Hierarchy of nonlinear Gyrokinetic Maxwell-Vlasov models for verification of global GK codes

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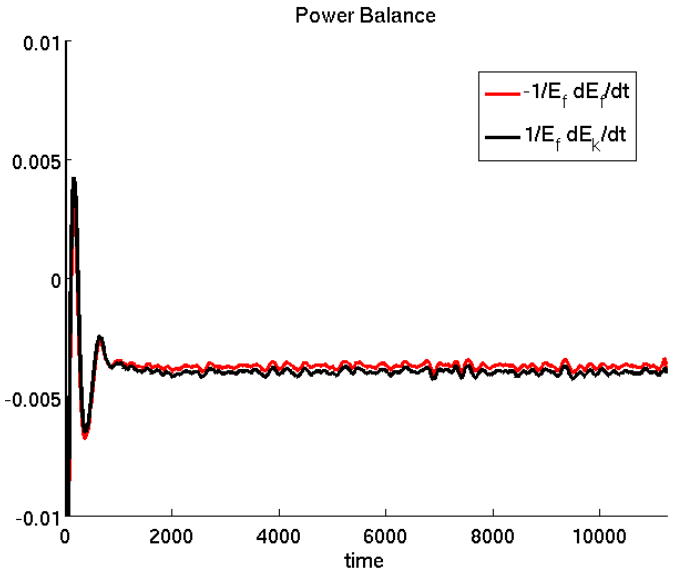
- **European project VeriGyro :**
  - Most popular tools for plasma turbulence investigation
  - Extended development over last 10 years
  - Variety of implemented GK models
- **Building up hierarchy of Gyrokinetic models implemented into the codes** ***(task leader N.Tronko)***:
  - Systematic derivation from the Variational GK framework
  - Verification of approximations consistency
  - Identification of regimes of applicability
- **Intercode Benchmark: implicit numerical schemes verification**
- ***(task leader T.Goerler****; contributors N.Tronko, W.Hornsby, R.Kleiber, V.Grandgirard)*
  - Hierarchy of numerical test cases: from adiabatic electrons towards linear electromagnetic simulations:

    GENE/GKW (Eulerian); **ORB5/EUTERPE** (PIC); **GYSELA** (Semi- Lagrangian)

Second order Gyrokinetic theory for Particle-In-Cell code

- **Poster focus: second order Gyrokinetic theory for Particle-In-Cell code ORB5**
- *Systematic approach : Derivation from action functional*
- *Second order Gyrokinetic Vlasov-Maxwell system*
- *Corresponding second order Energy conservation law*
- *Comparison with code diagnostics*



Power balance equation

$$\frac{1}{\mathcal{E}_F}\frac{d\mathcal{E}_k}{dt} = -\frac{1}{\mathcal{E}_F}\frac{d\mathcal{E}_F}{dt}$$