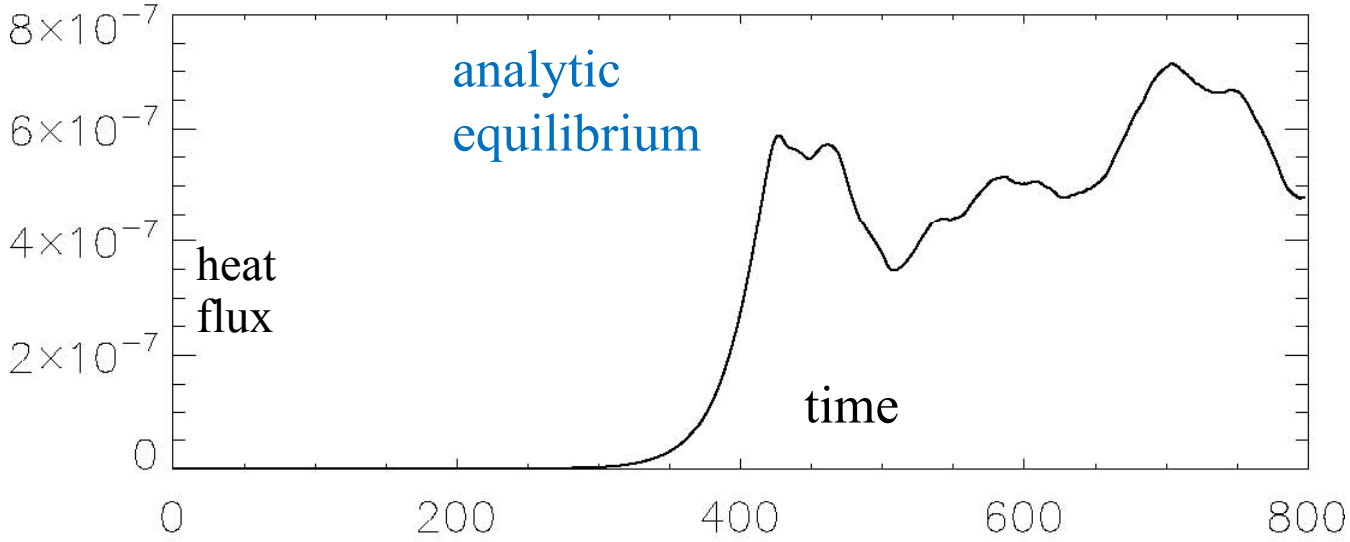
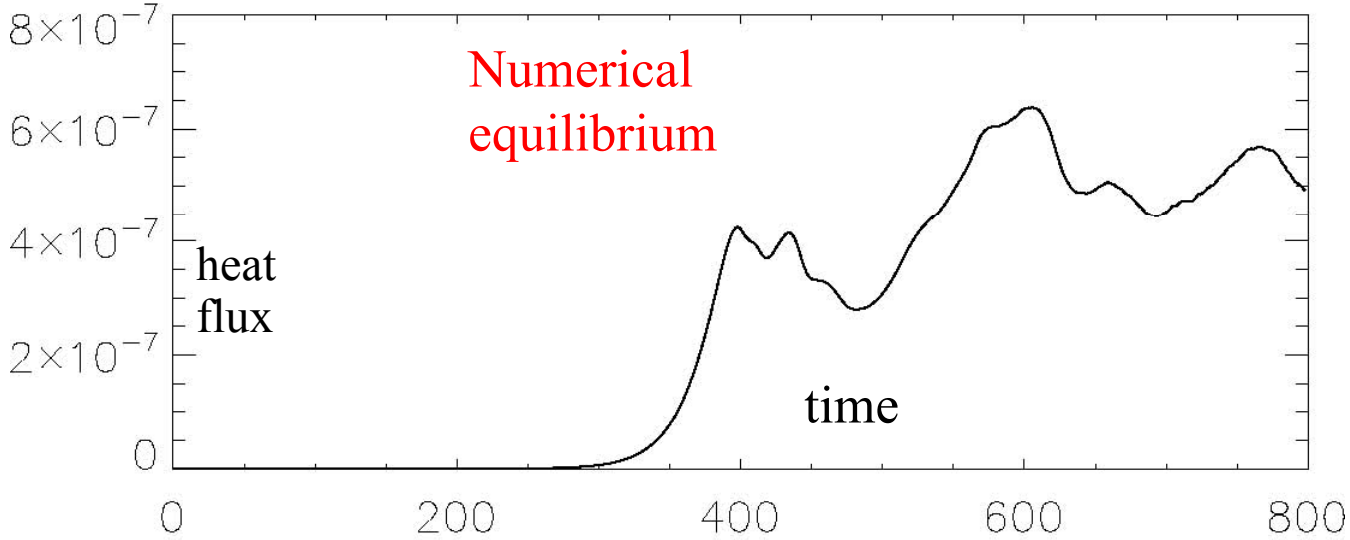
GTC Status and Plan

- Integration of key capabilities in a single GTC version:
  - Kinetic electrons via fluid-kinetic hybrid electron model
  - Electromagnetic solver using PETSc
  - General geometry MHD equilibrium and plasma profiles using spline
  - Global field-aligned mesh using magnetic coordinates
  - Multi-level parallelism using mixed mode of MPI/OpenMP
  - Advanced I/O using ADIOS
- Short term priorities for GTC upgrades:
  - Full-f ion simulation (2 months)
  - Neoclassical physics (6 months)
- GTC is part of benchmark suites for OASCR, NERSC, and Cray; pioneering applications of ORNL LCF computers; INCITE FUS017; SciDAC GPS, GSEP, & CPES
- Key active developers: Z. Lin, I. Holod, W. Zhang, Y. Xiao (UCI), S. Klasky (ORNL), S. Ethier (PPPL). Supported by GPS & GSEP

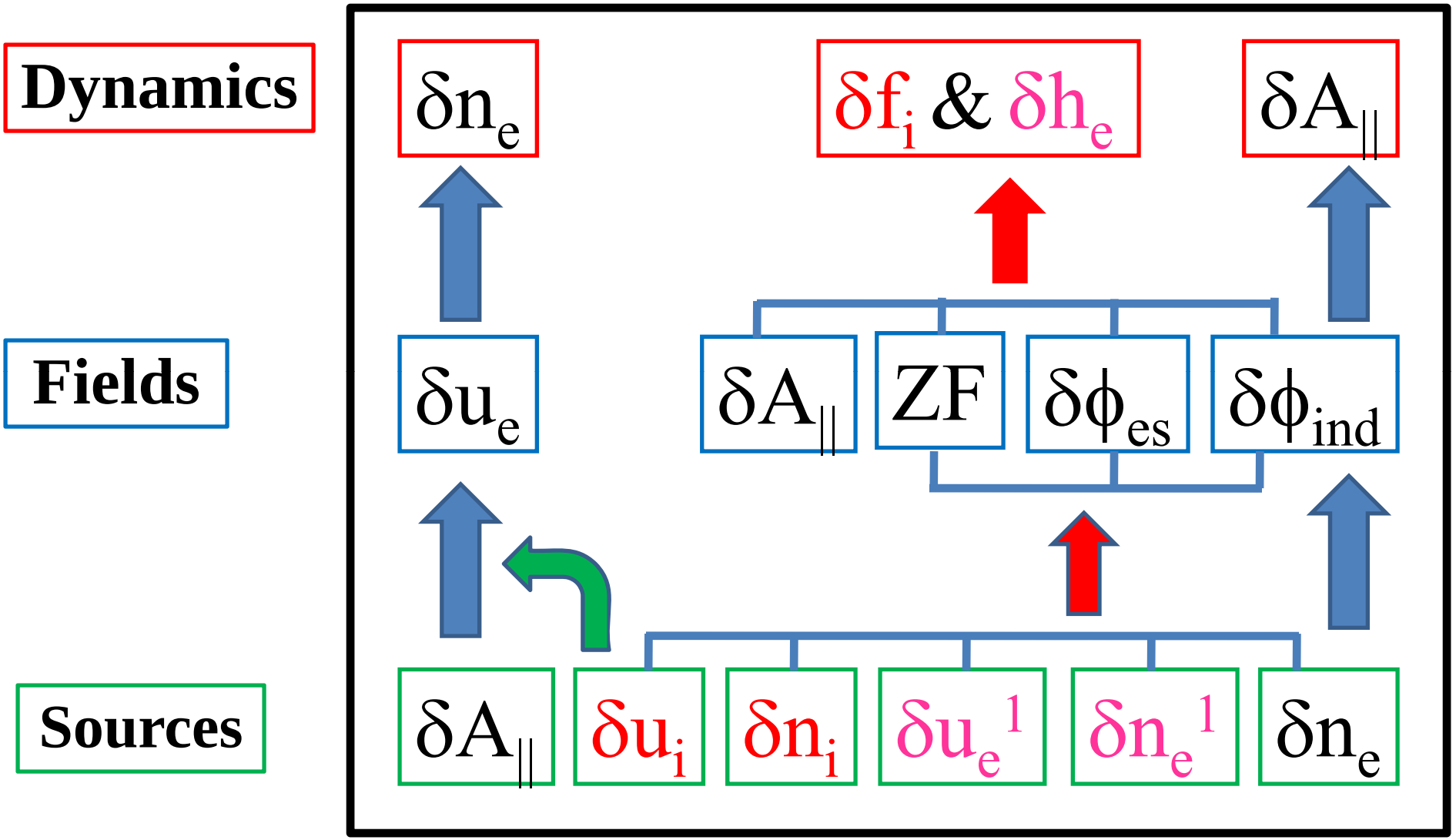
General Geometry and Profile

- MHD equilibrium data: EFIT
- Plasma profile data: TRANSP
- Single GTC version accept both analytic & numerical equilibrium
- Numerical equilibrium increases CPU time by 10% only
- Magnetic coordinates with global field aligned mesh:
  - Boozer: good for both turbulence and neoclassical
  - equal arc: only good for neoclassical





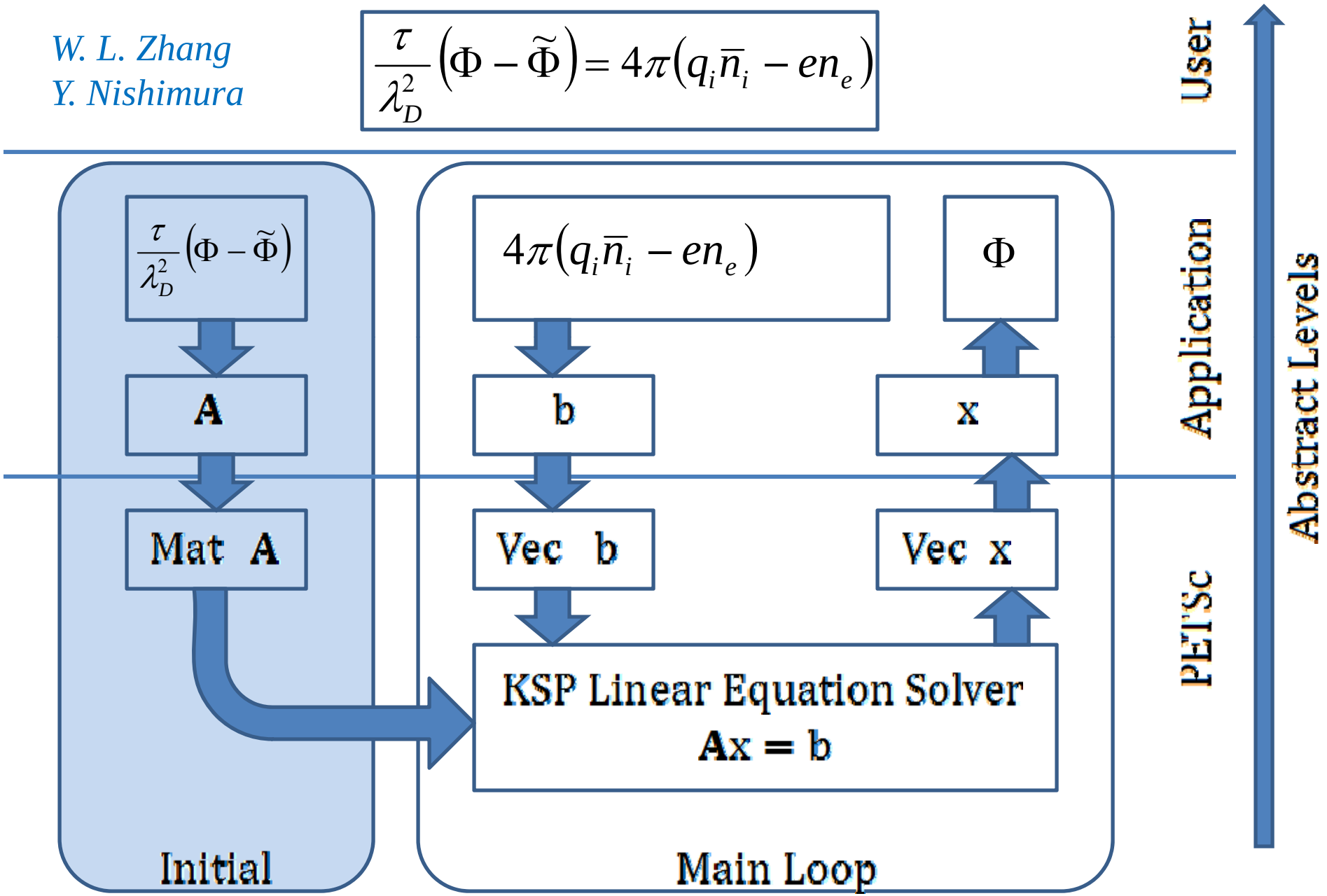
Electromagnetic GTC via Fluid-Kinetic Electron



Electromagnetic Solver Using PETSc

W. L. Zhang
Y. Nishimura

$$\frac{\tau}{\lambda_D^2}\left(\Phi-\tilde{\Phi}\right)=4\pi\left(q_i\bar{n}_i-en_e\right)$$



Advanced I/O in GTC

Y. Xiao
S. Klasky
C. Jin

- GTC I/O issues and solution
  - GTC needs to produce large amount of data for post analysis
    - 3D fluid data is of size 100G
    - Particle data is of size 100T
  - Data needs to be shared and reused
  - Implementation of ADIOS in GTC
    - Fast I/O speed: >20G/sec; Small over head: <3% CPU time
    - Smooth writing to avoid disk choke, essential huge data in parallel file system
    - Flexible data format output (bp, hdf5, netcdf)
- What is ADIOS?
  - a simplified, easy to use Application Programming Interface for scientists to write/read data, developed by Klasky et al
- Current ADIOS status in GTC
  - 2D, 3D, and particle diagnosis data enable many useful post-run data analyses
  - Restart data enables GTC to restart at every check point
  - Both have ADIO switch on/off options