tune sweeping 0.5022-0.5024. Then we decide to measure polarization as function of fixed driving tune. It confirmed that spin tune is around 0.5023-0.5024. The spread is very narrow, ~0.0006. This is the direct proof that spin tune spread is indeed smaller (~ five times) with equal D' lattice.
- The most fascinating result came from the spin flipping results. In the sweeping driving tune measurement, we had one case of spin flipping efficiency as 0.945+- 0.066. It was done with driving tune sweeping between 0.5 to 0.505 in 3 sec.
- The first set of driven spin coherent precession measurement was taken with driving tune at 0.5004, or 0.002 away from spin tune. We took seven sets data. This was followed by five sets with driving tune at 0.5009, or 0.0015 away. The preliminary analysis showed that the oscillation amplitude is large.

Plan for Next Time

- Replace 3-bump with 4-bump at spin flipper.
- Take more spin flipper measurements at injection with proper driving tune sweep.
- Test spin flipper at store with D' lattice.
- Measure the spin tune with several ways: fixed driving tune method, sweep driving tune method, driven coherent precession method. This may take 5-7 ramps.

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.