An asteroseismic data-interpretation pipeline for Kepler

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"From a theorist's perspective, the light goes in here, and the answers come out here."

– Art Cox

Schematic pipeline



pulsation frequencies and other constraints

ASTEC + ADIPLS

optimal parameters, other model output



teragrid bluegene



desktop workstation

Global search: parallel GA



- Genetic algorithm probes a broad range of possible model parameters
- Finds optimal balance between asteroseismic and other constraints

Fitting for stellar age



- Large frequency spacing <Δv> decreases almost monotonically with age
- Binary decision tree to fit age from the observed large frequency spacing
- Calculates only radial modes until final step, scales surface effects

Correcting for surface effects



- Incomplete modeling of surface convection zone leads to systematic errors
- Parameterize the offset, calibrate with solar data, apply homology scaling
- For near-optimal models, this procedure is enough to correct β Hydri data

Local analysis: SVD+LM



- We use each GA result as an "initial guess" for the local analysis
- SVD probes information content of the seismic and other observables
- Levenberg-Marquardt method for optimization and error analysis

The Future

- Apply to existing ground-based asteroseismic observations to calibrate the method – initially on Sun-as-a-star data, then for other stars.
- Refine this objective automated pipeline using space-based asteroseismic data, allowing for hundreds of analyses simultaneously.
- Provide on-demand model-fitting through the TeraGrid as a "Science Gateway" project? (input: frequency list, <u>output</u>: optimal model)