



Spin Transparency APEX

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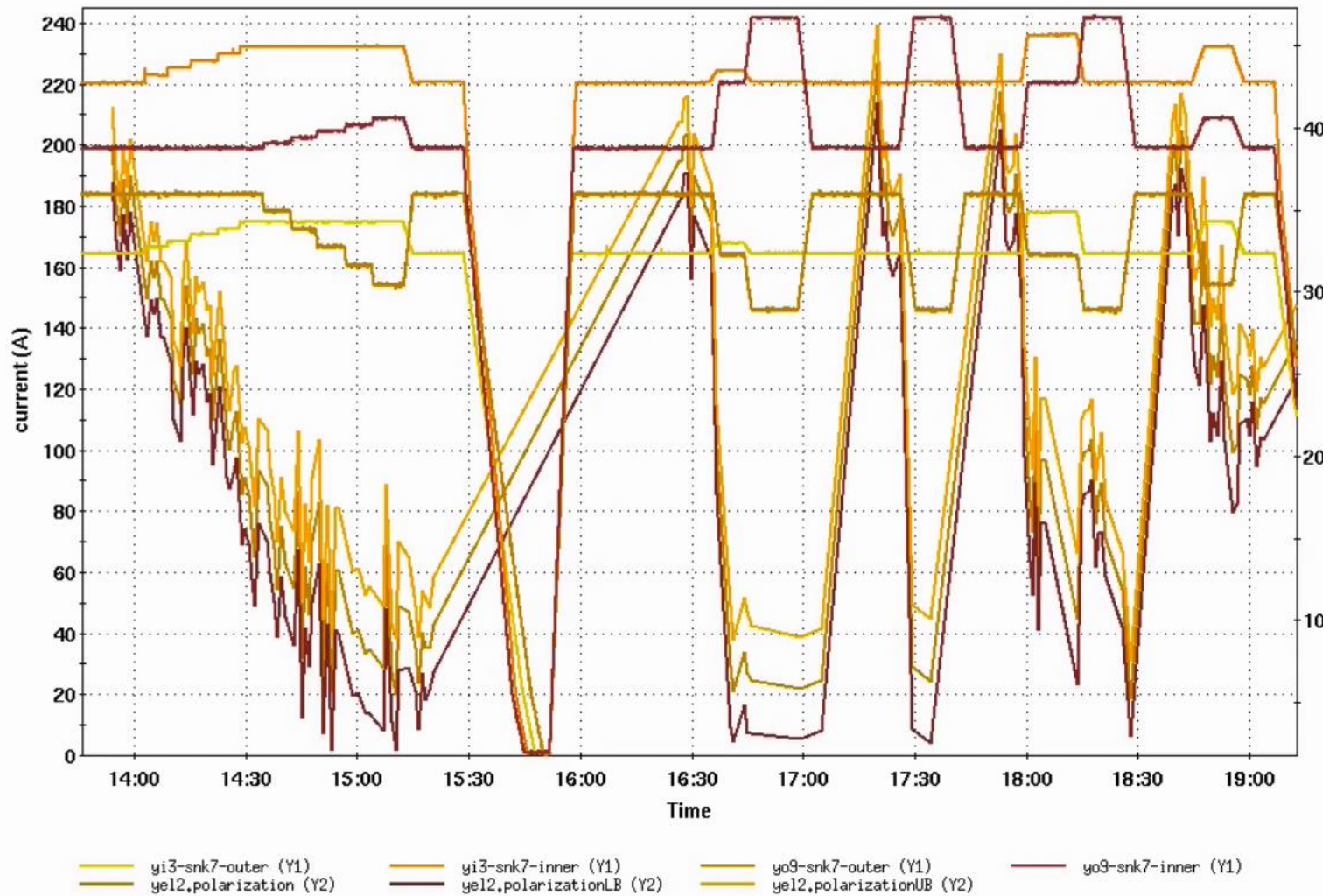
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Timeline of APEX Session of 3/30

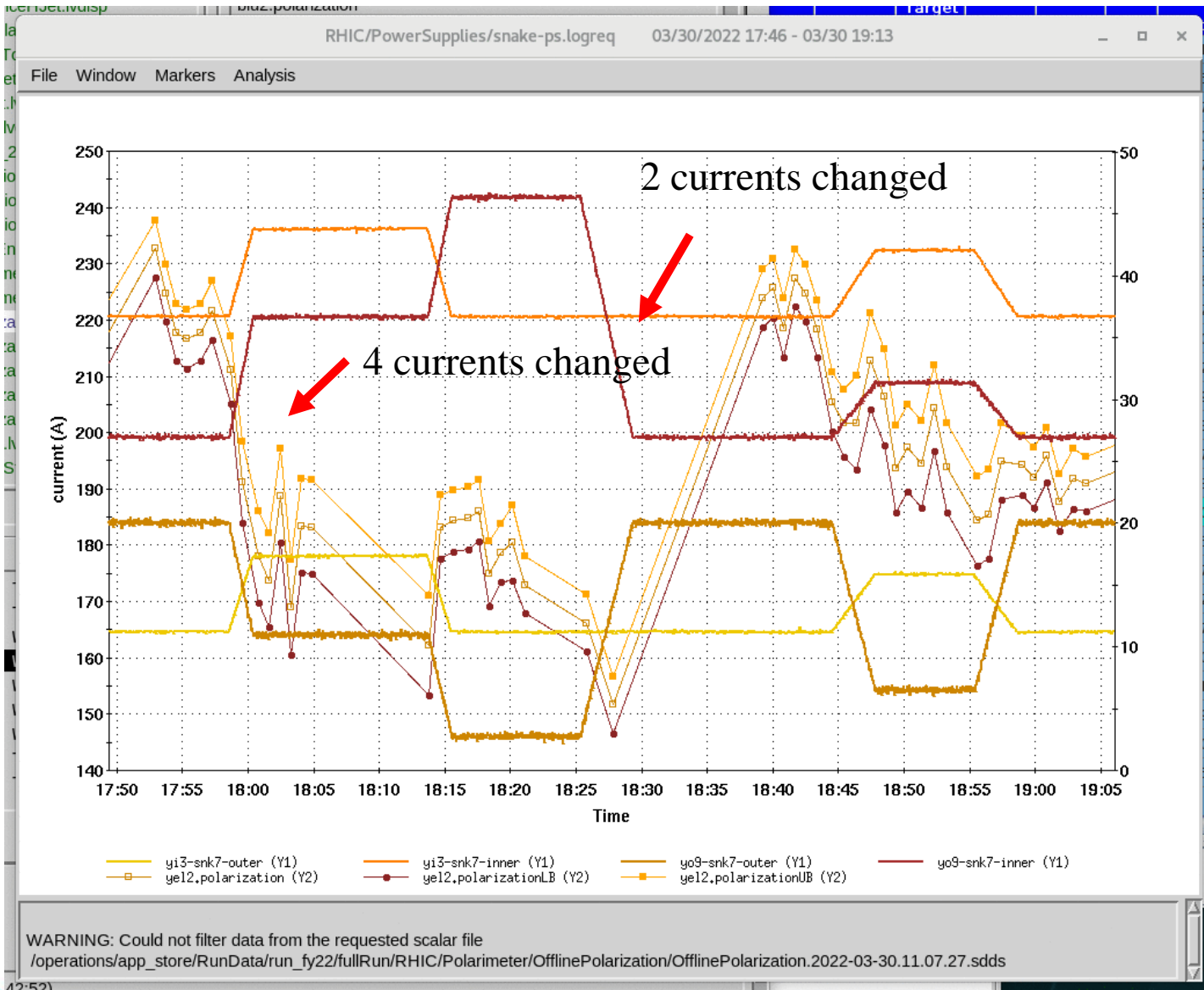
- 13:00 There was a power dip around 12:15. Beam was back to injection.
- 14:00 Snakes were ramped to the new configuration. Started the vertical->radial rotation experiment (in ten steps). The measurements were done in 90 minutes.
- 15:30-16:00. Ramp snake to zero current then back up.
- 16:30 Started the spin flip experiment.
- 17:00 Started the spin flip experiment with tune feedback on.
- 17:50 Started spin flip with new middle point (to keep spin tune constant). Spin is partially flipped. On the way back, there was no stop at the middle point (spin tune is not a constant). Polarization was lost in the last step.
- 18:40 Start vertical->radial rotation. Polarization is partially lost in the rotation vertical->radial. The loss from radial to vertical is much less.
- 19:03 end the APEX.
- Our experiment lasted 6 hours.

All Five Ramps and Polarization Results



The snakes were only ramped back down to zero current once. The back and forth took half hour.

The Last Two Ramps from Initial to Final States



Left: Spin Flip; Right: rotate to radial

Experimental Results

- Radial rotation with ten steps. In the end, one step back to the initial condition. There is orbit feedback but no tune feedback. Polarization loss is larger, but there is some polarization left which showed the expected angles in the rotation (vertical \rightarrow radial \rightarrow vertical).
- Spin flip (up \rightarrow down) with middle point stop. Polarization is lost in the ramp to middle point.
- Another spin flip attempt with tune feedback on in one step. Only 9 o'clock snake currents were changed. Again, polarization was lost.
- Change the middle point to a new set value so that the spin tune is more or less a constant in the spin flipping process. There is polarization loss in the first half of ramp 37.6% \rightarrow 18%. There is almost no loss in the second part: 18% \rightarrow 17.9%. Spin is flipped. On the way back, we skipped the middle point. On this different path, polarization was lost.
- Radial rotation with one step then reverse back. There is quite some polarization loss in the vertical \rightarrow radial part, but much less loss in the radial to vertical part. Well, error bars are large.

Spin Flipped but Partially

		Pol. error		angle error.		Pol. Ratio		
initial	F31	.373	.010	.369	2.283			tune feedback on
new middle point	F32	.180	.016	-78.636	3.163	.481	.043	& new middle point
final flip	F33	-.179	.010	-169.028	4.408	-.998	-.103	
back to initial	F34	.007	.024	-71.267	30.783	-.038	-.131	w/o mid-point, pol lost

The tune feedback was on. The key for the spin flip is the constant spin tune along the path. After changing the middle point, we got the spin flipped. On the way back, we skipped the middle point (meaning the spin tune is not a constant), polarization is lost.

Second Radial Rotation (One Step)

		Pol. error	angle	error.	Pol. Ratio		
radial rotation initial	F41	.378	.010	1.267	2.256		
radial rotation final	F42	.264	.015	-95.086	2.108	.698	.043
back to initial	F43	.237	.010	.101	3.497	.897	.061

This time the tune feedback was on.

The rotation of spin is as expected (angle).

The polarization losses on the two steps are different: the P_f/P_i is around 70% vs. 90%. Not sure if it should be expected.

Feedbacks used: orbit feedback, coupling feedback, and tune feedback.

Next time, we will try to put spin tune as close to a constant as possible.

We also plan to use a script to ramp snakes for truly synchronized ramp. “Smooth” ramp option will also be used.

Summary and Plan

- Tune feedback seems important. It showed the difference in the first and last radial rotation experiment.
- The spin tune constant is also important. Constant spin tune+ tune feedback showed partial spin flip. Without the spin tune constant, the polarization is just lost. Given this result, we will run the radial rotation also with constant spin tune next time.
- We got spin flip and radial rotation done as expected. But there is polarization loss in both cases.
- In next (final) session, we ask for eight hours. If there is more time available, we may want to add energy ramp with additional two hours.
- The spin tune will be kept closer to constant for the vertical->radial rotation next time.
- We will first work at injection. Probably quick (one step) on both radial and flip ramp. Then move on to the ten steps ramps.
- If there is time left, we will attempt to ramp energy to 100GeV.