Coupling extra physics into NIMROD's two fluid model

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What is “extra” physics?

- NIMROD advances equations for n, **V**, T's and **B**.

  - Terms computed trivially from these like, p = nT, **J**= curl **B**, **E** from Ohm's Law without electron stress are not extra *physics.*

  - Numerical additions such as div **B** or n diffusion are not extra *physics.*

- *Extra physics =* closure terms for 5 moment model, **q** and Π, source terms from external drives, Q_{NB} or $\mathbf{F}_{RF}$, additional fluid equations for impurity species.

Minimal coding requirements

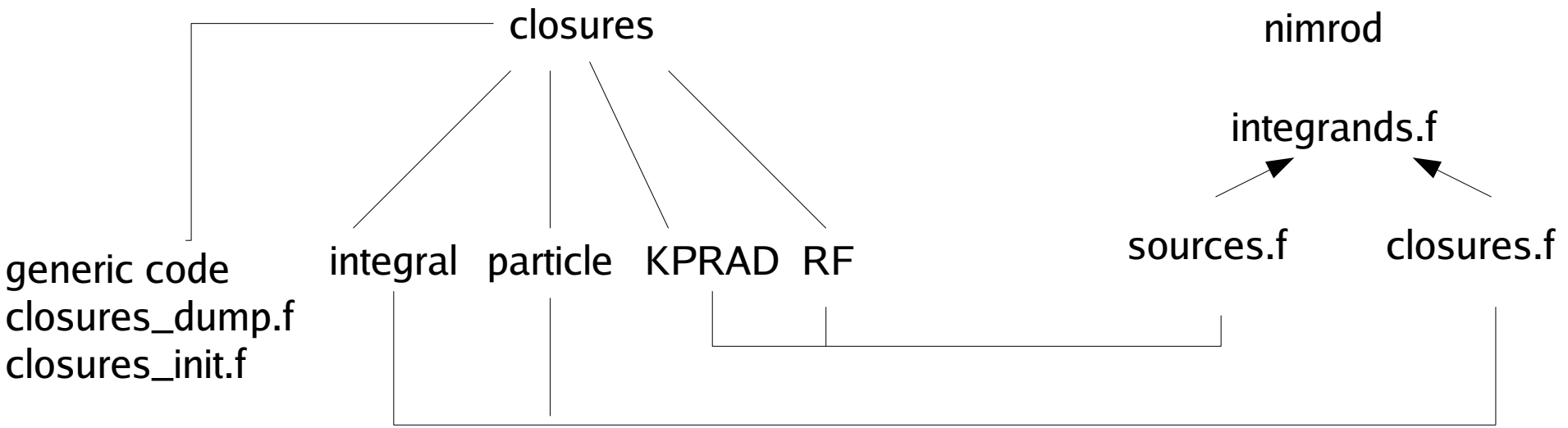
- Read in and initialize additional fields: closures_dump.f and closures_init.f

- Compute extra physics using calls in advance routines: get_cel.f (integral closures), nimpart.f (particle closures), KPRAD.f (impurities), GENRAY + CQL3D? (RF), etc ...

- Couple to fluid equations: closures.f and sources.f compute terms added in integrands.f

- Diagnose separately from nimplot: closures_plot.f?

Code Map



Nimrod calls closures_dump.f and closures_init.f and flags determine what extra physics is in play.

Questions remain.

- Do we hardwire explicit calls to extra physics calculations in NIMROD's advance routines or have generic calls to get_closures.f prior to advancing each fluid variable?
- Does all closure and source data get written to a common dumpfile or should each bit of extra physics have its own dumpfile?
- Do we have a closures_plot executable which links to needed code in nimplot directory or something else?