



Spin Rotator for LHeC: Ring-LINAC Option

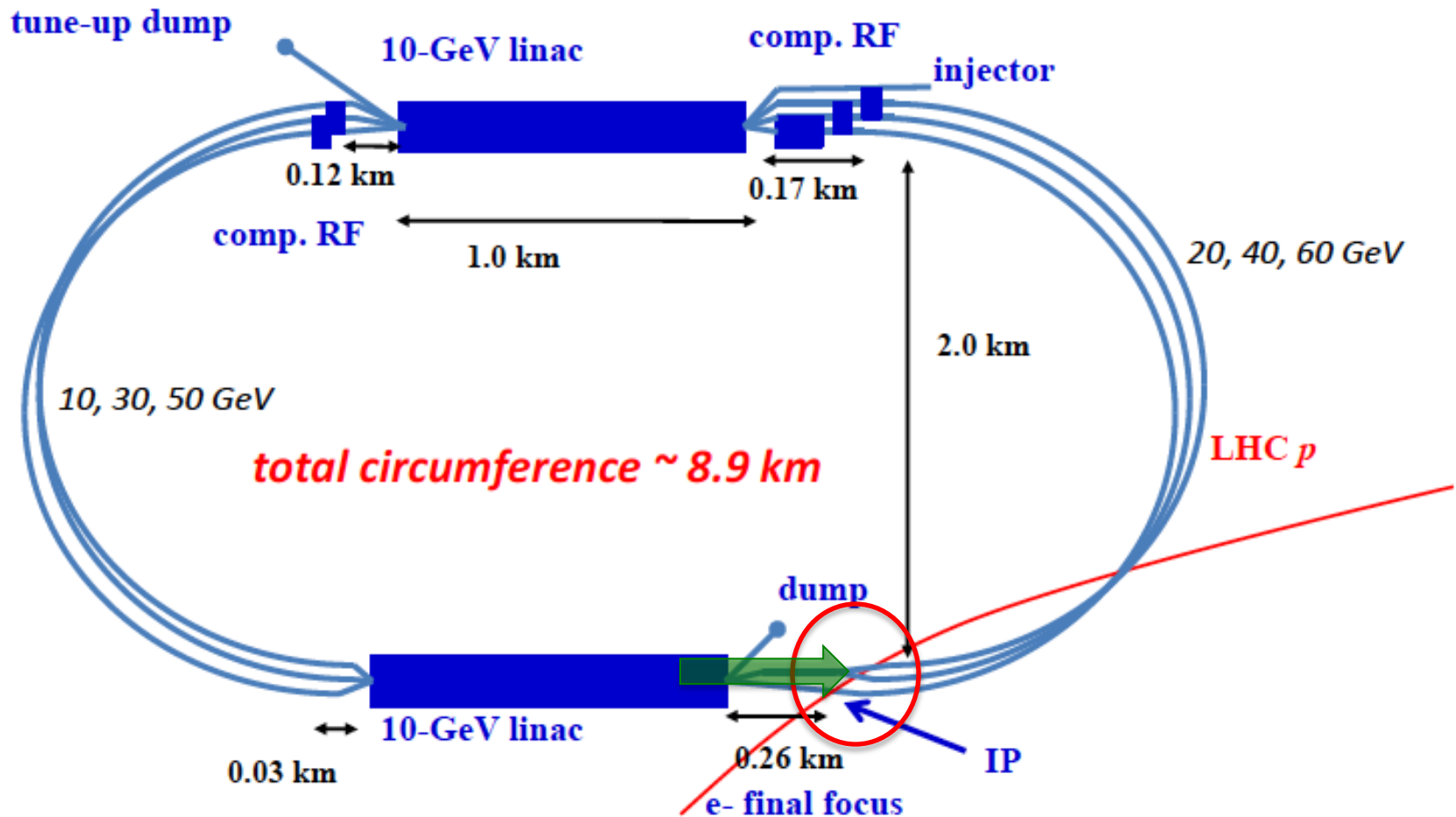
M. Bai, C-A Department
Brookhaven National Lab, Upton, NY

Outline

- Introduction
 - LHeC requirement
- Options
 - Low energy spin flipper
 - HERA type
 - RHIC type
- Conclusion

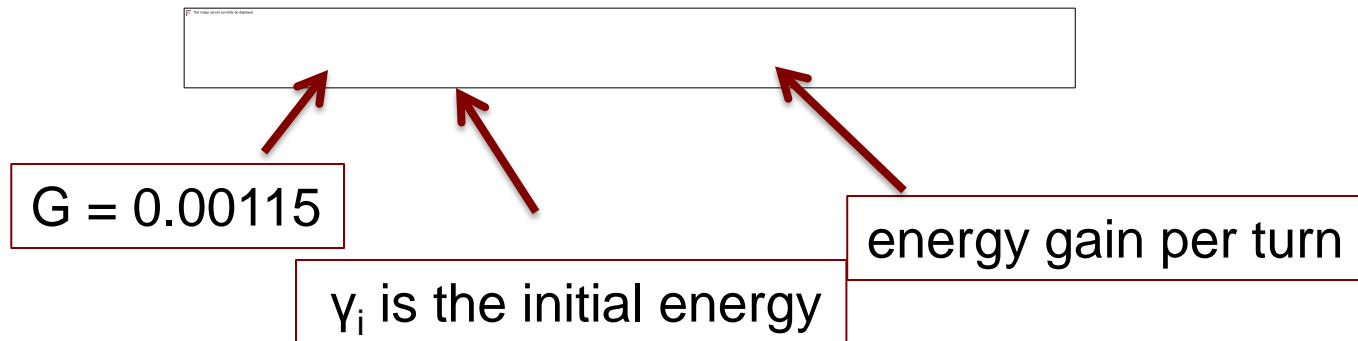
Requirement on polarized electron beam

- Longitudinally polarized 60 GeV electron beam at IP



Spin motion of e Beam in ERL

- For a spin vector in the horizontal plane, it precesses at its n th path through arcs by

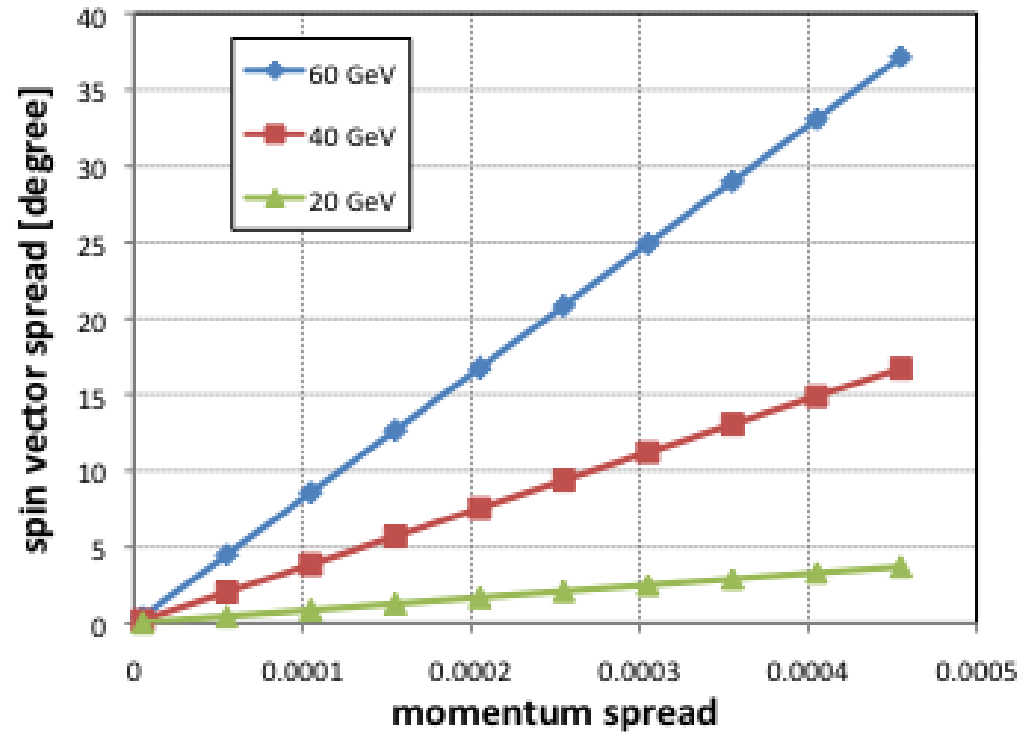


Beam Energy[GeV]	Φ [degrees]	Spin direction before IP
20	14.64	120.6
40	242.0	348.0
60	359.1	105.1

Option 1: Low Energy Spin Rotator

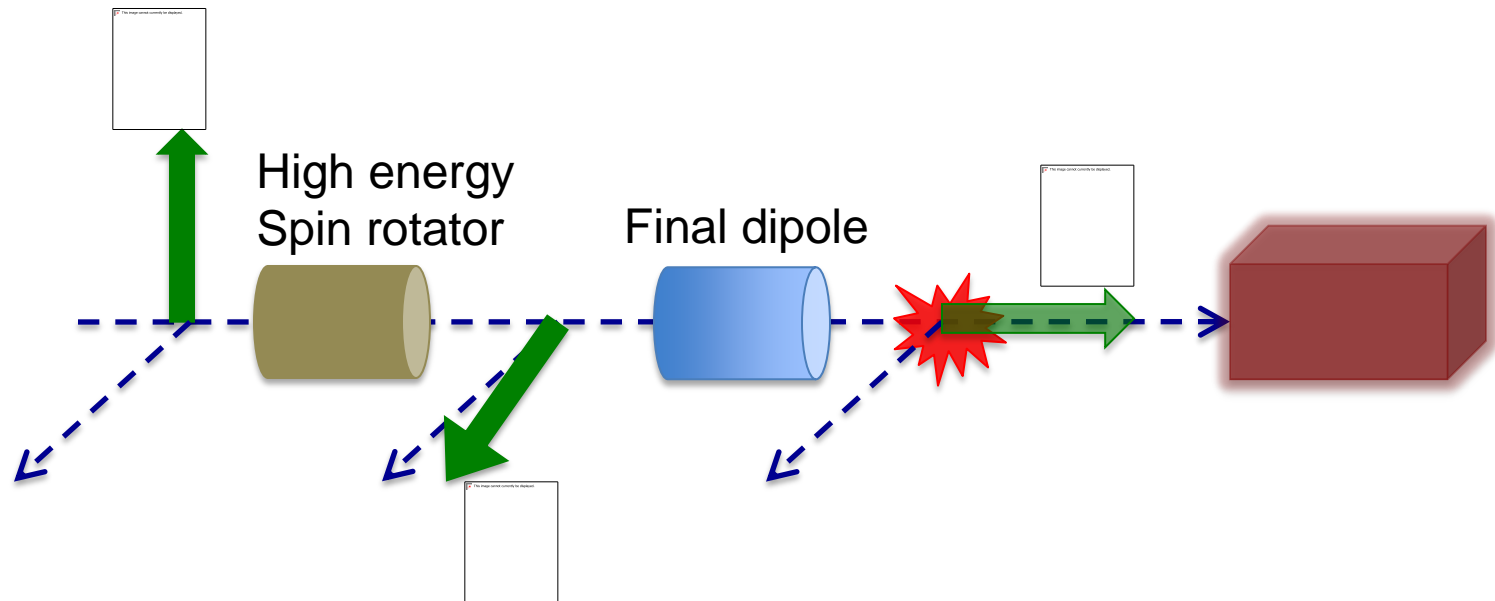
- Wien-filter in the injector to control the spin direction
 - Pros: economical and straightforward
 - Cons: spin spread due to different amount of spin rotation for particles with different energy, ie. momentum spread

Spin rotation by an magnetic field



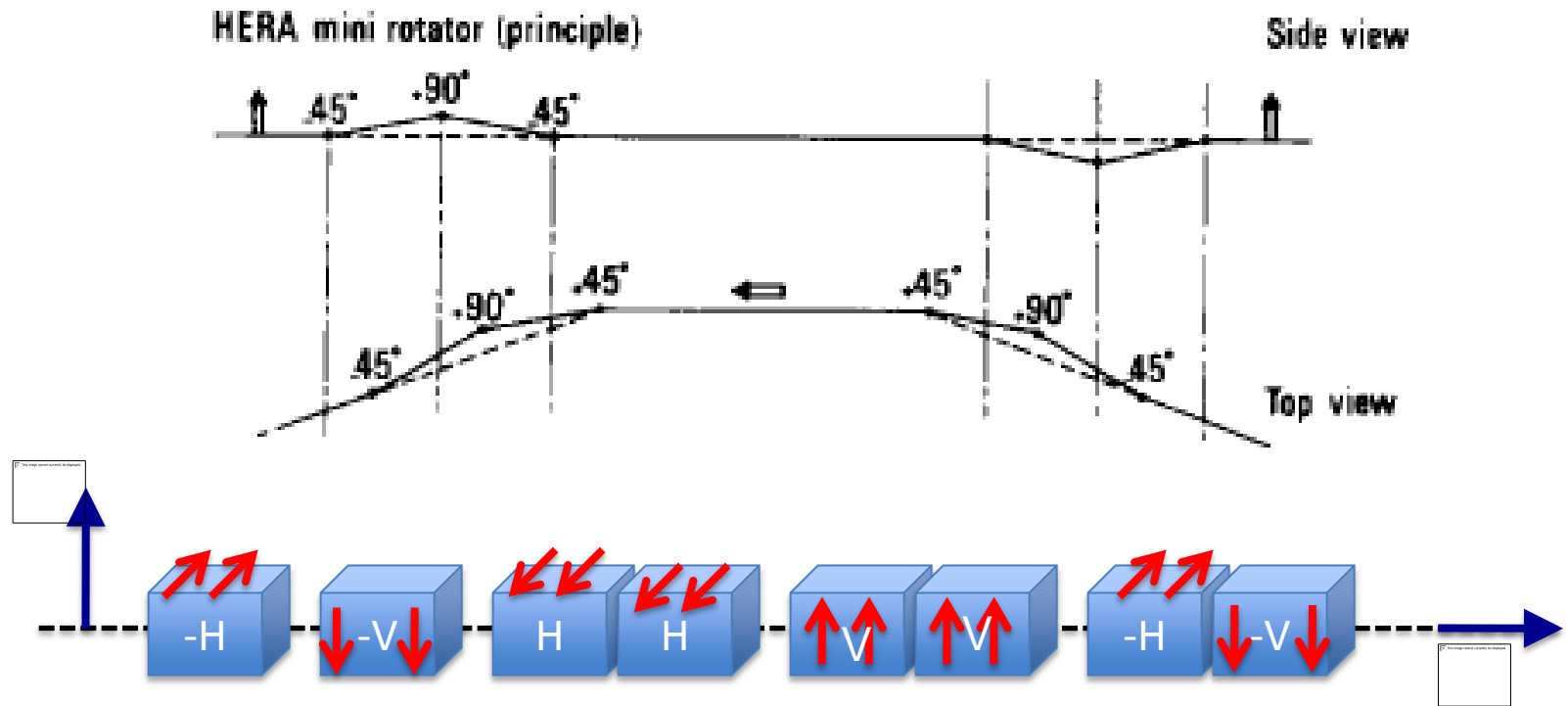
Option 2: High Energy Spin Rotator

- Low energy spin rotator to bring



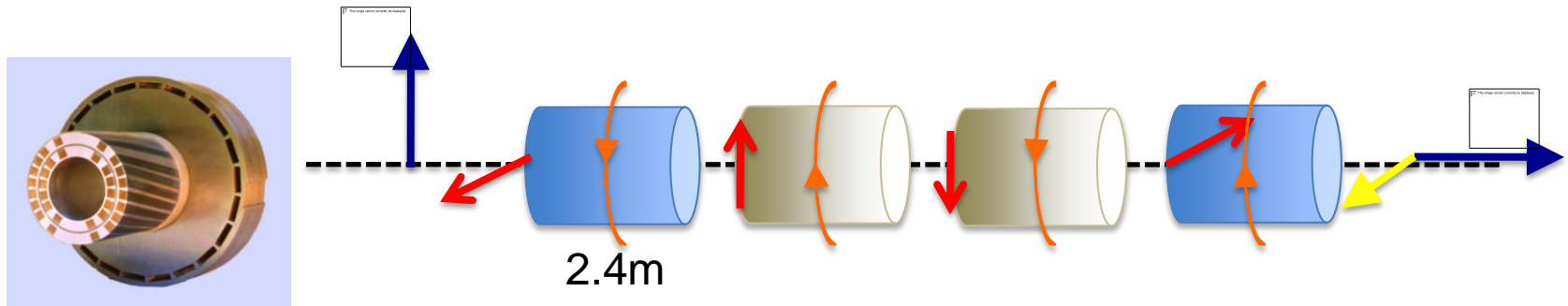
HERA Spin Rotator: Steffen

- Consists of a series of dipoles



RHIC Spin Rotator

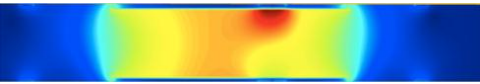
- Consists of four helical dipoles to rotate spin vector by 90 degrees around an axis in the horizontal plane



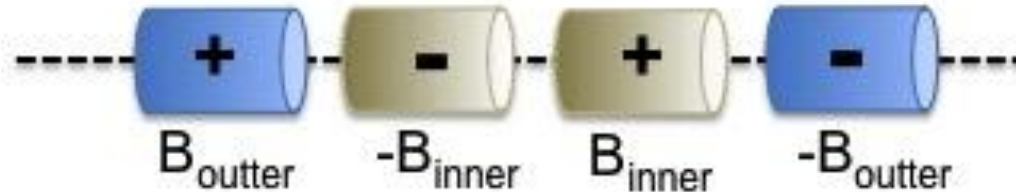
For each helical dipole,



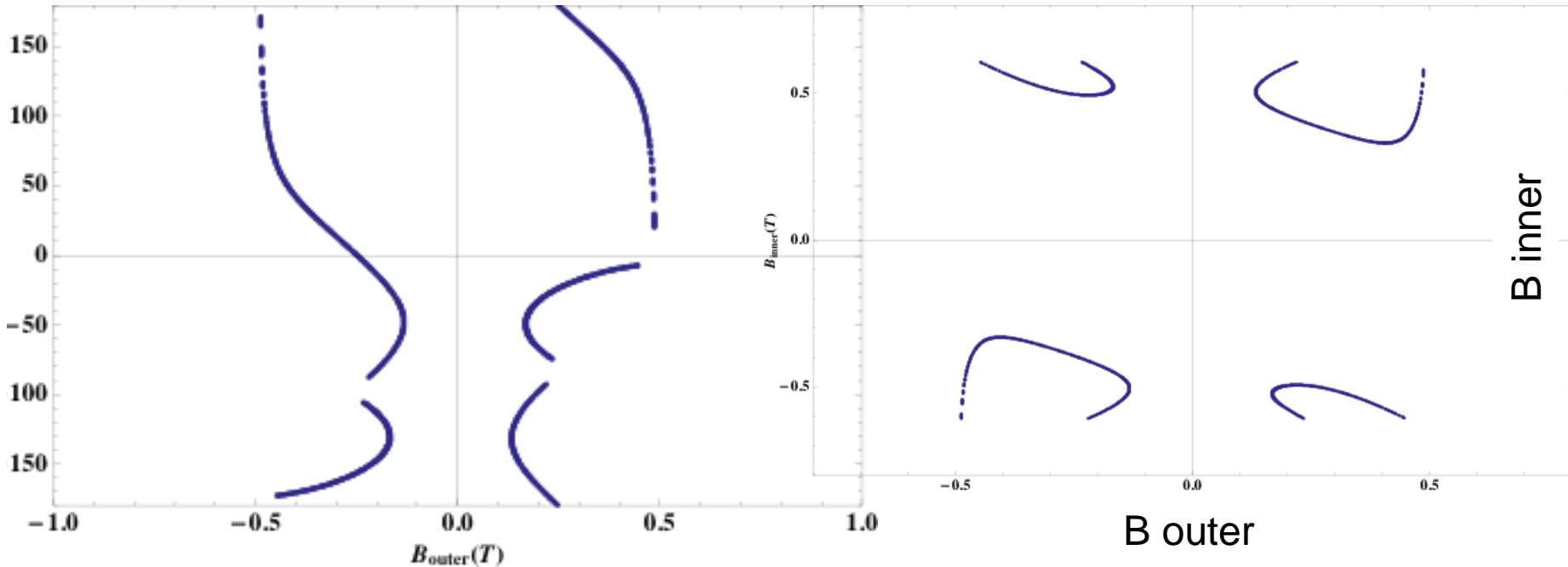
High Energy Spin Rotator: RHIC Type



For each helical, $L = 15$ m
Total length: ~ 60 m

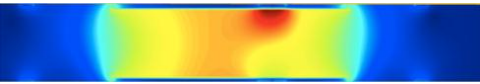


Angle of spin vector from longitudinal at IP [degrees]

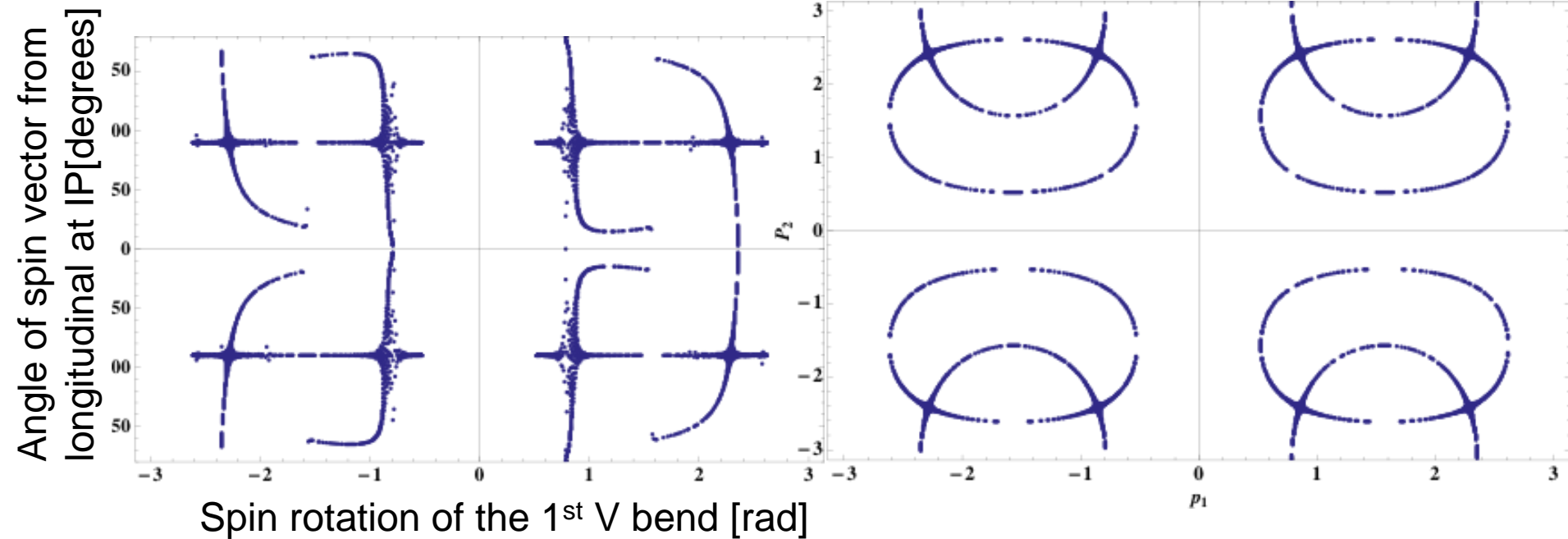


$B_{\text{outer}} = 0.46$ T $B_{\text{inner}} = 0.37$ T SR power = 0.31 Mwatt

High Energy Spin Rotator: HERA Type



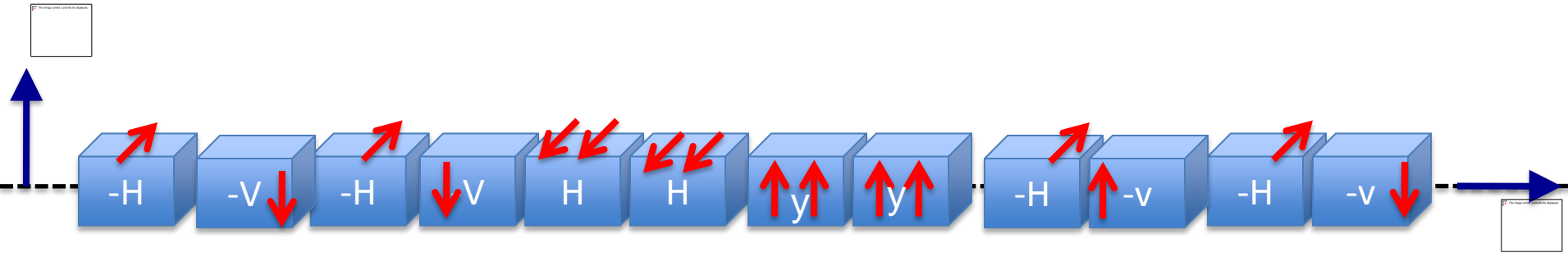
Each dipole is 5 meter long, total length is ~ 40 m



BH = 0.67 T BV = 0.68 T SR power = 0.81 Mwatt

High Energy Spin Rotator: Modified HERA Type

- Each dipole is 5 meter long, total length is ~60 m



Spin rotation of the 1st V bend [rad]

$$BH = 0.46 \text{ T} \quad BV = 0.56 \text{ T} \quad \text{SR power} = 0.39 \text{ Mwatt}$$

Summary

- High energy spin rotator options

	Length of spin rotator [m]	Maximum orbit excursion [mm]	SR power [Mwatt]
RHIC type	60	82	0.31
HERA type	40	>100	0.81
Modified HERA type	60	>100	0.39

- It is a challenge of building a spin rotator for 60 GeV e beam
- With the same space, RHIC type seems to be more practical and flexible for controlling the spin direction at IP
- Needs more detailed study on how to meet the SR budget