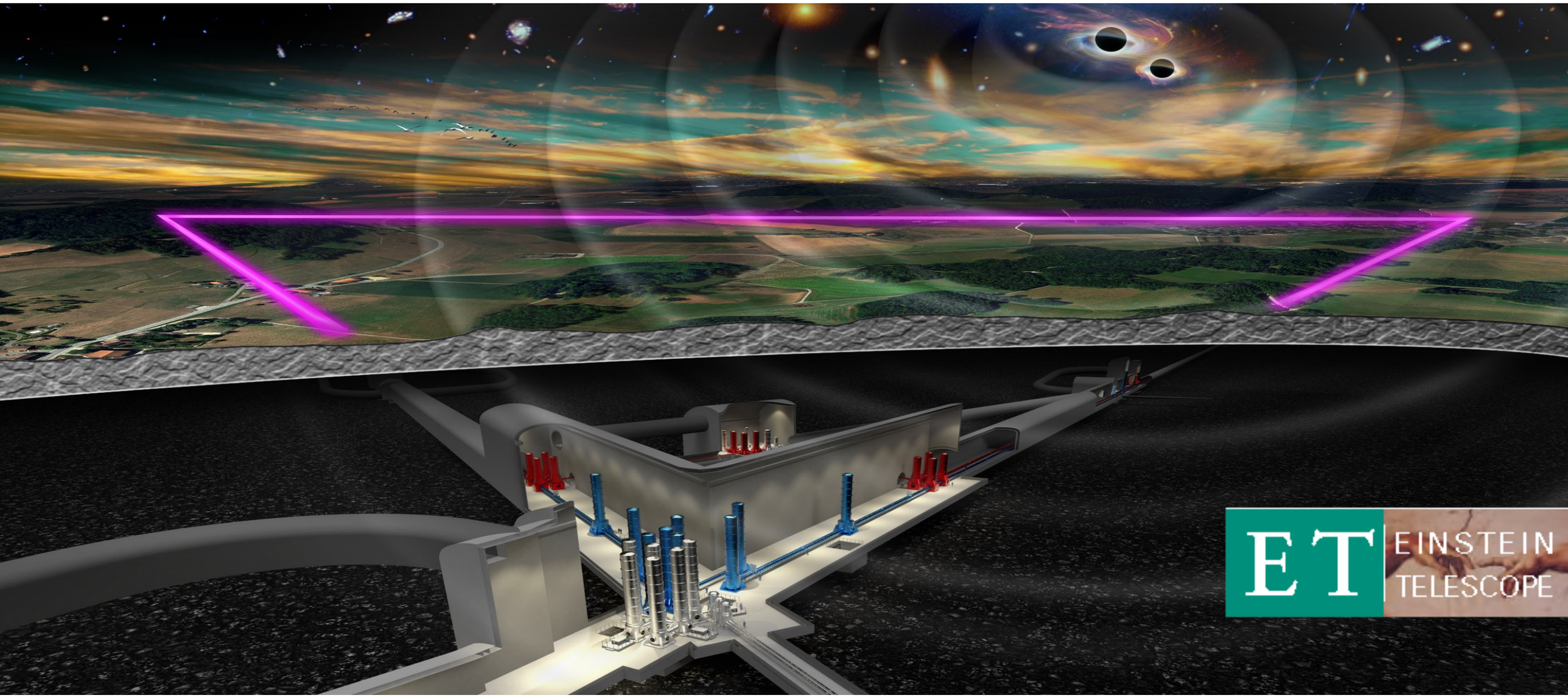
ET sensitivity, expected rates and computing challenges



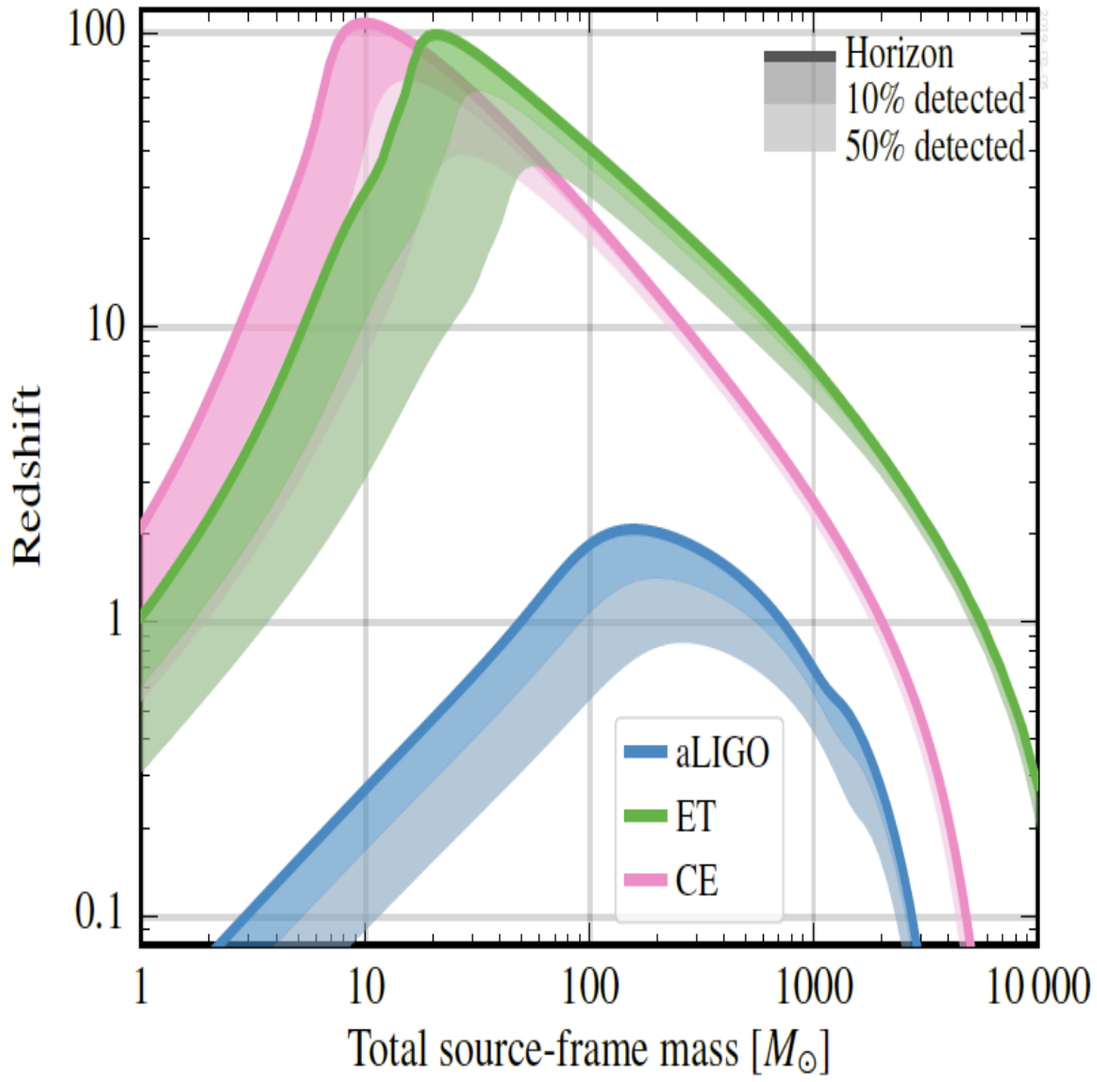
Ed Porter (APC/CNRS)

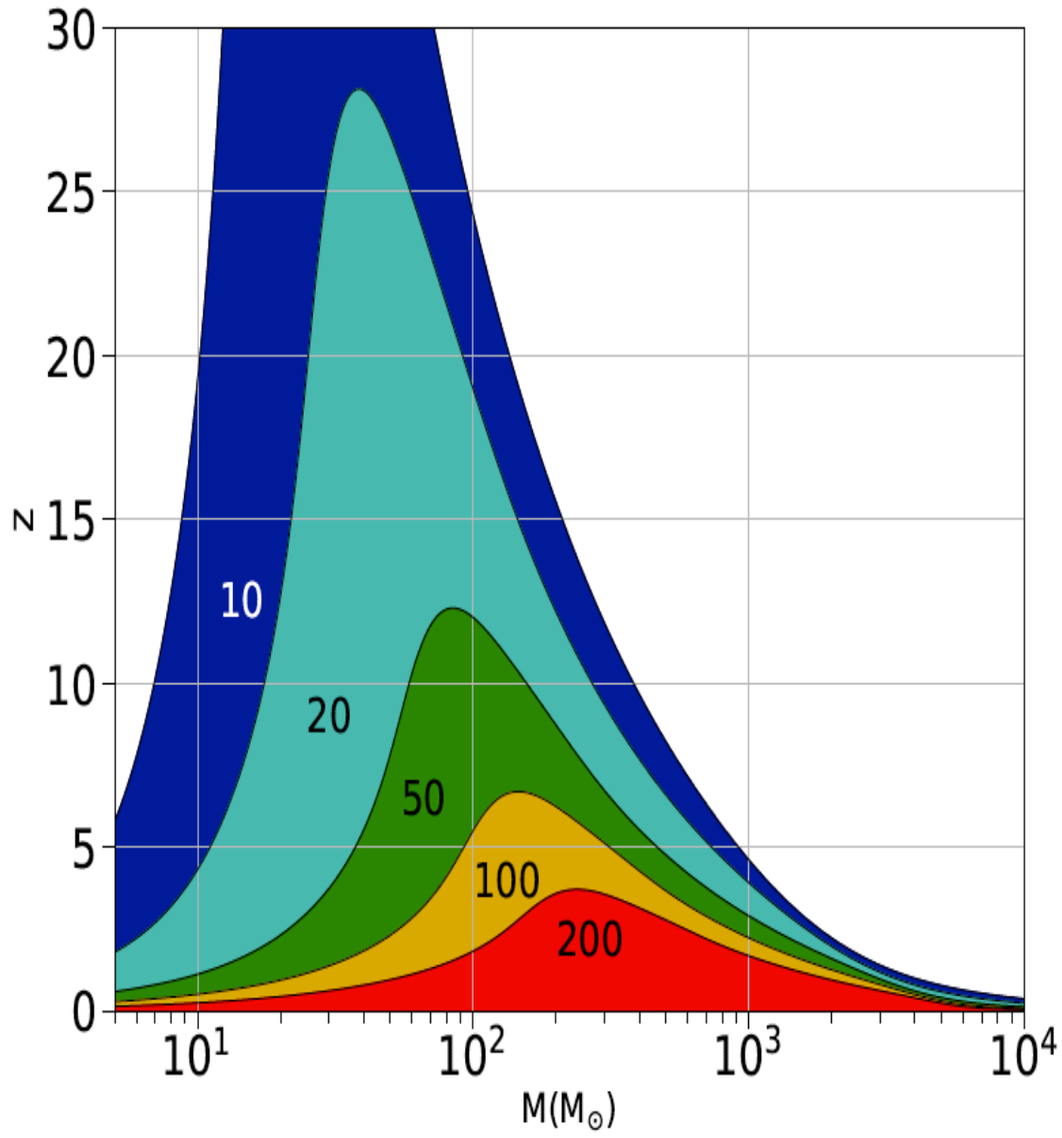
ET-EIB kickoff workshop, Nov. 2021

Overview

- Science potential and expected rates
- Computational challenges:
- Short, medium and long term

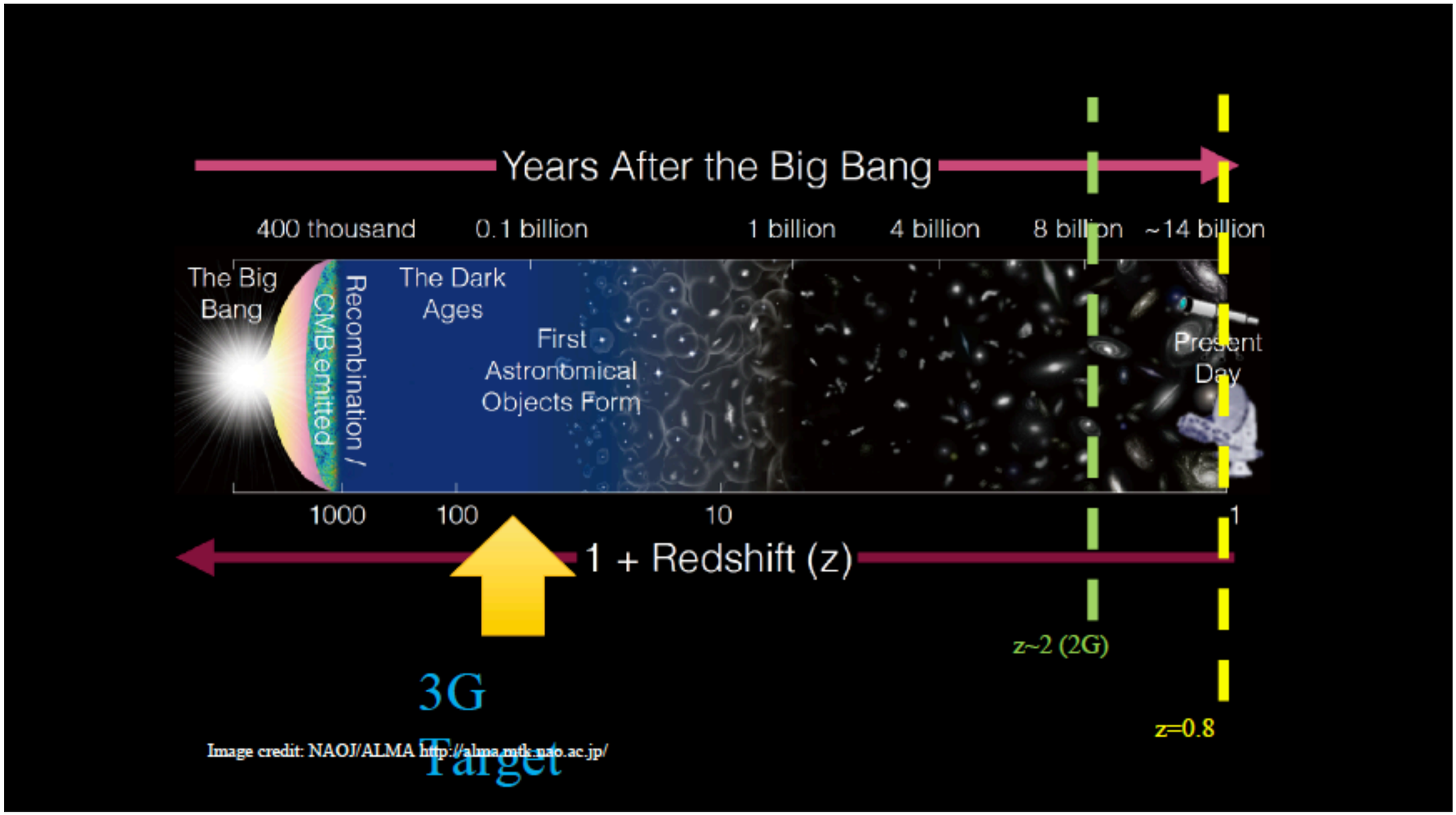
ET Science Potential





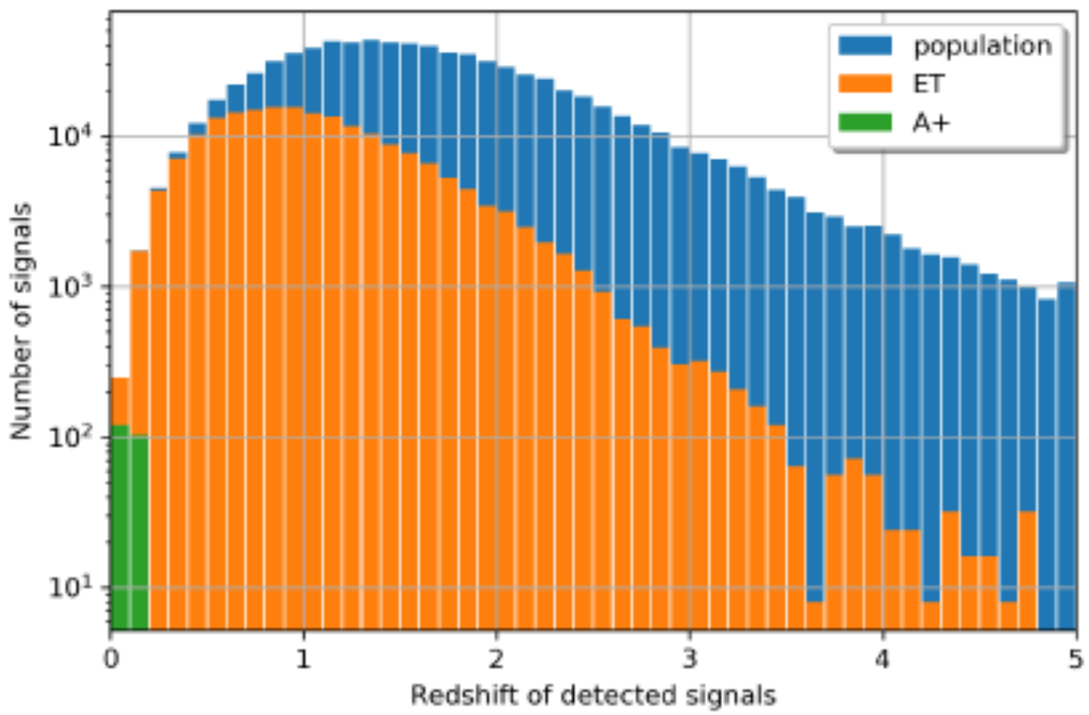
Michele Maggiore *et al* JCAP 03(2020) 050

ET Science Potential

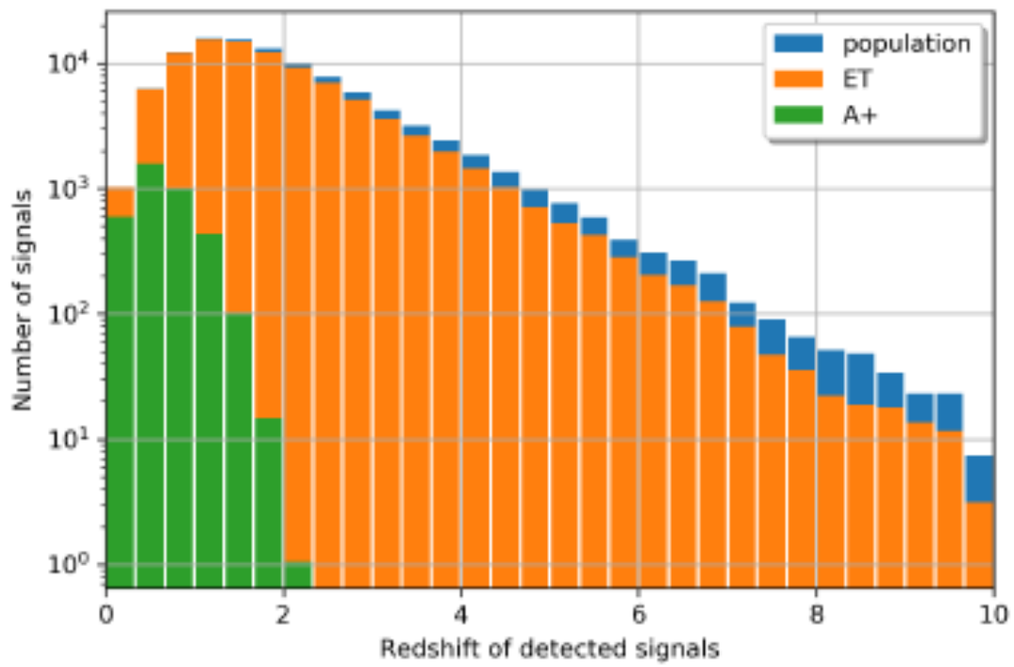


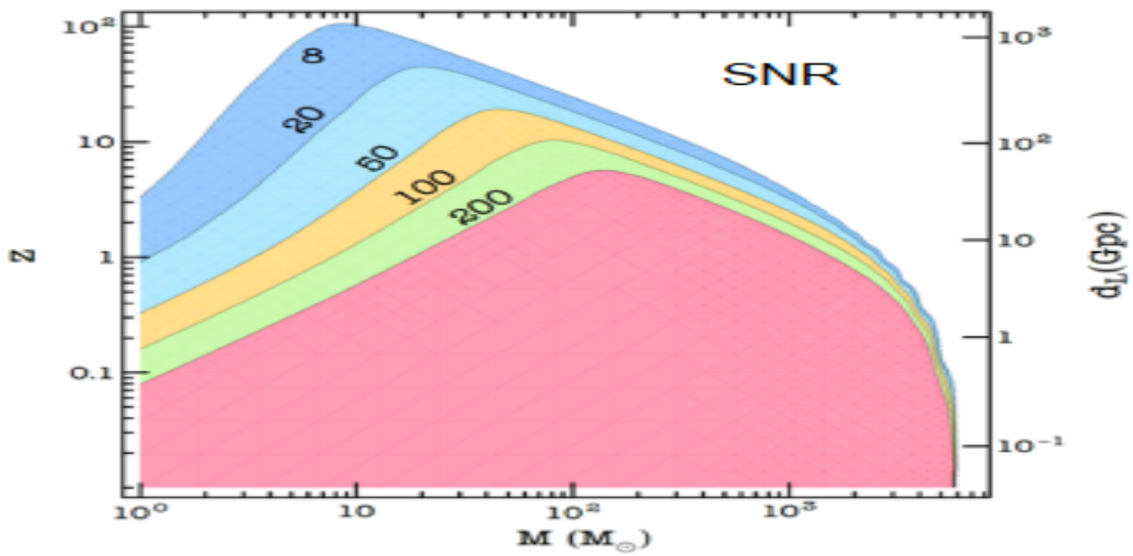
ET event rate

BINARY NEUTRON-STAR MERGERS



BINARY BLACK-HOLE MERGERS





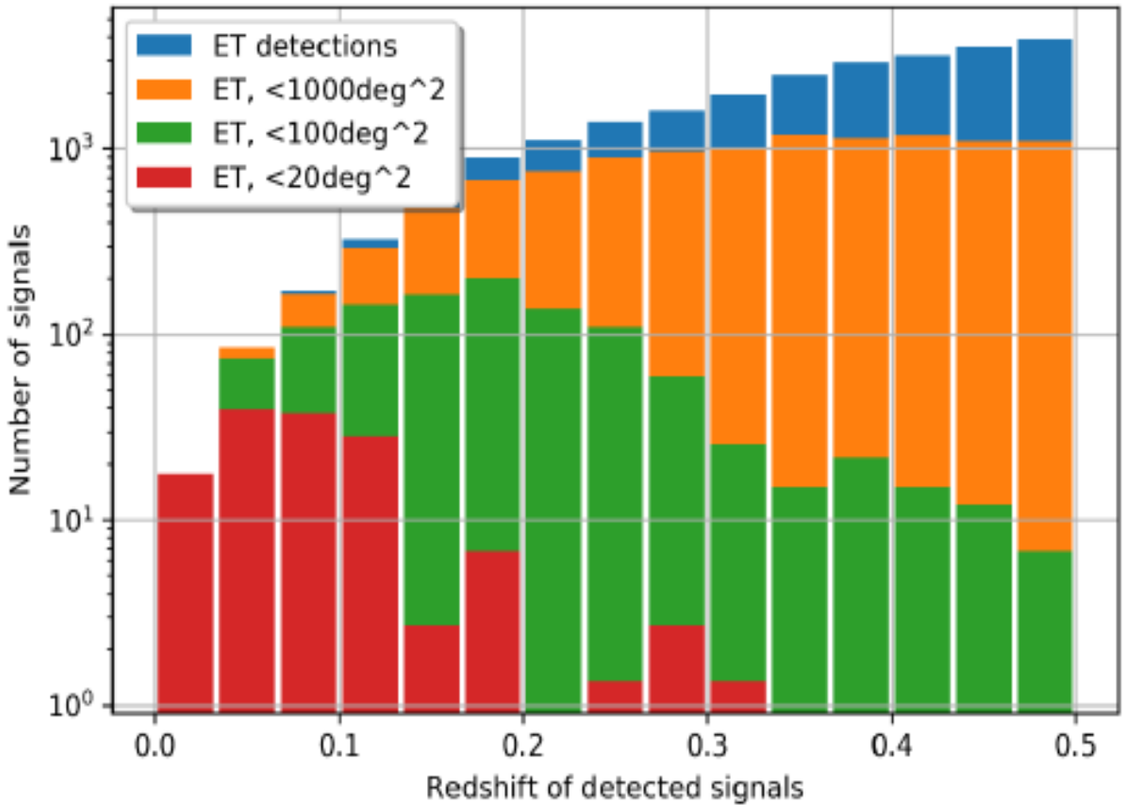
credit: M. Maggiore, M. Branchesi

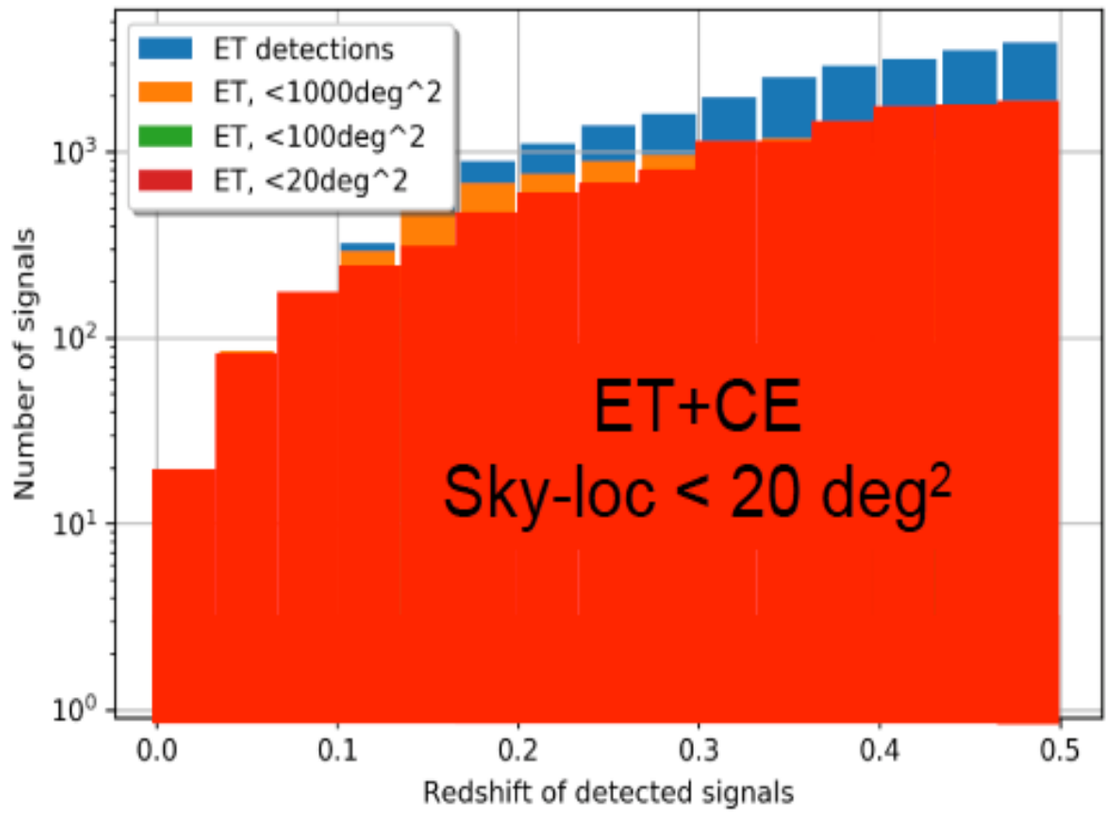
- 10^6 BBH mergers/yr up to z = 50
- 10^5 BNS mergers / yr up to z = 2
- 10-100 possible EM counterparts / year
- High SNR events

Multi-band/messenger observations

credit: M. Branchesi

Multi-band/messenger observations

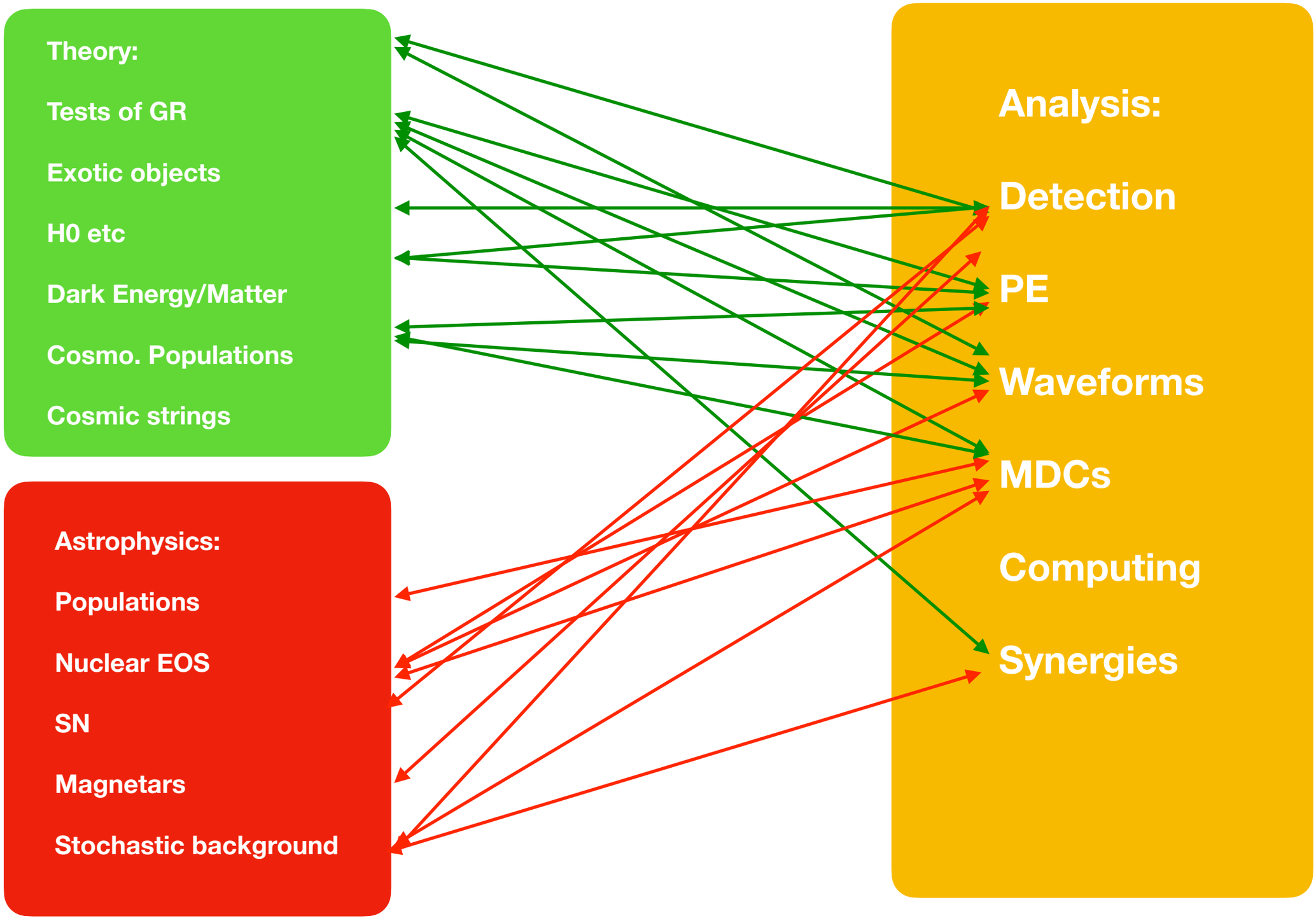




credit: M. Branchesi

- In 1 year of observation:
  - 100 detections/yr with sky error < 20 sq. degrees
  - Pre-merger alerts of hours - minutes

OSB synergy


Theory:
Tests of GR
Exotic objects
H0 etc
Dark Energy/Matter
Cosmo. Populations
Cosmic strings
Astrophysics:
Populations
Nuclear EOS
SN
Magnetars
Stochastic background
Analysis:
Detection
PE
Waveforms
MDCs
Computing
Synergies

Working group synergy

OSB:

ET science case

Prepare DA requirements

Evaluate computing requirements

Realistic PSDs
Tools for BNS range
Configuration studies

Computational infrastructure
Data format/storage/transfer
Data security
Mock data challenges
Waveforms etc.

ISB:

ET-TDR for infrastructures and detector

Identify missing technologies

Plan R&D activities

Data storage
Data transfer

EIB:

Define computing resources

Study computing models

Possible synergies

GW Synergies

LIGO Hanford

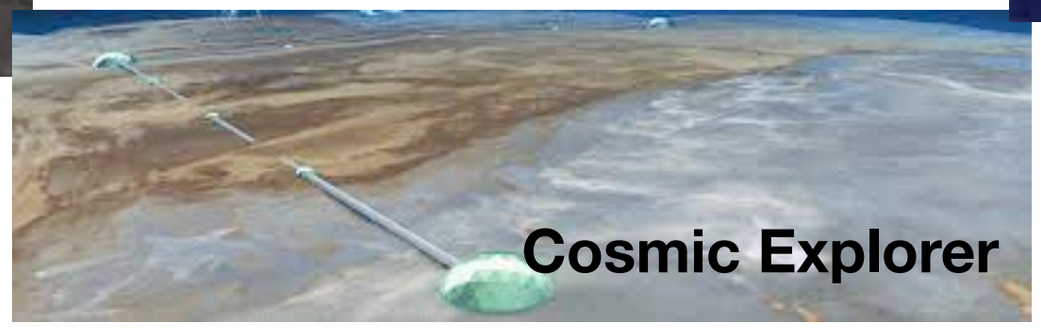
LIGO Livingston

Virgo

KAGRA

Data Analysis Synergies

LISA



Computational Challenges

- These can be broken down into three catagories
  - Short (i.e. now - 6 months)
  - Medium (6 month - ??)
  - Long (pre and mid operations)

Computational Challenges

- Short term
  - Need an idea of the basic computational infrastructure
  - Common storage for waveforms, common tools, PSDs, study results (ESFRI, CoBe, etc.)
- ET Science challenges
  - Codes
  - Astro/Cosmo populations
  - Science challenge data storage
  - Interface for data acquisition, submission and evaluation

Computational Challenges

- Medium term
  - Dedicated computational resources, e.g. CCs, cloud etc. As science challenges get more complicated, more computing power will be needed for analysis
  - Low latency analysis of multiple sources
  - Benchmarking studies using alternative technologies, e.g. GPUs
  - Public platform for open source tools/waveforms/pipelines

Computational Challenges

- Long term
  - Development of a MMA alerts infrastructure
  - ET-CE data transfer?
  - Searchable online catalog database.
  - GWOSC-like platform for public data release

Conclusion

- ET will represent a new era in GW astronomy
- Hundreds of thousands of sources per year to deal with
- Computational challenges for analysis, storage and dissemination