GRAVITATIONAL WAVES FROM CORE-COLLAPSE SUPERNOVAE
GWS FROM CORE-COLLAPSE SUPERNOVAE

- Strongly dependent on the total angular momentum and its distribution throughout the progenitor core
- Slowly rotating; turbulent convection and standing accretion-shock instability
- Rapidly rotating; proto-NS bounce/ringdown, low T/|W| instabilities
- Excess-power search typically used; messy and complicated signal, no templates
THE 99%: SLOWLY ROTATING PROGENITOR CORES

Buoyancy modes (g-modes) of proto-neutron star (PNS) surface

PNS accretion modified by SASI downflows

Kuroda et al. (2016)
THE 99%: SLOWLY ROTATING PROGENITOR CORES

- Use time-frequency evolution to preferentially search along astrophysically motivated t-f tracks [improve detectability, waveform reconstruction]

- Time-frequency evolution dependent on PNS properties, evolution of the explosion:
  - Use theory to develop phenomenological models linking observables to progenitor properties
  - Use simulation data to tune and improve models
THE 1%: RAPIDLY ROTATING PROGENITOR CORES

Bounce/ringdown of PNS

low T/|W| triaxial instabilities
THE 1%: RAPIDLY ROTATING PROGENITOR CORES

- PNS ringdown frequencies dependent on PNS mass, rotation rate of precollapse core, nuclear matter EOS
- Observed ringdown spectra can uniquely probe precollapse angular momentum distribution
- Low $T/|W|$ instabilities indicative of rapid precollapse rotation
HOW CAN THE SN SIMULATION COMMUNITY HELP?
How can the SN simulation community help?

Share data!
HOW CAN THE SN SIMULATION COMMUNITY HELP?

- Share data!

Welcome to ChimeraSN.org

ChimeraSN.org is the online home of the Chimera collaboration, the Chimera code, and our results.

Our group is dedicated to the study of core-collapse supernova explosions. CHIMERA is our multi-dimensional numerical code, capable of tracking the evolution of these systems from the pre-collapse stellar stage up to a second of evolution time after the core bounce.

**Current interest**

- New 3D C Series results.
- Updated 2D B Series results.
- Gravitational wave signals from A and B Series simulations.

**Other links**

stellarcollapse.org
chimeraSN.org
HOW CAN THE SN SIMULATION COMMUNITY HELP?

- Share data!

Why?

stellarcollapse.org

chimeraSN.org
HOW CAN THE SN SIMULATION COMMUNITY HELP?

- Share data!
- Include waveform families in Advanced LIGO-Virgo searches
- Encourage collaboration between data analysts and simulation groups
- Improve interpretation of observations and search methods
IMPROVING INTERPRETATION OF OBSERVATIONS

- GWs from core collapse: all about the PNS
- Turbulent convection/SASI -> fluid downflows strike PNS -> excite g-modes of PNS -> GWs
- Early time SASI -> modifies PNS accretion rate -> GWs
- Bounce/ringdown of PNS -> GWs
- Low T/|W| instability -> triaxial deformation of PNS -> GWs
GWs

More 3D GR

sims resolving

the PNS pls!
How can the SN simulation community help?

- Share data!
- Include waveform families in Advanced LIGO-Virgo searches
- Encourage collaboration between data analysts and simulation groups
- Improve interpretation of observations and search methods