# Yorsh stellar black hole binaries dataset

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This is a short note that provides technical details on the Yorsh stellar black hole binaries (stBBH) dataset.

## 1 Conventions

All the conventions are the same as for the Sangria dataset. They can be found in the LDC manual, available on the LDC website[1].

## 2 Production workflow

The production is divided in three main blocks that are described hereafter. (figures to be added)

### 2.1 Noisefree TDI signals

For given source, we perform the following steps:

1. Compute $h_+$ and $h_\times$ strains. This is performed with the LDC Toolbox, based on the IMRPhenomD [1] phenomenological model.
2. Compute strain projection on LISA arms. This is also performed with the LDC Toolbox. The orbits are chosen to be fixed and equal arm lengths. They are produced with lisaorbits.
3. Compute the TDI response using TDI2. This is performed with pyTDI.
4. Filter the TDI response.

### 2.2 Instrumental noise

The instrumental noise is produced using LISANode.

### 2.3 Confusion noise

The confusion noise is produced by simulating a catalog of 30 millions galactic binaries, from which we substract the ones with SNR squared above 50.

## 3 Data

All signals consist in **2 years of data sampled at** $0.2\,\mathrm{Hz}$ (i.e. one data point every 5 second). The accompanying notebook shows how the data is extracted from the file.

There are 8 stBBH in the hdf5 file. Their parameters are shown on Fig. 1. The angles are given in radian, the masses in solar masses, the luminosity distance in Mpc, the initial frequency in Hz, and the observation duration and cadence are both in seconds. The redshifts have been computed with a flat $\Lambda$-CDM cosmology model using a value of the Hubble constant of $H_0 = 67.1$ and a value of the density of non-relativistic matter of $\Omega_{m,0} = 0.3175$. There is a single instrumental and confusion noise realisation in the hdf5 file. All signals are available separately such that the user can build their own noisefree or noisy signals.

[1] https://lisa-ldc.lal.in2p3.fr/

| | Name | EclipticLatitude | EclipticLongitude | Mass1 | Mass2 | Spin1 | Spin2 | Inclination | InitialFrequency | InitialPhase | Polarization | Redshift | Distance | ObservationDuration | Cadence |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | sobhb1 | 0.951881 | 5.683863 | 35.432815 | 32.089232 | 0.763621 | 0.206713 | 2.979326 | 0.005858 | 3.394436 | 3.176550 | 0.034875 | 159.904954 | 6.311630e+07 | 5 |
| 1 | sobhb2 | 0.505704 | 3.403435 | 46.748179 | 46.041423 | -0.139867 | -0.315725 | 0.532588 | 0.002785 | 0.100000 | 0.378623 | 0.020511 | 93.061374 | 6.311630e+07 | 5 |
| 2 | sobhb3 | -0.184457 | 4.610949 | 52.519087 | 30.371929 | 0.195047 | -0.051965 | 2.032833 | 0.003007 | 0.583265 | 2.993149 | 0.010434 | 46.988885 | 6.311630e+07 | 5 |
| 3 | sobhb5 | 0.078151 | 3.504416 | 34.499636 | 28.802451 | -0.681947 | -0.385757 | 0.738223 | 0.012243 | 1.996578 | 1.861111 | 0.036661 | 168.310236 | 6.311630e+07 | 5 |
| 4 | sobhb6 | -0.646900 | 1.903788 | 8.571895 | 7.564647 | 0.210554 | -0.599386 | 1.052530 | 0.028024 | 0.387789 | 2.301022 | 0.003862 | 17.304767 | 6.311630e+07 | 5 |
| 5 | sobhb8 | 0.104561 | 1.691095 | 33.712362 | 19.926473 | -0.022495 | 0.032351 | 1.526063 | 0.027654 | 2.186094 | 1.624495 | 0.007569 | 34.013334 | 6.311630e+07 | 5 |
| 6 | sobhb9 | -0.654182 | 0.802623 | 30.724619 | 29.227329 | 0.123650 | 0.078372 | 2.075090 | 0.023768 | 1.341579 | 5.384847 | 0.018876 | 85.540696 | 6.311630e+07 | 5 |
| 7 | sobhb10 | -1.235802 | 3.288491 | 48.087722 | 42.093315 | -0.110226 | 0.194370 | 2.685023 | 0.011311 | 3.138914 | 1.999555 | 0.036789 | 168.911407 | 6.311630e+07 | 5 |

Figure 1: Parameters of Yorsh sources.

# References


[1] Frequency-domain gravitational waves from non-precessing black-hole binaries. II. A phenomenological model for the advanced detector era, Khan et al., Phys. Rev. D 93, 044007 (2016), arXiv:1508.07253