Application of a Grid-free Kinetic Model to the Collisionless Sheath

K. Matyasha\textsuperscript{a}, R. Schneider\textsuperscript{a}, R. Sydora\textsuperscript{b} and F. Taccogna\textsuperscript{a}

\textsuperscript{a}Max-Planck Institut für Plasmaphysik, EURATOM Association, D-17491 Greifswald, Germany
\textsuperscript{b}Department of Physics, University of Alberta, Edmonton, Alberta, Canada T6G2J1

1d3v hierarchical tree code

- force evaluation and moving particles
- particles loss / gain boundaries, emission, absorption
- filling tree with the multipole moments
- constructing tree, inserting particles

Δ$t$

Treecode in 1D:
- no multipole moments higher than 0-th are necessary
- exact solution of $N$-body problem (and this with $N \log(N)$ scaling!)

Hierarchical tree structure

Elegant field solver

- struct Model
- Node *left, *right; // daughters
- Node *parent, *next; // for non-recursive force calculation
- Particles *ps; double E[xyz], Max, X, Ez;
- int *Q; // total charge
- if (left) // actually we don't need it if (md-halfl)

- double Efield (Node *nd, double x, double MB)
- double xill, X, Xill, Height;
- if (md)leaf == 0 // twig node
- xill = x - md-X;
- if (MB$>$E$>$xill$>$md-halfl) // far enough
- X = xill$>$MB$>$E[xyz];
- else // doping deeper
- if (md-left) Xleft = Efield tree(md-left, x, MB);
- if (md-right) Xright = Efield tree(md-right, x, MB);
- X = Xleft + Xright;
- else //leaf node
- xill = x - md-X;
- if (xill == 0) X = 0.0; // no self-action allowed
- else Eill = 0 if (xill<0):
- return X;

Elegant, but slow – we replaced it with non-recursive one

Benchmarking the treecode against the PIC

- Very good!

Benchmarking the PIC against the treecode

- Not really...

5 cells per sheath is not enough!