

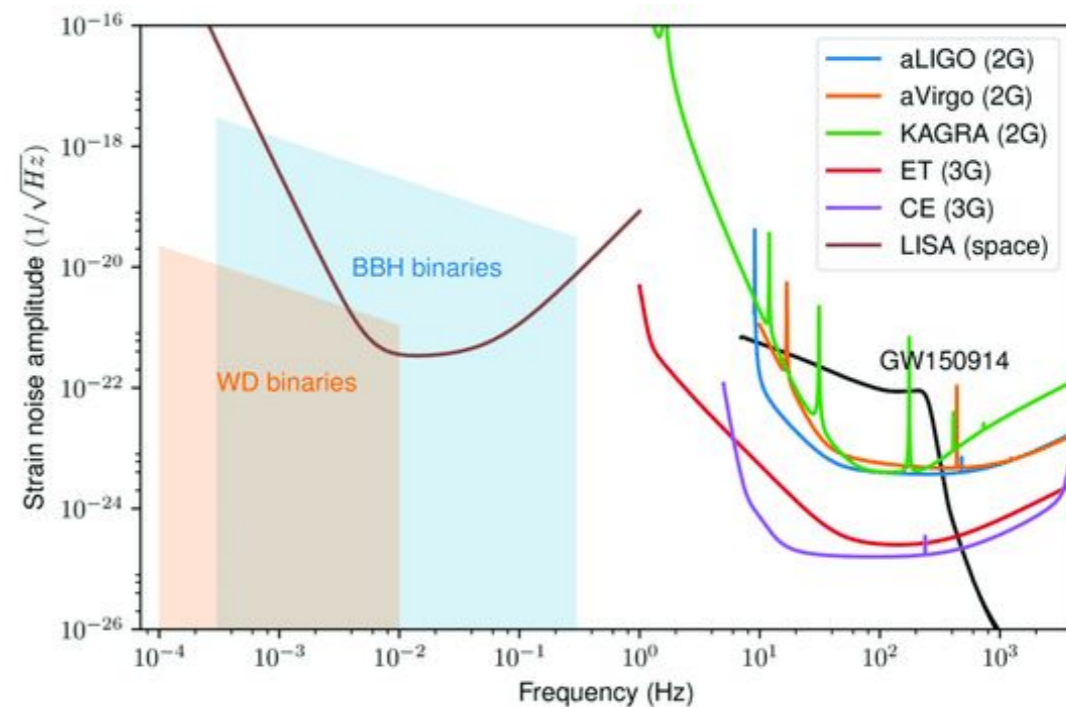
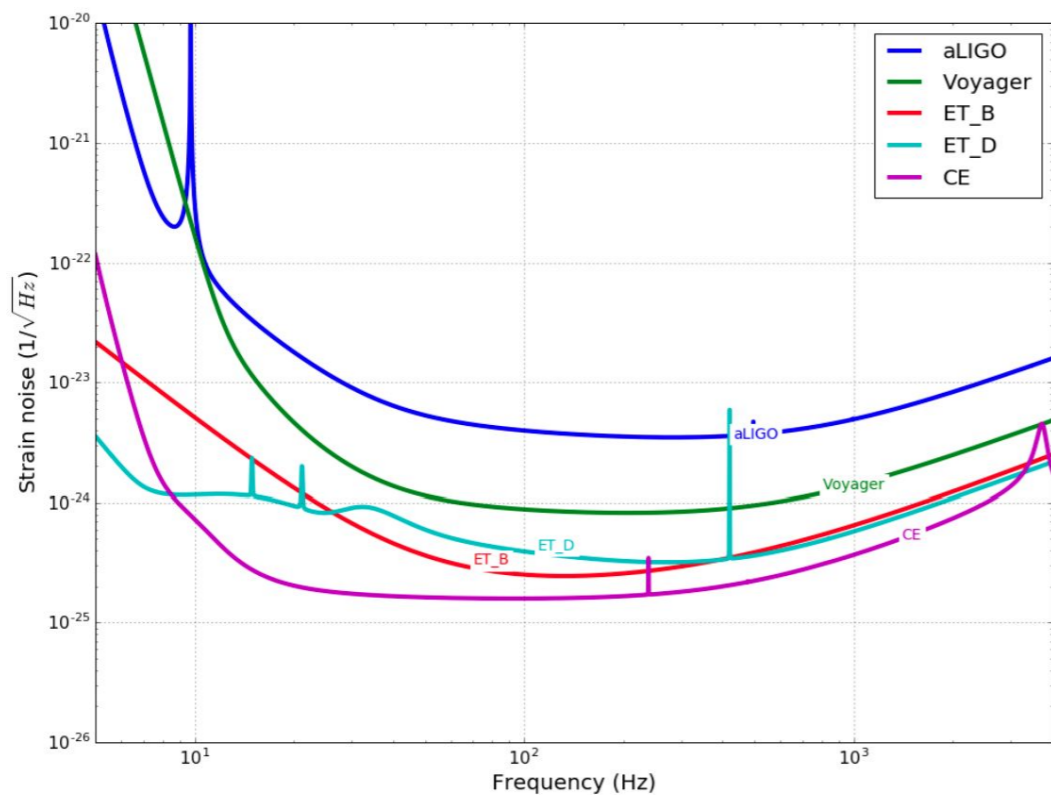
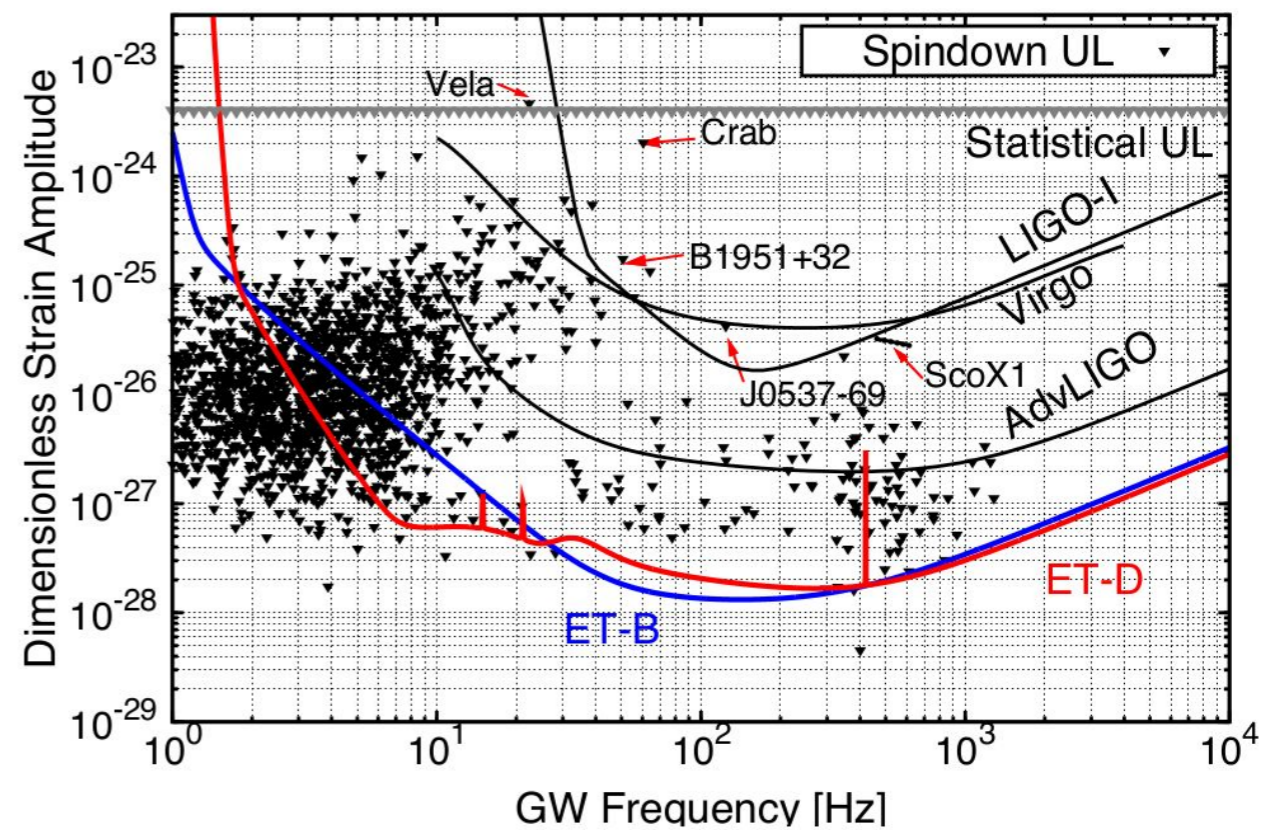
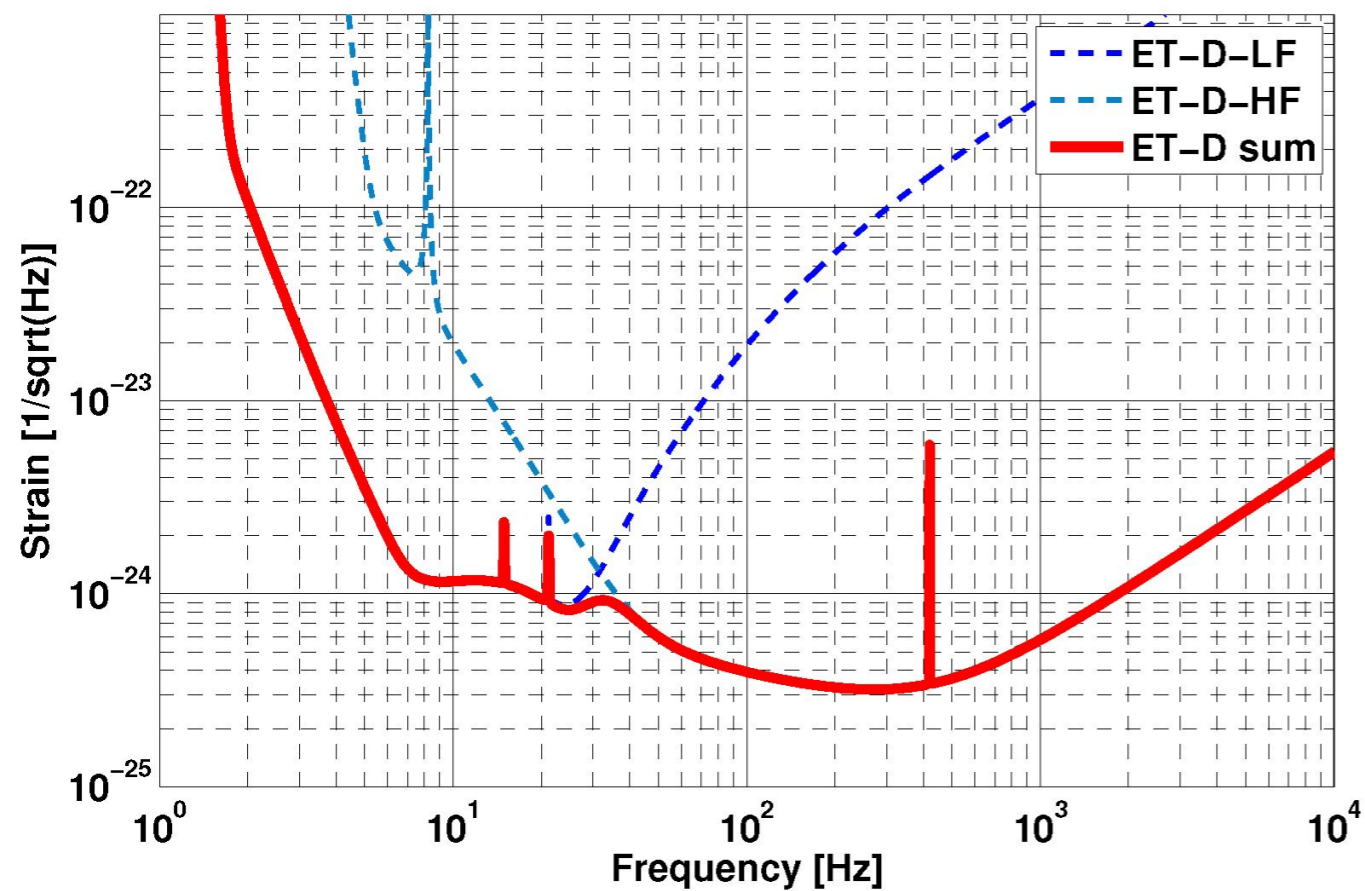
*OSB **Div9**: Scientific potential of different detector configurations, and common tools*

@ Einstein Telescope Symposium, Cagliari, 10 May 2023

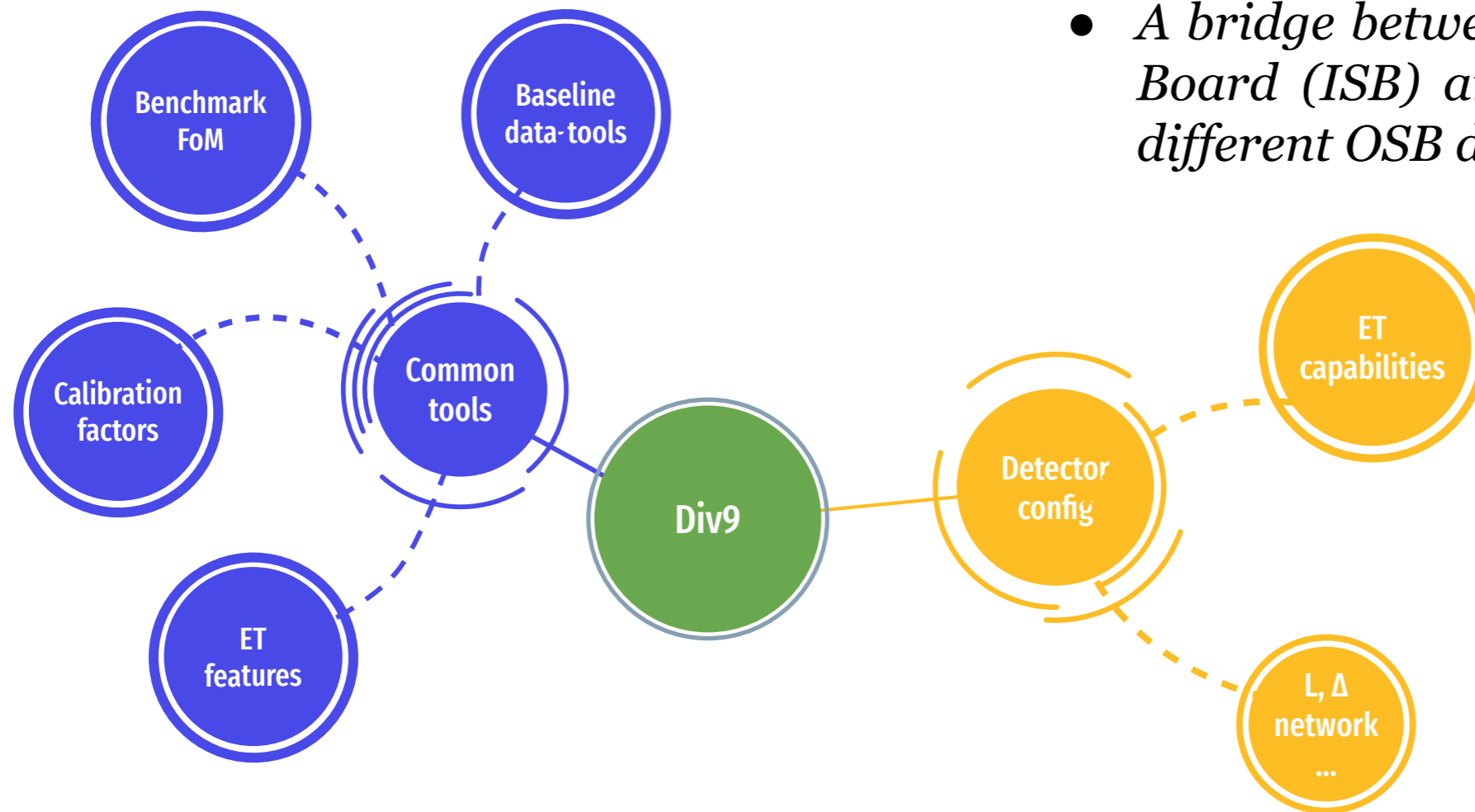
Michał Bejger (CAMK Warsaw / INFN Ferrara)
Siong Heng (University of Glasgow)
Andrea Maselli (Gran Sasso Science Institute)



ET configuration & detector networks



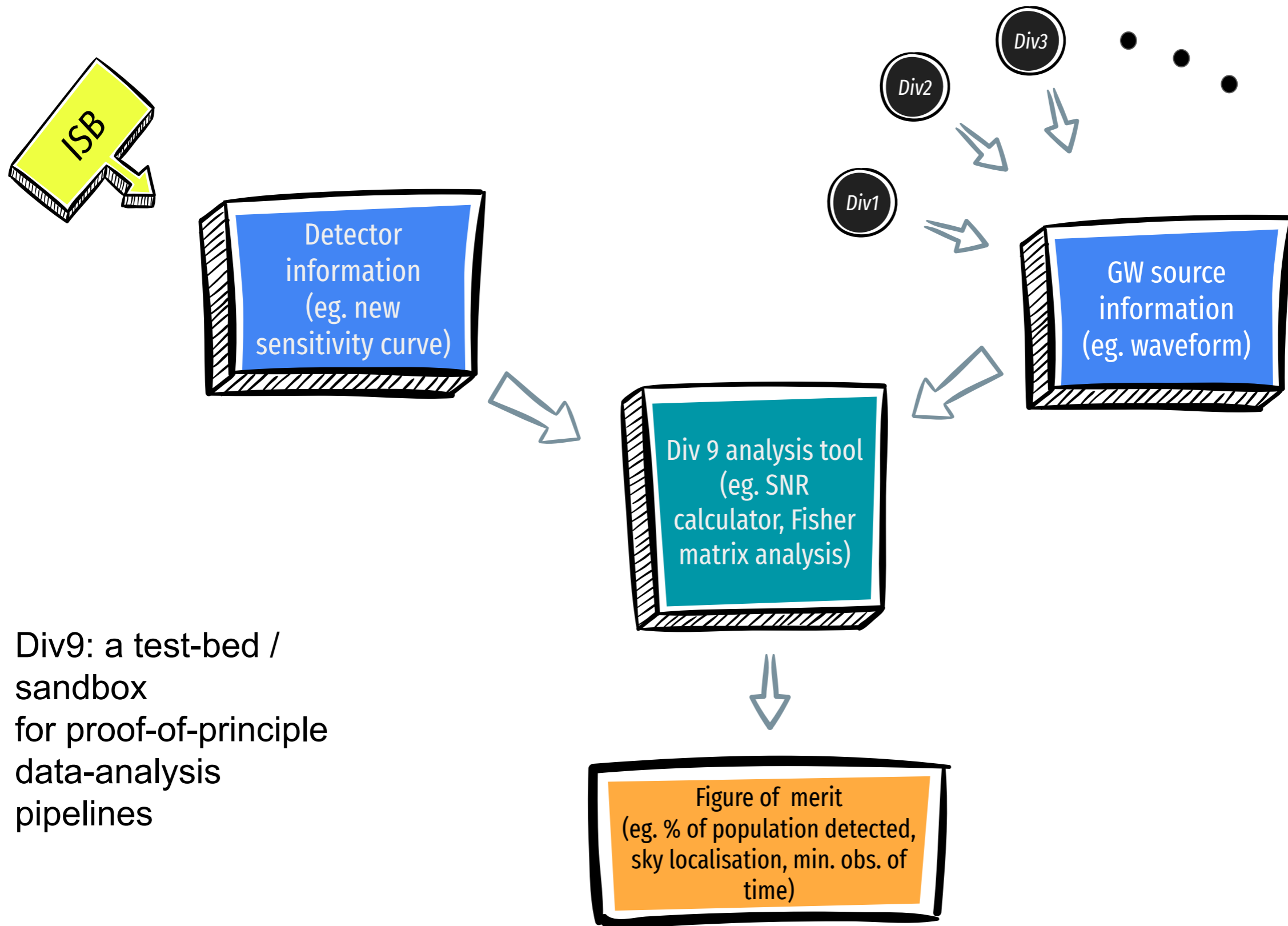
What this division is about



- *A bridge between the Instrument Science Board (ISB) and the OSB, and between different OSB divisions*

- *providing publicly available tools to*
 - *calculate the ET capabilities for astrophysical predictions*
 - *calculate standardized and official figures of merits for different detector configurations / detector networks for the Blue Book and beyond*
- *providing ‘quick’ responses to needs of the collaboration for presenting plots and results to funding agencies, outreach, etc., in a consistent manner*

Possible flow diagram/pipeline prototype



Div9: a test-bed /
sandbox
for proof-of-principle
data-analysis
pipelines

Common tools - verification and tests

Key tools and codes

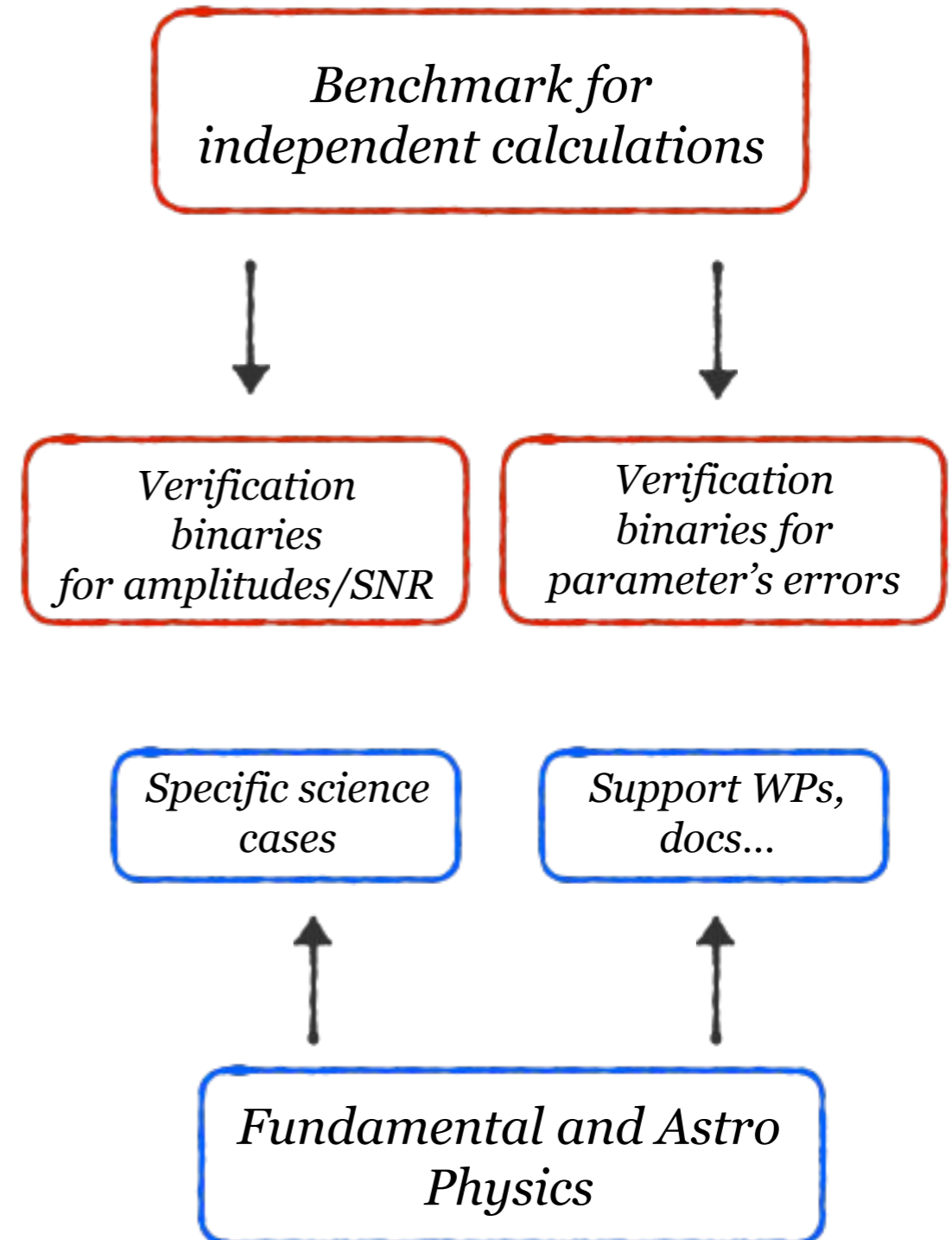
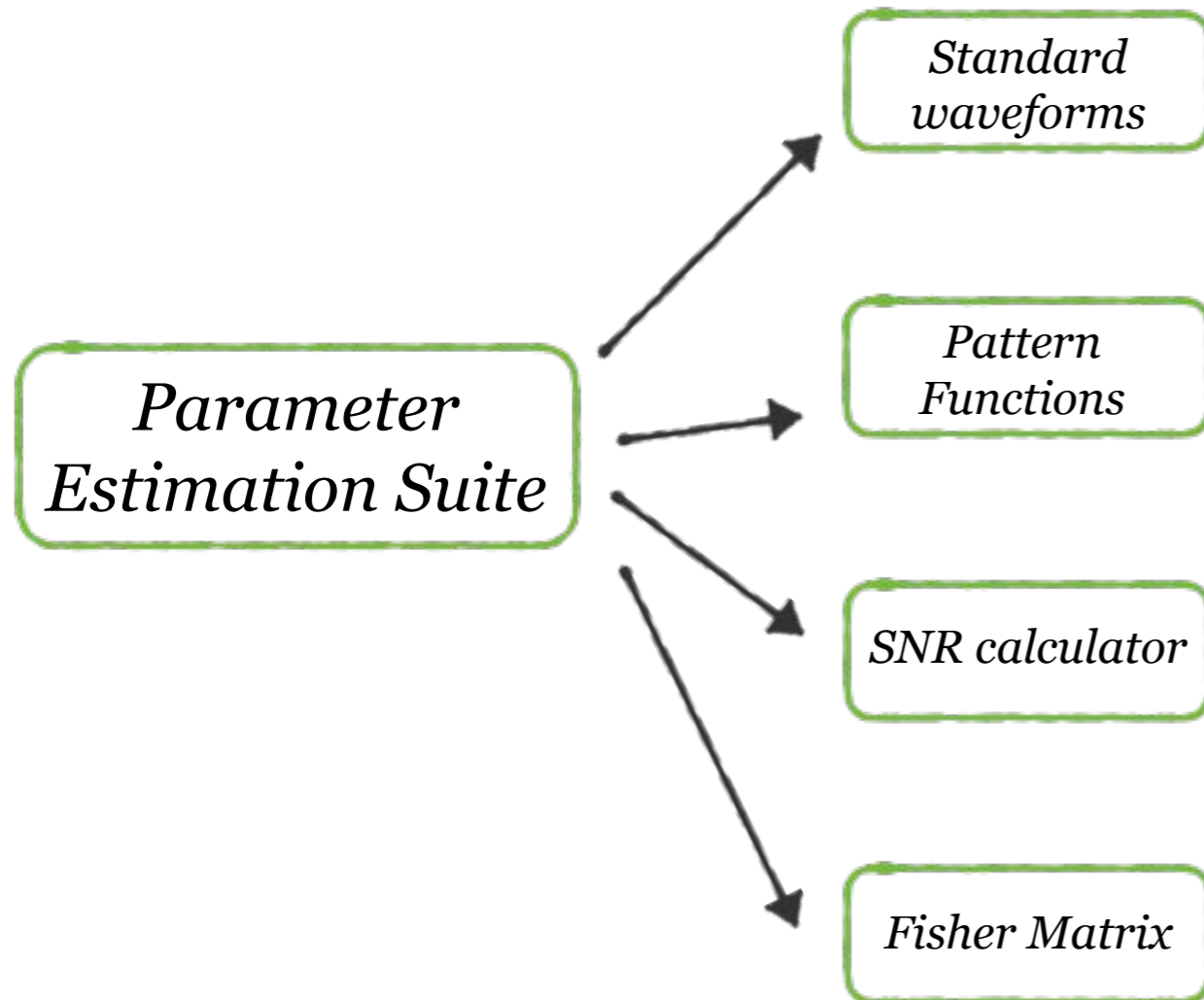
- *Noise Spectral Density of ET - different configurations, sensitivity curves...*
- *Null stream simulator (?)*
- *Pattern functions*
- *Waveform templates and calibration factors*
- *SNR calculator*
- *Parameter estimation tools (e.g. Fisher matrix codes)*
- *Code verification examples with exemplary data (input data, standard waveforms?)*

Test suite / benchmarks for independent calculations, e.g.:

- *Verification binaries for amplitudes/SNR*
- *Verification binaries for small set of parameters*

Common Tools

Development of the infrastructures



Several Fisher matrix codes participating in a common effort to standardize FOMs



GWFast

S. Foffa, M. Maggiore, M. Mancarella, F. Iacovelli

GWFish

U. Dupletsa, B. Biswajit, J. Tissino, J. Harms

GWBench

S. Sborhanian, B. Sathyaprakash

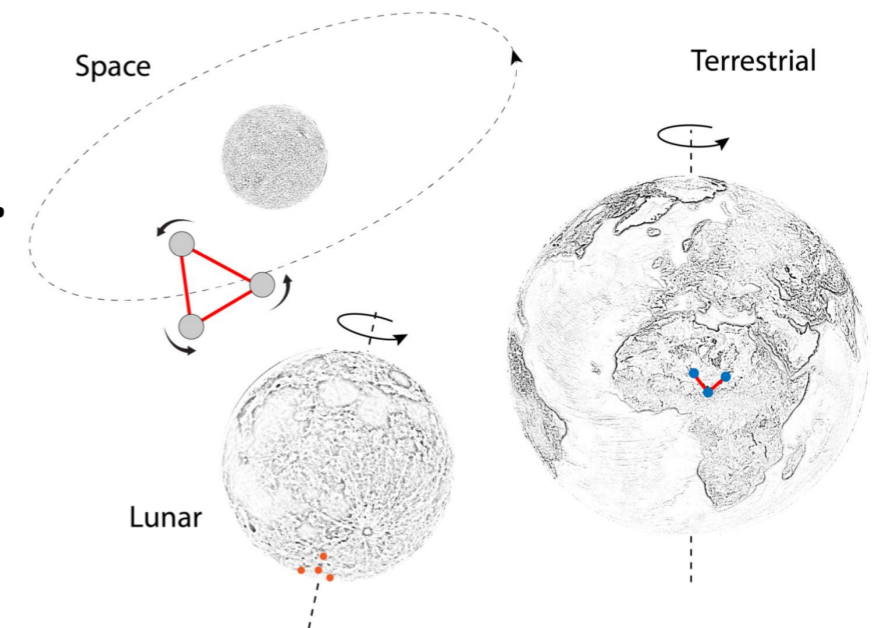
TiDoFM

Y. Li, M. Chan, C. Messenger, X. Fan, S. Heng

Common features

All around suites specifications

- *Time and frequency domain codes for waveform generation and statistical errors on source parameters*
- *A variety of GW templates already available (TaylorF2, Phenom,...)*
 - *Ready-to-include more sophisticate models*
 - *Ready-to-use standard GR tests*
- *Easy to include post-merger templates for ringdown analysis*
- *Tidal Love numbers to study neutron star physics*
- *Interface with LAL suite*
- *Time dependent pattern functions with detector localization*
 - *Detector orbital motion included*
- *Multi-detector platform*



Where we are? (division activities so far)

- [Google docs with a list of common tools](#)
- [Hackathon](#) for the XIII ET Symposium

See the [Div9 wiki page](#) for details and [minutes](#)

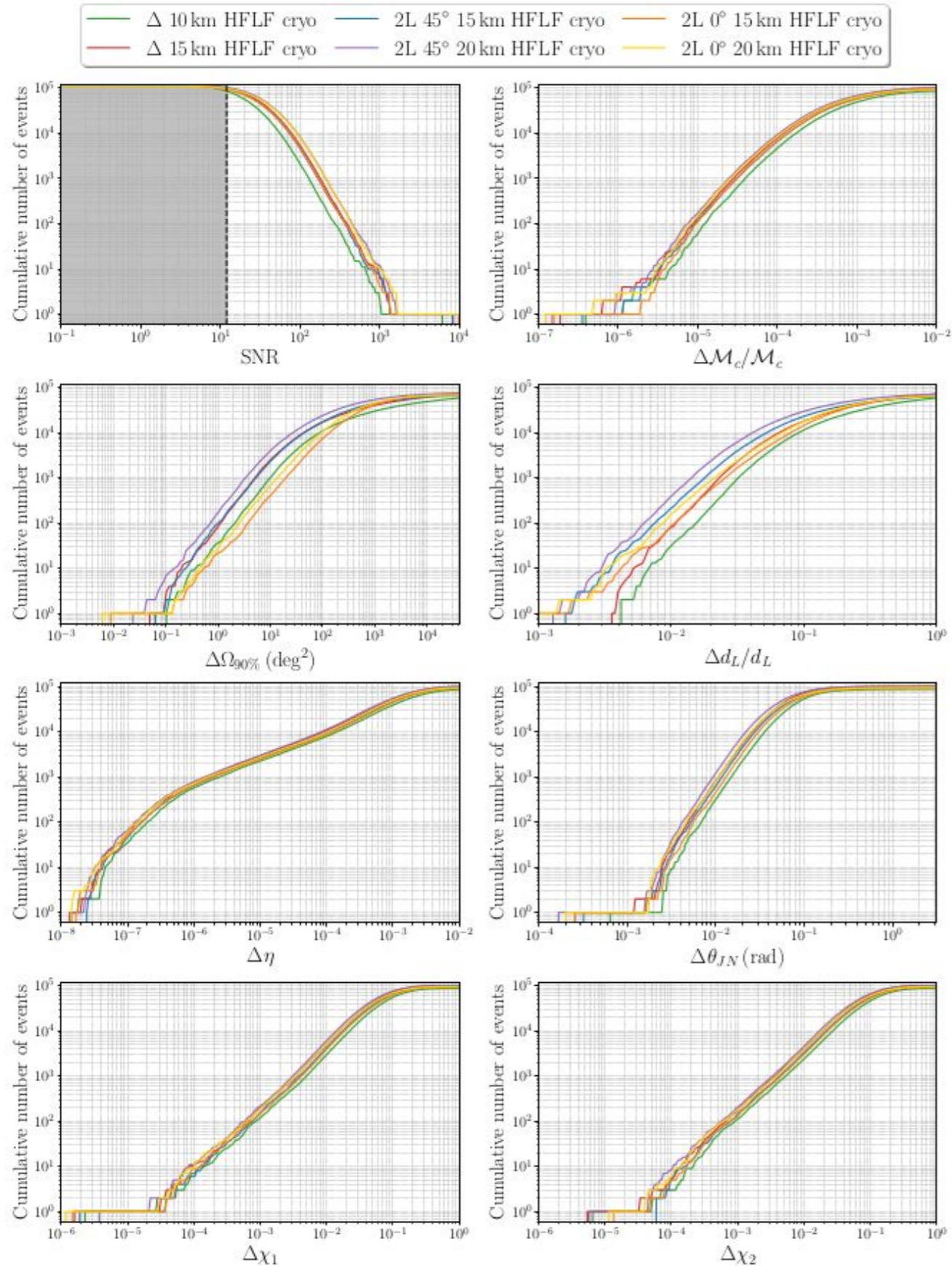
Use of Fisher matrix codes in the CoBA study
(<https://apps.et-gw.eu/tds/?content=3&r=18192>):

3 Coalescence of compact binaries

In this section we study the impact of the different detector geometries and different ASDs on the detection and parameter estimation of BBHs and BNSs. Several parameter estimation codes, tuned toward 3G detectors, have been developed recently, in particular **GWBENCH** [19, 30], **GWFISH** [31], **GWFAST** [17, 32], **TiDoFM** [33, 34] and the code used in [35]. In the context of the activities of the Observational Science Board (OSB) of ET, we have performed extended cross-checks between these codes, finding very good consistency.

Details will be presented in following talks...

BBH



BNS

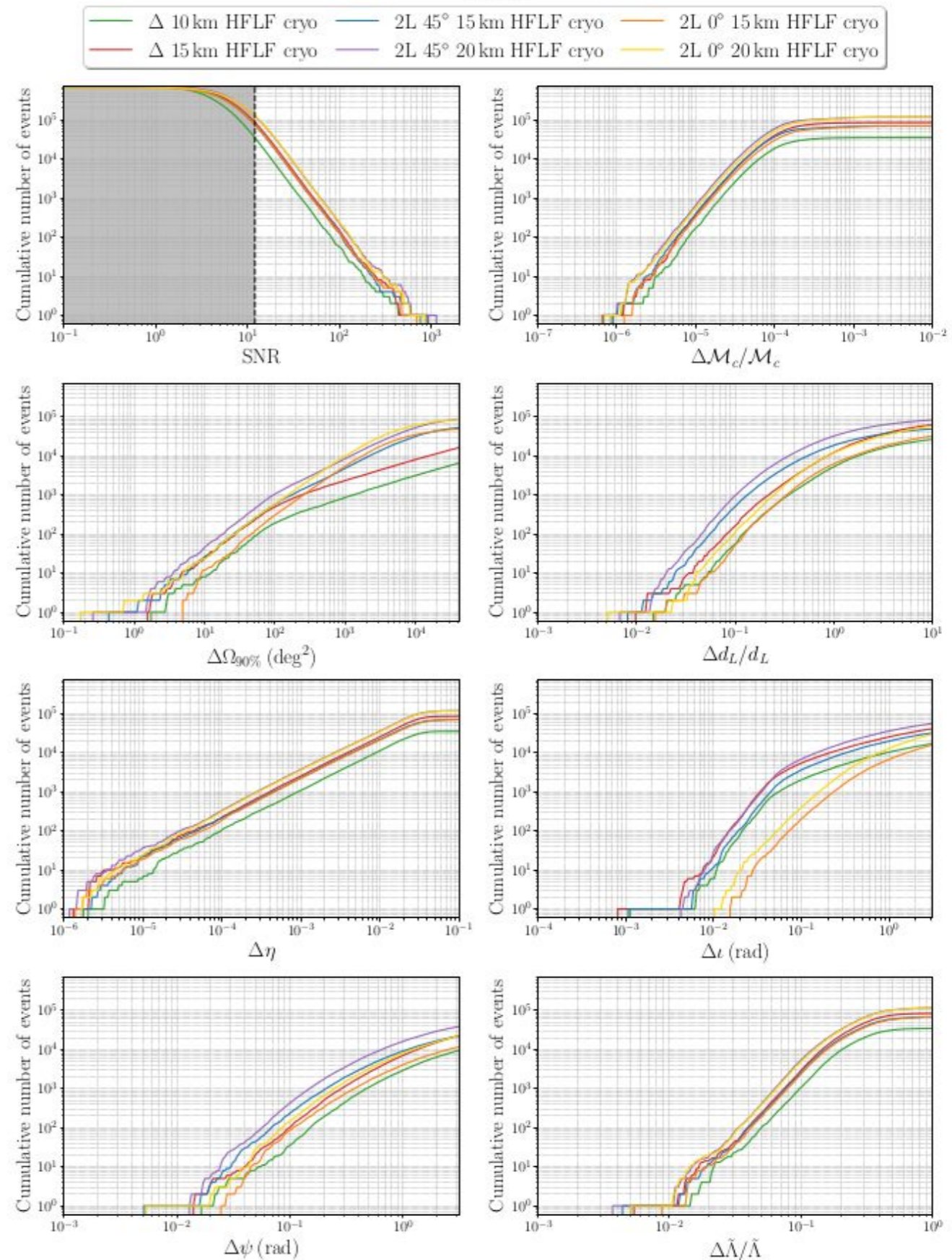


Figure 4: Cumulative distributions of the number of detections per year, for the SNRs and for the error on the parameters, for BBH signals, for the six considered geometries, all with their best ASD, including xylophone configuration and cryogenic LF instrument.

Figure 10: Cumulative distributions of the number of detections per year, for the SNRs and for the error on the parameters, for BNS signals, for the six considered geometries, all with their best ASD, including xylophone configuration and cryogenic LF instrument.

We need your ideas as input

Key links:

- wiki <https://wiki.et-gw.eu/OSB/CommonTools/WebHome>
 - meeting roughly once per month (typically first Friday of the month, 15 CET/CEST)
 - publication list
- git <https://gitlab.et-gw.eu>,
- document server <https://apps.et-gw.eu/tds>
- [CoBA](#)

We have focused (so far) on inspiral waveforms - input on other types of GW signals (CW, stochastic) is welcome!

Please join the OSB Div9 activities and the mailing list:

<http://mail.ego-gw.it/mailman/listinfo/et-osb-tools>