High spin NR and NR follow-up

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Disclaimer

Most of the contents of this brief talk will not be related to O3.

Sorry

High spinning black hole binaries

- Highly spinning black holes are out there.
- To detect them and measure their parameters correctly, models that include waveforms for large values of spins $\chi_i = S_i/m_i^2 \sim 1$ need to be developed.
- Simulating highly spinning binaries is difficult: complicated to create initial data and tricky to evolve.
- In [gr-qc] 1804.03704, these non-precessing SXS waveforms
  - $q = 1.22$, $\chi_1 = 0.330$, $\chi_2 = -0.439$ (not high spin)
  - $q = 1.3$, $\chi_1 = 0.961$, $\chi_2 = -0.899$
  - $q = 1$, $\chi_1 = 0.998$, $\chi_2 = 0.998$ (new)
  - $q = 1$, $\chi_1 = -0.969$, $\chi_2 = -0.969$ (new)

  were analyzed with LALInference: even when both spins are aligned, recovered spins are less extreme, spin priors disfavour large spins, need higher SNR.

SXS waveforms in open catalog

(Excision).
Spins above $\chi_i = 0.9$, non-precessing, included in LVC NR repository:

- $q = 1$, $\chi_1 = 0.96$, $\chi_2 = 0.96$, SXS:BBH:0176
- $q = 1$, $\chi_1 = 0.99$, $\chi_2 = 0.99$, SXS:BBH:0177
- $q = 1$, $\chi_1 = 0.995$, $\chi_2 = 0.995$, SXS:BBH:0178
- $q = 1$, $\chi_1 = 0.98$, $\chi_2 = 0.98$, SXS:BBH:0172
- $q = 1$, $\chi_1 = 0.95$, $\chi_2 = 0.95$, SXS:BBH:0157
- $q = 1$, $\chi_1 = 0.97$, $\chi_2 = 0.97$, SXS:BBH:0158
- $q = 1$, $\chi_1 = -0.9498$, $\chi_2 = -0.9498$, SXS:BBH:0156
- $q = 1.31$, $\chi_1 = 0.9617$, $\chi_2 = -0.8997$, SXS:BBH:0306
- $q = 1.5$, $\chi_1 = 0.9910$, $\chi_{2x} = 0.1414$, $\chi_{2z} = 0.1414$, precessing

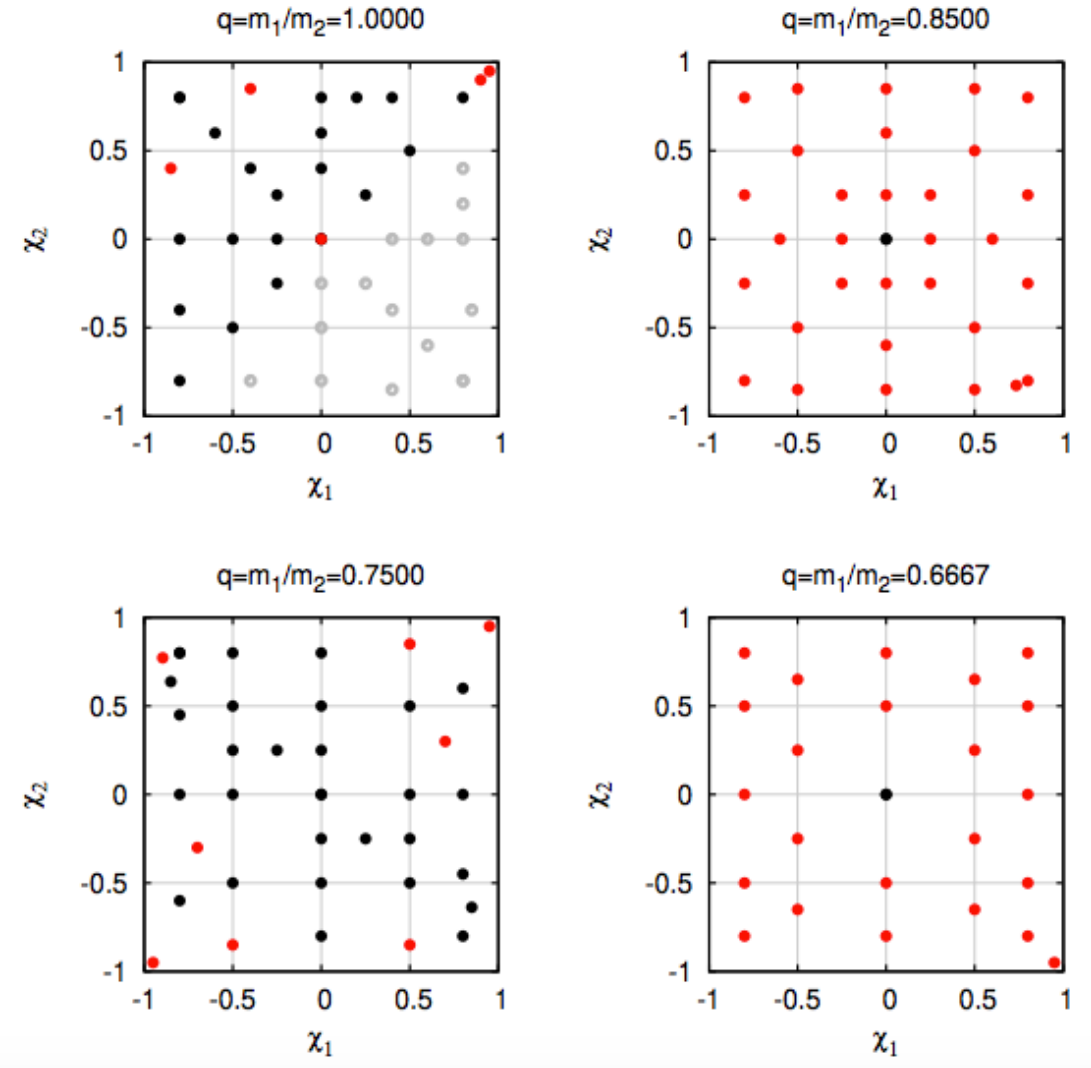
Question for Cardiff: put existing interesting waveforms in LVC NR repo or make new simulations in uncovered areas of parameter space?

RIT waveforms in open catalog

(Moving punctures).
Spins above $\chi_i = 0.85$,
non-precessing:

- $q = 1$, $\chi_1 = \chi_2 = 0.95$
- $q = 1$, $\chi_1 = \chi_2 = 0.9$
- $q = 1.33$,
  $\chi_1 = \chi_2 = 0.95$
- $q = 1.33$,
  $\chi_1 = \chi_2 = -0.95$
- $q = 1.508$, $\chi_1 = 0.95$,
  $\chi_2 = -0.95$

Create more $\chi_i > 0.9$
simulations to decrease
extrapolation error.



Figures from [gr-qc] 1901.02553.

NR follow-up simulations - useful?

- Current models are expected to cover most events to be detected.
- However, PE results may correspond to a poorly described area of parameter space, or available models may give different results.
- Possibility to run simulations around the event, to improve coverage of existing models or to create a local model.
- Many aspects to take into account:
  - Number of waveforms
  - Distance in parameter space
  - Time needed for performing simulations
  - Time needed to create the model
  - Etc.
- Discussion: better leave computational resources for developing current models or use some for follow-ups? Related issues?