

XXXV cycle Ph.D. course in Physics

Third Year Report

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RESEARCH ACTIVITY

During my third year I mainly focused on Advanced Virgo Plus (AdV+) commissioning for the squeezing system for the O4 observation run (starting from 2023). My activities carried out were aimed at the Frequency-Dependent-Squeezing (FDS) measurements below 100 Hz with low losses. To achieve this I took care of various activities that concerned the entire squeezing system of AdV+ which is composed of an external bench in air that contains the squeezing source, two benches suspended in vacuum leading the alignment of the squeezing beam inside 300 m long filter cavity, which allows the rotation of the squeezing ellipse (FDS). I took care of optimizing the automatic-alignment (AA) loop on the homodyne detector present in the air external squeezing bench, for the squeezing measurements in order to reduce the power losses; I collaborated in the development of the infrared automatic-alignment loop on the filter cavity using the quadrant technique; I collaborated in the development of the active control loop of scattered light, as scattered light limited the squeezing measurements by introducing noise in the low frequency band of the homodyne; I started to study the filter cavity longitudinal control on the infrared beam with the homodyne differential audio channel instead of a bright beam, in order to compensate the drift of the infrared detuning from the filter cavity resonance. In conclusion, after several optimization activities, FDS measurements were made up to about 40 Hz of filter cavity detuning. In parallel, I carried out some activities related to the EPR experiment, both at the Genoa laboratory and in the R&D laboratory at EGO VIRGO. In order to develop an automatic-alignment loop with dither lines on a triangular cavity, I installed and aligned a new optical setup at the Genoa laboratory, having two motorized mirrors for the AA loop and two other for manual alignment (work in progress). The idea is to develop AA loops for the EPR experiment with the same logic as those developed for AdV+. In the R&D laboratory at EGO VIRGO, I collaborated in the advancement of the optical installations and in the alignment of the beams.

COURSES/EXAMS/SCHOOLS

- **Introduction to High-Energy Astrophysics** (F. Tavecchio):
Exam passed on February in form of seminar on
“Active Galactic Nuclei: Blazars”
- **Criogenia Applicata** (R. Musenich) → Exam scheduled shortly.

PUBLISHED ARTICLES/CONFERENCES

- Open Day DIFI (11th,15th,17th February 2022)
- Oral talk, with a ppt presentation, during the Virgo Week (5th Aprile 2022)
- One of the winners of the competition Art&Science Across Italy at the National Archaeological Museum of Naples (13th-15th May 2022, <https://artandscience.infn.it/tappa/i-edizione-2022/>)
- Poster presentation for the Gravitational Wave Advanced Detector Workshop GWADW 2022 (24th and 26th May 2022, <https://indico.icrr.u-tokyo.ac.jp/event/255/overview>)
- Oral talk, with a ppt presentation, for the workshop [ET@TO](https://agenda.infn.it/event/31463/) (<https://agenda.infn.it/event/31463/>) at the Physics Department of Turin (15th-16th June 2022)
- Open Summer Day DIFI (14th July 2022)
- Guide for a tour inside Virgo experiment for a group of external people (19th July 2022)
- Oral talk, with a ppt presentation, for the XI International Conference on New Frontiers in Physics in Crete (ICNFP 2022, 05th-09th September 2022, <https://indico.cern.ch/event/1133591/>). Opportunity to publish the proceeding in the journal of the XI ICNFP 2022 (in the next months).
- Oral talk, with a ppt presentation, for the International Conference PUMA22 (Probing the Universe with Multimessenger Astrophysics) and chair in sessions of the conference in Sestri Levante (26th-30th September 2022, <https://agenda.infn.it/event/18651/>)