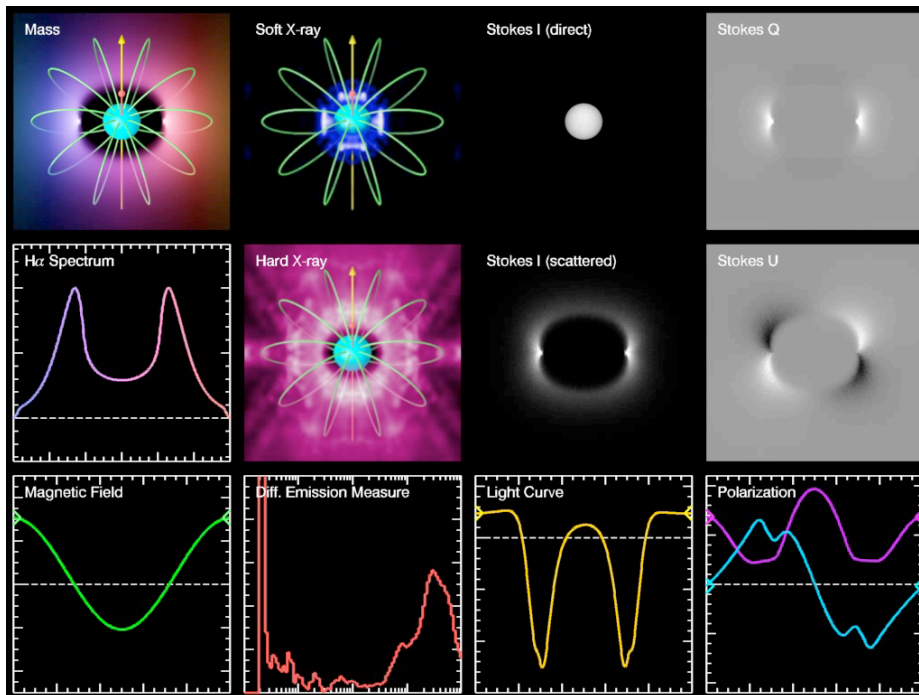
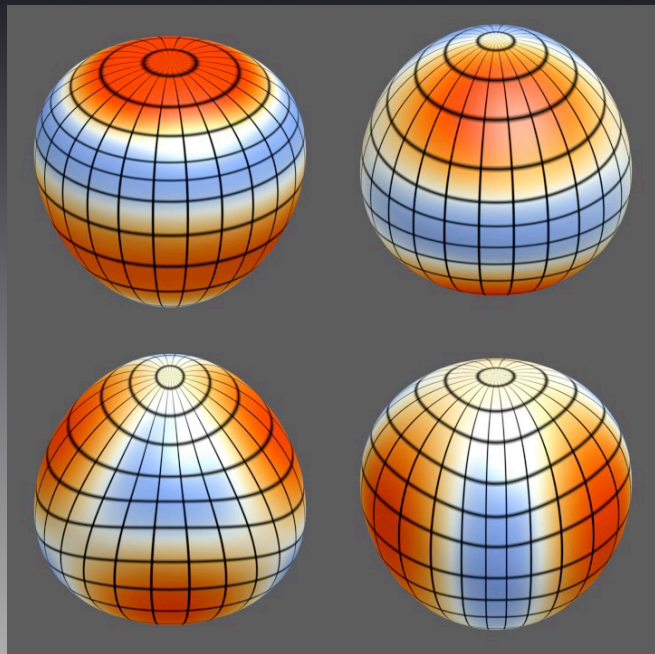


# Two faces of massive-star pulsation

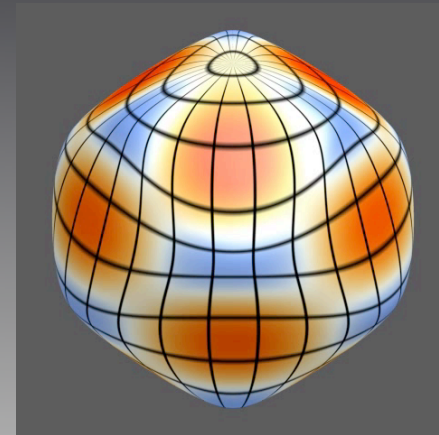
Rich Townsend



Stellar pulsation: the periodic disturbance of a star by wave-like motions

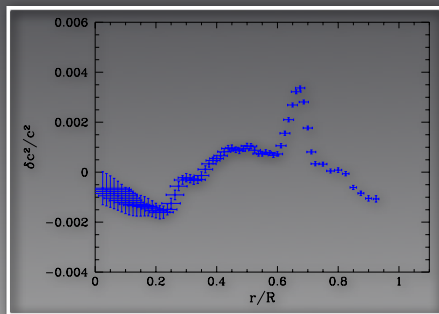


## Asteroseismology: probing internal structure by analyzing pulsations



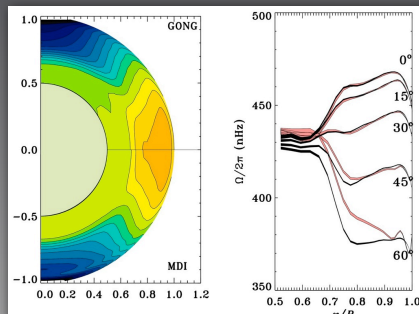
## Highlights from helioseismology

Sound-speed squared throughout interior



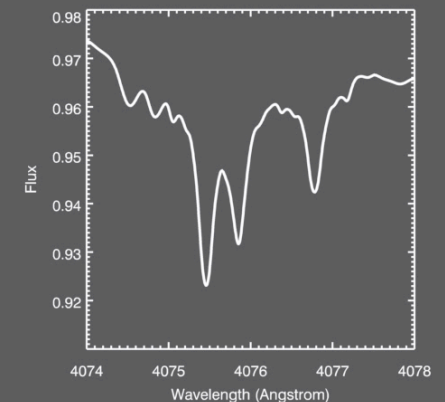
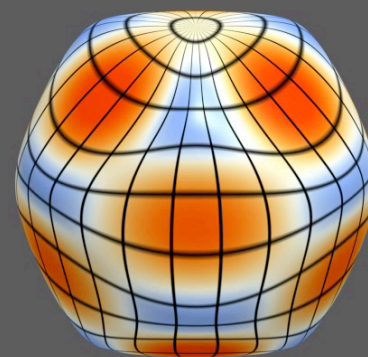
SOHO/MDI

Rotation in outer envelope



GONG & SOHO/MDI

## For remote stars, mode identification requires spectroscopic follow-up



BRUCE / KYLIE codes (Townsend)



# GRASSY: A Hardware-Accelerated Spectral Synthesis Engine for Asteroseismic Mode Identification

- NSF *Advanced Technology and Instrumentation* program
- 3 years
- With CompSci (co-PI Karu Sankaralingam)
- 2 graduate students
- \$348,681 (\$15,000 equipment)

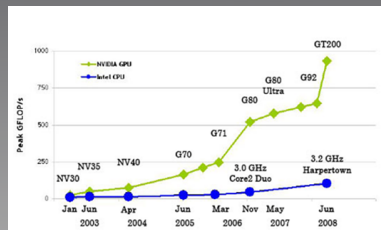
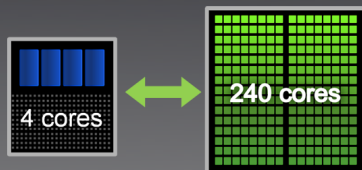


Mirror's Edge (DICE)



NVIDIA GeForce 7960 GT

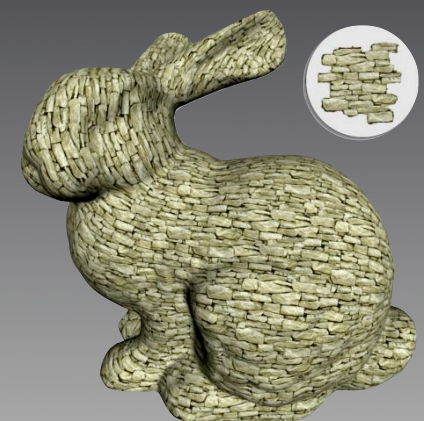
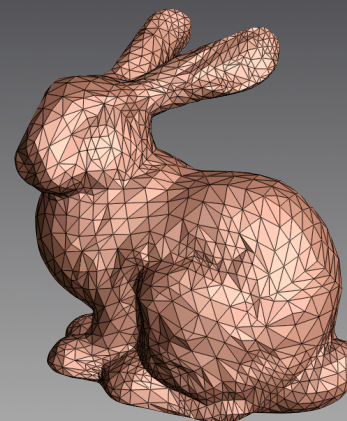
## General-Purpose Computing on GPUs (GPGPU)



- Exploit parallel processing capability of GPUs
- Example applications:
  - Engineering (fluid dynamics, FFT)
  - Finance (pricing, market sims)
  - Cryptography (hashing, encryption)
  - Astronomy (data processing, N-body sims)
- Dedicated GPGPU platforms are available from a number of vendors

see <http://gpgpu.org/>

## GPUs excel at table-based lookups ('texturing')



# GRASSY: Status

- Design & purchasing phase
- Likely platform: 8 x NVIDIA C1060 units (~8 Teraflops)
- Projected performance:
  - 3ms / spectrum / GPU
  - 2700 spectra / s
  - Speed up x 1,000
- Timeline:
  - Prototype by Spring 2010
  - Integrated platform by Spring 2011



Colfax CXT8000

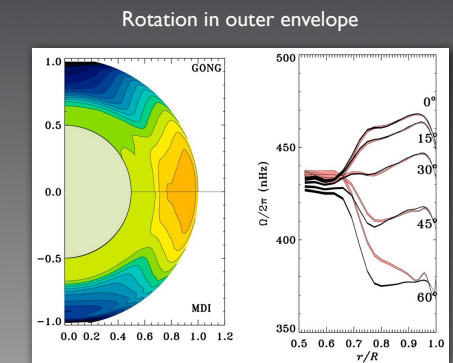
From narrator...

...to protagonist



# Angular momentum transport by waves in the Sun

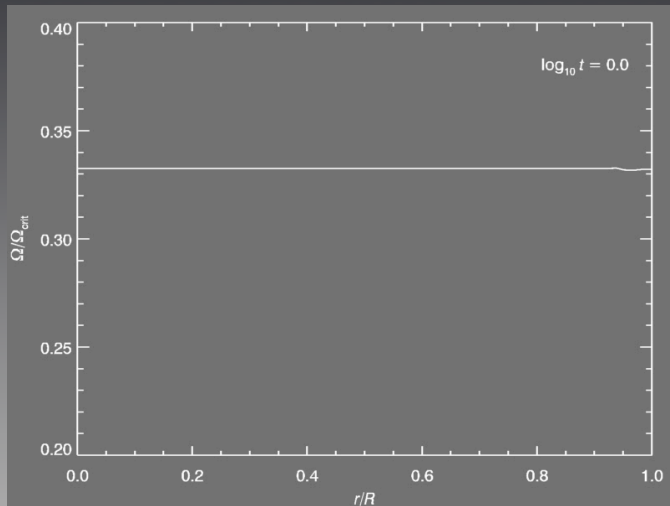
- Helioseismology reveals a uniformly-rotating interior in the Sun
- Pulsation waves proposed as a mechanism for extracting angular momentum from the interior
- Can this occur in massive stars?



GONG & SOHO/MDI



# Wave transport in a $5 M_{\odot}$ model



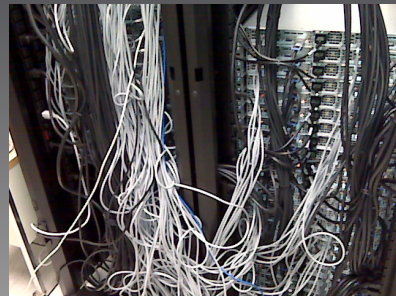
HEIMDALL CODE (Townsend)

## Wave Transport of Angular Momentum: A New Spin on Massive-Star Evolution

- NSF Astronomy & Astrophysics Research program
- 3 years
- 1 postdoc, 1 grad student
- \$428,021

## Wave Transport: Status

- Initial work favorably received at Santa Fe meeting
- Recently purchased Medusa supercomputer (w/ theory group)
- Currently working on new technique for modeling pulsation on parallel architectures (pencil & paper); v.excited!
- Personnel:
  - Nick Hill (1st-year grad student)
  - Advertising for postdoc



Infiniband cabling at the back of Medusa

## Summary

- Goals for year 1:
  - Teach ✓
  - Write proposals ✓
  - Don't get frostbite ✓
- Goals for year 2:
  - Enjoy teaching ✓
  - Do science