LSC – Numerical Relativity Interactions:
A View From Outside the LSC

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- How might LIGO use NR simulations?
- Are current NR simulations good enough for LIGO?
- How might LSC – NR interactions be organized?
- Are NR Standards Needed?
  - Possible Standards.
  - Formulating and Applying Standards.

How Might LIGO Use NR Simulations?

- Calibrate Data Analysis Pipeline: Search for injected NR waveforms to test existing (and/or develop improved analytical) search template families.
  (This kind of interaction is already taking place.)

- Increase Probability of Detection: Improve sensitivity by using specially constructed template banks of NR waveforms (produced by close collaboration between LSC and NR researchers).

- Increase Scientific Payoff: Extract full scientific content of detections by matching signals with optimal NR waveform models (constructed by close iterative collaboration between LSC and NR researchers).

Are Current NR Waveforms Good Enough for LIGO?

- Phase errors for BBH inspiral-merger-ringdown waveform using 6th order finite difference code (Jena) is about 2 radians; for inspiral only waveform using spectral code (Caltech/Cornell) about 0.03 radians.
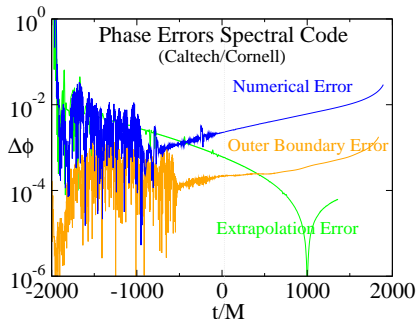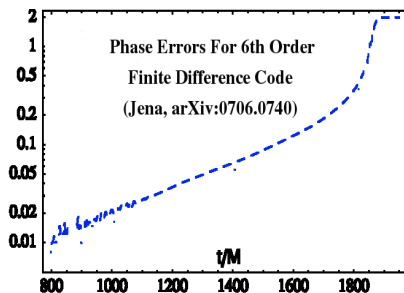
- Is this accuracy good enough for LIGO?
- Are incomplete waveforms (e.g. waveforms lacking mergers like Caltech/Cornell, or too short to match accurately to PN waveform) really useful for LIGO?

How might LSC – NR interactions be organized?

- No official LSC – NR interactions at all. (LSC only uses publicly available NR waveforms or publicly available data analysis methods developed using NR waveforms.)

- LSC – NR collaborations only for limited authorship technical papers. (No analysis with real LIGO data.)

- LSC collaborations with interested (and qualified?) NR researchers for projects involving LIGO data and resulting in joint papers with these NR researchers and full LSC authorship.

- Interested (and qualified?) NR researchers included into the LSC to contribute NR capabilities to LIGO data analysis.

Possible Standards for LSC – NR Interactions

- **No Standards:** LSC collaborates with any NR group interested in collaborating.

- **Minimal Standards:** LSC collaborates with (or admits to membership) only NR groups having codes capable of simulating some source of interest to LIGO.

- **Strict Standards:** LSC collaborates with (or admits to membership) only NR groups having codes with demonstrated capability of simulating waveforms at the level of accuracy needed by LIGO data analysis.

Formulating and Applying Standards

- Quality standards for NR waveforms could be formulated by LSC data analysts in collaboration with NR researchers.

- Standards could be published openly (e.g. posted on gr-qc or in the refereed literature) where they could be debated by the full community and revised as needed.

- The LSC could *recommend* these standards if the No Standards or the Minimal Standards collaboration approach is adopted.

- If the Strict Standards approach is adopted, the LSC could *require* that NR groups qualify their codes (e.g. by demonstrating compliance to some joint LSC – NR advisory committee) before collaboration with (or membership in) the LSC is approved.