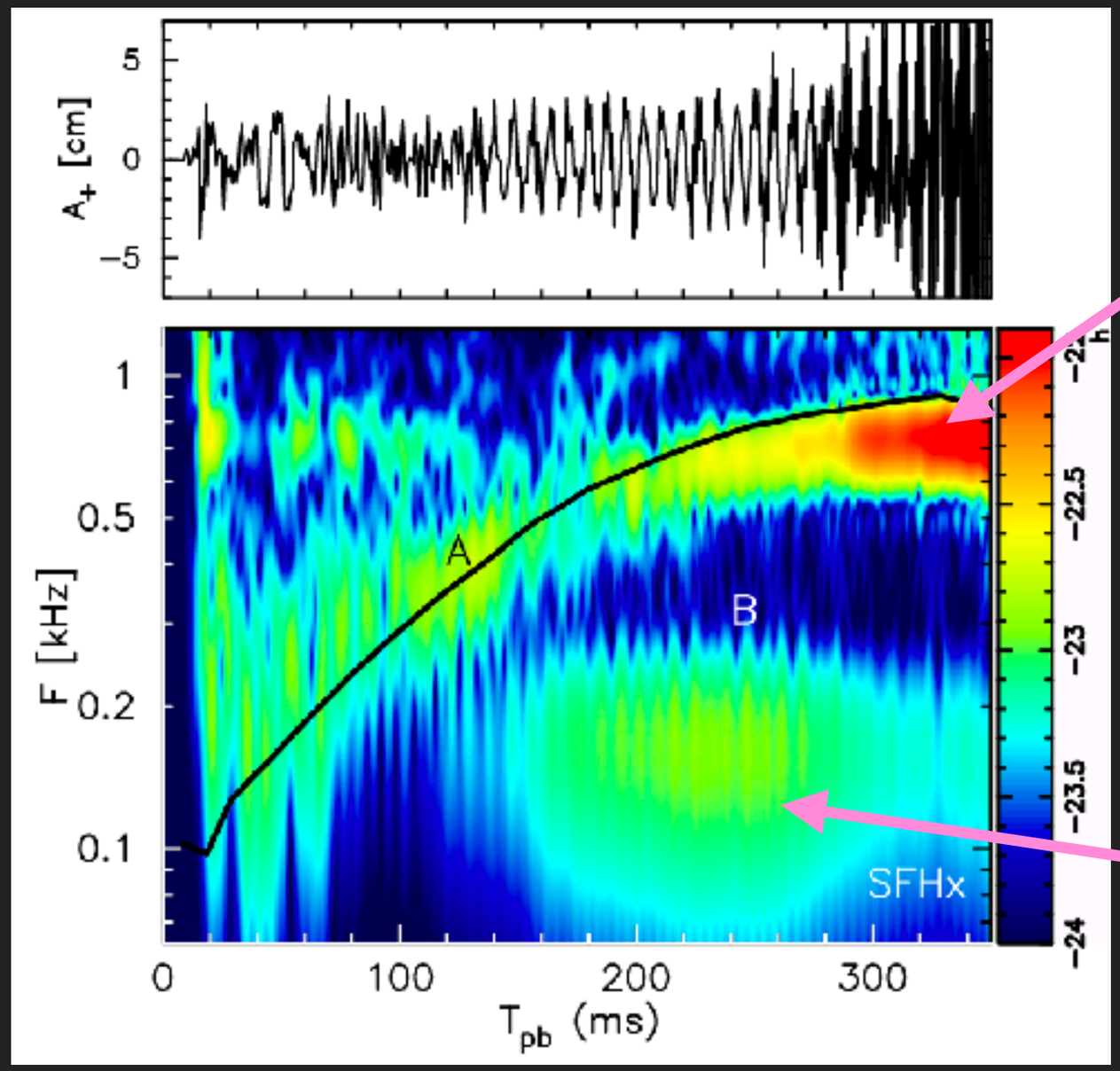
SARAH GOSSAN (CALTECH)

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



Kuroda *et al*. (2016)

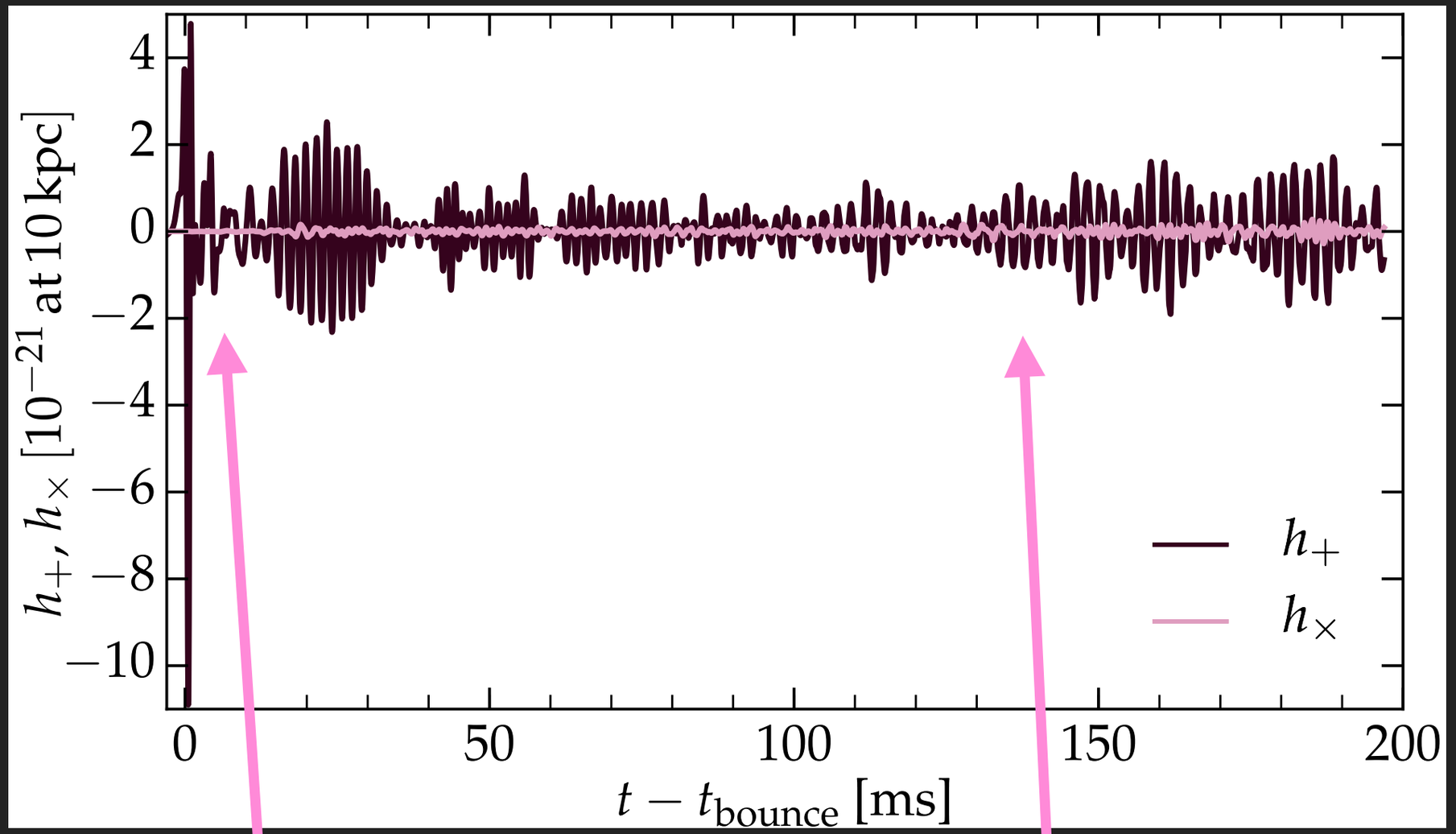
Buoyancy modes (g-modes) of proto-neutron star (PNS) surface

PNS accretion modified by SASI downflows

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?

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Share data!

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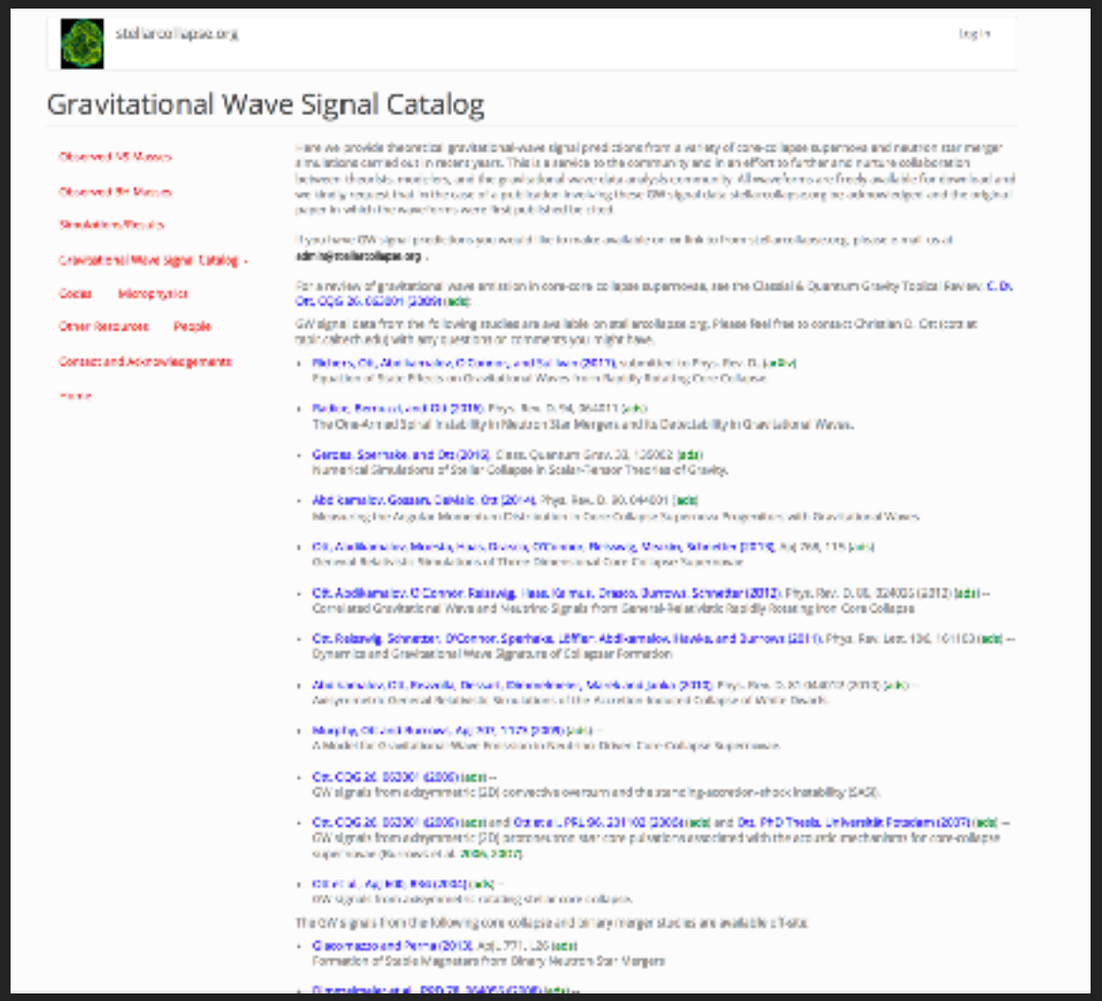

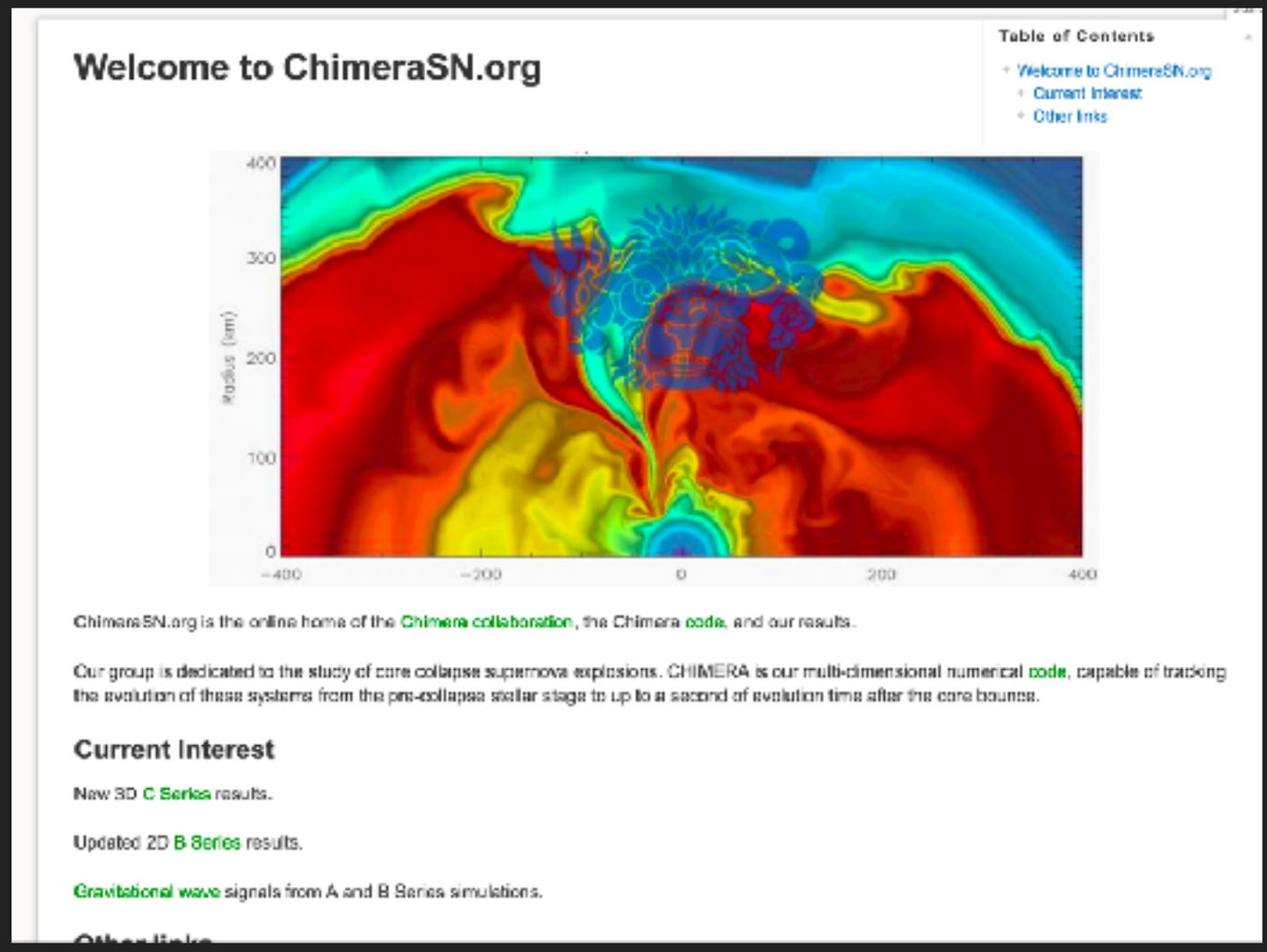

stellarcollapse.org

chimeraSN.org

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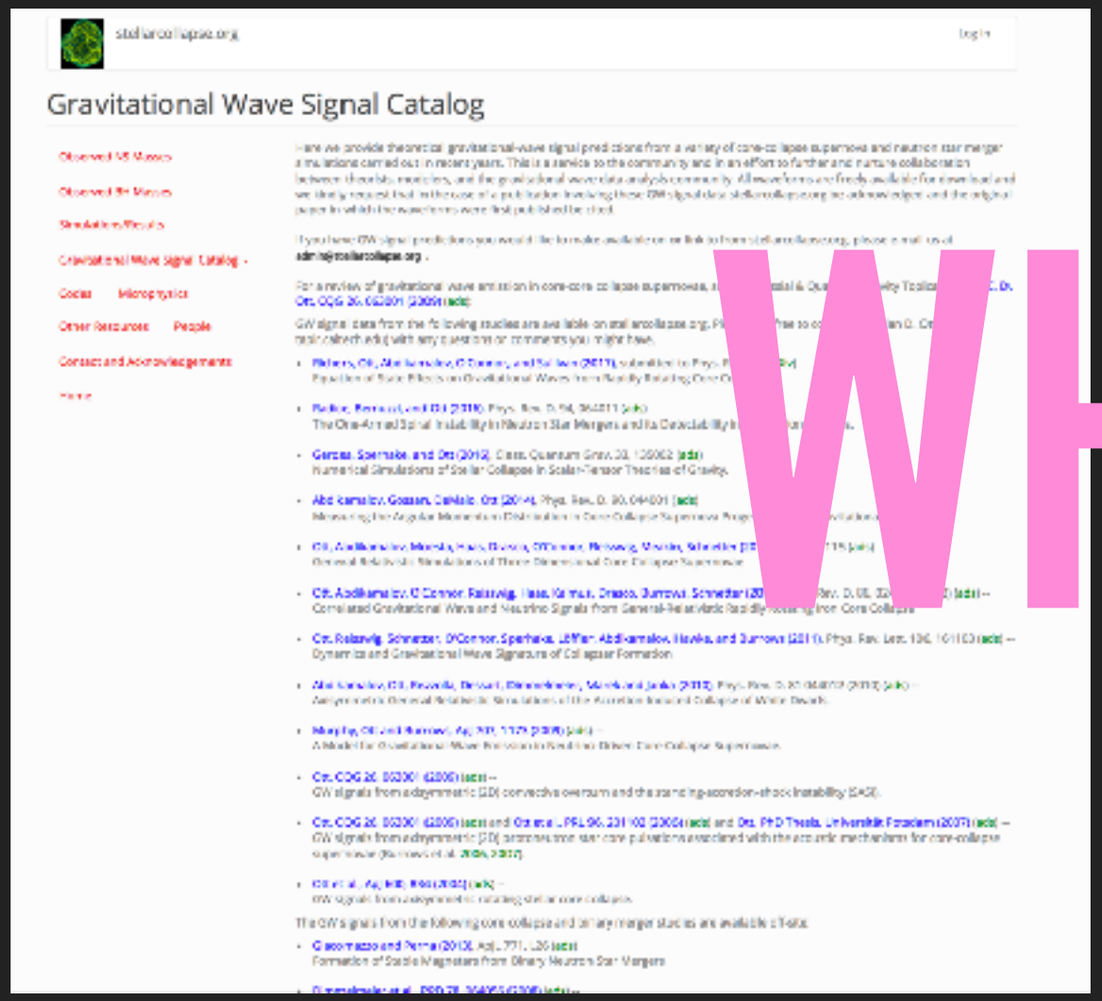

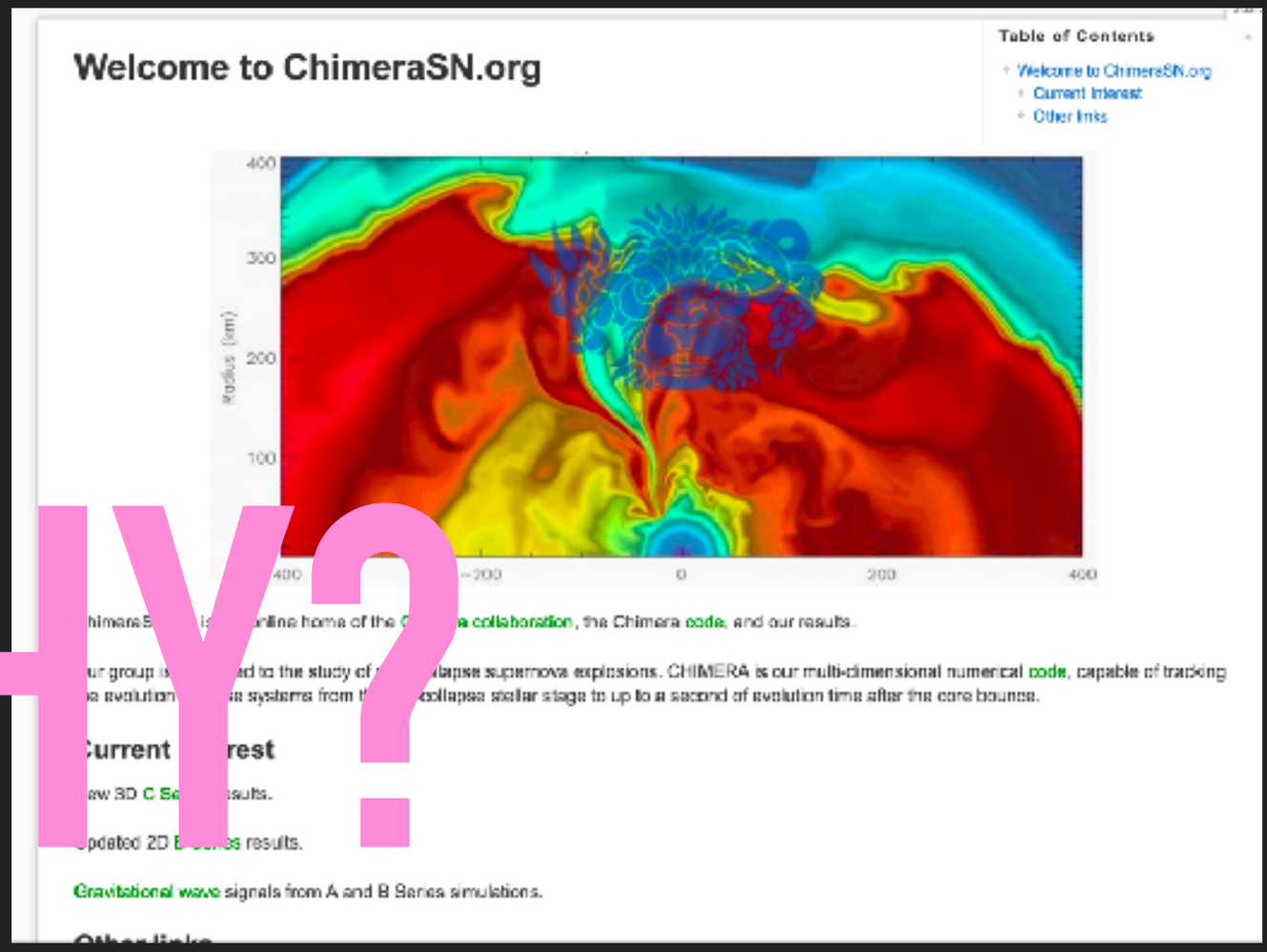

WHY?

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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

IMPROVING INTERPRETATION OF OBSERVATIONS

- GWs
- Turb
  excit
- Early
- Bour
- Low

More 3D GR sims resolving the PNS pls!

PNS ->

Vs

· GWs

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