Influence of space charge effect on dynamics of charged particles trapped in laser channels

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\textit{Channeling-2016}
Content

- System
- Calculation method
- Space charge
Channeling in laser fields

\[ U_{am} = \frac{e^2 E_0^2 \left( -\cos (2\alpha) - 2\beta z \sin \alpha + \beta_z^2 (1 + \cos^2 \alpha) \right)}{2\gamma_z k^2 m c^2 (1 - \beta_z \sin \alpha)^2} \]
PIC. The most common
PIC. Amazing results

http://picongpu.hzdr.de

low electron and high ion density create positive area
PIC. Why not?

- No screening in our case
- Heavy field calculations
- Interest in long calculation regions
Used method

\[ E = e \left( 1 - \frac{v^2}{c^2} \right) \left( R - \frac{\mathbf{v}}{c} R \right) + \frac{e}{c^2} \left( R - \frac{\mathbf{Rv}}{c} \right)^3 \left[ \mathbf{R} \left( \mathbf{R} - \frac{\mathbf{v}}{c} R \right) \hat{\mathbf{v}} \right] \]

Realized on: **C++**
Current state

- Rewritten from scratch
- Increased “amount” of particles
- Acceptable computation speed
Non-Channeled beam
Channeled beam
Histograms for both beams
TODOs:

- Manage close collisions
- Generate beam
- Add radiation losses
- Play with real parameters
- Play with various geometries
Thank you!
No space charge
Space charge. Binary collisions

- \(N=200\)
- 200 steps
- Minutes of work

\[
E = e \frac{1 - v^2/c^2}{(R - \frac{Rv}{c})^3} \left( R - \frac{v}{c} R \right) + \frac{e}{c^2 \left( R - \frac{Rv}{c} \right)^3} \left[ R \left( \left( R - \frac{v}{c} R \right) \dot{v} \right) \right],
\]
Potential inversion