

KSETA Annual Report 2021



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Introduction

The main focus of my Ph.D. work is to study the supernova neutrino detection sensitivities of state-of-the-art dark matter detectors such as XENONnT and DARWIN. I analyse XENONnT data and simulate supernova signals within the experiments software framework to study its properties and build a dynamic automated supernova trigger. I am also a member of Supernova Early Warning System (SNEWS) where I work within the implementation team to build a communication network between edge cutting neutrino detectors around the World to track and identify coincident neutrino signals that can possibly be originated from a nearby supernova that is about to go off.

Progress on the Doctorate

Over the past year I joined XENONnT, DARWIN and SNEWS collaborations. I am actively participating in XENONnT and SNEWS tasks while for DARWIN, I have not contributed in the past year. I have participated in all task groups and observed their efforts to gain insights about the collaboration structure and the workflow for the first couple of weeks. Later, I chose to be more active in the team-d working group which is specialized in the backgrounds and simulations.

My main science task within XENON collaboration is to study the sensitivity of our detector to detect neutrinos from a possible supernova. For this purpose, I have started implementing some software tools that allows simulating supernova signal within our detector and investigating it. These software tools and the basic applications are available in a [public GitHub repository](#).

I am also contributing to the main science goal of the experiment. I have studied the accidental coincidence backgrounds and their suppression in XENONnT detector. I have also been working on improving our XENONnT simulation to generate better S2 type signals in our detector. Both accidental coincidence background suppression and improved S2 simulations helps better understanding and characterizing the supernova signal in our detector.

In the past year, I also enjoyed visiting the experiment, and participating the activities in-situ. I have travelled to Assergi/Italy twice and contributed to the hardware related efforts, and in total spent over two months.

Furthermore, within SNEWS (Supernova Early Warning System) network, I have been developing a software tool for member experiments to communicate with the network¹, and another automated software tool to collect data from experiments and run a coincidence algorithm to search for possible supernova indicators².

¹ frontend, [SNEWS Publishing Tools](#)

² backend, [SNEWS Coincidence System](#)

Activities

In the past year I have attended several conferences, workshops and virtual meetings.

- KSETA Topical Courses (*Online*) March, 2021
Observational Cosmology
Statistical methods in particle physics and data analysis
Introduction to astroparticle physics
- XENON Technical Meeting (*Online*) April, 2021
- XENONnT detector shifts at LNGS³ May, 2021
- SNEWS Collaboration meeting (*Online*) May, 2021
- SNEWS Hackathon (*Online*) May, 2021
- XENON Virtual Analysis Meeting (*Online*) June, 2021
- XENONnT hardware work at LNGS July, 2021
- Heidelberg XENON data analysis workshop (*In-person*) November, 2021
- KSETA Topical Course (*Online*) October, 2021
Neutrino mass phenomenology
Introduction to Machine Learning and Deep Learning
- XENON Virtual Analysis Meeting (*Online*) December, 2021
- XENON Collaboration meeting (*Online*) February, 2022

I also completed a A.1.2 level German language course offered by Studienkolleg Karlsruhe and covered by Karlsruhe House of Young Scientists.

I took part in the Physics Faculty exam corrections.

³ Laboratori Nazionali del Gran Sasso