Hysteresis near transition of the large-scale dynamo in presence of the small-scale dynamo

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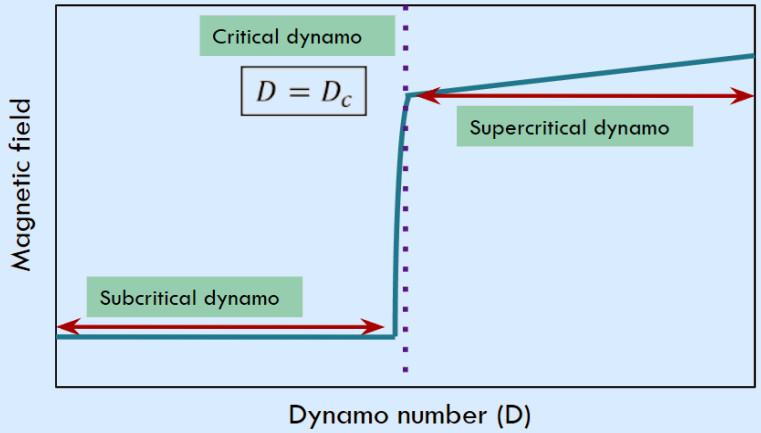
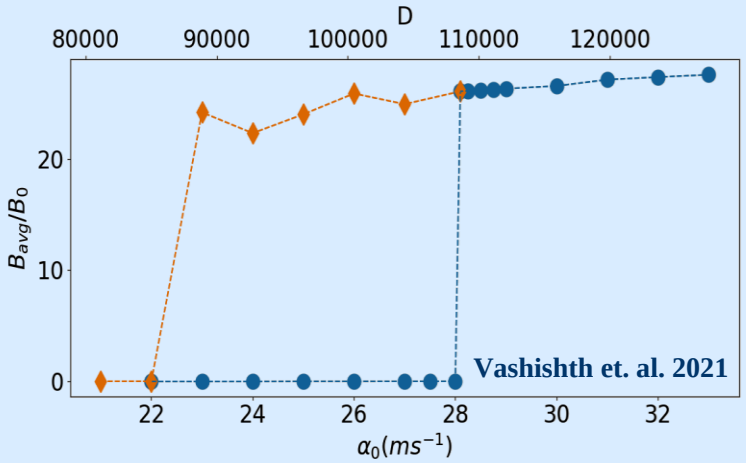
IAU Symposium 365

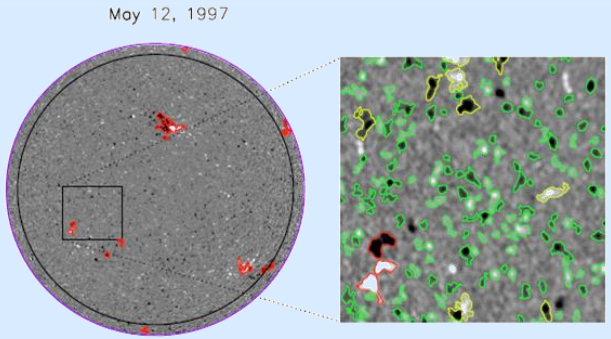
Solar dynamo: Large-scale:

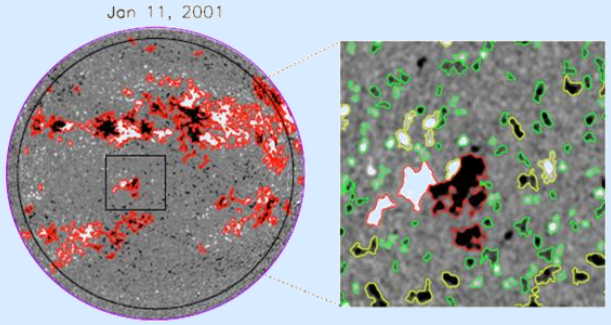


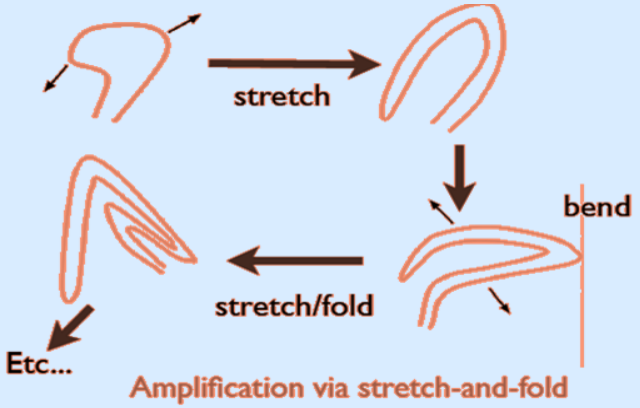


- Crucial parameter that governs the dynamo is the **dynamo number,** $\mathbf{D} = \frac{\alpha \Delta \Omega R^3}{\eta^2}$
- In dynamo hysteresis, two dynamo solutions are possible depending on the initial parameters used.

Small-scale (local) dynamo:







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Large-scale field:

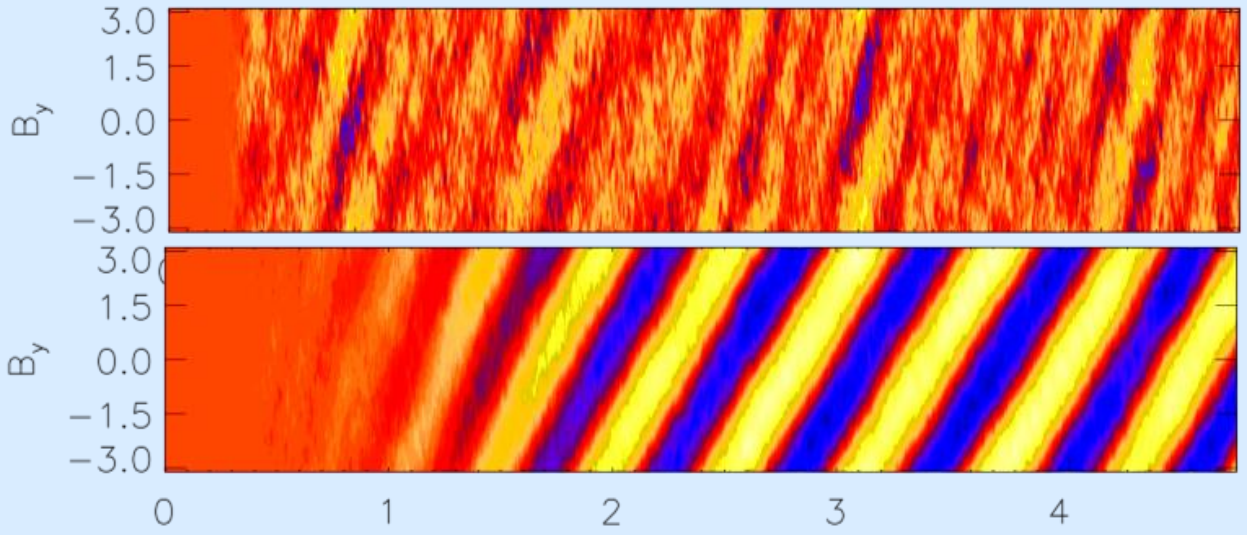


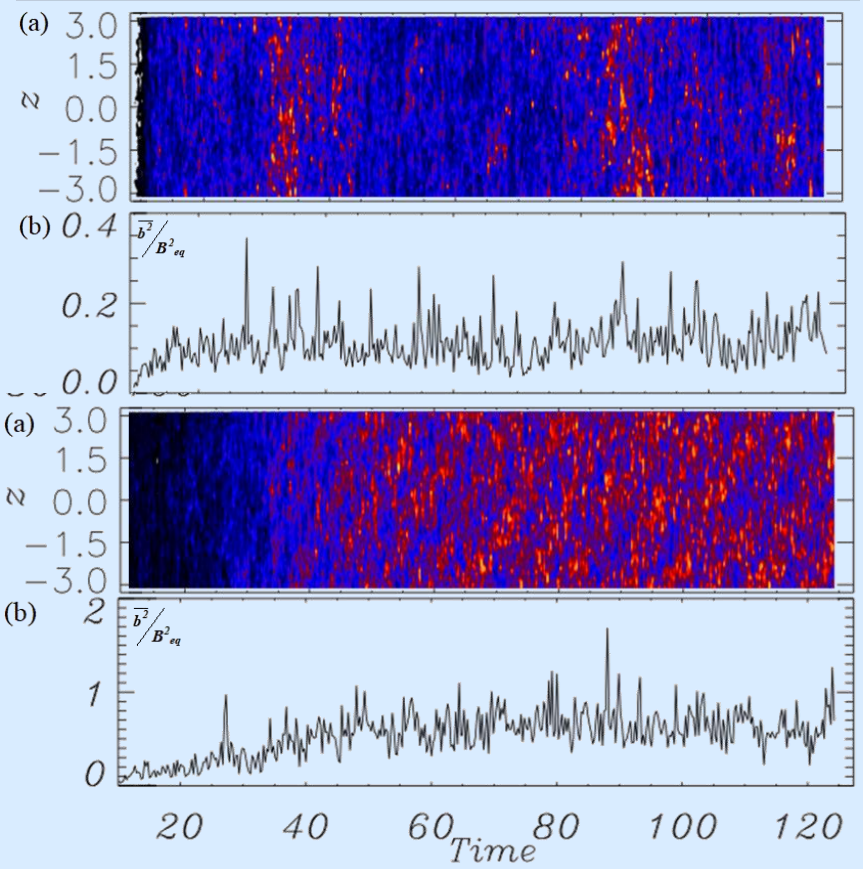
Figure: Butterfly diagrams of B_y as functions of z and t, normalized by the diffusive time scale for the

(a) Decaying resultant field at Subcritical dynamo regime , and

(b) Oscillating field for the Critical dynamo,

when the simulation was started with a weak magnetic field.

Small-scale (local) dynamo:



Butterfly diagram of the energy density of the large-scale magnetic field B^2, and (b) time series of the small-scale field b^2 at z = 0 for the subcritical and critical dynamodynamo

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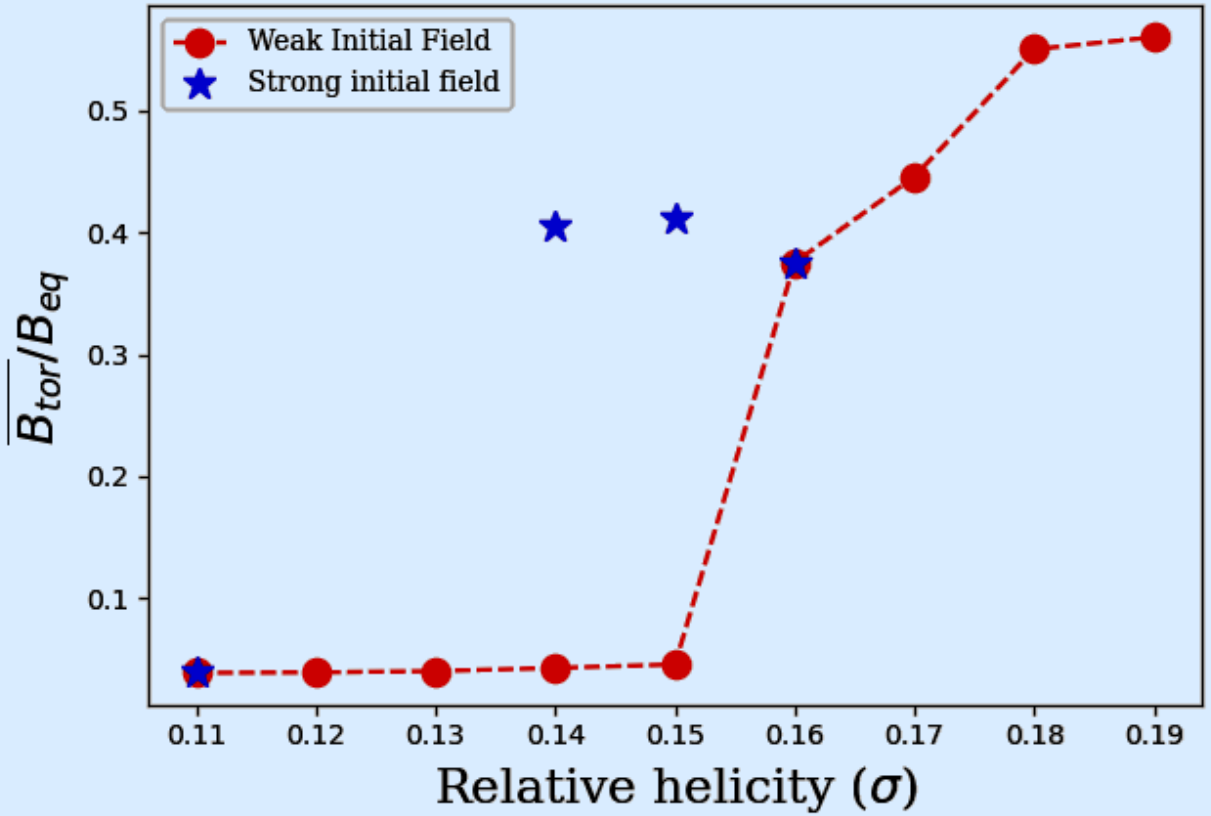

Figure shows the variation of the temporal average of the mean toroidal field when from simulations started with a weak field. (red) and from simulations started with strong field of previous simulation (blue).

Conclusions

- **With the help of PENCIL CODE, we have set up an $\alpha\Omega$ dynamo simulation which excites both large-scale and small-scale dynamo.**
- **We observed the dynamo transition and hysteresis of the large-scale dynamo in the presence of the small-scale dynamo.**