WP5: Data Analysis and Computing

objective: Data Analysis and Computing WP is aim to develop a dedicated analysis strategy for axion like particles and High Frequency Gravitational Waves as well as setup and validate an internationally distributed computing infrastructure.

G. Mazzitelli/K. Schmieden

front end

- DAQ HW and driver (any choice of filtering or correlation needs uniformity in HW and SW)
- DAQ timing; testing SW and define final HW
- DAQ slow controls and **framework** (eg MIDAS)
- DAQ online tools, and middleware: data quality monitoring, data management etc. (eg CYGNO DM experiment at LNGS)
- we can exploit the work done for CYGNO and the generalised computing model under development for the PNRR project aimed to develop a framework for small/medium experiment in astro-particle physics



resources monitor

generalised framework computing model for medium/small astro-particle experiments







logical units, "composed" services



production setup at LNGS

Mariadb replica for metadata sql.cygno.cloud.infn.it



S3 storage minio.cloud.infn.it



messaging kafka.cvgno.cloud.infn.it



Identity and Access Management iam.cloud.infn.it



data and metadata monitor grafana.cygno.cloud.infn.it





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analysis and simulation web interfaces notebook01.cygno.cloud.infn.it notebook02.cygno.cloud.infn.it



backup tape.cygno.cloud.infn.it



TAPE DRIVE

batch queues condor01.cygno.cloud.infn.it condor02.cygno.cloud.infn.it



pre analysis and data quality sentinel.cygno.cloud.infn.it











Work in progress DAQ and data streaming

- an embryo of DAQ based on MIDAS framework with streaming simulated data and acquiring auxiliary channels is up and running
- data can be streamed with a "fake" time tag in order to start first example of long distance correlation





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Logger [localhost

Work in progress DAQ and data streaming

 an embryo of KAFKA server and streaming client has ben setup, and same test of online correlation can be done.



INFN cloud Bologna VM KAFKA server

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back end

- computing infrastructure (local? INFN data cloud? other site?)
- **resources** (pledge requirements; sites contribution)
- beside data analysis resources, the GravNet project requires a large amount of resources for simulation, templates production, etc. (where, how, who? not included in TDR)
- data management (eg. RUCIO?)
- data analysis tools (notebook and batch system, online scheduler and analysis, alert system, etc what else?)
- **libraries** (C/C++, python, root, what, and what else?)
- data sharing (agreements and open data access)
- **R&D** tools (eg GPUs)

analysis and conclusion

- while axion searches, apart from the idea of exploiting machine learning models, are in principle easy and do not need much computing resources, searching for High Frequency Gravitational Waves (HFGWs):
 - requires a well-known understanding of signal candidates and/or detector noise.
 - needs standardization of hardware (HW) and software (SW) to maintain correlation/decorrelation of signal/noise.
 - is very computing demanding, both for signal simulations and data analysis T_{gw} << T_{cavity} (signal shorter then detector length).
 - probably requires a large amount of storage.
- besides exploiting the generalized computing model, we need to carefully evaluate issues related to WP5, especially because we soon have to submit a request for a pledge for 2026 at INFN.