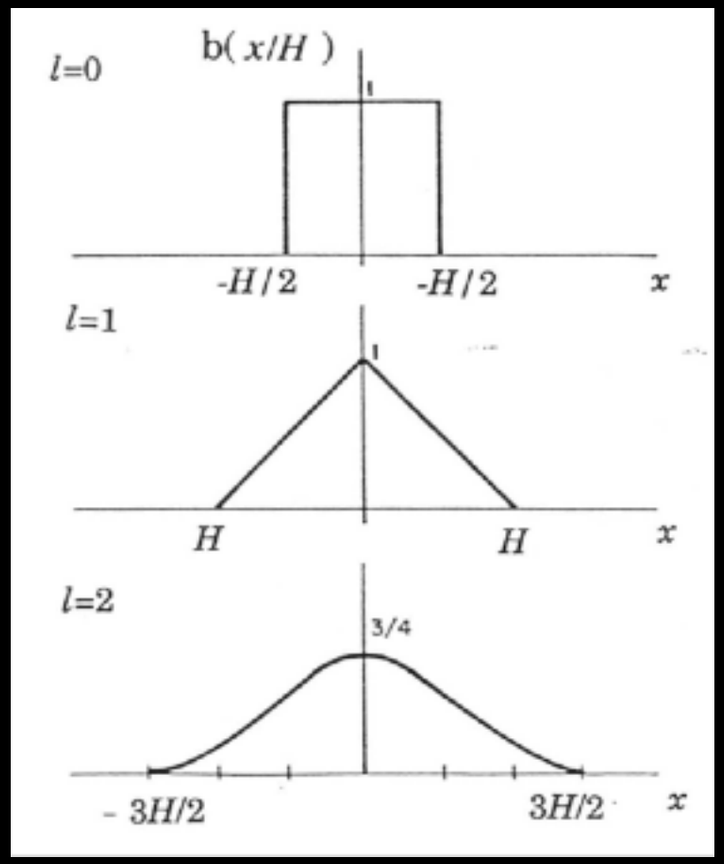
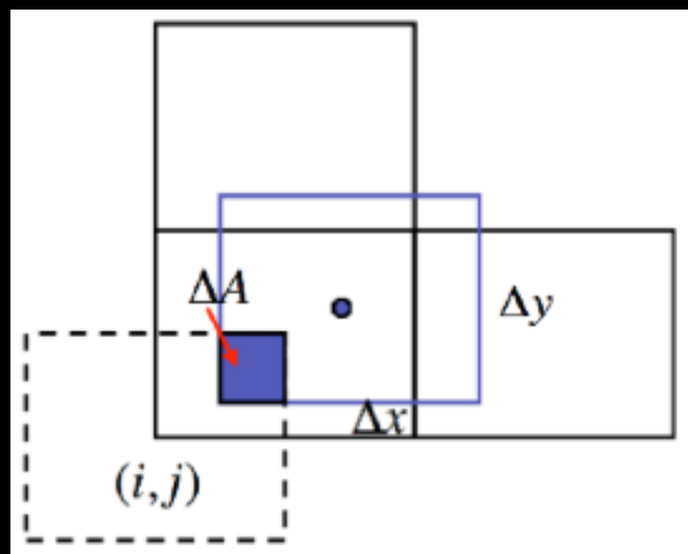
2. Interpolate fields to particle positions

- The fields obtained from Maxwell's equations are determined only at the grid points, they need to be interpolated to the particle positions.
- The interpolation is done by assuming a particle shape function.
- The shape function needs to be:
  1. isotropic
  2. zero outside some range
  3. higher order B-splines are computationally more expensive, but more accurate and less "collisional"





$$E(\vec{x}_k) = \sum_{i,j} E_{ij} S(\vec{x}_k - \vec{X}_{ij})$$

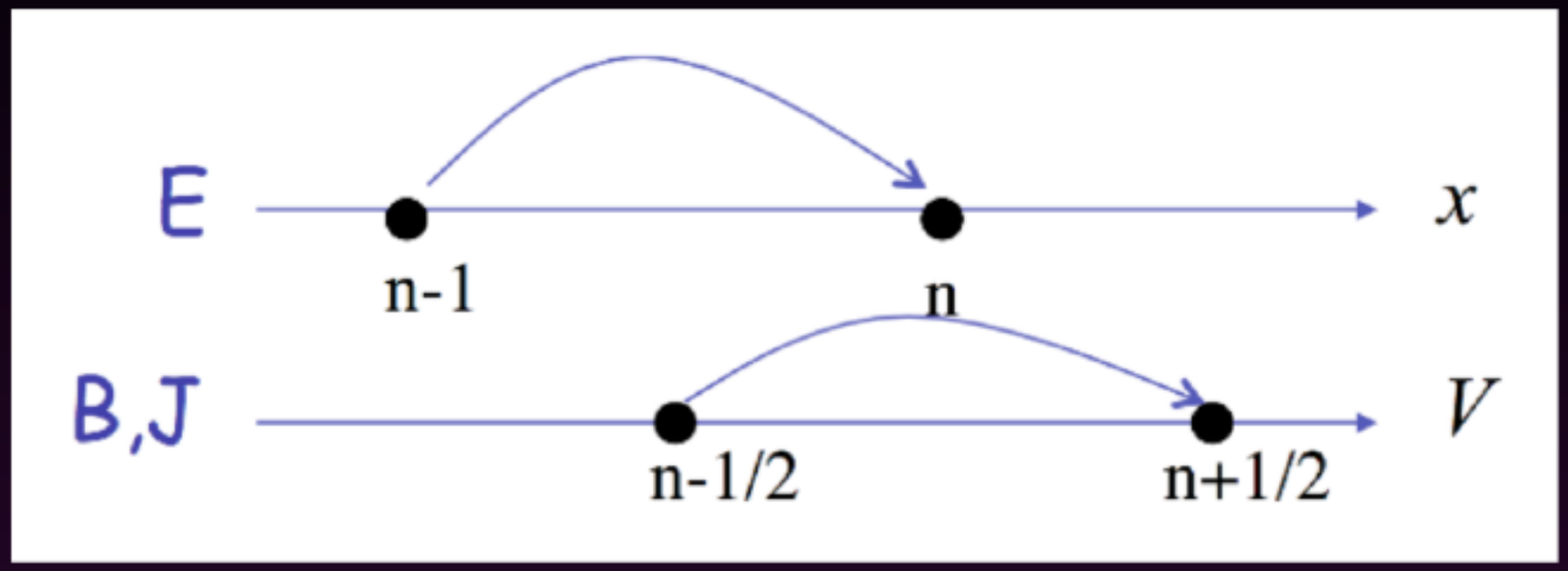
$$S(\vec{x}_k - \vec{X}_{ij}) = \frac{\Delta A}{\Delta x \Delta y}$$

$$\sum_{i,j} S(\vec{x}_k - \vec{X}_{ij}) = 1$$

3. Push the particles

If the number of ppc is >>1, most of the computing time is spent in pushing the particles.

The BORIS pusher (leapfrog method)



advance the position

$$x^{n+1} = x^n + \frac{p^{n+1/2}}{\gamma^{n+1/2}}\Delta t$$

advance the momentum

$$\frac{p^{n+1/2} - p^{n-1/2}}{\Delta t} = \frac{q}{m}(E^n + \frac{1}{c}\frac{p^{n+1/2} + p^{n-1/2}}{2\gamma^n} \times B^n)$$

$$(B^n = \frac{B^{n+1/2} + B^{n-1/2}}{2})$$