Extraction of gravitational waves from SASI with Hilbert-Huang Transform

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collaborated with

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§ Hilbert-Huang Transform (HHT)

High resolution time-frequency analysis

Ensemble empirical mode decomposition

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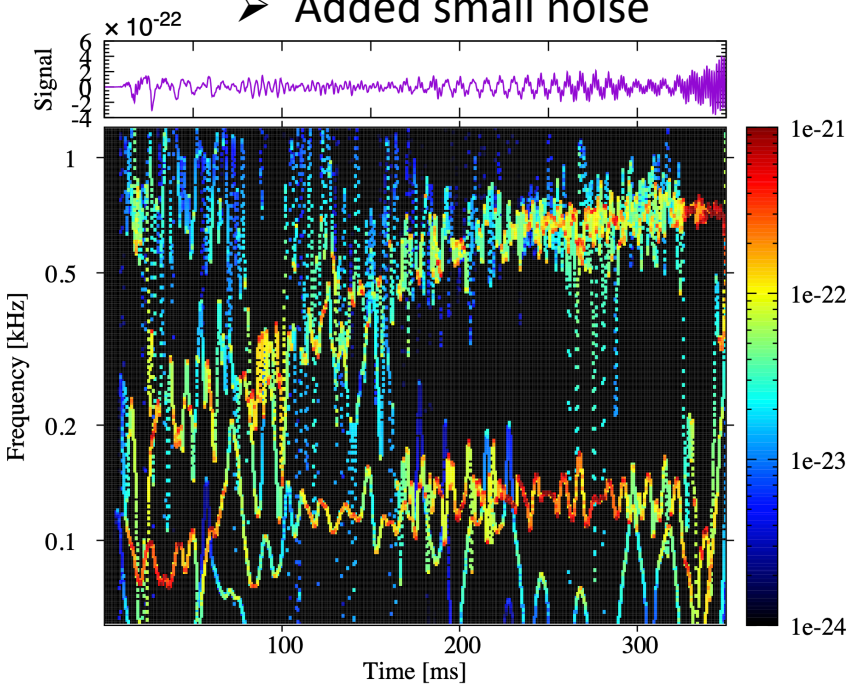
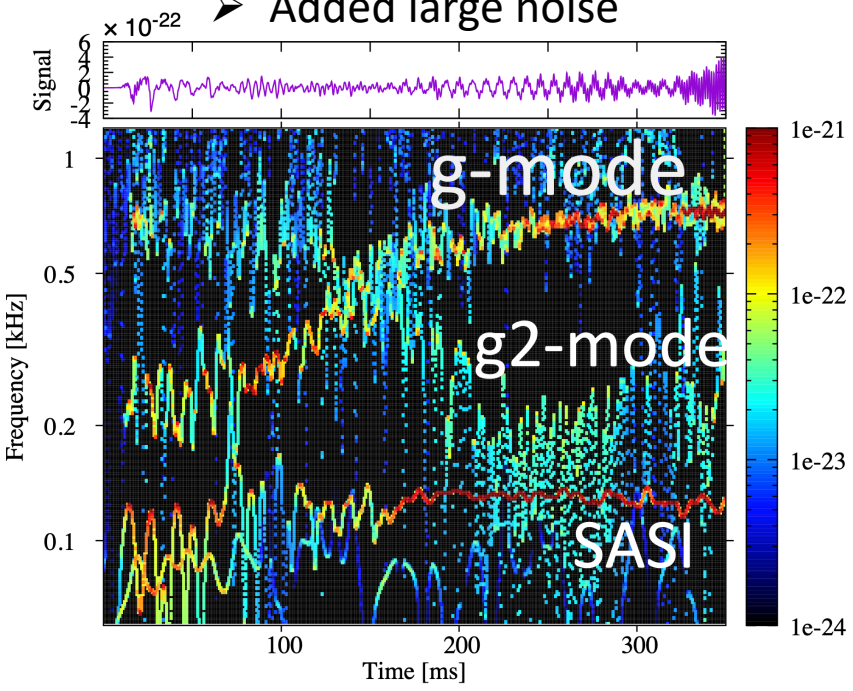
Hilbert transform

- We apply the Hilbert-Hung transform (HHT) to analysis of gravitational waves (GWs) from a core collapse supernova.
- By adding large noise for ensemble empirical mode decomposition, we found that GWs induced by g-mode and standing accretion shock instability (SASI) can be clearly extracted.
- In addition, a signal whose frequency decreases in time appears. It is considered as GWs from g2-mode.

➢ Added small noise

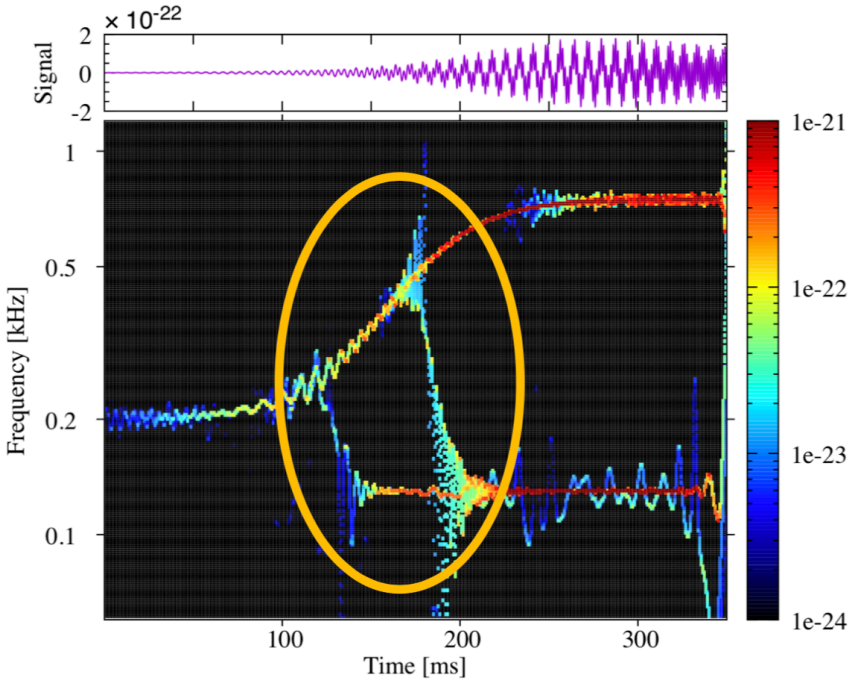


➢ Added large noise

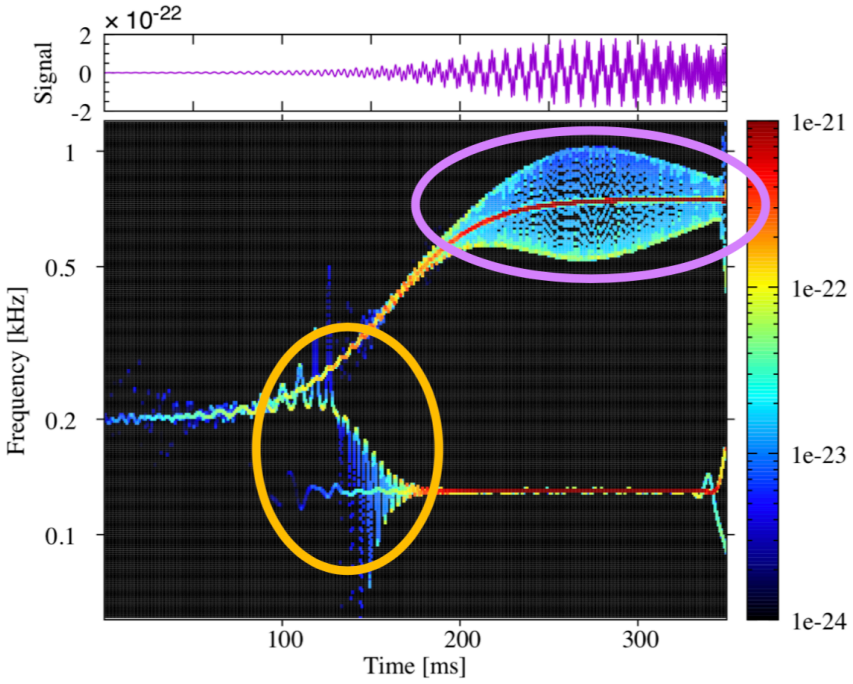


- To confirm whether these modes is really physical, we generate a model signal that consists of a chirp signal (200~750Hz) and sine-Gaussian signal of constant frequency (130Hz), and analyze it by the HHT.
- A signal whose frequency decreases in time, like g2-mode, appears as shown in the area surrounded by an orange circle in the figure, although such a mode is not injected.

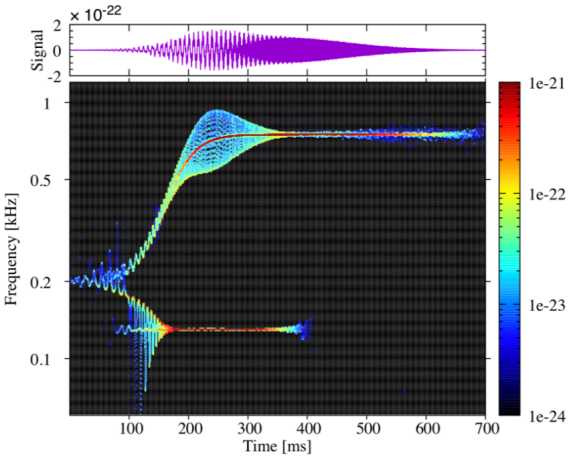
➢ Added small noise



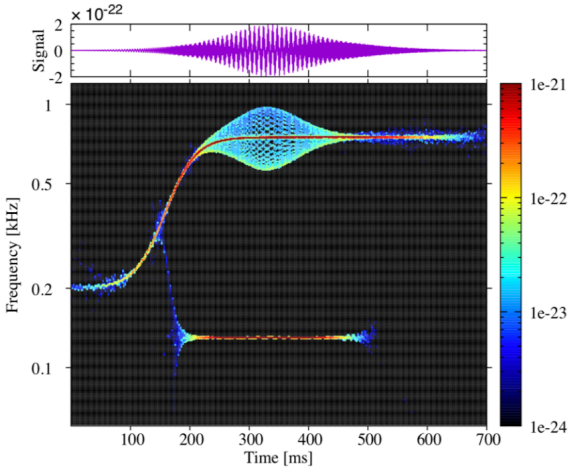
➢ Added large noise



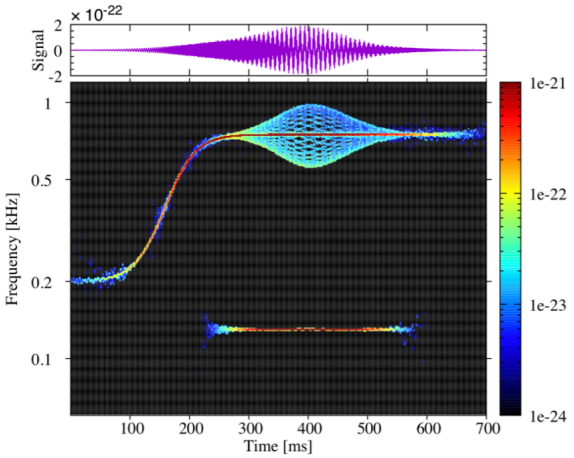
- We also investigate the relationship between the “bulge” of frequency and the peak position of sine-Gaussian signal.
- When the peak of the sine-gaussian signal changes, the “bulge” also changes.



Sine-gaussian signal peak : 230ms



Sine-gaussian signal peak : 330ms



Sine-gaussian signal peak : 400ms

- Those reasons have not been clear yet.
- We need further investigation.