

CIEMAT GW group activities

C. Delgado for CIEMAT group

The CIEMAT group

Relatively new group in the business, created in 2022.

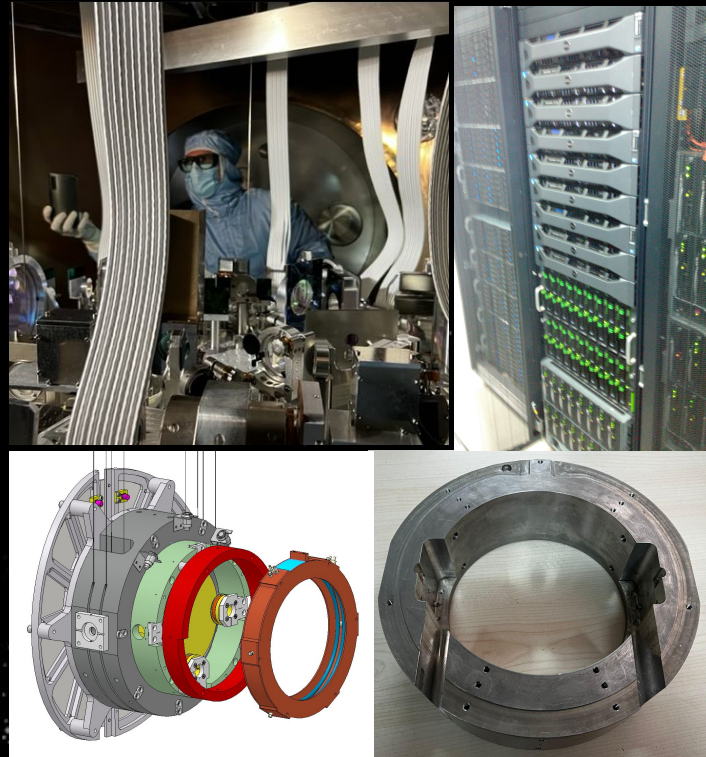
Aiming to play a relevant role in the ET instrumentation development in the long-shot, and prepare for the data analysis.

Joined Virgo in 2023 to acquire experience, but only became full member in 2025.

Hardware and computing development, as well as low level analysis considered as the roots of our contribution.

- **Mostly happening in Virgo so far, but for some computing activities led by PIC.**
- Higher level analysis is also within our portfolio, but we are still getting into it.
 - Looking forward to collaborate with other groups.

The group (<10 members including technical personnel) is relatively small for such ambitious plans: working hard to increase its size.



Content

1 Introduction

2 Hardware

3 Computing

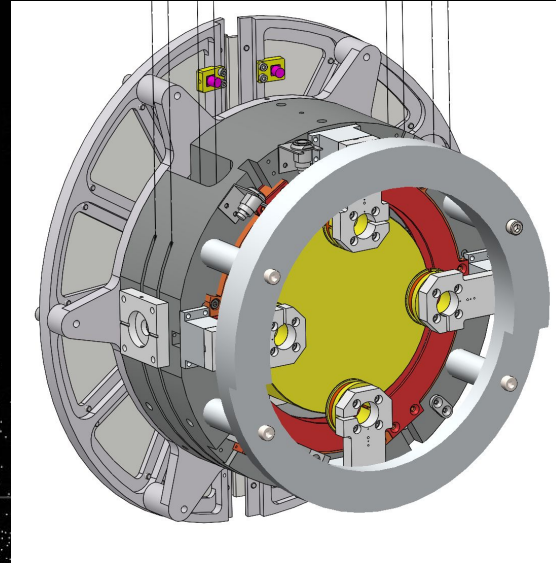
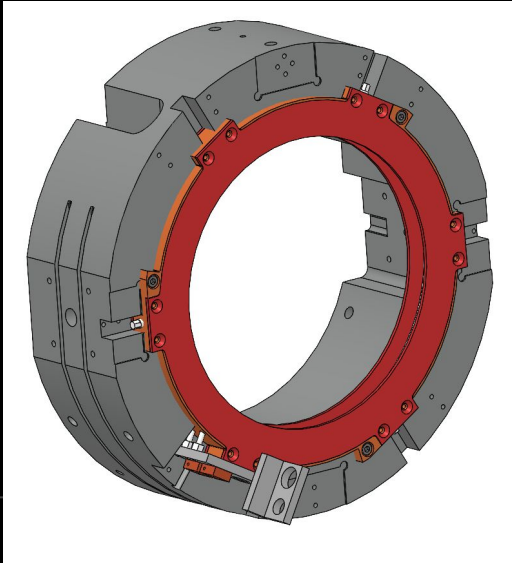
4 Analysis

5 Add section title

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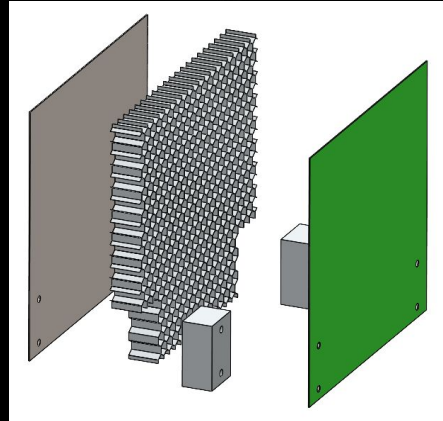
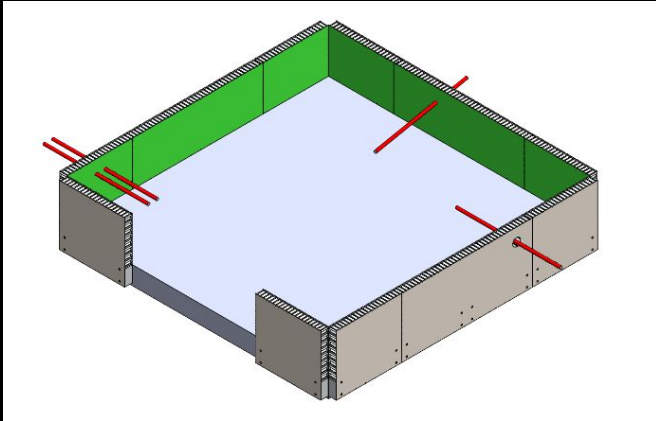
IMC upgrade for O5

During O4 commissioning, higher order mode (HOM) were resonating in the Injection Mode Cleaner. The upgrade will add a ring heater to the payload to correct for thermal effect and get out of any possible degeneracy working point for HOM.



Baffles for suspended benches for O5

Design, construction and installation of passive baffles for stray light mitigation for the new Virgo's suspended injection and detection benches.



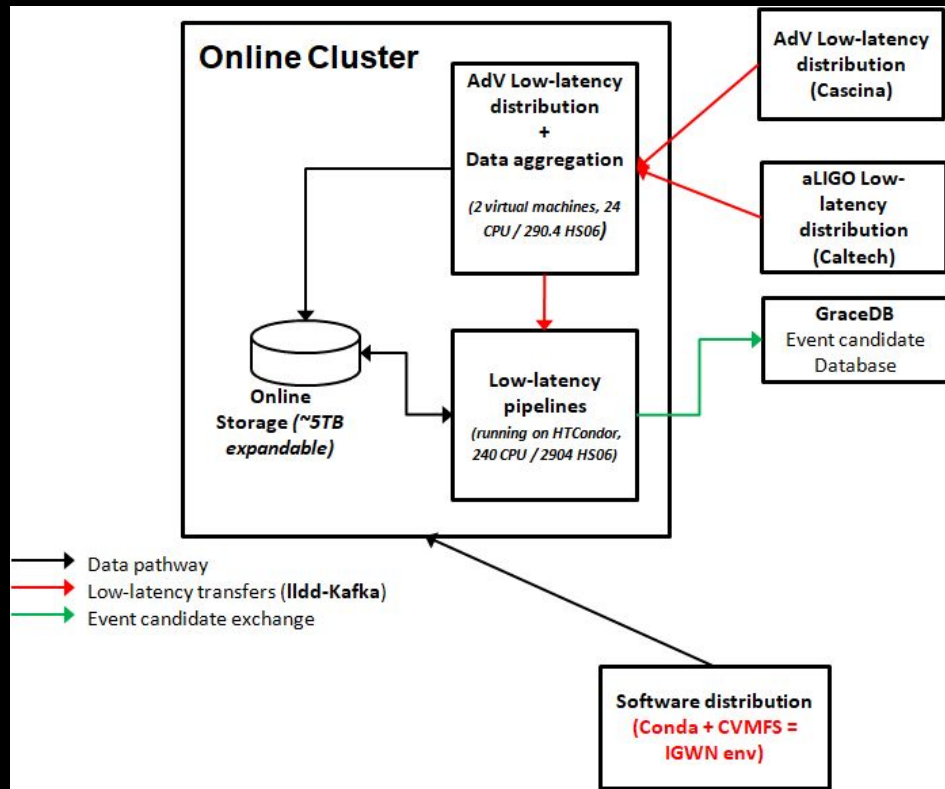
Requirement description	Value required
Minimum resonance frequency	>300Hz
Total weight	SRB: ≤ 20 kg PRB: ≤ 20 kg SDB1: ≤ 26 kg SIB1: ≤ 30 kg (Top and bottom part)

Low latency cluster

Running at CIEMAT since 2023.

Running PyCBC low-latency online pipeline since mid 2024.

Its role is under discussion.



Resources at PIC

Joint CIEMAT-IFAE effort.

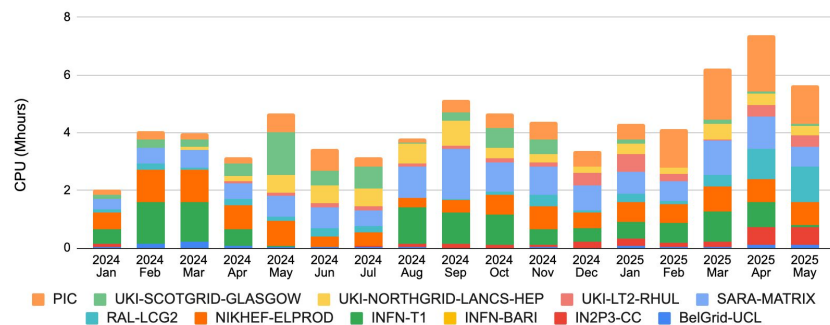
Joined the LIGO/VIRGO Grid in Summer 2019.

Overall contribution to IGWN Grid since Jan'24:

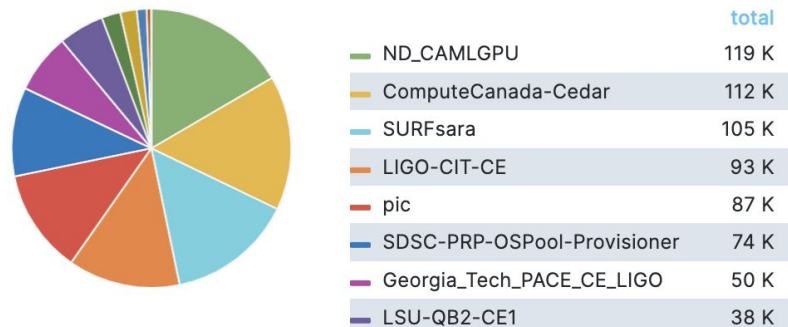
- 16% of the CPU (EU, from EGI accounting)
- 12% of the GPU (Global, from GRACC)

With only opportunistic resources

CPU IGWN (EGI Accounting)



GPU Wall Hours by Facility



Computing for ET

Contributing in the development of the ET Computing Model.

- provide a running estimate of the computing resources needed.
- define the overall architecture of the e-Infrastructure.
- define a process to evaluate computing needs.

Coordinated work with WP8 from ET Preparatory Phase.



Preparatory Phase for the Einstein Telescope Gravitational Wave Observatory

Deliverable 8.1

Computing and Data Requirements

Lead beneficiary: UNIGE
Delivery Date: 29 February 2024
Dissemination level: public
Version: 1.0

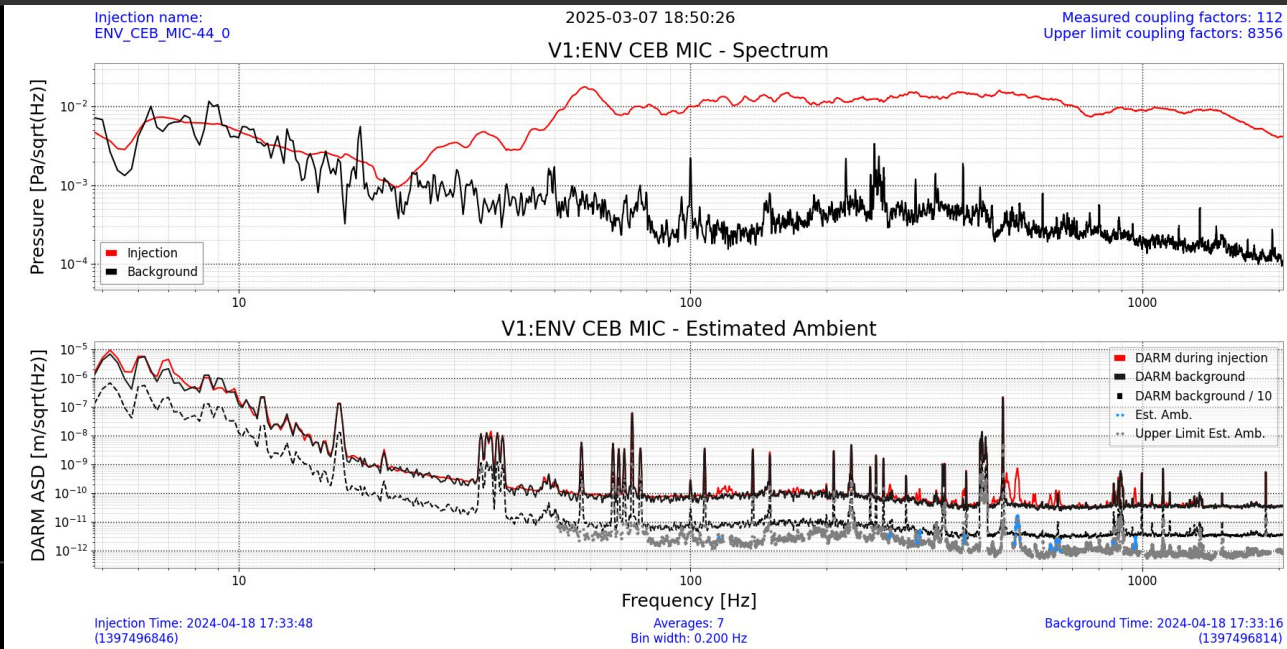


This project has received funding from the European Commission Framework Programme Horizon Europe Coordination and Support action under grant agreement 101079696.

Detector characterisation

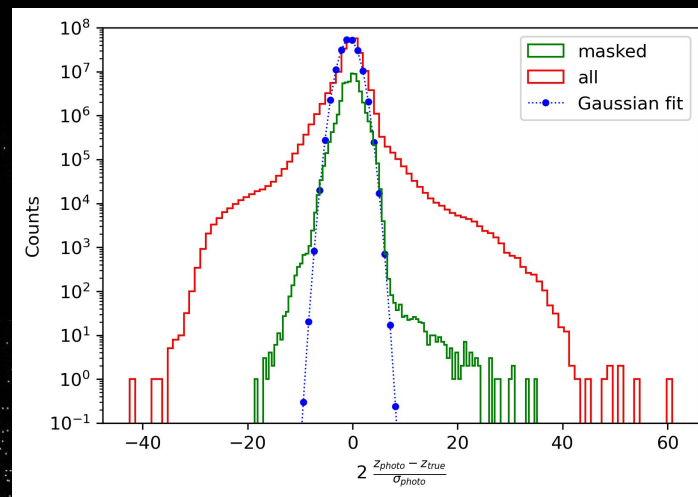
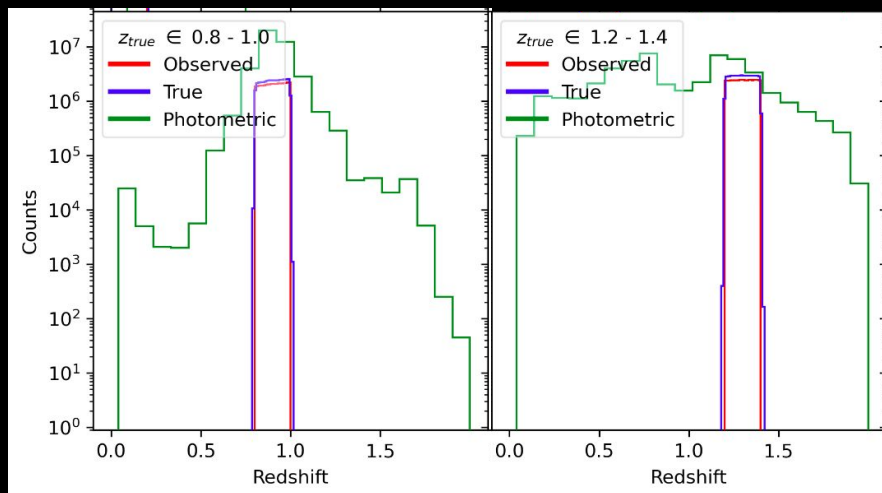
Study the response of the detector (DARM) to environmental perturbation, through the computation of coupling functions with controlled noise injections.

Adapt LIGO tools for Virgo implementation



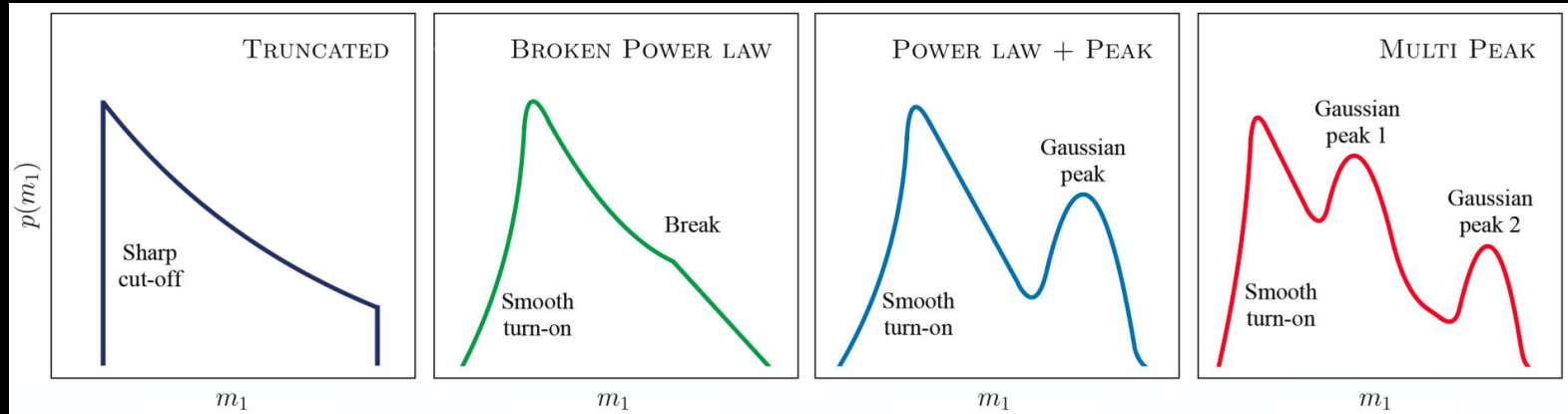
Galaxy Catalog Systematics Study

Study systematic effects from galaxy catalogs photometric redshift estimations, as well as the uncertainty in the luminosity function vs z in cosmological inference analysis with gravitational waves.



Rates and populations studies

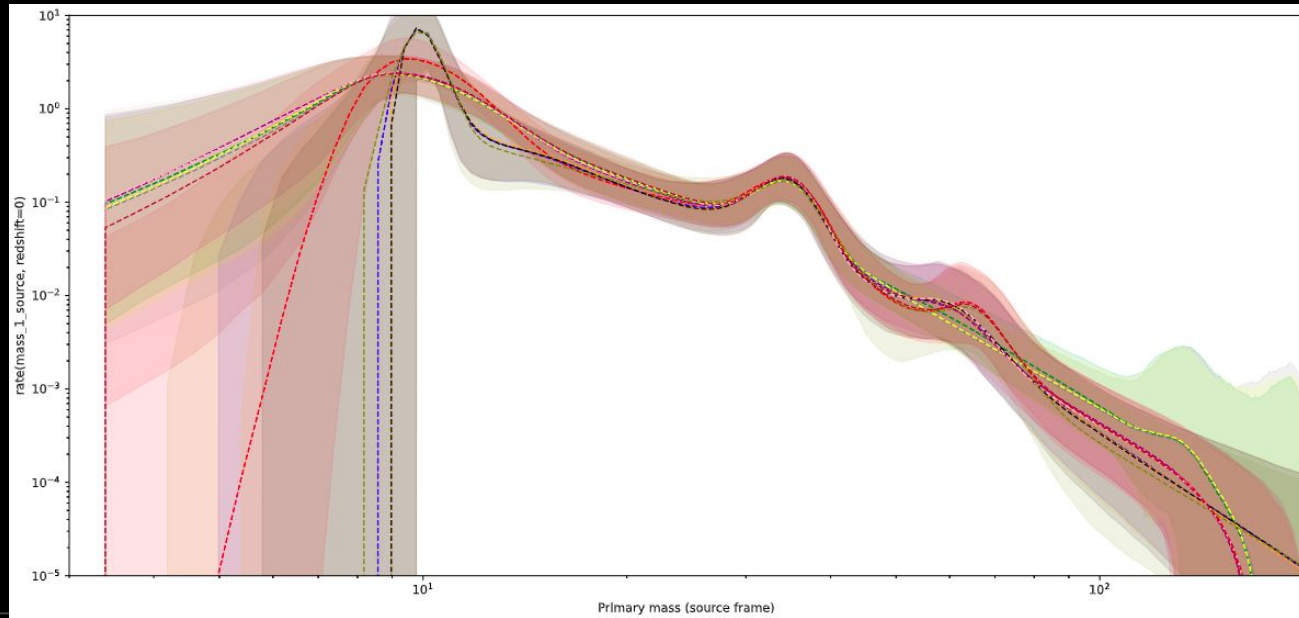
Model comparison study between different models to choose the preferred by data following Bayes factor statistics



Astro paper LVK GWTC-2 (O1 - O3a runs) [\[Abbott+ 2021\]](#)

Rates and populations studies

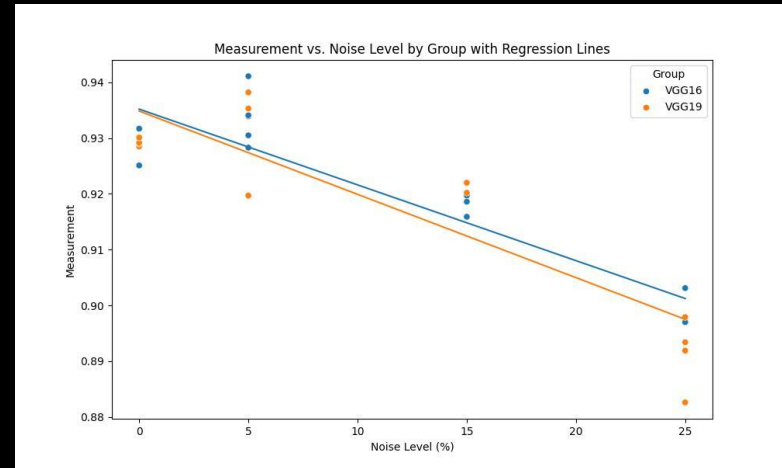
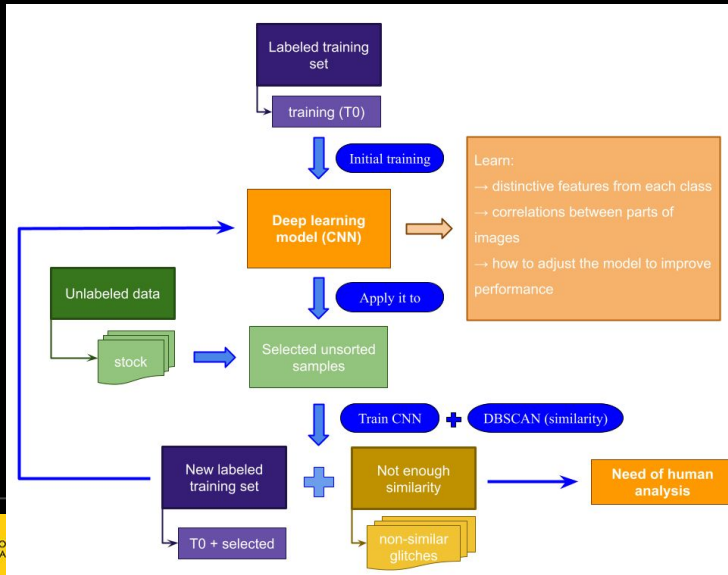
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Development of AI tools for GW

Deep Active Learning (DAL) for labeling previously identified events (glitches and events), and detect as anomalous previously unidentified events using Gravity Spy dataset.

Evaluation of robustness of CNN against noisy inputs, and comparison of CNN against visual transformers.





Thank you