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PROPOSED SYMBOLS TO BE USED FOR DIMENSIONS AND PARAMETERS OF THE 100 MeV ACCELERATOR.

1. Magnet Geometry.

(a) Azimuthal dimensions: to be specified in terms of angles $\textcircled{H}$ in radians subtended at the centre of the accelerator.

$\textcircled{H}_N$ = magnet period = $\frac{2\pi}{N'}$ (half of (+) magnet + short straight section + whole of (-) magnet + short straight section + half of (+) magnet)

$\textcircled{H}_M$ = magnet superperiod (measured from centre of a long straight section to the centre of the next equivalent long straight section) = $\frac{2\pi}{M}$

$\textcircled{H}_P$ = angle subtended by iron of one pole

$\textcircled{H}_S$ = " " " short straight section (i.e. between edges of adjacent poles)

$\textcircled{H}_L$ = angle subtended by long straight section.

(b) Radial dimensions: to be specified in terms of radii in metres from the centre, measured in the median plane.

R_M = maximum (overall) outer radius of magnet

R_m = minimum " inner " " "

R_{MI} = outer radius of iron

R_m = inner radius of iron

R_{MV} = outer internal radius of vacuum chamber

R_{mV} = inner " " " " "

R_{MF} = outer radius of good field

R_{mF} = inner " " " "

(c) Vertical (axial) dimensions.

G_{mI} = minimum gap between pole faces

G_{mV} = internal vacuum chamber gap at $R = R_{MF}$

G_{MV} = " " " " " $R = R_{mF}$

Z_M = overall vertical dimensions of magnet measured from the median plane.

2. Fields and Orbits.

Basic field equation: $$B = - B_o \left(\frac{r}{r_o}\right)^k \sum_{j=1}^{s} b_j \sin j M \theta$$

B and B_o are in Weber/sq. metre.

r_o is an arbitrary radius at a particular azimuth at which the induction has the value B_o.

k = magnetic field index (momentum compaction parameter)

θ = azimuthal co-ordinate

r = radial "

b_j = Fourier coefficients of field

M = superperiodicity (integer)

Orbit co-ordinates:

r , θ , z

Scaled co-ordinates: ρ , θ , ζ } scale factor S , $r = s_1 \rho$

Canonical conjugate variables: ρ , p_ρ

ζ , p_ζ

Linearised betatron oscillation variables: x, p_x

y, p_y

Application of suffixes to scaled canonical conjugate variables:

ρ_o , $p_{\rho o}$ at $\theta = 0$

ρ_e , $p_{\rho e}$ at equilibrium orbit

ρ_{eo}, $p_{\rho eo}$ values of ρ_e , $p_{\rho e}$ at $\theta = 0$

L = Integrated orbit length. Scaled value: λ ; $L = S_1 \lambda$

Ψ = scalar magnetic potential (in calculating Ψ, r, z are scaled by factor S_2 ; $r = S_2\rho$, $z = S_2\zeta$)

$B = - \Delta \Psi$

e = electronic charge (coulombs)

$p = mv = m_o \gamma v$ v = particle velocity

3. Acceleration Parameters.

Ω = particle revolution frequency in rad. $sec.^{-1}$

$\nu = \Omega/2\pi$ = particle revolution frequency in cycle sec^{-1}

ω = R.F. gap voltage frequency in $rad.sec^{-1}$

$f = \frac{\omega}{2\pi}$ = " " " " cycle sec^{-1}

h = harmonic number $= \frac{\omega}{\Omega} = \frac{f}{\nu}$

Suffixes s, i, t refer to the synchronous particle of stacking energy (e.g. 100 MeV), injection energy (e.g. 2 MeV), and transition energy, respectively.

E = total energy of electron (usually in MeV)

E_o = rest " " " (" " ")

$\gamma = E/E_o = (1 - \beta^2)^{-1/2}$; $\beta = \frac{v}{c}$

$\Omega' = \Omega (d\Omega/dE) = d\Omega/dW$

$W = \int \frac{dE}{\Omega}$

Canonical conjugate variables: W , φ

" " " (scaled): y , ψ

U = gap voltage (peak) in volts

Q_s = phase of synchronous particle (stable fixed point)

Γ = $\sin \varphi_s$ = "acceleration parameter"

A = bucket area in eV.sec. (suffixes s, i apply)

$\alpha(\Gamma)$ = a special function of Γ

g = bucket growth factor = A_s/A_o

α = frequency modulation ratio = f_i/f_s

R = radial co-ordinate of an equilibrium orbit at a specified azimuth.

$$\frac{\Delta R}{R} \cong \frac{1}{(k+1)} \frac{\Delta E}{E} \quad (\text{for } v \to c)$$

ΔR_s = radial spread of electrons of a single stacked bucket

n = no. of stacked buckets

R_T = total radial spread of n stacked buckets

$$\simeq n\Delta R_s \simeq \frac{1}{k+1} \frac{\Delta E_T}{E_s}$$

A_T = total phase-space area occupied by n stacked buckets $\simeq n A_s$

t = time variable

t_a = acceleration time

τ = phase oscillation period (small amplitude oscillations)

Note.

If anyone wants to change any of these symbols, will they please think about the consequential changes and then get in touch with one of us.

The idea is for symbols dealing with aspects of theory and/or design not yet worked out to be chosen taking into account the above list of symbols already allocated to other things.

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