How Do We Reach 70% Polarization in the AGS?

Haixin Huang

Brookhaven National Lab

Abstract

This presentation gives some thoughts on how to reach 70% polarization in the AGS. A 5% partial Siberian solenoidal snake and a 18 G-m rf dipole have been tested successfully in the AGS[1]. A spin tracking code[2] is used to understand the behavior of the beam polarization during acceleration in the AGS. The simulation results show that much of the remaining depolarization occurring in the AGS is associated with transverse coupling resonances. And in fact, a major source of the coupling is the solenoidal field of the partial Siberian snake. If a helical dipole partial snake[3] is used in the AGS, in addition to a stronger rf dipole(28 G-m) and energy jump scheme[4], 70% polarization in the AGS is feasible. Among these upgrade options, a helical dipole partial snake is crucial.

REFERENCES

1. M.Bai, these proceedings.

2. H. Huang, T. Roser, A. Luccio, Spin Tracking Study in the AGS, AGS/RHIC/SN-043, November, 1996.

3. T. Roser, et al., Helical Partial Snake for the AGS, AGS/RHIC/SN-072, March, 1998.

4. H. Huang, et al., Polarized Proton Experiment in the AGS with a Partial Snake, AGS/RHIC/SN-044, November, 1996.

The "visible" spin resonances in the AGS can be divided into four categories:

Imperfection Resonances $G\gamma = 5, 6, \cdots 45$	arising from vertical closed orbit distortion $G\gamma = n$ (integer)
Intrinsic Resonances $G\gamma = 0 + \nu_y, 12 + \nu_y, 36 \pm \nu_y$ (strong) $24 \pm \nu_y, 48 - \nu_y$ (weak)	caused by vertical betatron motion $G\gamma = kP \pm \nu_y$
Coupling Resonances $G\gamma = 0 + \nu_x, 12 + \nu_x, 36 \pm \nu_x$	horizontal betatron motion coupled to vertical betatron motion by some coupling elements: solenoid $G\gamma = kP \pm \nu_x$
Semi-Intrinsic Resonance $G\gamma = 60 - \nu_y - 9$	caused by strong 1st order intrinsic resonance combined with large horizontal closed orbit distortion $G\gamma = kP \pm \nu_y \pm [\nu_\beta]$

Current schemes to overcome these resonances.

Imperfection Resonances — 5% partial snake (solenoid)

Intrinsic Resonances

strong ones — 18 Gm RF dipole

weak ones

Coupling Resonances — Reduce the resonance strength by separating the two betatron tunes with 0.15 unit.

Semi-Intrinsic Resonance — 9th harmonic orbit correction

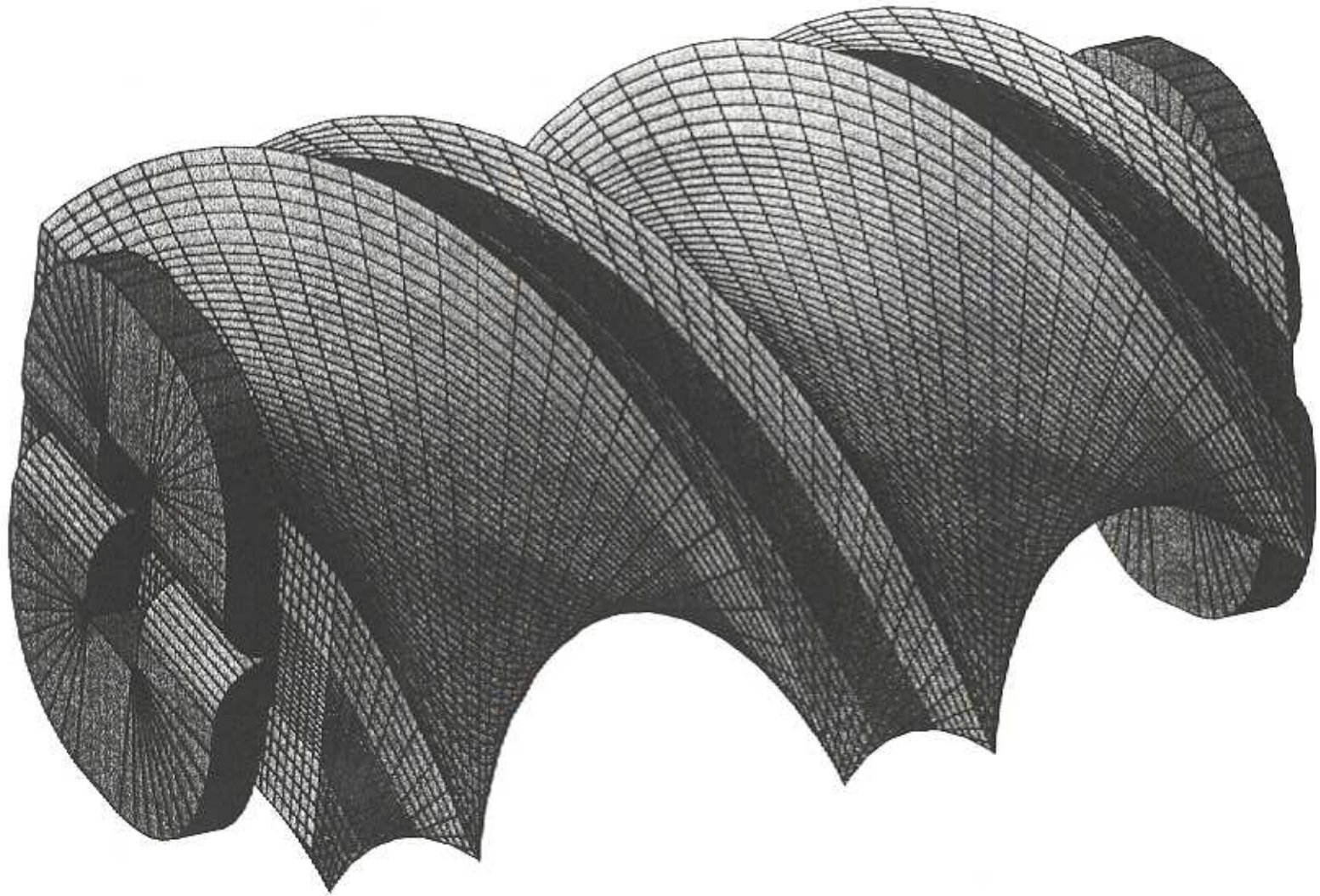
$$\frac{P_f}{P_i} = 0.547 \quad \text{(simulation)}$$

With 75% polarization from the source,

the polarization at $G\gamma = 47.5$ is

41%

5% helical partial snake



New Schemes

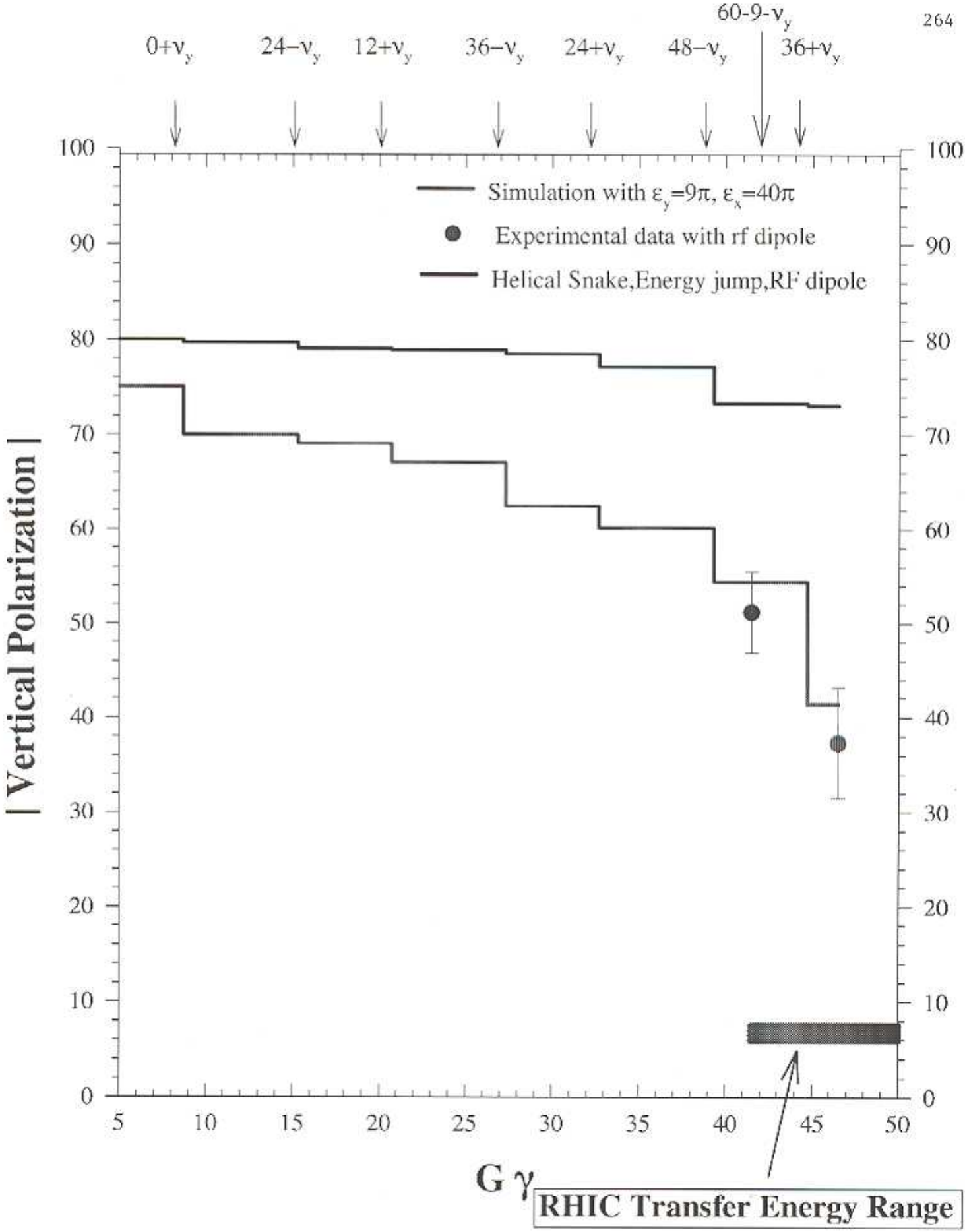
		Improving factor
Imperfection Resonances	5% helical partial Snake	1
Intrinsic Resonances		
strong ones	28 Gm RF dipole	1.05
weak ones	Energy jump	1.07
Coupling Resonances	Eliminating the source of coupling with the 5% helical partial snake	1.47
Semi-Intrinsic Resonance	9th harmonic orbit correction	1

$$\frac{P_f}{P_i} = 0.915 \quad (\text{simulation})$$

The new polarized source will give 80% initial polarization

The polarization at $G\gamma = 47.5$ will be

73%


0+ν_y
24−ν_y
12+ν_y
36−ν_y
24+ν_y
48−ν_y
60-9-ν_y
36+ν_y
Simulation with ε_y=9π, ε_x=40π
Experimental data with rf dipole
Helical Snake,Energy jump,RF dipole
| Vertical Polarization |
G γ
RHIC Transfer Energy Range