Status of Division 10
Data analysis Platform

ET-France, CAEN, 10/10/2024

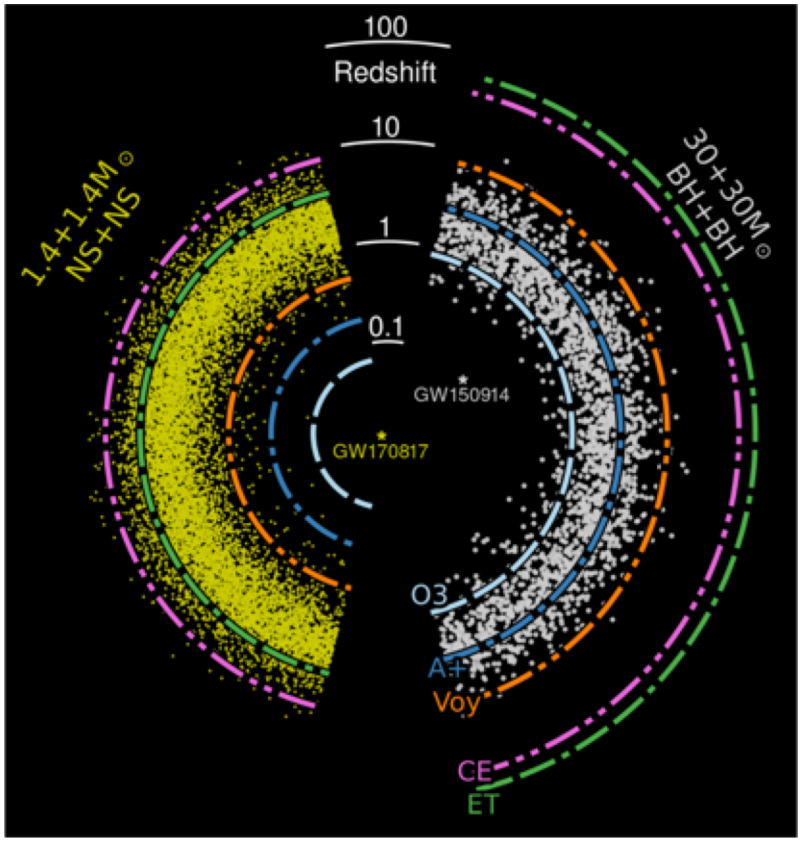
Organization

- 4 chairs: Elena Cuoco, Gianluca Guidi, Tania Regimbau, Anuradha Samajdar
- Liaison persons with other divisions and EIB (John Veitch)
- 160 subscriptions to mail.ego-gw.it/mailman/listinfo/et-osb-DA
- Bi-monthly meetings
- Wiki page: https://wiki.et-gw.eu/OSB/DataAnalysisPlatform

Goal of division 10

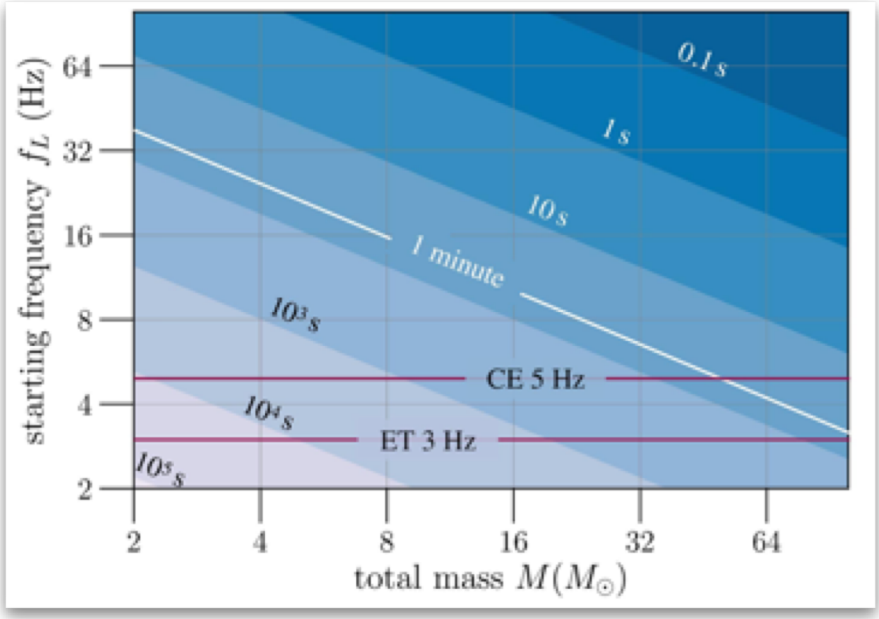
- Prepare the analysis and parameter estimation with 3G data (methods and software) in order to exploit the full potential of 3G detectors.
- New challenges: signal regime, long waveforms, overlapping events, new sources.
- New geometry (null stream, correlated noise), new network (+CE).
- New computing technologies (GPU/TPU/FPGA, cloud computing) and algorithms (classical development, IA, Quantum algorithm).

Horizon beyond the peak of the star formation rate



Credit Cosmic Explorer

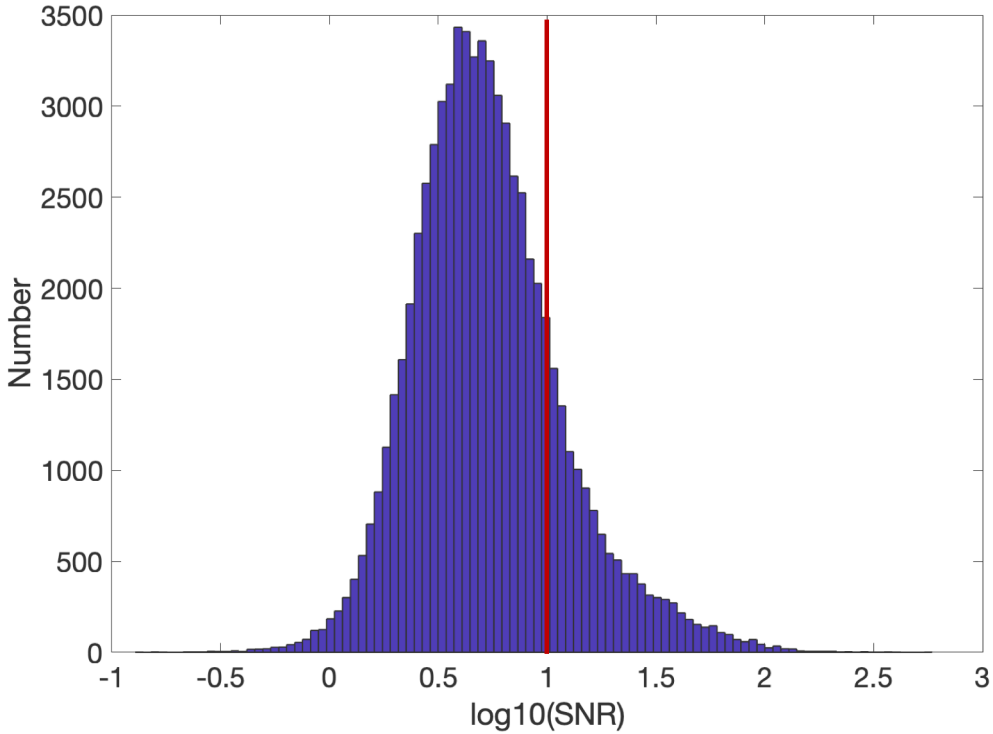
Long duration waveforms can dramatically increase the computational cost
+ Impact of Earth rotation

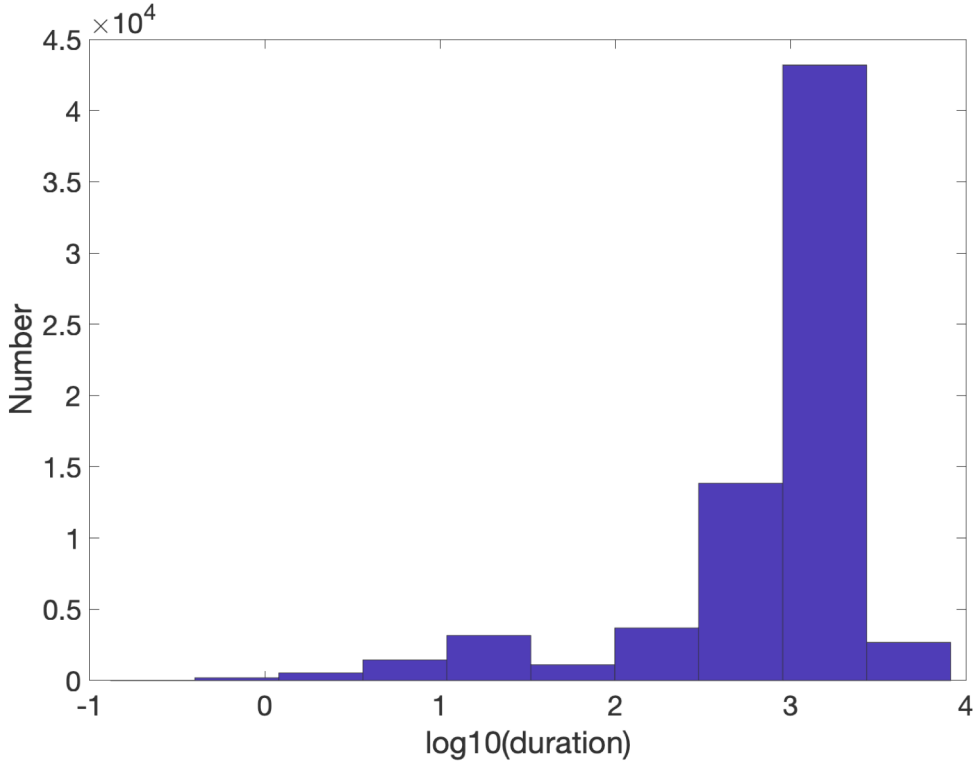


Mock data challenges

- Common training simulated data sets.
- Test, develop, optimize, compare data analysis and parameter estimation techniques, adapted to the the new challenges/requirements of XG detectors.
- Science potential with ET or XG.
- Requirements for computing infrastructure.
- MDC1 ongoing with only CBCs
- MDC2 brainstorming (glitches, correlated noise, bursts, CWs, cosmological sources, calibration errors, missing data…?)

Some statistcs





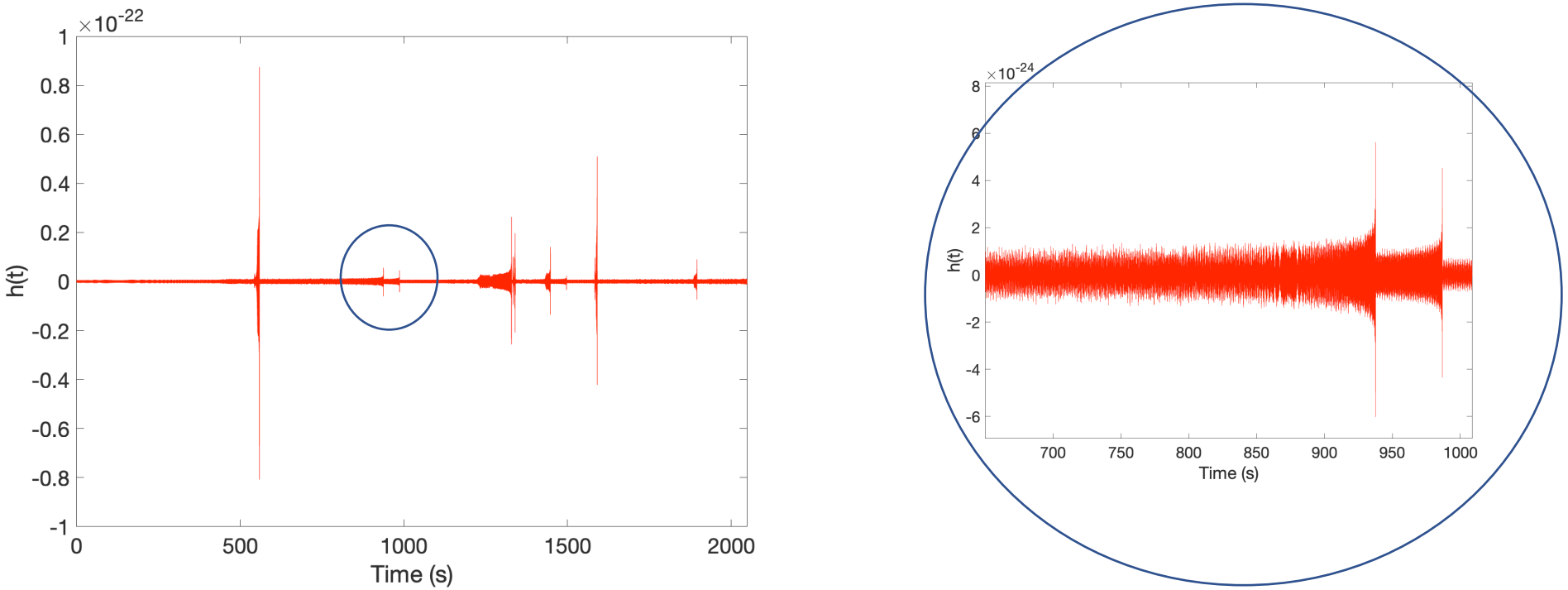
SNR>8: 11551 BNS , 537 BHNS, 6119 BBH

SNR>12: 4048 BNS, 238 BHNS, 5228 BBH

Example of the GW data

28 signals with SNR>6, largest at SNR=85

BNSs merging at 937s and 986s, that are both long duration and overlapping



Challenges

Beginner

- Recovery of high-SNR signals within given time windows

SNR = 597, 386, 383 (BNS), 374, 343, 306

Expert

- Parameter estimation of ultra-high SNR BBH signals
- Long duration binary neutron stars
- Overlapping signals

Current activities

- Run of existing pipelines ongoing on MDC1 (PyCBC, MBTA, Gwastro, PySTAMPAS, PyGWB).
- Many presentations at the div 10 f2f in Maastricht about new techniques to deal with long waveforms and overlapping signals.
- Coordination with EIB

Current activities

The following is a table with the details of groups working on ET DA within obs-da div 10. Please indicate if you are running on MDC1 in the remarks :

Group	Expertise level	Brief explanation of aims	Software used	Contact person	Remarks
Utrecht University	Experts	Parameter estimation (automated classifier for telling number of overlapped signals), joint parameter estimation, Searches (template bank versus global optimisers, null stream background), Machine-learning	PyCBC, other software developed in UU...	Bhooshan Gadre, Thibeau Wouters, Harsh Narola, Justin Janquart, Anuradha Samajdar,	MDC1
ICCUB	Medium	PE, searches	cWB, PyCBC	Tomas Andrade, Pablo barneo, Ruxandra Bondarescu	MDC1
University of Geneva	Beginners	CBC signals, early-inspiral regime	Not final, machine-learning related	Carlos Moreno Martinez, Sarah Baimukhametova, Steven Schramm	MDC1
IJCLab	Experts	Test existing searches based on PySTAMPAS and PyCBC; develop template banks for CBC searches	PySTAMPAS, PyCBC	Tito Dal Canton	MDC1
Annecy, Urbino	Experts	Test existing searches based on MBTA	MBTA, pycbc	Buskulic, Grimaud, Fabrizi, Guidi	MDC1
RWTH Aachen	Medium	Parameter estimation (Fast machine learning based posterior reconstruction)	LAL, pytorch, own developed software	Markus Bachlechner, Tobias Reike, Johannes Erdmann, Achim Stahl	MDC1
APC-Paris	Experts	BNS parameter estimation (DNN based Hamiltonian Monte Carlo)	Bilby, pytorch, own developed software	Ed Porter, Jules Perret	MDC1
Ewha Womans University (Korea)	Beginners	CBC signal search pipeline review/test with matched filtering, (plan) PE focusing on mass distributions of the detected sample (in relation with div3)	LAL, pyCBC (plan) Bilby	Sumi Lee, Seohyun Park, Chunglee Kim	MDC1
University of Pisa	Medium	Detection, PE and Early Warning for high SNR sources with Deep Learning	Pytorch, own developed software	Federico De Santi, Lucia Papalini, Massimiliano Razzano	MDC1

Blue book chapters