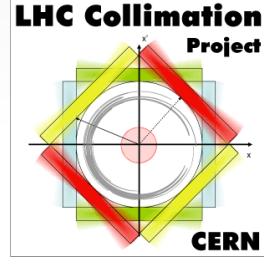




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# BDSIM Update

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# BDSIM Tracking

- All elements (inc. multipoles) are implemented in tracking
- Only quadrupoles are symplectic just now
- Quadrupole, Sector Bend, Rect. Bend use map
- Sextupole & Octupole use approximations
- General multipole uses 4<sup>th</sup> order Runge-Kutta

## Quadrupole

### Drift

$$\begin{pmatrix} x \\ x' \\ y \\ y' \end{pmatrix} = \begin{pmatrix} 1 & h & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & h \\ 0 & 0 & 0 & 1 \end{pmatrix} \times \begin{pmatrix} x_0 \\ x'_0 \\ y_0 \\ y'_0 \end{pmatrix}$$

$$M_f = \begin{pmatrix} \cos(h\sqrt{k}) & \frac{1}{\sqrt{k}} \sin(h\sqrt{k}) & 0 & 0 \\ -\sqrt{k} \sin(h\sqrt{k}) & \cos(h\sqrt{k}) & 0 & 0 \\ 0 & 0 & ch(h\sqrt{k}) & \frac{1}{\sqrt{k}} sh(h\sqrt{k}) \\ 0 & 0 & -\sqrt{k} sh(h\sqrt{k}) & ch(h\sqrt{k}) \end{pmatrix}$$

$$\begin{pmatrix} x \\ x' \\ y \\ y' \\ \frac{\Delta p}{p} \end{pmatrix} = M \times \begin{pmatrix} x_0 \\ x'_0 \\ y_0 \\ y'_0 \\ \frac{\Delta p_0}{p} \end{pmatrix} + \begin{pmatrix} \frac{0.5Fh}{1+\Delta p/p} \\ \frac{F}{1+\Delta p/p} \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

$$M_d = \begin{pmatrix} ch(h\sqrt{k}) & \frac{1}{\sqrt{k}} sh(h\sqrt{k}) & 0 & 0 \\ -\sqrt{k} sh(h\sqrt{k}) & ch(h\sqrt{k}) & 0 & 0 \\ 0 & 0 & \cos(h\sqrt{k}) & \frac{1}{\sqrt{k}} \sin(h\sqrt{k}) \\ 0 & 0 & -\sqrt{k} \sin(h\sqrt{k}) & \cos(h\sqrt{k}) \end{pmatrix}$$

$$M = \begin{pmatrix} \cos(F) & \frac{h}{F} \sin(F) & 0 & 0 & -\frac{h}{F}(1 - \cos(F)) \\ -\frac{F}{h} \sin(F) & \cos(F) & 0 & 0 & -\sin(F) \\ 0 & 0 & 1 & L & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

### Sector Bend



# Status & Direction

- Implement symplectic routine for other elements
- Use generic geometry for machine (elements & collimators)
- Geometry conversion software ongoing
  
- Validate tracking w.r.t. SixTrack
  - define the exact comparison plots
- Comparative tracking studies to SixTrack