Characteristic decomposition for numerical simulations in GR hydrodynamics and MHD[1] SAUL TEUKOLSKY, Cornell University — Numerical simulations in GR hydrodynamics and MHD are almost universally carried out with equations written in conservative form. This allows robust handling of shocks and other discontinuities in the flow. To enforce boundary conditions and handle shocks, it is useful to be able to transform back and forth between the conservative variables and the characteristic variables. However, the required characteristic decomposition for GRMHD has proved too complicated to derive in the usual Eulerian frame used in simulations. One method that has been tried transforms the variables instead of the equations, starting with the relatively simple decomposition in the comoving frame. However, this method is extremely complicated and also does not seem able to handle both the left and right eigenvectors in full GR. To handle this problem, we introduce a new kind of transformation that is only quasi-invertible. It leads to simpler forms for the hydro case than those in the literature, and may finally make more robust methods tractable for GRMHD.

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