Basics of PyCBC

Alexander Nitz (on behalf of the PyCBC team)
MPI for Gravitational Physics
(Albert Einstein Institute)
PyCBC: Toolkit for Gravitational-wave Data Analysis

- Began in 2011 as a joint project between the MPI for Gravitational Physics (AEI), Syracuse University, and Cardiff University.
  - ~ 5 initial contributors
- Initial goals:
  - python-based (with hooks into lower-level libraries)
  - modular toolkit
  - flexible computing backends
    - take advantage of GPUs / multicore / etc
  - Build replacement for the aging iHOPE analysis (workhorse search pipeline for analysis of initial LIGO data)
- Open-source (github.com/gwastro/pycbc) and community-developed
- > 80 contributors (as of 2020) from dozens of institutions
PyCBC Impact

- “PyCBC Offline” Flagship archival / deep-offline analysis used by LIGO/Virgo/Kagra
  ○ Determined significance of GW150914
  ○ used in all observing runs of the 2G ground-based detectors to detect CBCs
- “PyCBC Live” Low-latency detection of gravitational waves
  ○ Generated skymap (with Bayestar) used for follow-up of GW170817
  ○ Producing alerts since O2
- “PyCBC Inference” Bayesian estimation of source parameters and evidence
  ○ dozens of papers using PyCBC Inference or its data products
- > 200 citations for pycbc codebase
Package Functionality

- core functionality
  - reading detector data
  - data conditioning / deglitching
  - detector response model
  - waveform generation interface
    - interfaces to existing libraries (lalsimulation, TaylorF2e, SEOBNRe)
  - template bank placement
  - matched filtering
  - signal consistency tests
  - candidate ranking statistics
- Documentation
  - [https://pycbc.org/pycbc/latest/html/](https://pycbc.org/pycbc/latest/html/)
- Tutorials
  - [https://github.com/gwastro/PyCBC-Tutorials](https://github.com/gwastro/PyCBC-Tutorials)