Update on Final Focus

Skunk Meeting

November 29, 2006

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New Beam Parameters

Improved Layout

Chromatic Correction

New Parameters

1.0 MJ Total beam energy

400 beam pulses

80 Linacs

5 pulses per Linac

$m_{\text{SS}} = 39.9639 \text{ amu}$ $A_r + 8$ in Linac

$A_r + 16$ in Final Focus

Kinetic Energy = $\begin{cases} 160 \text{ MeV} & \text{Train Head} \\ 240 \text{ MeV} & \text{Train Tail} \end{cases}$

→ Velocity Tilt = .20

Pulse length in Linac = 10.0 m

Core Roset length in Linac = 10.0 m

→ Train Length in Linac

$$= (5 + 4) \times 10 = 90 \text{ m}$$

$$\text{Drift Distance} = \frac{90}{.2} = \underline{\underline{450 \text{ m}}}$$

(3)

Parameters Cont.

$$\text{Charge per pulse in linac} = 100 \mu\text{C}$$

$$\text{line charge density} = \frac{100 \mu\text{C}}{10 \text{ m}} = 10 \frac{\mu\text{C}}{\text{m}}$$

$$\text{Pulse duration at 200 MeV} = .32 \mu\text{s}$$

$$\text{Train duration end of linac} = 7 \times .32 = 2.24 \mu\text{s}$$

Strip Ions $+8 \rightarrow +16$
at end of linac

(only K shell is left)

Rigidity is low by HIF standards

$$160 \text{ MeV } \text{Ar}^{+16} \rightarrow (B\rho) = .72 \text{ T-m}$$

$$240 \text{ MeV } \text{Ar}^{+16} \rightarrow (B\rho) = .88 \text{ T-m}$$

∴ Relatively weak Solenoids may
Be Used

Layout

(Larger Focus
for Fine Focus)

Parallel to Point Focus 40m
 Trajectories cross axis at intermediate point
 Pulse Magnet adjusts trajectory to
 hit target when energy > 160 MeV
 Spot radius ≈ 3 mm for $E_{\text{inc}} \approx 2 \times 10^{-6}$ m-r
 Angles on target $\approx .7 - 3$ radians

(5)

Chromatic Study

T	BP	B kick	ϕ target	r_{max}	cross point
160	.721	0	.201	.383	27m
170	.742	.128	.197	.370 ^(?)	25.5
180	.764	.181	.198	.41	24
190	.785	.225	.205	.45	23
200	.805	.264	.215	.52	21.5
210	.825	.303	.231	.59	20.0
220	.845	.343	.253	.70	18.0
230	.864	.386	.283	.84	16.5
240	.883	.436	.324	1.02	14.5

↑
Note
Variation

```

In[725]:= A = 39.963;
q = 16;
T0 = 160;
T = 160
 $\beta\gamma_0 = ((T0/931.5/A)^2 + 2*(T0/931.5/A))^{.5};$ 
 $\beta\gamma = ((T/931.5/A)^2 + 2*(T/931.5/A))^{.5};$ 
Brho0 = 3.107* $\beta\gamma_0$ *A/q;
Brho = 3.107* $\beta\gamma$ *A/q

z0 = 0;
z1 = 1;
z2 = 27;
z3 = 37;
z4 = 40;

B1 = 0.
B2 = Pi*Brho0/(z2 - z1)
B3 = Pi*Brho0/(z3 - z2)
B4 = Pi*Brho0/(z4 - z3)

B0[z_] = B1*If[z0 ≤ z ≤ z1, 1, 0] +
  B2*If[z1 ≤ z ≤ z2, 1, 0] + B3*If[z2 ≤ z ≤ z3, 1, 0] + B4*If[z3 ≤ z, 1, 0];

Plot[B0[z], {z, z0, z4 + 1}, PlotPoints → 300];

x0 = 1.0
xp0 = 0.000
phi0 = 0
zi = z0 - 1
zf = z4 + 1

aol = NDSolve[{x'[z] = xp[z],
  xp'[z] = -(B0[z]/2/Brho)^2*x[z], phi'[z] = -B0[z]/2/Brho, x[zi] = x0,
  xp[zi] = xp0, phi[zi] = phi0}, {x, xp, phi}, {z, zi, zf}, MaxStepSize → .01,
  MaxSteps → 110000];

xx[z_] = x[z]/.aol;;
xkp[z_] = xp[z]/.aol;
phi[z_] = phi[z]/.aol;
X[z_] = xx[z]*Cos[phi[z]];
Y[z_] = -xx[z]*Sin[phi[z]];
Plot[xx[z], {z, zi, zf}];
Plot[xx[z], {z, z4 - .1, z4 + .1}];
Plot[phi[z], {z, zi, zf}];
Plot[{X[z], Y[z]}, {z, zi, zf}];
xx[z4]
xkp[z4 - .01]

```

Out[728]= 160

KE

Out[732]= 0.720278

Bp

Out[738]= 0.

B kick

Out[739]= 0.0870315

Out[740]= 0.226282

Out[741]= 0.754273

B weak
B medium
B strong

$B(z)$

Out[744]= 1.

Out[745]= 0.

Out[746]= 0

Out[747]= -1

Out[748]= 41

$X(z)$ (Larmor Frame)

$X(z)$ at target
($z = 40$)

Larmor
angle

Lab Frame
coordinates

Out[759]= $\{-3.86878 \times 10^{-7}\}$

Out[760]= $\{0.201381\}$

← Final Angle

~~In[724]:= xx[31.]~~

~~Out[724]= $\{-1.02351\}$~~

Out[812]= 0.0870315

Out[813]= 0.226282

Out[814]= 0.754273

Out[817]= 1.

Out[818]= 0.

Out[819]= 0

Out[820]= -1

Out[821]= 41

X (z)

Out[848]= 0.0870315

Out[849]= 0.226282

Out[850]= 0.754273

Out[853]= 1.

Out[854]= 0.

Out[855]= 0

Out[856]= -1

Out[857]= 41

$X(z)$