Model-independent anomaly detection in gravitational waves

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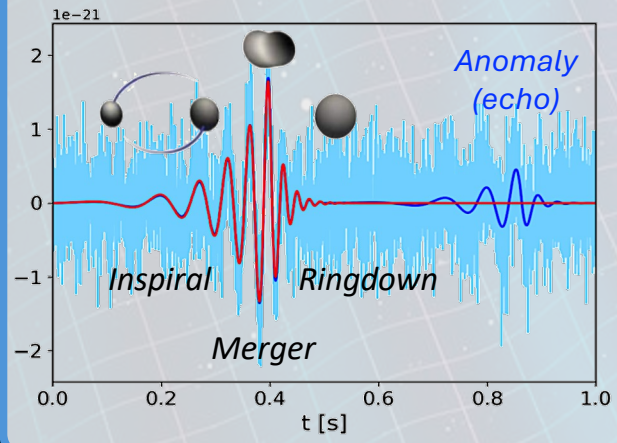
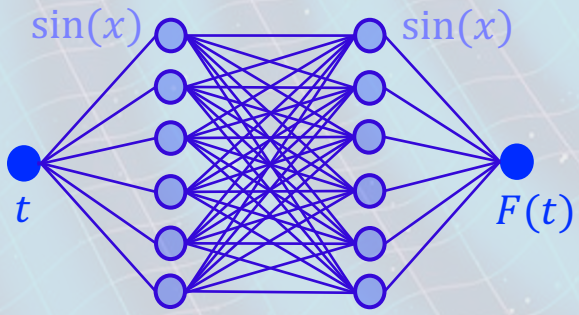
Goal: use a **neural network** as a **flexible fitting tool** to detect **deviations from GR** in **BBH gravitational wave** signals

- **Toy model** qualitatively similar to GW signal
- Add various **benchmark features** mimicking **non-GR effects**

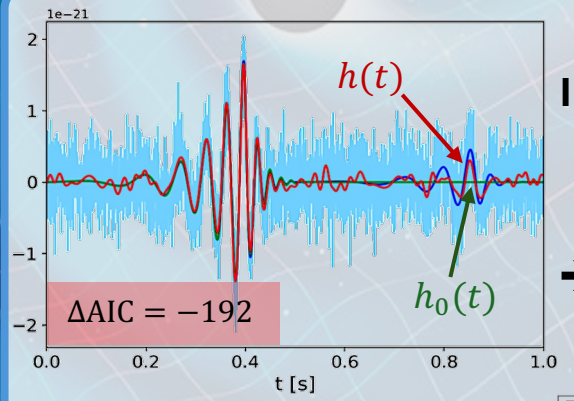


- **Null** hypothesis: best-fit **base model** template $\boldsymbol{h_0(t)}$
- NN trained on **individual** GW event to **overfit** the data



- **Alternative** hypothesis:

$$\boldsymbol{h(t) = h_0(t) + F(t)}$$



Model selection: **Akaike Information Criterion (AIC)**

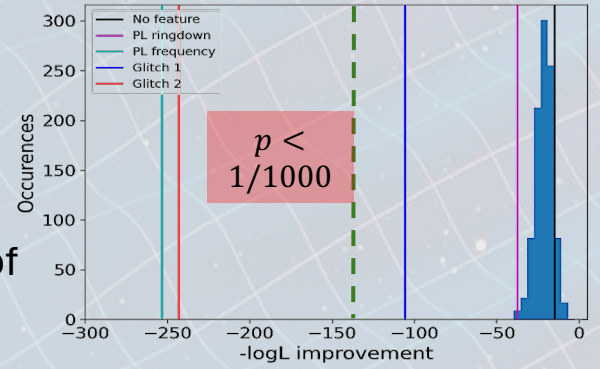
$$\mathrm{AIC} = -2\log\mathcal{L}(\mathbf{d}|\mathbf{h}) + 2k$$

k: # params

➔ h preferred if $\mathbf{AIC}(\boldsymbol{h}) - \mathbf{AIC}(\boldsymbol{h_0}) \leq -10$

Validation with **Monte Carlo analysis**

➔ Small p-values **confirm detection** of anomalous features



Successful proof of concept on **simplified mock data**; ongoing work towards implementation on **real data**!