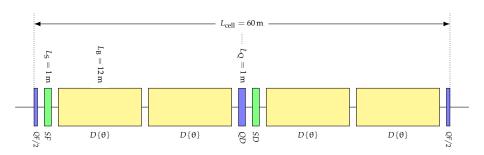
# JUAS22: Accelerator Design Workshop - Lattice Design Group 10

Marvin Noll Javier Olivares Adrien Plaçais

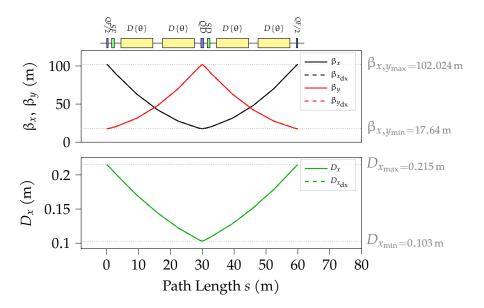
February 6, 2022

# Design of Arc Cell (1): Cell layout



- Cell type: FODO
- Phase advance:  $\mu = 90^{\circ}$

# Design of Arc Cell (2): β-Functions and Dispersion



# Closing the Ring

• Close the ring with a loop:

```
i = 0;
JC_ring : SEQUENCE, refer=centre, L=L_JC_ring;
while (i < numberOfCells) {
     JC_fodo_arc, at=(i + 0.5) * Lcell;
     i = i + 1;
}
ENDSEQUENCE;</pre>
```

• Check if ring is closed with survey:

$$\frac{\int \rho \, d\theta - 2\pi}{2\pi} = \frac{6.2854196 - 2\pi}{2\pi} = 0.035\%$$

### Synchrotron Radiation and Emittance

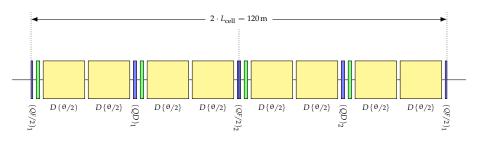
• Energy loss:

$$U_0 = \frac{C_q E^4 I_2}{2 \pi} = 3.96 \times 10^{-8} \text{ J}$$

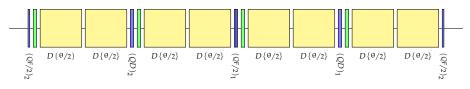
• Emittance:

$$\epsilon_x = \frac{C_q \gamma_L^2 I_5}{J_x I_2} = 2.58 \,\text{nm rad}$$

# Dispersion Suppressor (1): Layout

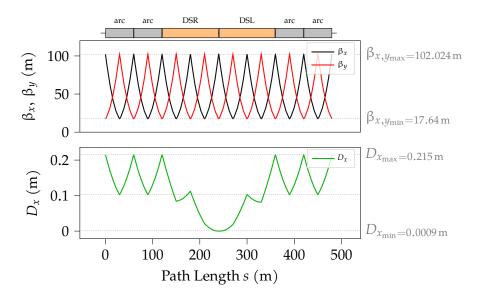


(a) DSL (Dispersion Suppressor Left)

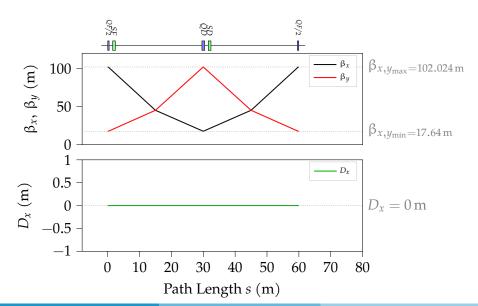


(b) DSR (Dispersion Suppressor Right)

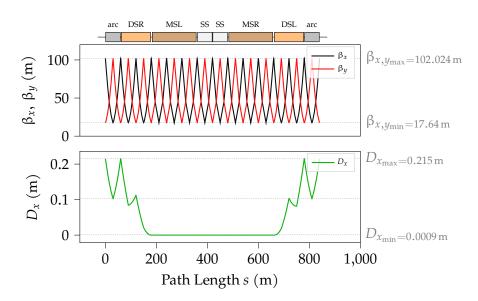
### Dispersion Suppressor (2): β-Functions, Dispersion



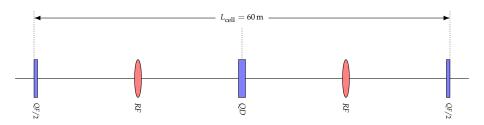
#### Straight Sections: β-Functions and Dispersion



#### **Matching Sections**



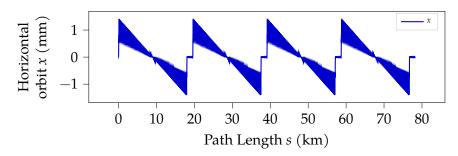
#### RF Sections (1): Layout



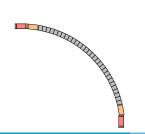
- From topic II groups:  $V_{RF} = 10.64 \,\text{GV}$
- Synchronous phase:

$$U_{\mathrm{turn}} = U(t = t_0) = e \, V_{\mathrm{RF}} \sin{(2\pi(\phi - h))}$$
  
 $\Rightarrow \phi_{\mathrm{above \, transition}} = 0.5 - \frac{\arcsin{\left(\frac{U_{\mathrm{turn}}}{e \, V_{\mathrm{RF}}}\right)}}{2\pi} = 0.33 \, \mathrm{rad}$ 

#### RF Sections (2): Transverse orbit



#### Quarter Ring:



- FODO Arc Sections (297 times)
- Dispersion Supressors
- Straight Sections with RF (19 times)
- Matching Sections

# Number of Bunches in the Ring

• Energy lost per particle and per turn, calculated with MAD-X:

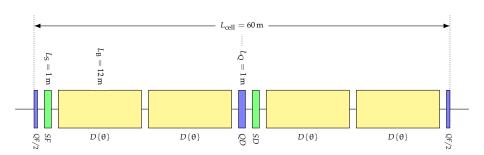
$$U_0 = 4.62 \,\mathrm{GeV}$$

$$P = \frac{\beta c}{L_{\text{ring}}} U_0$$

- $n_{\rm particles} \approx 2 \times 10^{11}$
- $P_{\text{max}} = 50 \,\text{MW}$
- Number of bunches limited by synchrotron radiation:

$$n_{\text{bunches}} = \frac{P_{\text{max}}}{P \cdot n_{\text{particles}}} = 122$$

# Thanks for Listening!



- Questions?
- Discussion?

