

# Solar Surface Magneto- Convection

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## Is there a Solar Surface Dynamo?

Answer: There is a global  
small scale dynamo

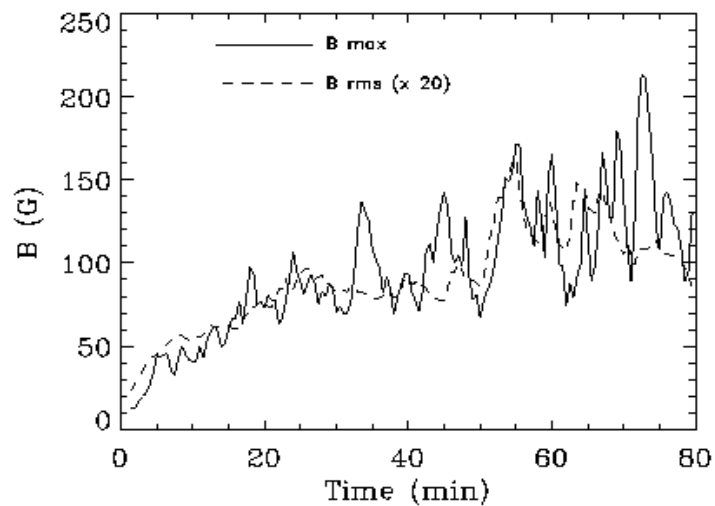
## Simulation

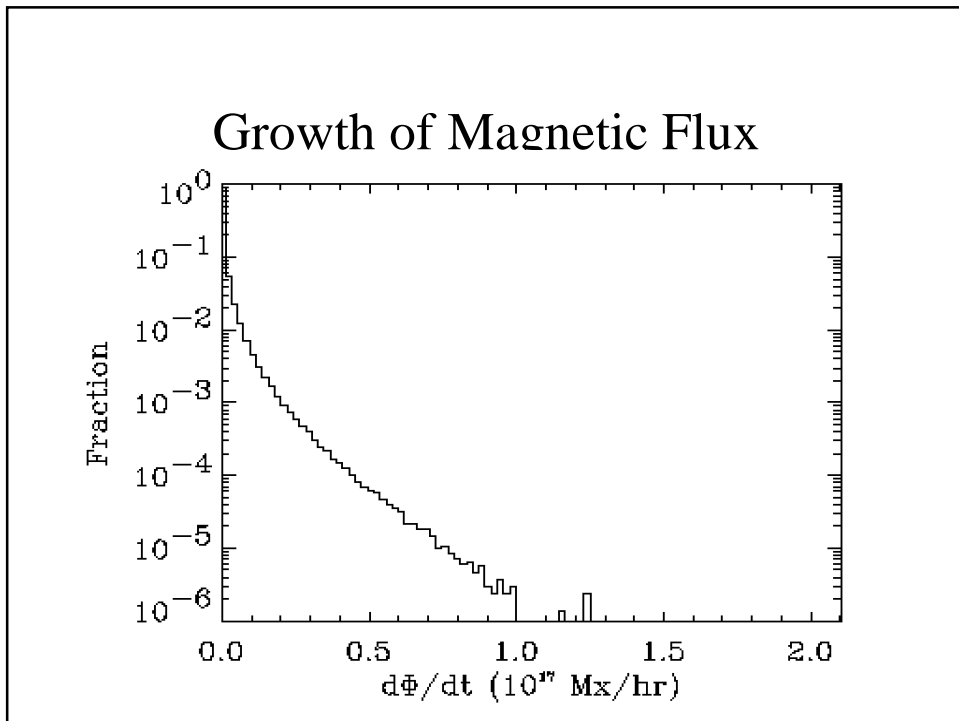
- Snapshot of hydrodynamic convection
- Impose 1G horizontal seed field
- Top boundary:  $B \rightarrow$  potential field
- Bottom boundary: inflows advect 1G horizontal field

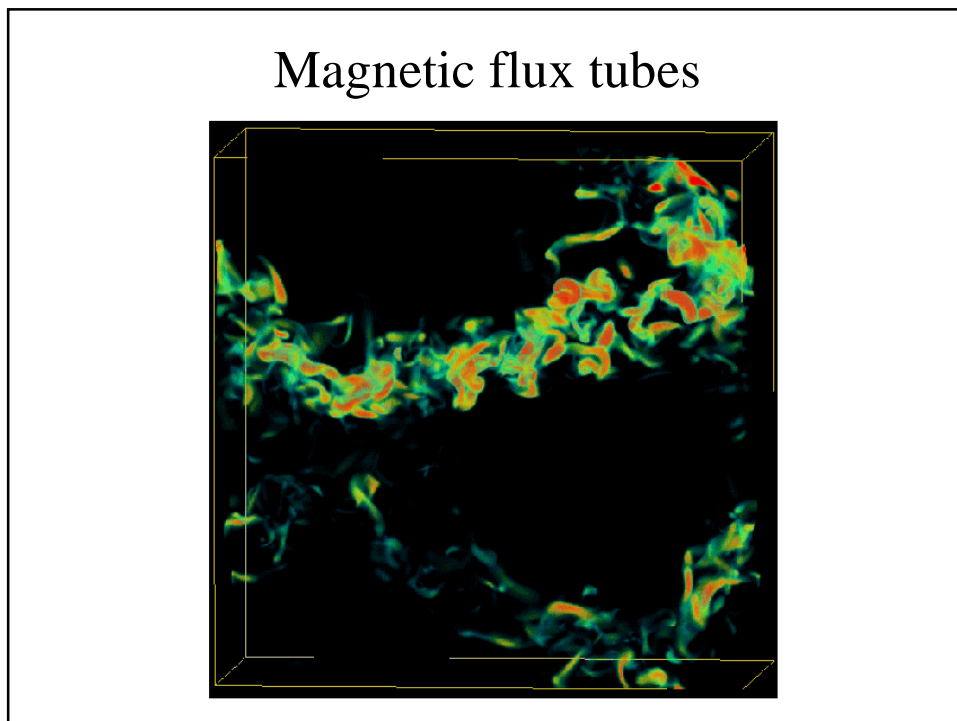
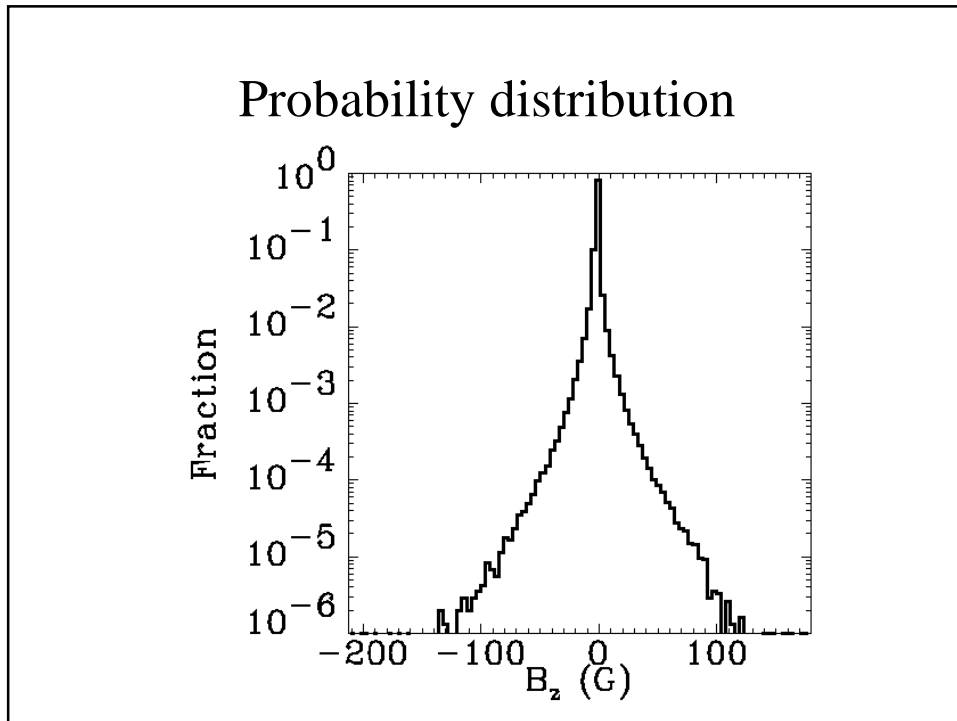
## Dynamo requirements

- Magnetic field amplification by stretching and twisting
- Diffusion to reconnect magnetic field lines and alter magnetic topology
- Circulation to continue process

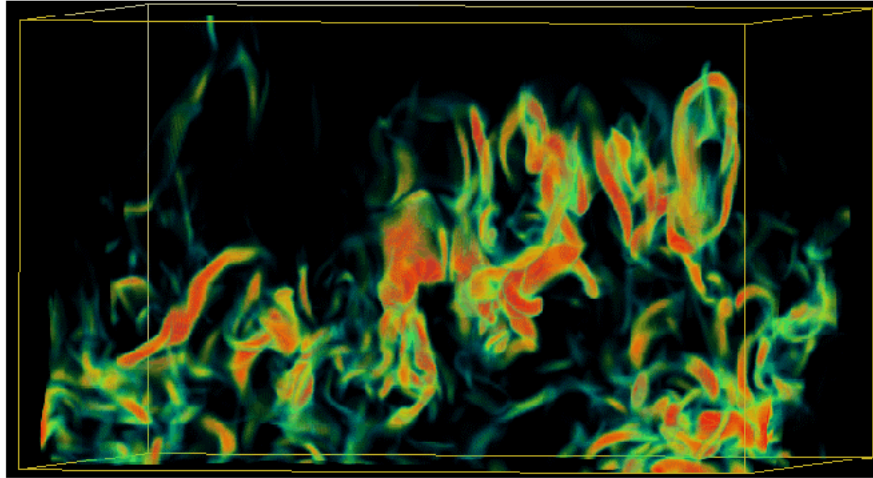
## Growth of Magnetic Field



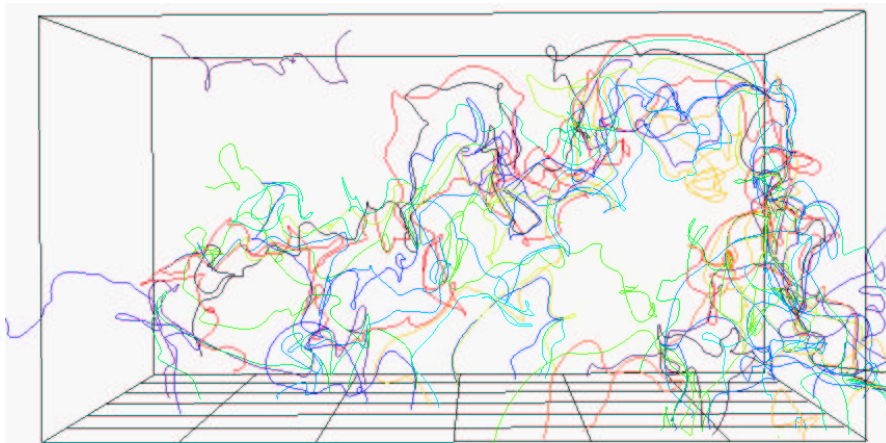




## Magnetic Flux Tubes



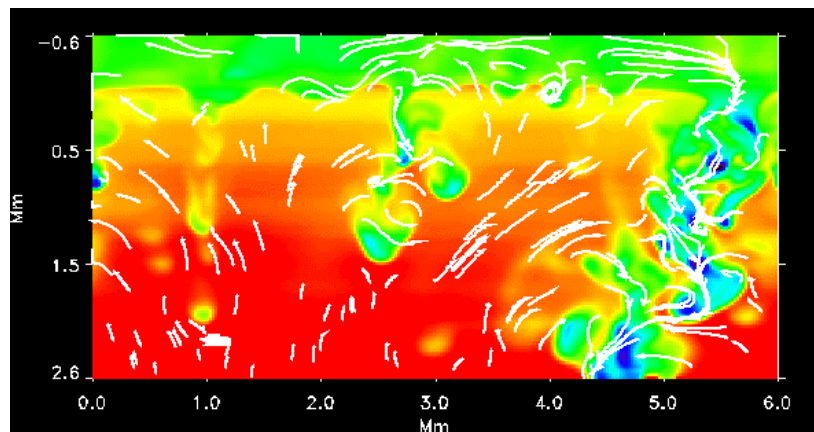
## Magnetic field lines



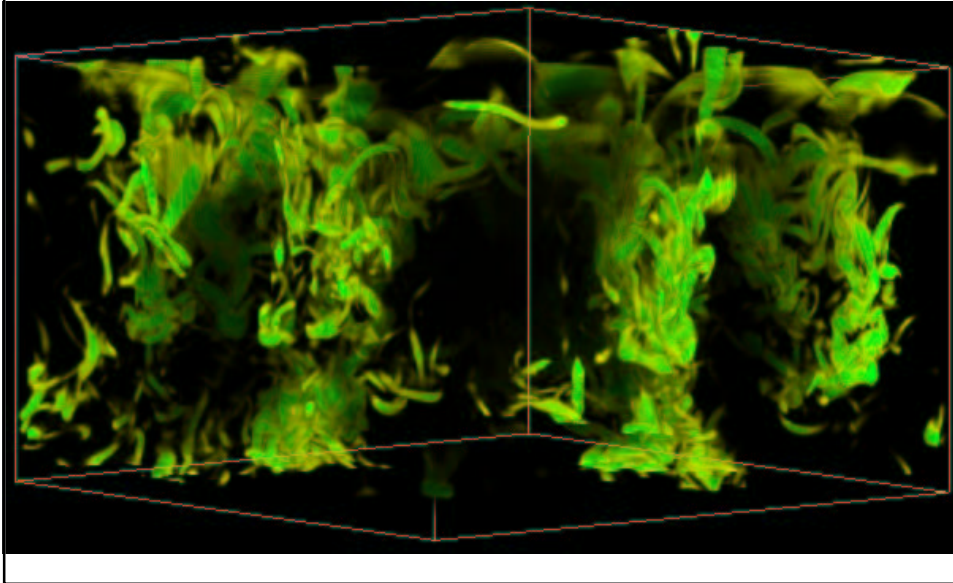
## Why NO Surface Dynamo?

- Little local re-circulation

Fluid flow  
little re-circulation



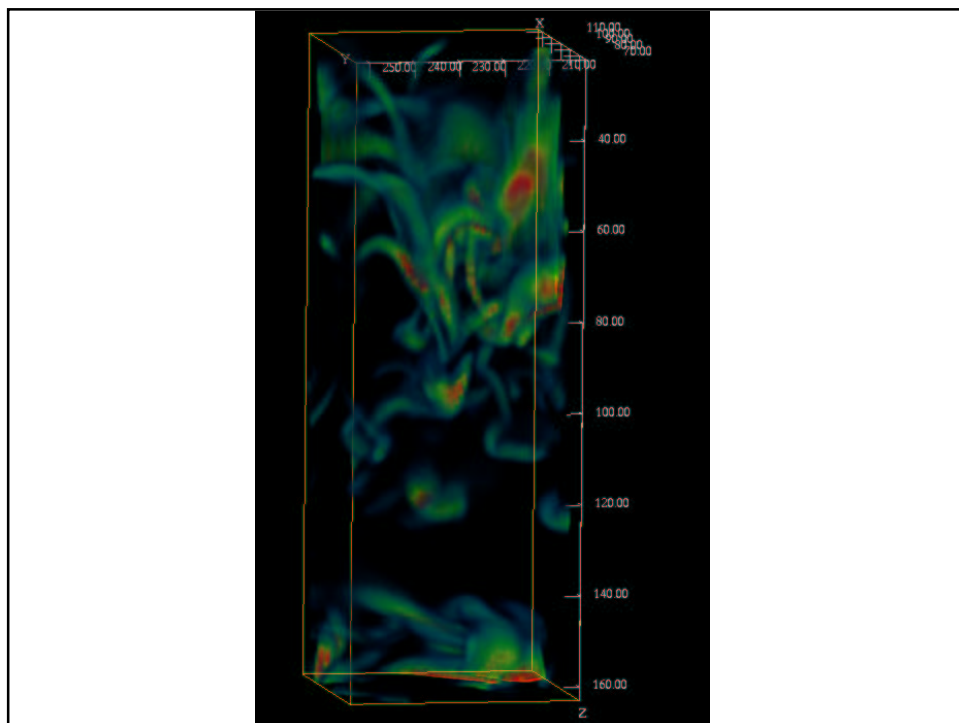
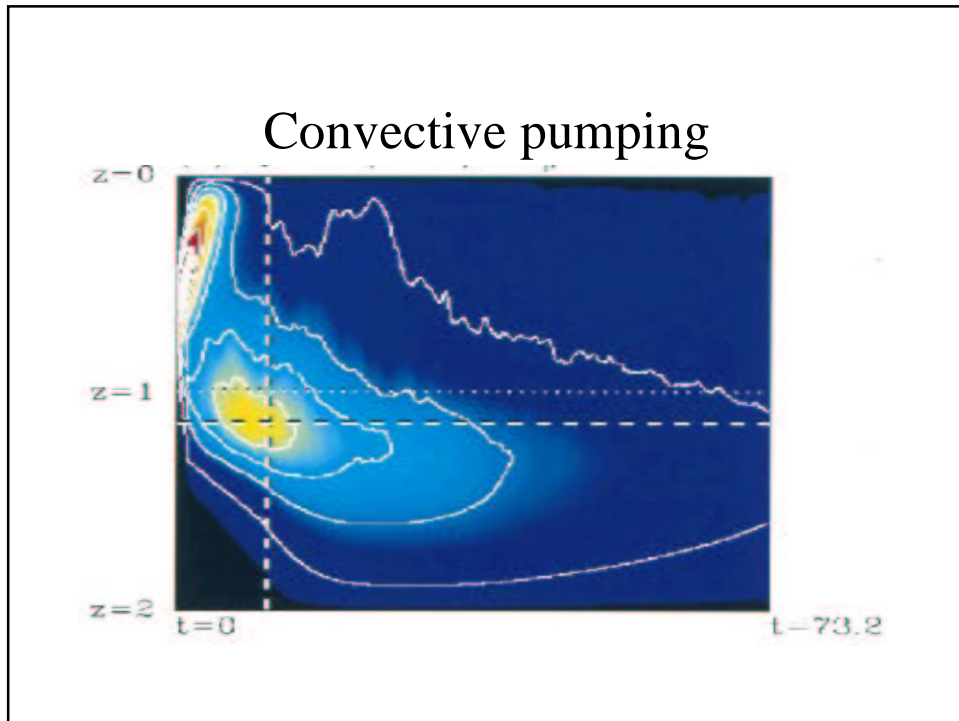
## Vorticity



## Why NO Surface Dynamo?

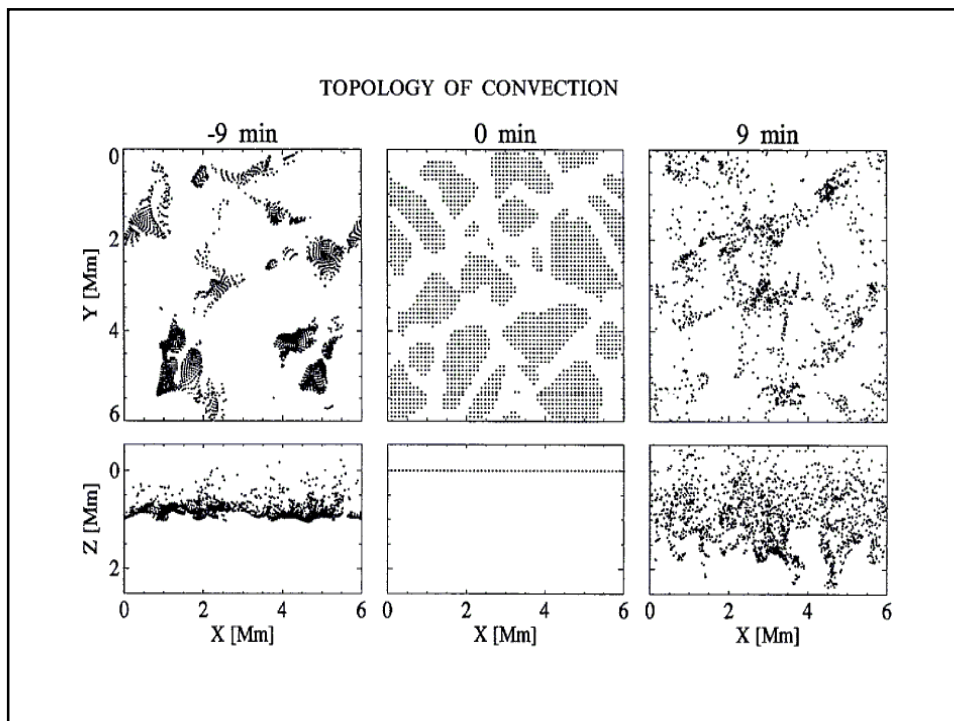
- Little local re-circulation
- Magnetic field is carried down by downdrafts to bottom of convection zone

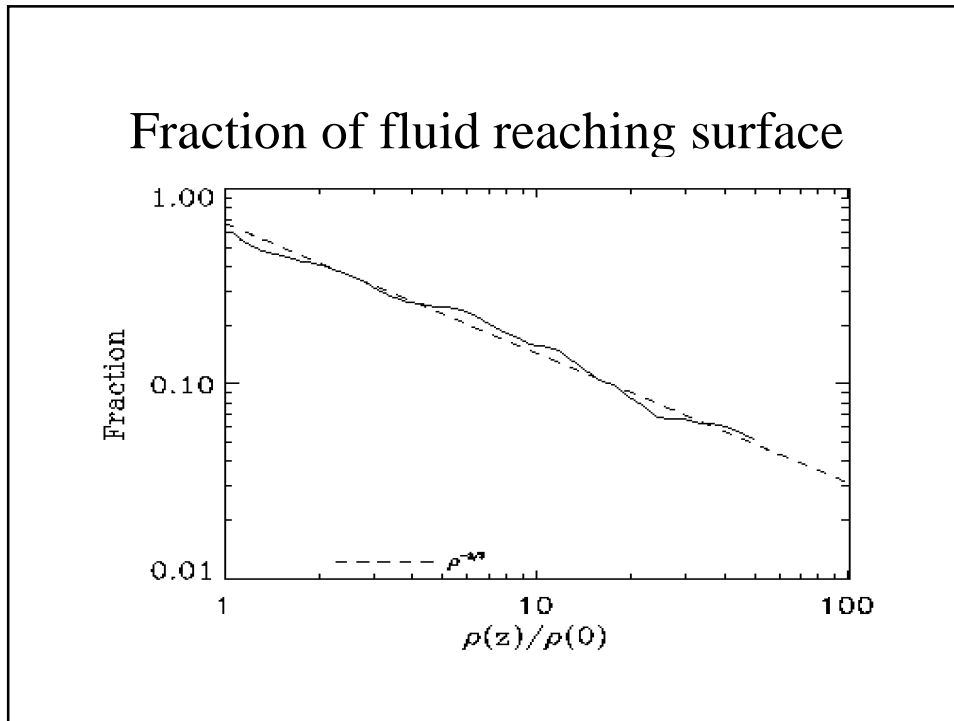




## Why NO Surface Dynamo?

- Little local re-circulation.
- Magnetic field is carried to bottom of convection zone by downdrafts.
- Turnover time at bottom of convection zone is months.
- Only small fraction of plasma starting up from bottom of convection zone reaches the surface.





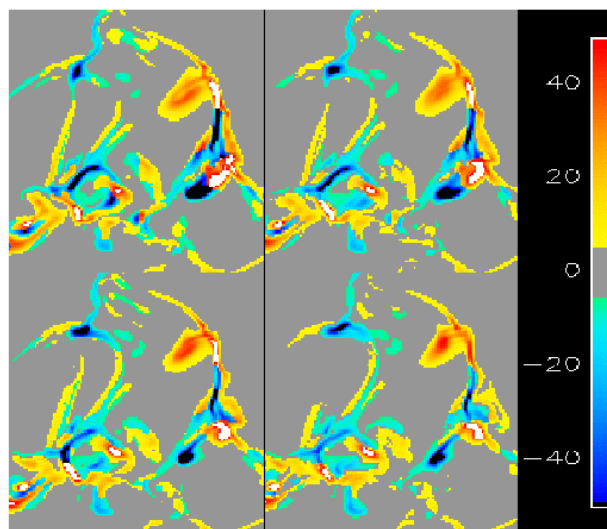
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- Turnover time at bottom of convection zone is months.
- Only small fraction of plasma starting up from bottom of convection zone reaches the surface.
- Re-circulation is global, time scale is long

## Small Scale Global Dynamo

- Small scale magnetic flux
- Global circulation
- Long time scale ( $\gg$  magnetic cycle)
- Seed field from dispersal of active regions  
→ dependence on solar cycle

## Flux Emergence & Disappearance



Next: follow field lines in time

- [Field lines](#)

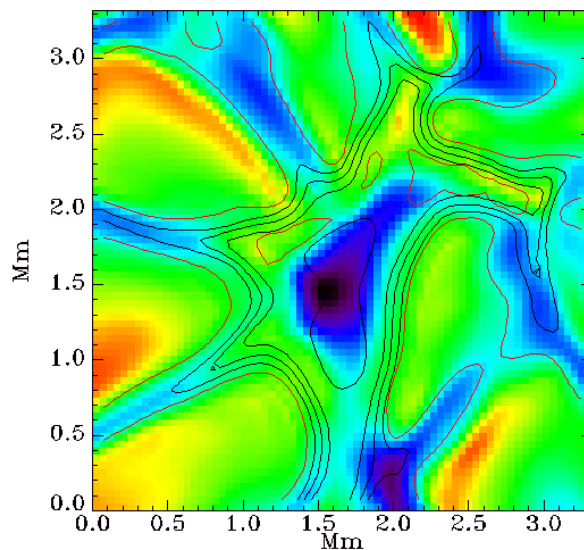
# Micropores

David Bercik - Thesis

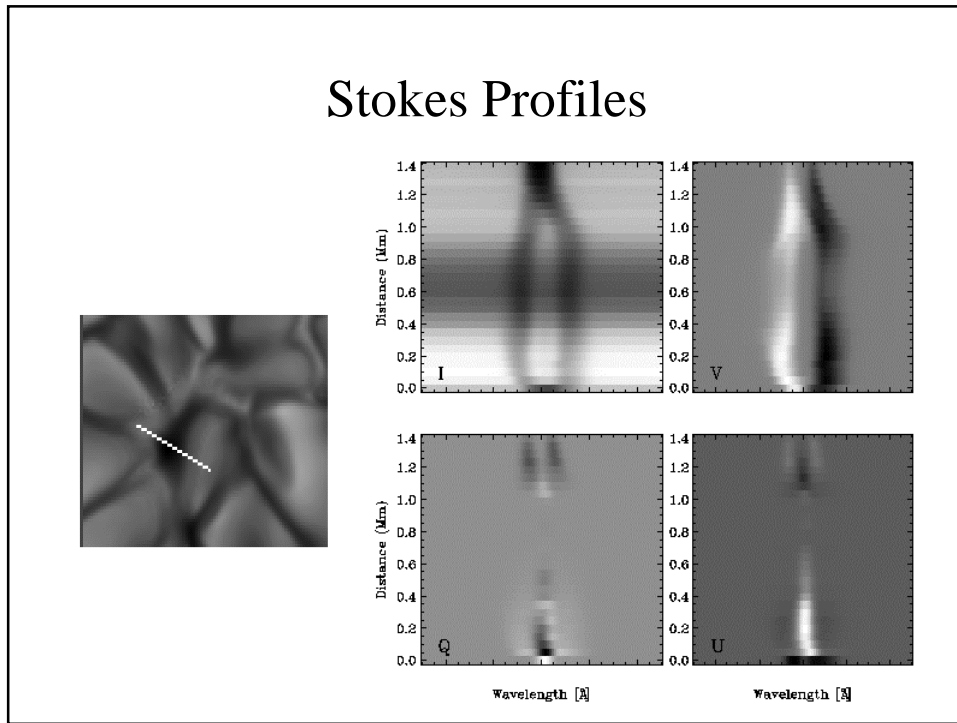
## Simulation

- Snapshot of hydrodynamic convection
- Impose 400G uniform vertical field
- Top boundary:  $B \rightarrow$  potential field
- Bottom boundary:  $B \rightarrow$  vertical

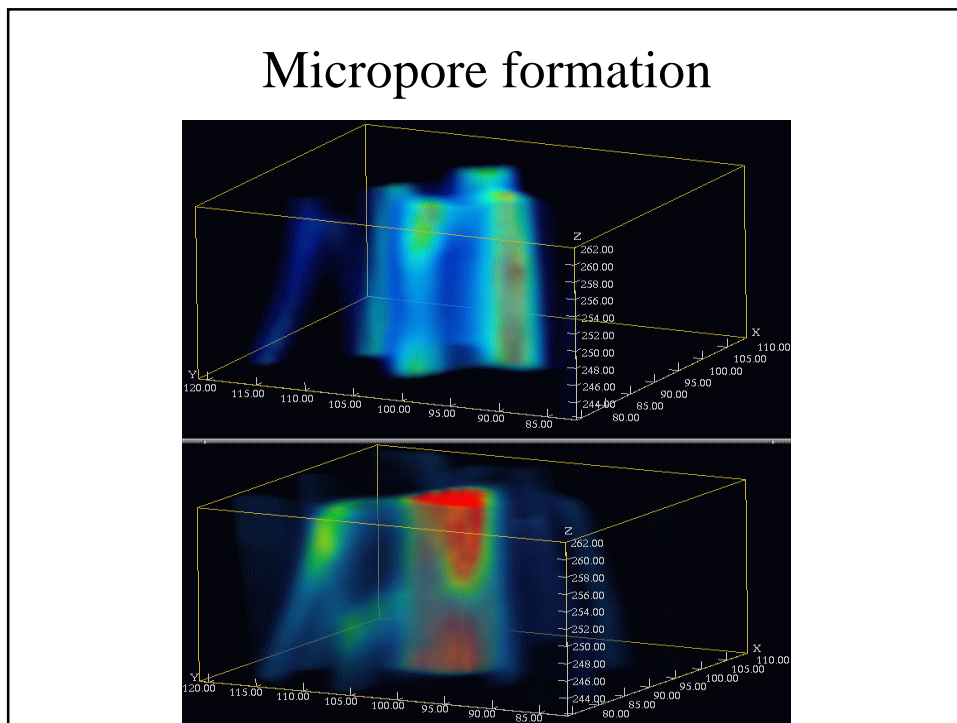
## Micropore

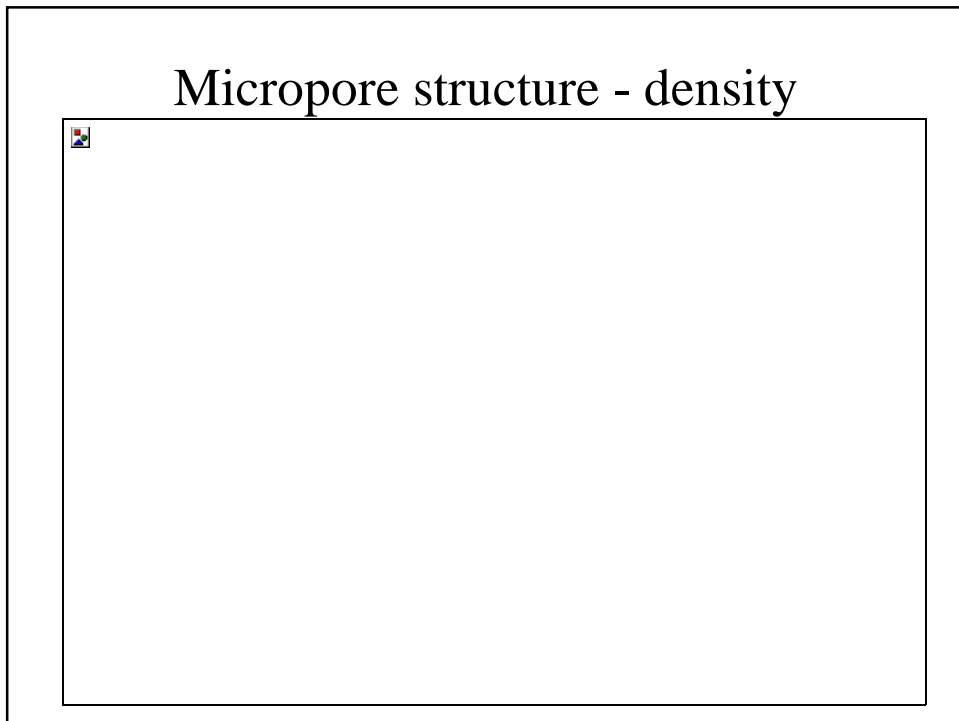
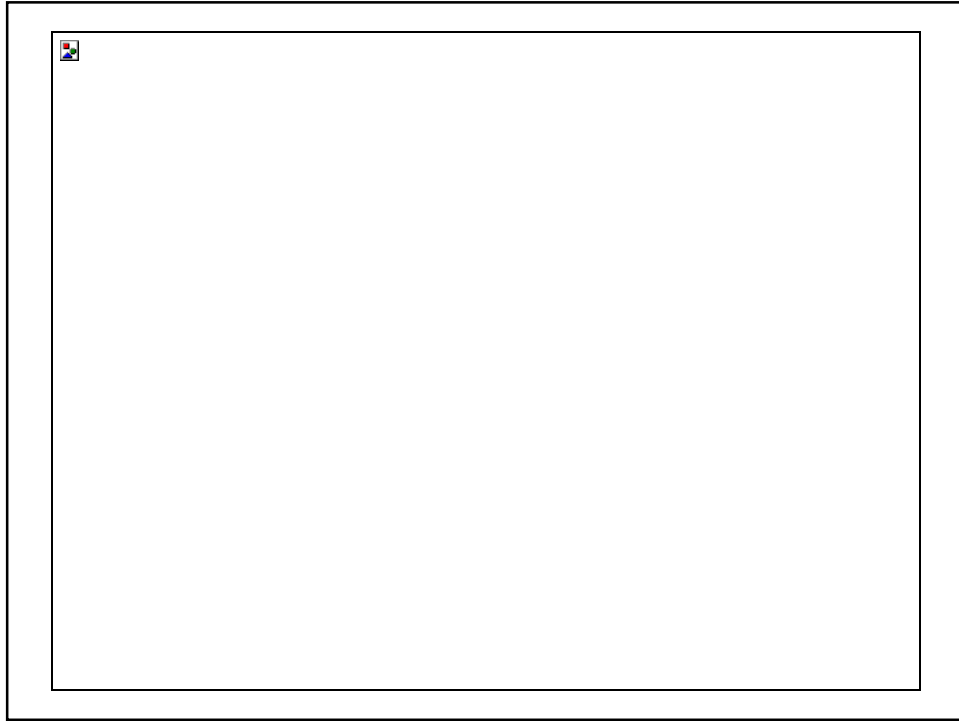


## Stokes Profiles



## Micropore formation







## Micropore structure - temperature

