

An Introduction to the Wien Filter Spin Rotator

WIENFILTER (pp. 168 and 306 in the Users' Guide) is used as an electron spin rotator (spin tracking: pp. 35, 87, 291), an exercise drawn from the EIC design studies ¹.

Working hypotheses:

- 1/ Take $\tilde{E} \parallel Y$, $\tilde{B} \parallel Z$, and $B=E/v$. Take E and B fields hard-edge so to allow tight comparison with theory, as follows.
- 2/ The rotation of the spin across the Wien filter amounts to

$$\phi = \frac{Ze(1+G)}{\gamma^2 m \beta c} \int B_{\perp} dl = \boxed{****}$$

$$\text{Precession/BL} = 54.850611232465710$$

Zgoubi :

step = 100	mm :	66.06464658
step = 10	mm :	66.04492798
step = 3	mm :	66.04474352
step = 2	mm :	66.04473338
step = 1	mm :	66.04472730
step = 0.1	mm :	66.04472530
step = 0.01	mm :	66.04472528
step = 0.001	mm :	66.04472527

¹Erdong Wang, eRHIC pCDR, BNL, 2019.

ELCYLDEF

Hyp. :

$$1/ \vec{E} \equiv E_r, E = E_0 R_0/R$$

2/ proton, $p = 700.74032$ MeV/c magic momentum. E field is hard-edge. Thus field expected to be 10482708.580827460 V/m

Spin precession is expected to be zero.

Momentum expected to be constant.

Zgoubi :

5 FAISCEAU

TRACE DU FAISCEAU

OBJET

FAISCEAU

	D	Y (CM)	T (MR)	Z (CM)	P (MR)	S (CM)	D	Y (CM)	T (MR)	Z (CM)	P (MR)	S (CM)
O 1	1.0000	4000.000	0.000	0.000	0.000	0.000	1.0000	4000.012	0.008	0.000	0.000	4000
		Time of flight (mus) :		0.22297784		mass (MeV/c2) :		938.272				
O 1	1.0000	4000.000	0.000	0.000	0.000	0.000	1.0000	4000.012	0.008	0.000	0.000	4000
		Time of flight (mus) :		0.22297784		mass (MeV/c2) :		938.272				
O 1	1.0000	4000.000	0.000	0.000	0.000	0.000	1.0000	4000.012	0.008	0.000	0.000	4000
		Time of flight (mus) :		0.22297784		mass (MeV/c2) :		938.272				

6 SPNPRT

Spin components of each of the 3 particles, and rotation angle :

	INITIAL				FINAL				GAMMA	(Si,Sf)	(Si,
	SX	SY	SZ	S	SX	SY	SZ	S	(deg.)	(d	
									(Sf_x - projection of Sf on plane x=		
O 1	1.000000	0.000000	0.000000	1.000000	1.000000	-0.000001	0.000000	1.000000	1.248112	0.0000	90.00
O 1	0.000000	1.000000	0.000000	1.000000	0.000001	1.000000	0.000000	1.000000	1.248112	0.0000	0.00
O 1	0.000000	0.000000	1.000000	1.000000	0.000000	0.000000	1.000000	1.000000	1.248112	0.0000	0.00

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Test ELCYLDEF
'OBJET'
2.33741810885e3
2
3 1
4000. 0. 0. 0. 0. 1. 'O'
4000. 0. 0. 0. 0. 1. 'O'
4000. 0. 0. 0. 0. 1. 'O'
1 1 -1

'PARTICUL'
938.27203 1.602176487E-19 1.79284735 0. 0.
'SPNTRK'
4
1. 0. 0.
0. 1. 0.
1. 0. 1.

'ELCYLDEF'
20
1. 40. -10482708.58082 1.04 deviation (rad), r (m), E at r (V/m)
0. 0. 5. 2.
4 .1455 2.2670 -.6395 1.1558 0. 0. 0.
0. 0. 5. 2.
4 .1455 2.2670 -.6395 1.1558 0. 0. 0.
0.1 cm
2
0. 0. 0. 0.

'FAISCEAU'

'SPNPRT'
'END'

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