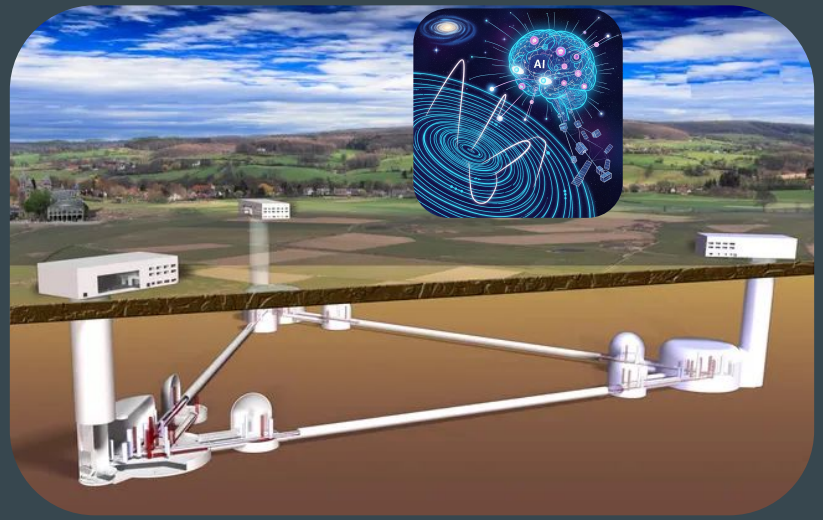
Einstein Telescope and AI/ML:

panel discussion starter



EuCAIFCon 2025

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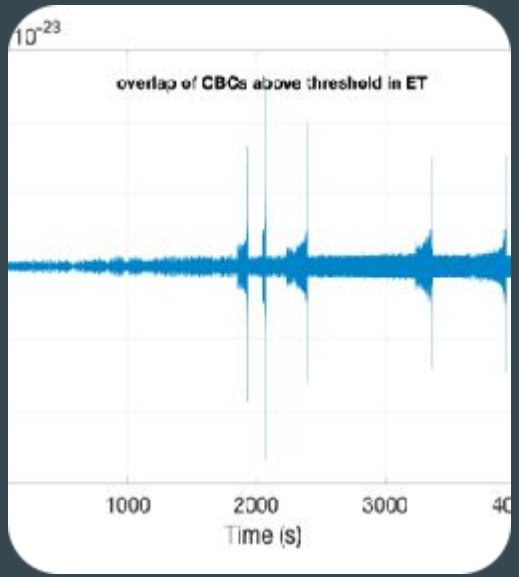
LIGO-G2501288

signal challenges

Long duration CBC waveforms:

- Huge number of templates
- Time-varying response functions
- Earth motion and rotation
- Noise stationarity and glitches
- Require low latency analysis and early warnings for astronomers



Overlapping signals:

- big impact on parameter estimation

Transition to detection regime for new signal types:

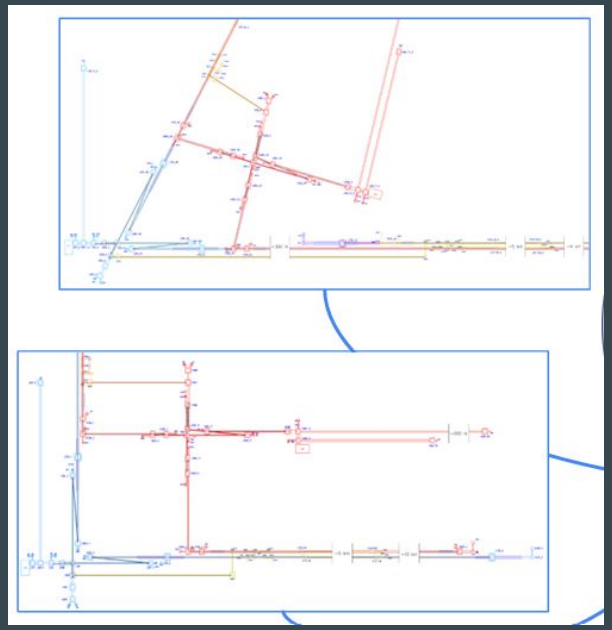
- non-CBC transients (“bursts”)
- continuous waves
- stochastic backgrounds
- ...unknown unknowns?

How can AI/ML help?

detector and noise challenges

- optimal design and control of all detector components
- noise characterisation and mitigation
  - Newtonian noise subtraction
  - environmental correlated noise
  - can we treat (sub-)detectors as independent?

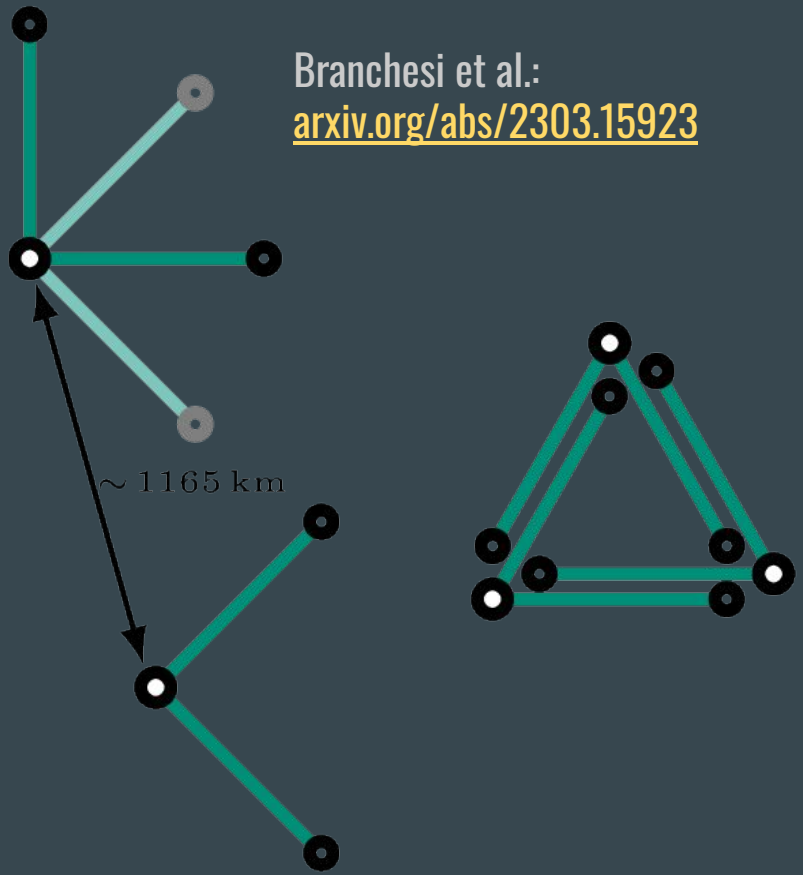
- signals becoming noise:
  - large number of signals → foreground for other analyses



XV ET Symposium Bologna, Italy
(26-30 May 2025) ET-0228A-25

How can AI/ML help?

For context: different ET configuration options



Branchesi et al.:
arxiv.org/abs/2303.15923

- we have to manage big data flux from multiple interferometers, and possibly 2 or more sites (in double-L configuration)
  (3–4 if Cosmic Explorer operative with ET)
- in both configurations, we need:
  - efficient data management and data quality pipelines overall
  - especially: low-latency AI-based searches for enabling public alerts and follow-ups!