**Topics for Today**

- What *helioseismology* shows about flows and structures deep inside the Sun
- How the Sun builds (and destroys) its *magnetic fields*: sunspots, flares, big loops
- Homework #2 due this Friday
- Observatory Night #2 tomorrow, Thurs, Feb 5 -- again by sign-up
- Review Sheet available for in-class Exam 1 on Fri 13 Feb (review session Wed 11 Feb)

**Reading Clicker Q**

A. What are the solar “layers”, in going from deep inside to outside?

- A. core, radiation zone, convection zone, photosphere, chromosphere, corona
- B. core, radiation zone, convection zone, corona, chromosphere, photosphere
- C. core, corona, radiation zone, convection zone, photosphere, chromosphere

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**Convection Zone and Radiative Interior**

- DEEP SHELL
- VERY TURBULENT CONVECTION
- DRIVES STRONG DIFFERENTIAL ROTATION

**Helioseismology: Millions of sound waves available to probe solar interior**

- Some waves noodle just below the surface
- Others almost make it to the center
- All excited by turbulent granulation visible in photosphere
**SOLAR OSCILLATION MODE**

One of millions of modes, each with a different tone!

**“Power Spectrum” of Solar Oscillations**

Each oscillation mode has a distinctive (measurable) tone
Sensitive to how sound speed varies with depth
Tests models of inside temperature
Observed from SOHO and GONG

**Interior Differential Rotation Profile**

Big surprises:
Fast equator, slow pole -- over most of convection zone
Tacholine of strong shear at its base
Radiative zone rotates uniformly

**Solar Rotation Profiles**

Variation with radius and latitude
TWO DYNAMOS:
Global magnetic fields built in tachocline
Small-scale fields in near-surface shear zone

**Helioseismic Probing of Near-Surface Shear Zone:**

Synoptic Mapping of SSW over Full Rotation

Global Patterns of SOLAR SUBSURFACE WEATHER
Meandering flows like jet streams, interact with active regions

**SSW in Global View, Apr 2002**
SSW Flows Changing as Cycle Progresses

SURFACE FEATURES

Now on to SOLAR MAGNETISM

Clicker -- Solar Wind

E.

- What are effects of the Earth being “bathed” in the wind of solar particles, especially when wind has strong hiccup?
  - A. “Auroral lights” visible at night
  - B. Electric power grids have problems
  - C. Short-wave radio talk interrupted
  - D. Satellites (and beepers) may get fried
  - E. All of the above

Northern Lights (Aurora Borealis)

Solar Wind and Earth’s Magnetosphere

Earth’s Magnetic Field
Is Shaped by Solar Wind
UV view of solar magnetism

Cycles of ‘magnetic activity’

Sunspot in White Light

Finest close-up.

11-year Cycles of Solar Activity

Butterfly Diagram

Reading for Next Class

- Start overview Chap 16, Properties of Stars
- Next lecture finishes Solar Magnetism, goes on to studies of other stars