

# Numeric Plasma Simulations

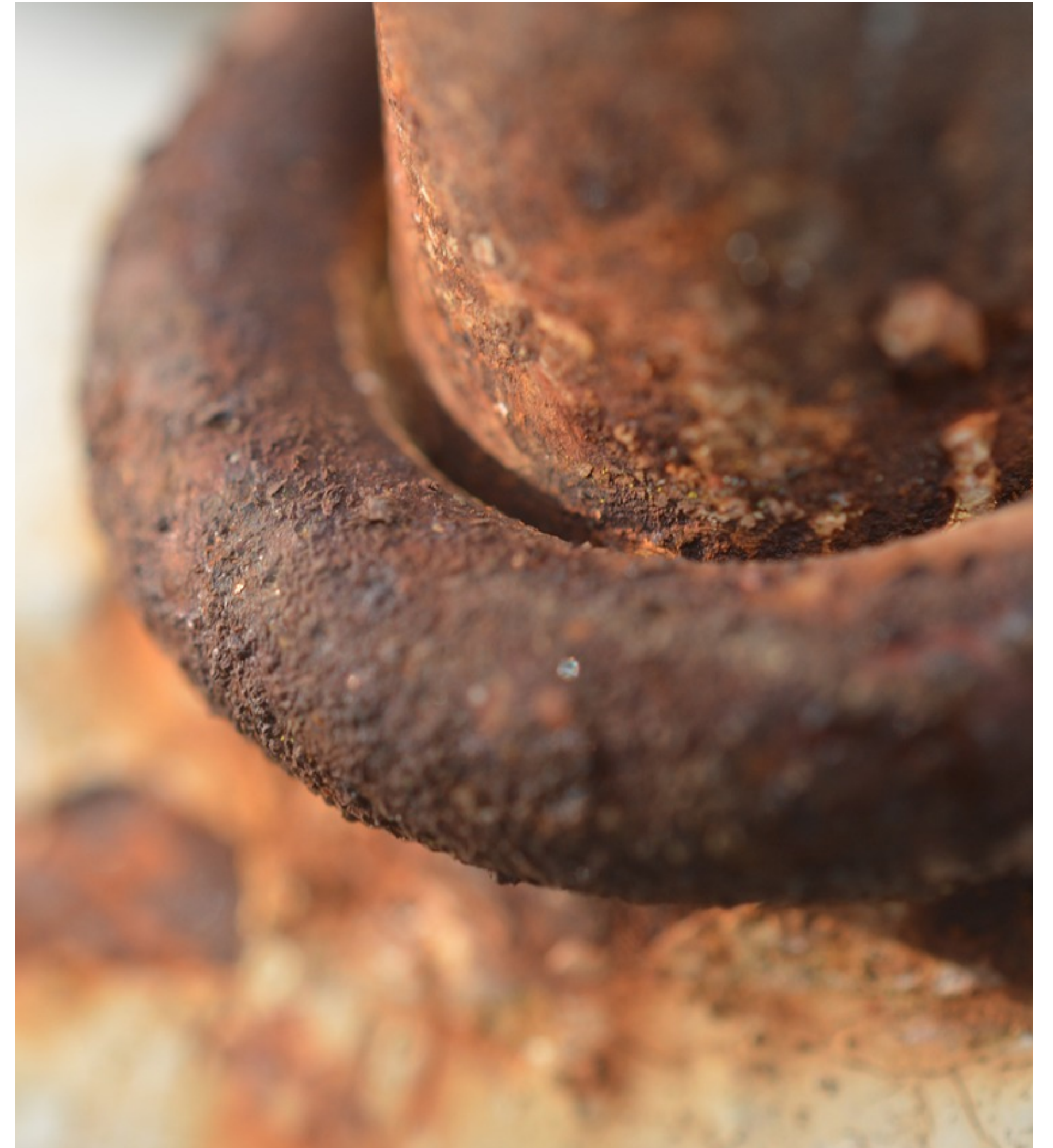
...with crustaceans






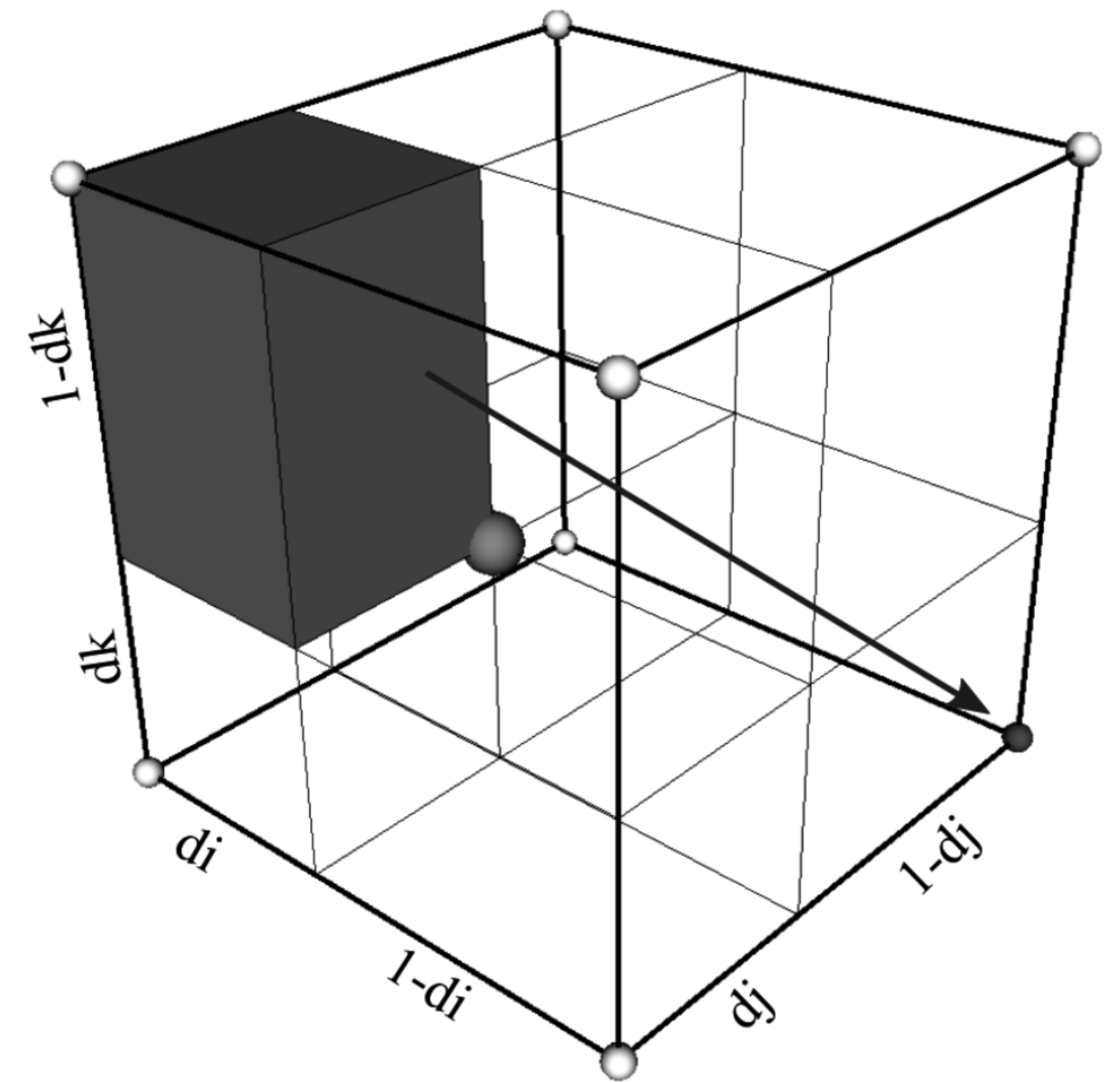
# Hi

- Christoph Beberweil
- MSc in 2017
- Software Developer since 2017
- Part time **PhD student** since 2023
- Musician since 1997



# Goals

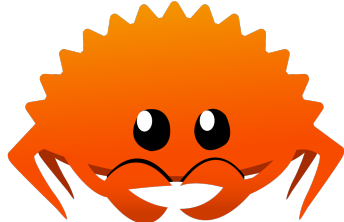
- Learn about modern plasma simulation methods and codes by writing a generic **particle in cell** simulation program
- Learn about **Rust** by writing it in Rust 
- Use the program to investigate ion beam transport and interactions in unusual and interesting geometries
  - Electron coolers
  - Gabor lenses
  - And **your** interesting application :)



Brieda: Visualisation of a 3d interpolation algorithm for **scattering** particle properties to the grid or **gathering** grid properties to particle positions



# The Code

- Portable (run anywhere reasonable that is a rust compile target, probably not on microcontrollers...)
- Simple to use
- Blazingly fast 
- Parallel execution, horizontal scalability
- Define data aggregation and plots to be created during the simulation automatically
- Orchestrate simulations across multiple systems
- Web UI to show live simulation progress



... will run here one day 🙌



# Performance Improvements

```
impl<T: Clone + Mul<Output = T>> Field<T> {
    pub fn scale_for(&mut self, factor: f64)
    where
        f64: Mul<T, Output = T>,
    {
        for i in 0..self.data.len() {
            for j in 0..self.data[i].len() {
                for k in 0..self.data[i][j].len() {
                    self.data[i][j][k] = factor * self.data[i][j][k].clone();
                }
            }
        }
    }
}
```



```
impl<T: Clone + Mul<Output = T> + Debug> Field<T> {
    pub fn scale(&mut self, factor: f64)
    where
        f64: Mul<T, Output = T>,
    {
        self.data
            .iter_mut()
            .flatten()
            .flatten()
            .for_each(|k_d| *k_d = factor * k_d.clone());
    }
}
```

```
pub struct Field<T: Clone> {
    pub data: Vec<Vec<Vec<T>>>,
}
```

# Infrastructure

- **Homepage** <https://nnp.pyhsik.uni-frankfurt.de>
- Published **Talks** <https://talks.nnp.physik.uni-frankfurt.de>
- Internal **Wiki** <https://wiki.nnp.physik.uni-frankfurt.de>
- **Git** Hosting <https://git.nnp.physik.uni-frankfurt.de>