

# SOLAR DYNAMO : EXACT SOLUTION IN IDEAL MHD FOR GIVEN RADIAL, POLOIDAL OR TOROIDAL FLOWS

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In a previous paper (Callebaut and Khater, IAUS 233, 'Solar Activity and its Magnetic Origin', Eds. V. Bothmer and A. A. Hady, Cambridge UP, 2006, p.9) we gave the exact solution in spherical coordinates of the ideal MHD evolution equation provided the velocity is purely toroidal. The toroidal flow generates a toroidal field from the poloidal components of the magnetic field as a result of the differential rotation. The relevance for the solar dynamo is obvious. However, several dynamo theories attempt (as a second step) to regenerate a poloidal field from the new field (or from its remains after losing energy in sunspots, etc.). Hence we consider here purely poloidal and purely radial flows and obtain the exact solution. Again the main feature is that the growth is linear in time and proportional to a Jacobian constructed from the velocity and the flux function of the components of the magnetic field perpendicular to the flow. The result may be applied to the meridional motion (first its surface latitudinal part and next its radial part, then its inner latitudinal part and again a radial part) or to (the inward part of) convective cells.