ISTITUTO NAZIONALE DI FISICA NUCLEARE
Laboratori Nazionali di Frascati

LNF-78/59(R)
18 Dicembre 1978

A. Turrin: PRECESSION WAVENUMBER AND LONGITUDINAL POLARIZATION WITH STEFFEN'S MAGNET ARRANGEMENT FOR A SIBERIAN SNAKE.

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A preliminary analysis of the magnet arrangement as proposed by Steffen[1] for a Siberian Snake with small orbit displacement has been given in a previous report[2], where the effective precession wave number of the polarization vector has been presented for the configuration as originally suggested by Steffen and for the same configuration, rotated about the y (velocity) axis by $\pi/2$.

This previous study has shown that the former arrangement does not make available a sufficiently wide energy range (in which depolarization can be prevented) under fixed-geometry conditions. For the latter arrangement, however, the expression of $\left| \cos(\pi\nu) \right|^{V \rightarrow H}_{H \rightarrow V}_{\text{extr}}$ as given in Ref. (2) contains an error.

The correct formula has been derived and is given in the present report, together with the expression for the corresponding polarization eigenvector in the straight section diametrically opposite to the snake insertion. We will continue to adopt Montague's notation[3].

For the "rotated" configuration the effective precession wavenumber, ν, is given as a function of the beam energy, E, by the equation

$$\cos(\pi\nu)^{\substack{V \rightarrow H \\ H \rightarrow V}} = (1/2)\,\mathrm{Tr}\cos(\chi/2) \quad , \qquad (1)$$

where

$$(1/2)\,\mathrm{Tr} = s^2(4)\left[c^3(4) + s^2(4)\cos(3\phi/4)\right] + c(4)\left[c^3(4) + s^2(4)\,c(4)\,c(2) - s^3(4)\,s(2)\right] \quad , \qquad (2)$$

and where

$$\begin{aligned} c(k) &\equiv \cos(\phi/k) \\ s(k) &\equiv \sin(\phi/k) \end{aligned} \qquad (k = 2, 4) \quad , \qquad (2a)$$

$$\phi = \pi E/E_o, \quad \text{and} \quad \chi = 2\pi\gamma\, a \, . \qquad (2b)$$

Here, (1/2)Tr is the halftrace of the transfer matrix through the "snake" insertion, E_o is the reference energy and χ is the precession phase per revolution ($\gamma \equiv E/(mc^2)$ and a is the gyromagnetic anomaly).

The graph of $\left|\cos(\pi\nu)\right|^{V\longrightarrow H}_{\substack{H\longrightarrow V \\ extr}}$ is shown by the dashed line in Fig. 1. From this graph, the available energy range (i. e. the energy range over which depolarization is avoided) appears to be comfortably wide even under fixed-geometry conditions.

Thus we obtain for the polarization eigenvector in the straight section diametrically opposite to the snake insertion

$$P_x \equiv 0 \quad ; \qquad (3a)$$

$$\left|P_y\right| = \sqrt{\left[1 - ((1/2)\,\mathrm{Tr})^2\right] \Big/ \left[1 - ((1/2)\mathrm{Tr}\cos(\chi/2))^2\right]} \qquad (3b)$$

($P_x^2 + P_y^2 + P_z^2 \equiv 1$ is our normalization condition).

The plot of $\left|P_y\right|_{min}$ is given in Fig. 1 (solid line).

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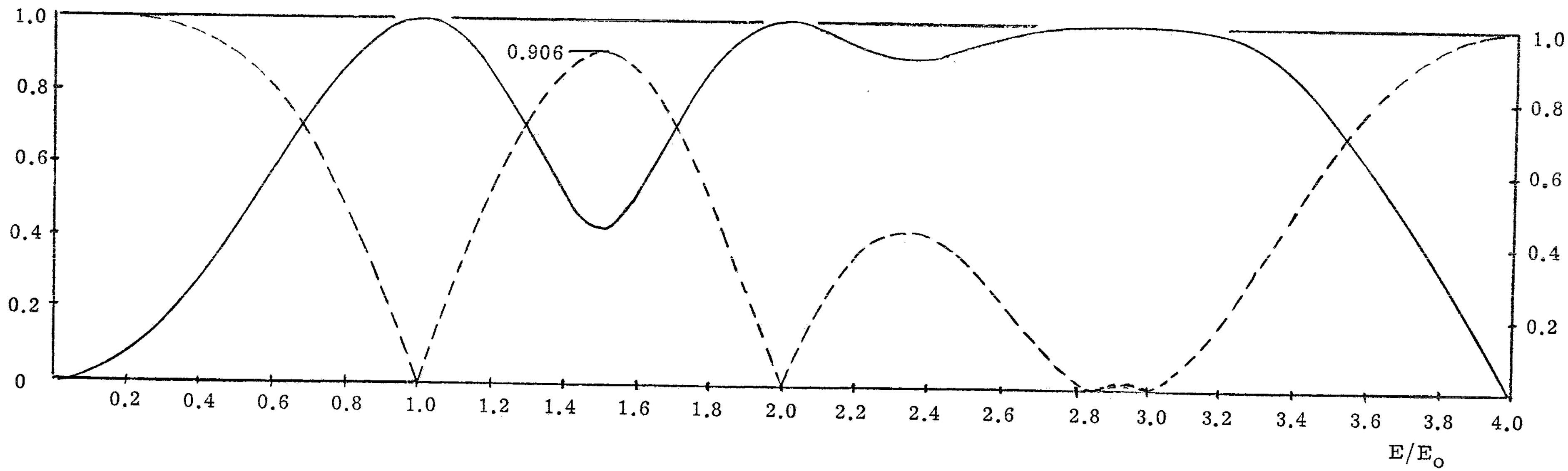
(1) - K. Steffen, DESY PET-78/11 (1978).

(2) - A. Turrin, LNF-78/54(R) (1978).

(3) - B. W. Montague, LEP-70/76 (1978).


1.0
0.8
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2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
E/E_o
1.0
0.8
0.6
0.4
0.2

FIG. 1

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