Present Understanding of the AGS Polarization and its Simulation

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April 12, 2002

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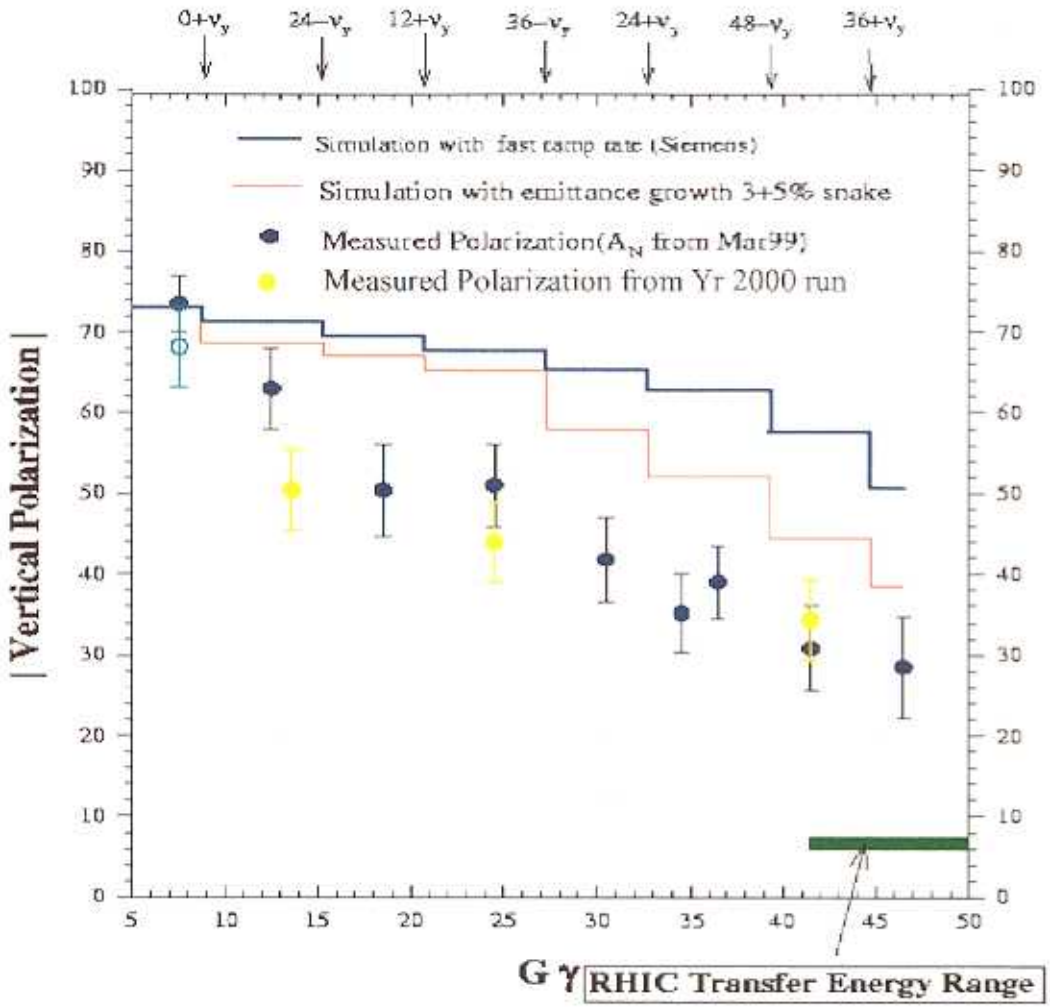
- AGS setup for the RHIC pp 2002 run
  - slow acceleration rate with the westinghouse power supply
  - hybrid snake, i.e. ramp from 3% to 5% between $0+\nu_y$ and $36+\nu_y$.
  - large vertical coherent betatron oscillation induced by Ac dipole at $0+\nu_y$, $12+\nu_y$ and $36\pm\nu_y$

- we reached
  - source polarization reached 0.70
  - polarization at $G\gamma=7.5$ measured as 0.70
  - 0.2~ 0.3 polarization at the AGS extraction energy

- outstanding problems
  - significant polarization loss at the weak intrinsic resonances and coupling resonances
  - AGS J10 bump modulating at 60Hz and 360Hz
  - beam emittance blowup
  - it was very difficult to tune the polarization with the existing polarimeter



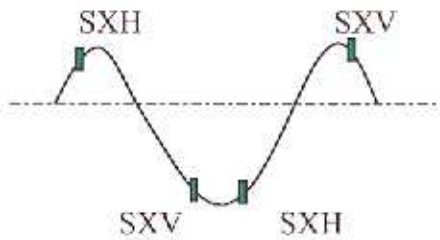
Puzzle:

significant polarization got lost between $0+\nu_y$ and $12+\nu_y$ with $24-\nu_y$ in-between.

Hypothesis:

1. Stronger resonance
2. Synchrotron motion. Since this resonance is very close to the AGS transition, the momentum spread can be large and may cause beam crossing through this resonance multiple times.

- AGS J10 bump power supply

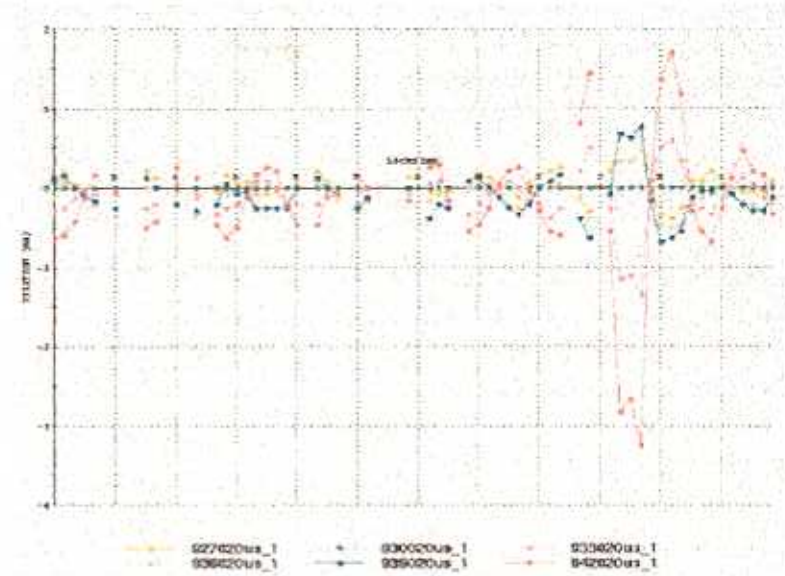


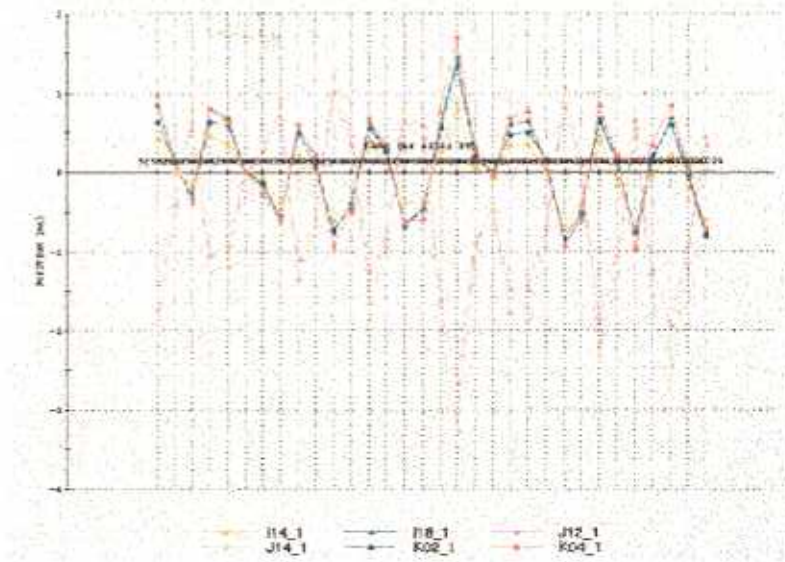
causes the horizontal bump being modulated at 60 Hz and 360Hz.

resonance	Isxh(Amp)	Isxv(Amp)
$0+\nu_y$	5.0	14.5
$12+\nu_y$	2.15	6.25
$36-\nu_y$	2.8	6.4
$36+\nu_y$	10.0	5.5

- $\Delta\nu_{x,y} < 0.001$

- no direct evidence of its impact on spin

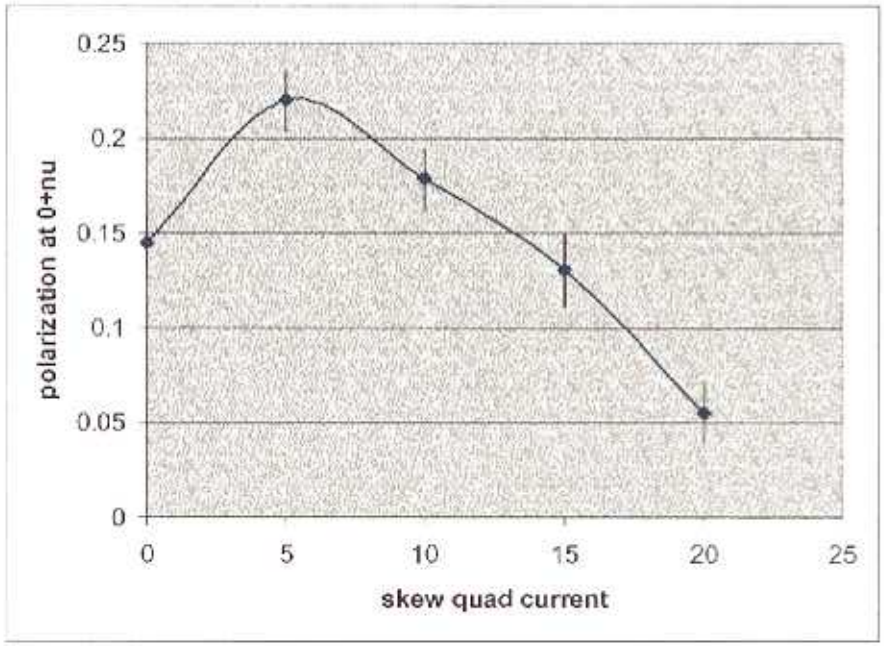


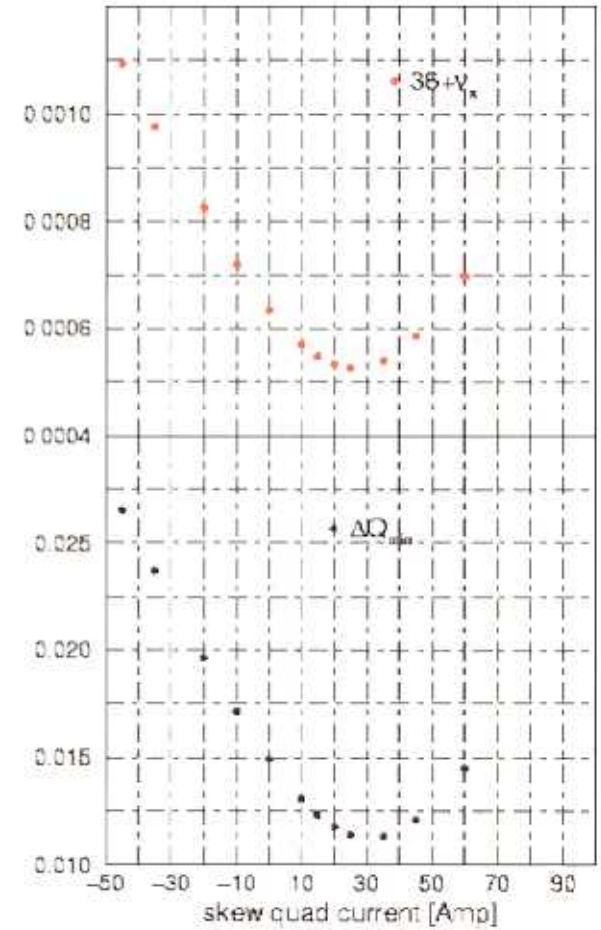


- AGS intrinsic and coupling spin resonance

intrinsic resonance	resonance strgenth	p_F/p_I westing house	p_F/p_I Siemens
$0+\nu_y$	0.006345	-0.681, 1.0	-0.450, 1.0
$24-\nu_y$	0.000246	0.984	0.992
$12+\nu_y$	0.002241	0.207, 1.0	0.505, 1.0
$36-\nu_y$	0.005685	-0.618, 1.0	-0.358, 1.0
$24+\nu_y$	0.000317	0.974	0.987
$48-\nu_y$	0.000568	0.919	0.959
$36+\nu_y$	0.011248	-0.886, 1.0	-0.784, 1.0
		0.881	0.936
Coupling resonance			
$0+\nu_x$	0.000479	0.942	0.970
$12+\nu_x$	0.000178	0.992	0.996
$36-\nu_x$	0.00069	0.883	0.940
$36+\nu_x$	0.001391	0.596	0.775
		0.492	0.704
		0.433	0.659

• using skew quads to reduce the strength of the coupling resonance





- agenda for preparing the next run

  - understand 24 - ν_y, what is the effect of the synchrotron motion?
  - Tracking studies of the coupling resonance
  - upgrading the AGS ac dipole system aiming for reliability, user--friendly and PPM-users
  - install an CNI polarimeter in the AGS

  - twice faster acceleration rate with Siemens back
  - CNI polarimeter will allow us to have quick and reliable measurement
  - use octupoles to correct high order resonances to reduce beam loss at $0+\nu_y$, $12+\nu_y$ and $36\pm\nu_y$ where the ac dipole is excited