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An Introduction to the Wien Filter Spin Rotator

`WIENFILTER` is used in this exercise (pp. 168 and 306 in the Users' Guide). B and E are set so to ensure straight trajectory, with B value such to ensure proper spin rotation from initial longitudinal orientation.

Working hypotheses

- The Wien filter length is L
  - Take $\vec{E} \parallel \vec{Y}$ and $\vec{B} \parallel \vec{Z}$
  - E and B fields taken hard-edge so to allow tight comparison with theory
  - Electron trajectory is straight, so $E = v \times B$

Expectations include:
Spin rotation ($\vec{B}$ and $\vec{E}$ contribute in opposition)

$$\theta_s = \underbrace{(1+a\gamma)\frac{BL}{B\rho}}_{\approx 50^o\ from\ \vec{B}} - \underbrace{(a\gamma + \frac{\gamma}{1+\gamma})\beta^2\frac{BL}{B\rho}}_{\approx 20^o\ from\ \vec{E}} = 30\,deg$$

Numerical experiments

1/ Set up a Wien filter in zgoubi with length $L = 0.5\,$m, and B and E such to (i) ensure straight trajectory., (ii) ensure 30 degree spin rotation.
FIT can be used.
Compare with theory.

2/ Check the effect of step size, considering accuracy on spin rotation this time: using REBELOTE, get a scan of S_X rotation values for $\Delta s = .01 : 10\,$cm.
Plot the rotation versus step size (can use gnuplot to plot data read from zgoubi.fai).

3/ Align three 30 degree Wien filter rotators to get 90 deg spin rotation. Check the latter.
Compute the spin transport matrix.

3/ Add fringe-fields, re-do a FIT, compare new E and B with hard-edge case.