

Paths to petascale computing with NIMROD

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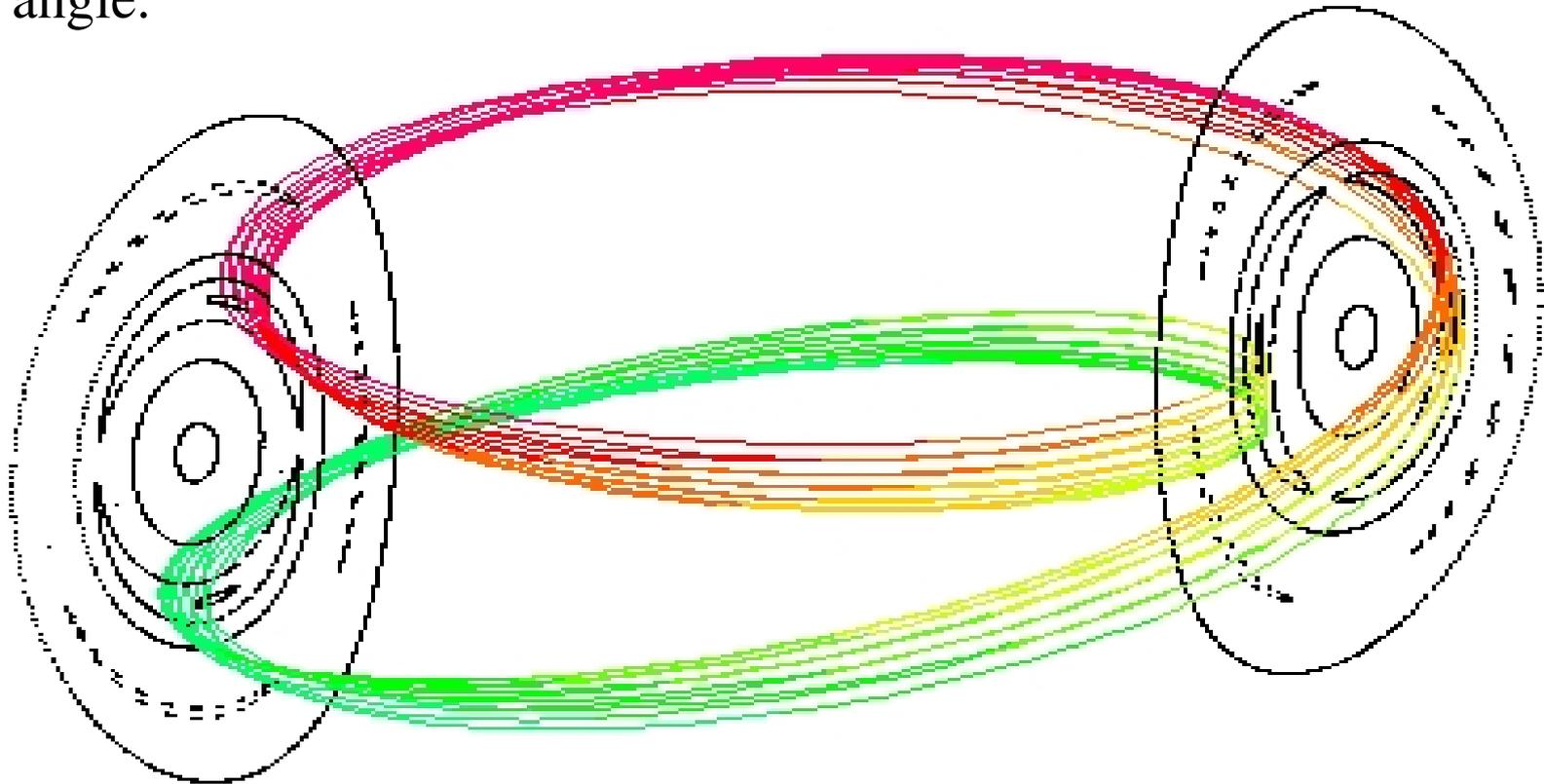
Easy approaches to using 10,000 processors.

- Simultaneously run multiple instances of NIMROD for parameter scans and convergence studies.
 - Accelerates plasma physics studies.
 - Implemented in nimcomm branch of NIMROD developers repository.
- Apply integral parallel closures (q_{\parallel} and Π_{\parallel}) in NIMROD plasma fluid simulations.
 - Calculation of integral parallel closures tantamount to solution of simplified kinetic equation in 1 spatial dimension.

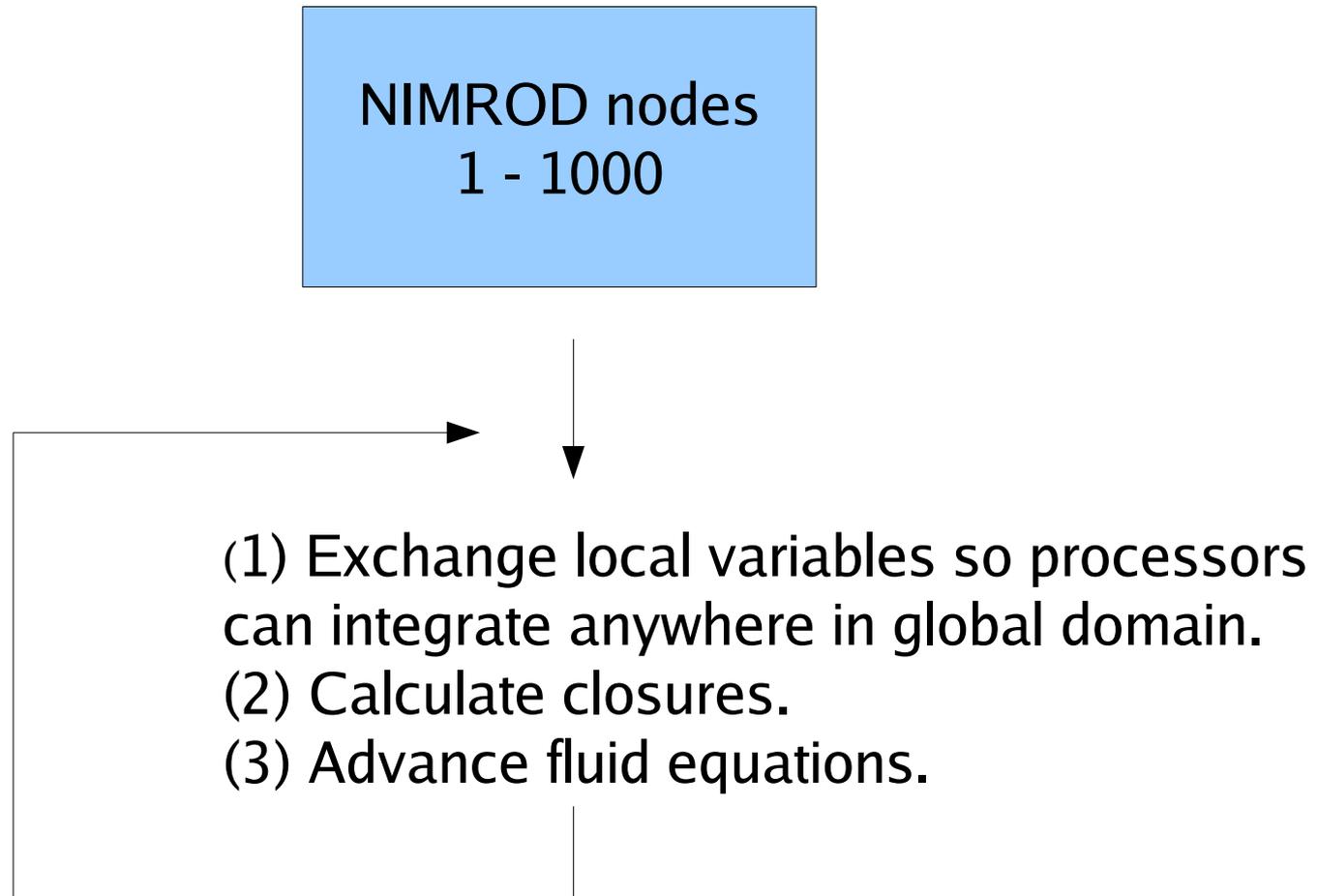
Calculation of parallel closures requires integration along magnetic field lines.

24 x 48 grid with quartic finite-elements
requires ~ 20,000 integrations at a single
toroidal angle.

$$q = \int_L dL' [T(-L') - T(L')] K(L')$$



Previous closure implementation has all processors doing both fluid and closure calculations.



Rethink NIMROD's parallel closure implementation for petascale computing.

- Independent integrations for q_{\parallel} and Π_{\parallel} are perfectly scalable.
- Closure calculation takes $\sim 1 - 10$ times longer than fluid advance.
- Implement closures in NIMROD using N fluid processors and $M*N$ closure processors, where $M > 1$.
- Petascale computing possible with $N=10^3$ and $M > 10$.

Calculate fluid and closure problems on separate groups of processors.

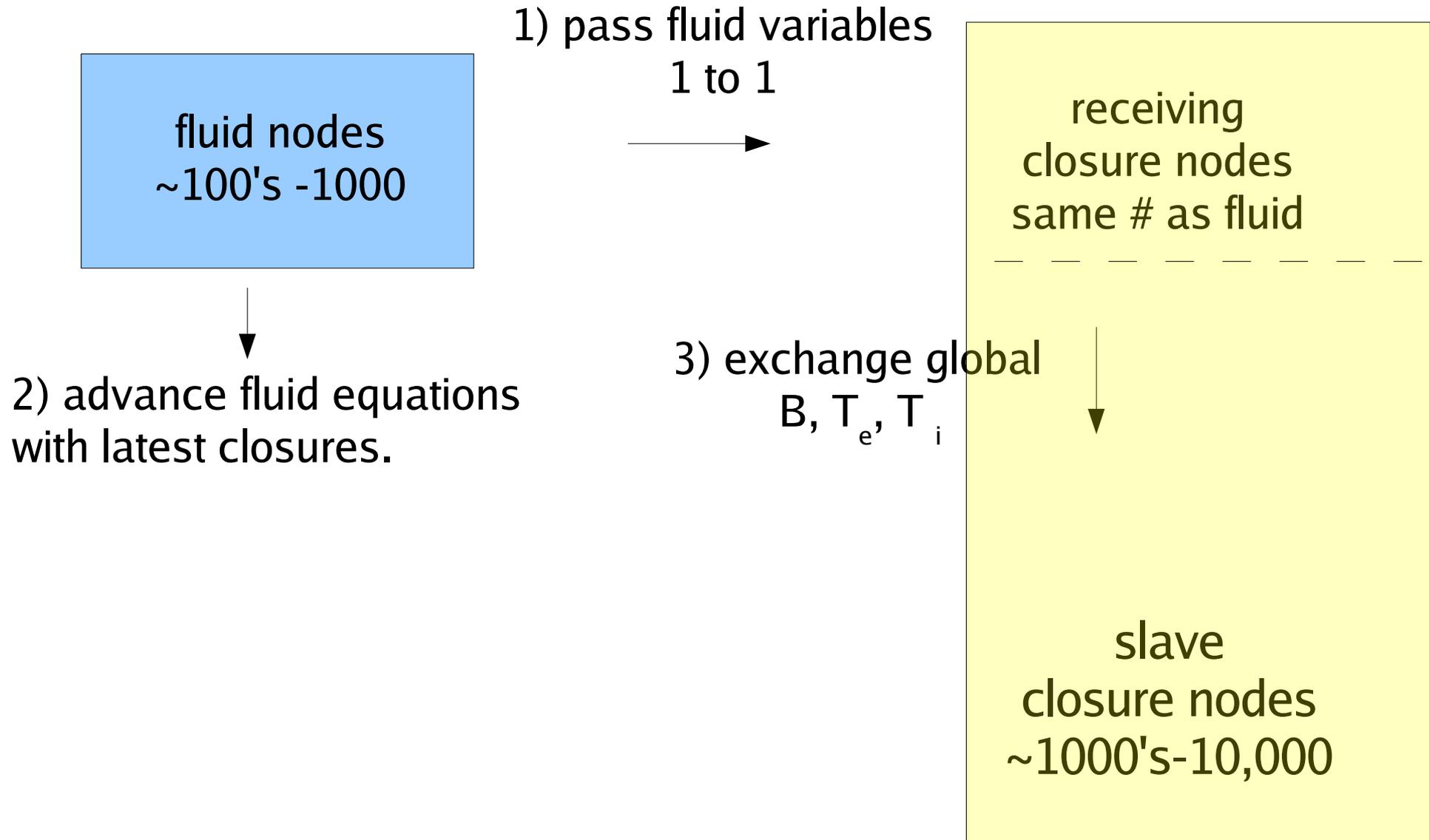
fluid nodes
~100's -1000

1) pass fluid variables
1 to 1

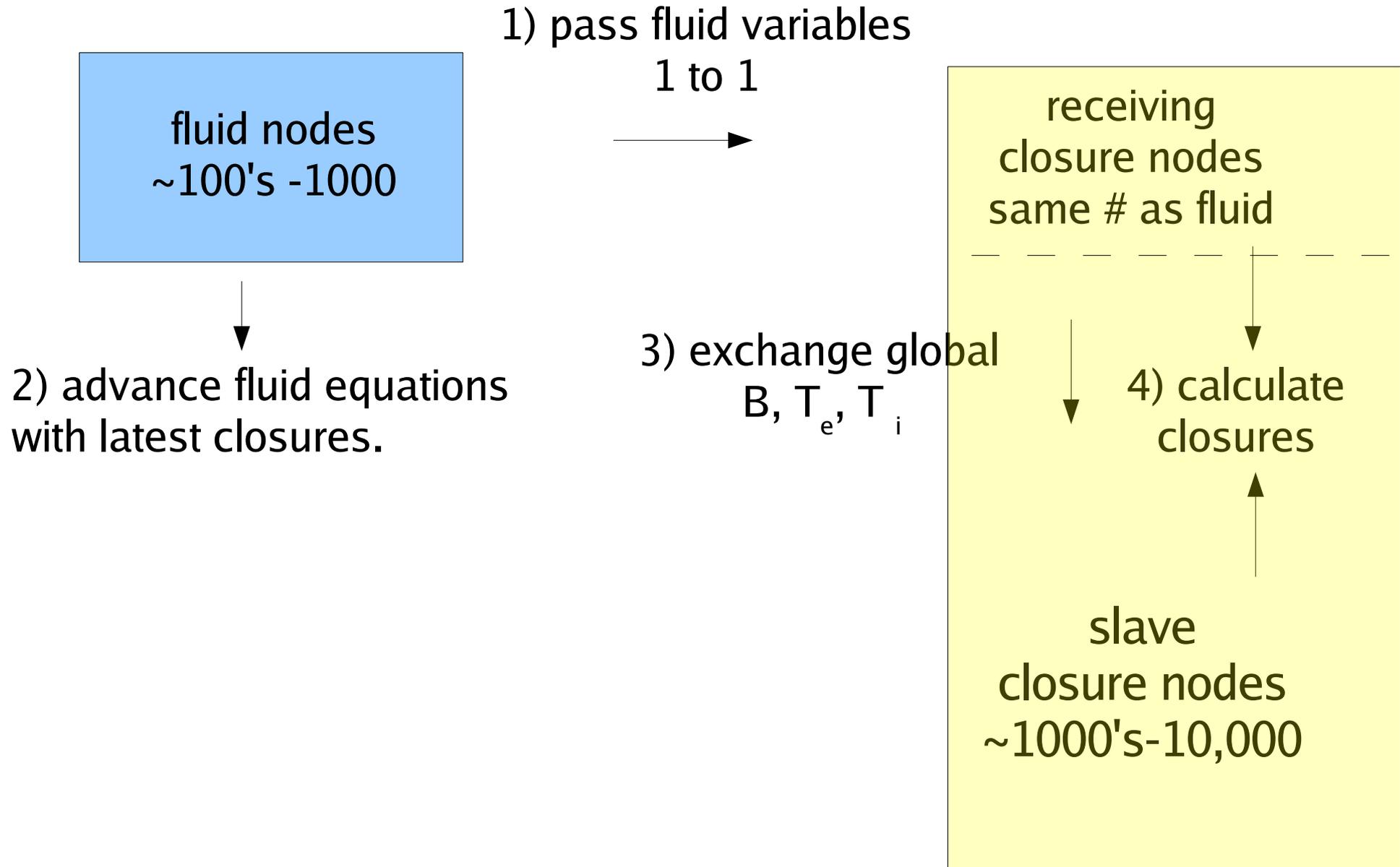


receiving
closure nodes
same # as fluid

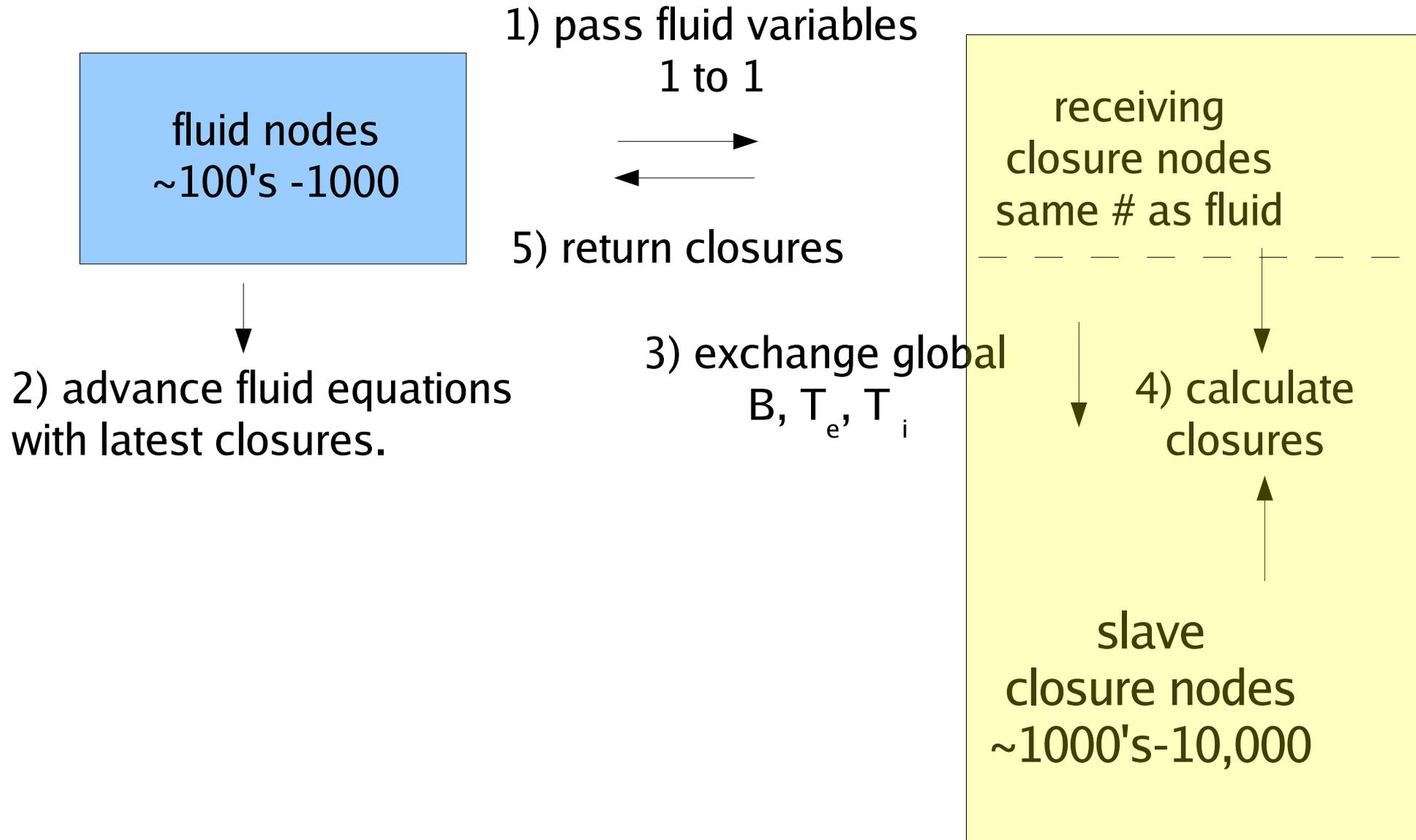
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Remaining issues.

- Initial implementation finished in NIMROD.
- In process of debugging on Bassi.
- Test implementation in simulations of heat transport for overlapping magnetic islands in slab geometry.
- Apply in NIMROD for neoclassical tearing mode simulations.