

IGFAE / USC interests in Einstein Telescope

ET-Spain meeting, October 8 2021, CSIC Madrid

T. Dent & A. Gallas Torreira for the IGFAE GW Research Programme

- ❖ Data analysis : Search for compact binary coalescence signals
- ❖ Black hole binary astrophysics & tests of GR
- ❖ Search for signatures of ‘non-standard’ compact objects
- ❖ Instrumentation : Si sensors, Electronics, DAQ and Control

- Interest in both online (low latency) & offline (publication) compact binary search, currently using 'PyCBC' library <https://pycbc.org>
- First ET MDC (2012!) : Showed that overlapping signals can be detected with standard tools Regimbau, Dent et al., Phys. Rev. D 86, 122001
- Developing online near-real-time parameter estimation methods for EM / MM followup (incl. HECR, $HE\nu \Rightarrow$ Pierre Auger)
- ET low frequency sensitivity \Rightarrow *early warning* detection (pre-merger)
 - currently first prototype for next LVK run
 - upcoming experience will inform future development ...
- Interest in search including *higher GW modes* Harry et al. Phys. Rev. D 97, 023004 (2018)

Compact binary astrophysics & fundamental physics

- TD currently co-chair of LVK Rate & Population technical group
- Reconstruct distribution of merging binary masses, spins, redshifts ...
- ET promises $\sim 10^{5\pm 1(?)}$ detected mergers per year : interest in *high statistics* methods
- Black hole spectroscopy : test of GR, parameter estimates etc. via ringdown
J. Calderón Bustillo+ Phys. Rev. D 103, 024041 (2021)
- Black hole binary kicks : determine magnitude & direction \Rightarrow
potential multi-messenger observations JCB+ Phys. Rev. Lett. 121, 191102 (2018)
- BSM physics : Searches for signatures of boson star mergers
JCB+ Phys. Rev. Lett. 126, 081101 (2021)

IGFAE Instrumentation in ET

Background and plans

- The IGFAE/USC HEP group has strong experience in instrumentation with silicon sensors for the LHCb experiment at CERN
 - Construction, operation of the Silicon Tracker for Run 1 & 2
 - Design and construction of the vertex detector (VELO) for the upgraded LHCb
- The group is specialised in Electronics, DAQ and Control systems
- Personnel (limited time at the moment, substantial increase in a year) :
 - 2 Microelectronics PhD engineers
 - 2 Microelectronics Technicians
 - Possibility to recruit students (Physicists / Engineers)
- Given the group's know-how and strengths, ET WPs that fit best our profile are :
 - *Wave-front sensing and control*
 - *Data acquisition and real time control*