MDC-ET-Next

(Sathya) I am going to collect here some thoughts on what we might do in the second round of MDC.

First of all, I would like these to be called Mock SCIENCE Challenges rather than Mock DATA Challenges. Our goal should be to extract the best possible science out of the mock exercise and show the extent to which we can reconstruct the various "input" parameters. Input should be interpreted in the broadest possible term. It could represent ET PSD, waveforms, source parameters, source rate, cosmology, general relativity or any assumption we make in producing the mock data. Each of our next set of challenges could focus on one or more aspects of astrophysics, fundamental physics or cosmology. Here is what I suggest for the next round.

What will the Data contain

1. Gaussian noise coloured with ET noise PSD. ET-D as it is the most recent design curve
    I. - ET-D is somewhat complicated: Stefan Hild's fit or use just the PSD vs frequency data. Stefan will participate in ETMDC
    II. - Lower frequency cutoff (of noise *and* signals?) 5Hz – 3Hz might be more challenging but we should do that if at all possible. Can we generate and add very long CBC signals to noise?
    III. - Length of data: 1 year
    IV. - Sampling rate: 4096 Hz
    V. - Three IFO outputs, ET1, ET2, ET3 - all at same position, that of Virgo detector
    VI. - Modulation of the antenna pattern to reflect the motion of the Earth (the model used should be made public)
    VII. - Artificial glitches? Single-ifo glitches or correlated noise? How could we model that?
2. CBC Injections
    I. - BNS signals with masses in a definite range but unknown to participants. The rate and the model for its evolution will not be known to everyone. The injection will use a specific distribution for injected intrinsic masses but these will not be known to analysts. Neutron star spins will be zero.
    II. - BH-NS signals. As above but BH will have a non-zero spin, chosen randomly (a flat distribution) in the range 0 to 1.
    III. - BBH signals. As above but both black holes could have spins.
    IV. Tania: Should we use a StarTrack distribution / set of parameters? Ask Belczynski et al for this? Redshift / masses / eccentricity / ? Sathya: Eccentricity can probably be neglected. Tom: We don't want to set a challenge if the answers (e.g. for the mass distributions) are already published… Are there different StarTrack results corresponding to different cosmological models for example?
    V. - EMRI signals (suggested by Nelson C's former collaborator)? Need someone with expertise in this
3. Other Injections
    I. - A rare supernova signal
    II. - A stochastic primordial background ? - for example a nearly flat power-law (cosmic string or inflation). The interest would be in disentangling this from the astrophysical (CBC) stochastic BG.
    III. Tania: Simply injecting at one amplitude is not very flexible .. would prefer to allow analysts to vary the amplitude and spectral index and do their own simulations.
    IV. - CW signals? - Isolated pulsars, what else? Pulsars in binaries? Chris: A colleague in NIKHEF has some expertise in this. Is the analysis / science fundamentally different from CW searches in (a)LIGO data? Who should produce the signals?

4. Cosmology
    I. - A flat Universe with H_0=70 km s^{-1} Mpc^{-1}, Omega_L=0.73, Omega_M=0.27 and w=-1

What are the Science Challenges for this run

1. Determine the rate of BNS, NS-BH and BBH as a function of luminosity distance
2. Determine the cosmological parameters to the extent possible
3. Determine the mass function of neutron stars and black holes
4. Determine the presence/absence and parameters of a primordial power-law stochastic background (OR: Determine the best sensitivity of a search for primordial BG in the presence of astrophysical BG).
5. CW-related challenge?

What publications do we envisage for ourselves and for other groups?

1. Sathya: Once the data are validated, release them and allow external groups to apply new techniques and write their own publications
2. At least one general paper presenting the data as a whole...