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Direct Numerical Simulation of Mechanically Driven Turbulent Dynamos in Spherical Geometry KLAUS REUTER, FRANK JENKO, Max-Planck-Institut fuer Plasmaphysik, CARY FOREST, ADAM BAYLISS, University of Wisconsin-Madison — A parallel version of a nonlinear pseudo-spectral MHD code for the simulation of liquid metal dynamos in spherical geometry was developed using a domain decomposition technique. The parallel code exhibits ideal scaling going up to 8 CPUs on shared-memory machines. At 16 CPUs, it still achieves efficient speedups between 14 and nearly 16. Given today's computational speed, it is now possible to resolve fluid Reynolds numbers of $\mathrm{Re} \approx 4000$ in the simulations, whereas previous serial computations were limited to $\mathrm{Re} \approx 1500$. Direct numerical simulations are performed to explore the dynamo threshold $\mathrm{Rm}_{\mathrm{crit}}$ (the critical magnetic Reynolds number) in Re-Rm-space for the flow profile of the Madison Dynamo Experiment. The shape of $\mathrm{Rm}_{\mathrm{crit}}$ has been determined up to $\mathrm{Re} \approx 3000$. Furthermore, the code was adapted to model the driving of a new generation of dynamo experiment using plasma instead of liquid metal. By employing pure toroidal driving in two thin counter-rotating hemispherical shells along the walls, numerical simulations show that the system reaches a quasi-stationary state with a self-excited magnetic field.

Klaus Reuter
Max-Planck-Institut fuer Plasmaphysik

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