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Relativistic MHD in dynamical spacetimes: Improved EM gauge condition for AMR grids VASILEIOS PASCHALIDIS, ZACHARIAH ETIENNE, YUK TUNG LIU, STUART SHAPIRO, University of Illinois at Urbana-Champaign — We recently developed a new GRMHD code with AMR that evolves the electromagnetic (EM) vector potential A_i instead of the magnetic fields directly. Evolving A_i enables one to use any interpolation scheme on refinement level boundaries and still guarantee that the magnetic field remains divergenceless. As in classical EM, a gauge choice must be made when evolving A_i, and we chose a straightforward "algebraic" gauge condition to simplify the A_i evolution equation. However, magnetized black hole-neutron star (BHNS) simulations in this gauge exhibit unphysical behavior, including the spurious appearance of strong magnetic fields on refinement level boundaries. This spurious behavior is exacerbated when matter crosses refinement boundaries during tidal disruption of the NS. We demonstrate via an eigenvalue analysis and a numerical study that zero-speed modes in the algebraic gauge, coupled with the frequency filtering that occurs on refinement level boundaries, are responsible for the creation of spurious magnetic fields. We show that the EM Lorenz gauge exhibits no zero-speed modes, and as a consequence, spurious magnetic effects are quickly propagated away, allowing for long-term, stable magnetized BHNS evolutions.

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