First Annual KM3NeT4RR meeting: WP7

R. Coniglione - INFN-LNS

Catania LNS - 23 Novembre 2023

KM3NeT4RR WP7 working package

- **WP7 – Multimessenger liasons** - This WP addresses items that are strictly related to the multimessenger activities. The upgrade to higher frequencies of an INAF radio telescope located near Noto (Sicily) is requested. Recent studies and some experimental evidence point out that high frequency radio emitting sources are good neutrino candidates thus making this upgrade and collaboration even more important. Follow-ups of sources in the radio and gamma emission band are also foreseen. Modelization of neutrino emission from other sources of cosmic neutrinos and activities for training of Phd students are also comprises in this WG.

Institutes participant:

- INAF - Osservatorio Catania (G. Umana)
- INAF - Osservatorio Palermo (F. Bocchino)
- Università Federico II - Napoli (G. Miele)
- Università di Genova (M. Sanguineti)
- Università di Catania (A. Tricomi)
- Università La Sapienza - Roma (I. Di Palma)

Funded with 1.7M€:

- Personnel 745.6k€
- Scientific instrumentation 499k€
- Training activities (PhD) 109.6k€
- Indirect cost (7%) 94.8k€

KM3NeT4RR - WP7 outcomes (1)

The main outcomes of the WP7 are:

1. Upgrade of the INAF radio antenna in Noto (Sr) and observation and follow-ups of neutrino sources 👉 INAF - Osservatorio Catania
   - Refurbishment of the Noto radio telescope (https://www.noto.ira.inaf.it/) to high frequencies (up to 100GHz). The Noto radio Antenna is part of the VLBI network and can operate as element of the network or a Single Dish.
   - Regular observation and followups of radio-sources that can be neutrino sources and also of sources observed by other INAF facilities at different bands of the electromagnetic spectrum
     A. Procurement of a new sub reflector and all the ancillary instrumentation (Automation for a quick switch between receivers, data acquisition system, server for data reduction and storage, software for control and monitoring and data analysis
     B. 2 units of personnel (1 researcher and 1 technologist)

2. Follow-ups of sources emitting high energy gamma-ray observed with HAWC and LHAASO 👉 University of Genova
   - Gamma-ray catalog studies related with HAWC and LHAASO observation and expected neutrino fluxes. Analysis of KM3NeT data.
     A. 2 units of personnel (1 RTDA and 1 PhD)

3. Modelization of Galactic SNR neutrino emission 👉 INAF - Osservatorio Palermo
   - Magneto-hydrodynamics simulation of SNR and simulation of the neutrino emission. Expectation of KM3NeT for the expected neutrino flux
     A. Procurement of computer cluster for simulation and storage
     B. 1 units of personnel (1 researcher)

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KM3NeT4RR - WP7 outcomes (2)

4. Theoretical and phenomenological models for diffuse flux emission and comparison with KM3NeT data 👉 Università Federico II - Napoli
   - Star-forming galaxy neutrino flux prediction and setting of upper limits with KM3NeT data
   - Template fitting analysis of Galactic diffuse gamma-ray emission detected by HAWC and SWGO and LHAASO and KM3NeT data analysis.
     A. 3 units of personnel (1 RTDA + 2 PhDs)

5. Support to external partners for the multi-messenger alert system and follow-ups of sources 👉 Università Catania
   - Support to INAF for the implementation for the alert system and support to the data acquisition system. Follow-ups of GW alerts
     B. 2 units of personnel (2 RTDA)

6. Follow-ups of binary sources emitting GW and optimization of algorithms for the online event reconstruction and follow-ups of external trigger 👉 Università La Sapienza - Roma
   - Fast reconstruction algorithm and event selection to alert the astronomical community in real time and follow external alert
   - GRB follow-ups
     A. 1 units of personnel (1 RTDA)

In Total 👉 2 researcher, 1 technologist, 5 RTDA, 3 PhD

KM3NeT4RR - WP7 Objective (1)

Bimestri

OI-7.1 Refurbishment of the Noto Radiotelescope for observations at high frequencies. The hardware needed for the upgrade of the radio telescope to higher frequencies will be procured. The hardware consists of a new sub-reflector and mechanics parts [10]
Deliverable D-7.1.1. Indicator I-7.1.1

OI-7.2 Data acquisition system for Noto Radiotelescope. Hardware for data acquisition will be procured. Development of the software for data acquisition, reduction and monitoring [11]
Deliverable D-7.2.1. Indicator I-7.2.1

OI-7.3 Radio observations and follow-ups of neutrino sources. A list of possible neutrino sources will be defined in coordination with KM3NeT (see objective 5 of the same WP) and an observation program will be defined. Data analysis will follow [15]
Deliverable D-7.3.1 Indicator I-7.3.1

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OI-7.4 Procurement and installation of the hardware of the HPC cluster. The cluster, that consists in CPUs, storage and a monitoring station is needed to run the codes for the modelization [10]
Deliverable D-7.4.1 Indicator I-7.4.1

OI-7.5 Modelization of the SNR neutrino emission and comparisons with data [15]
Deliverable D-7.5.1 Indicator I-7.3.1

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OI-7.6 Search for diffuse astrophysical components and follow-up of potential high-energy sources. Modelization of CR transport in astrophysical environments, EM and neutrino emission models, sensitivity study of KM3NeT neutrino telescope and cross correlation with gamma-ray telescopes [15]
Deliverable D-7.6.1 Indicator I-7.3.1

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KM3NeT4RR - WP7 Objective (2)

Bimestri

OI-7.7 Identification of potential high-energy neutrino sources detectable by the KM3NeT telescope. A candidate source list will be done looking at high energy gamma-ray sources. Follow-ups of HAWC and LHAASO sources [15]
Deliverable D-7.7.1 Indicator I-7.3.1

OI-7.8 Estimation of a high-energy neutrino flux from known gamma-ray celestial sources [15]. The KM3NeT data will be analysed with the aim to search for neutrinos from the source list identified in OI-7.4.1. [15]
Deliverable D-7.8.1 Indicator I-7.3.1

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OI-7.9 Data analysis and support to the multi-messenger activities. Low level data analysis will be done and good events delivered in suitable format for multi-messenger partners. [15]
Deliverable D-7.9.1 Indicator I-7.3.1

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OI-7.10 Realtime Multi-messenger investigation of transient astrophysical sources. Short-lived and flaring sources, as Gamma-Ray Bursts (GRBs) and blazars will be identified and the follow-ups of these sources will be performed. Cosmic object emitting gravitational waves (GWs), observed using laser interferometers will be put in correlation with data acquired with KM3NeT and search for neutrinos will be done. [15]
Deliverable D-7.10.1 Indicator I-7.3.1

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KM3NeT4RR - WP7 deliverable

Deliverable D-7.1.1 - Factory Acceptance Test (FAT). The Acceptance Tests of the sub-reflector will be presented in this document.

Deliverable D-7.2.1 - Report on the upgrade of the acquisition system of the Noto ratio telescope

Deliverable D-7.3.1 - Report on the radio observation program and results from the observed sources.

Deliverable D-7.4.1 – Report on the installation of the HPC Cluster

Deliverable D-7.5.1 - Report with the results of the SNR modelization and data comparisons where will be outlined the results presented in workshops and meetings

Deliverable D-7.6.1 - Report on the results of the modelization of CR transport, EM and neutrino emission models and sensitivity studies. Comparisons with data. The results will be presented in meetings and workshops and the list of these meeting will be reported.

Deliverable D-7.7.1 - Report with the list potential high-energy neutrino sources identified. The results will be presented in meetings and workshops and the list of these meeting will be reported

Deliverable D-7.8.1 - Report with the results from the search of neutrino from the candidate source list identified in D-7.7.1. The results will be presented in meetings and workshops and the list of these meetings will be reported

Deliverable D-7.9.1 - Report and the low-level data analysis and on the tools developed to do this work. In the report the support provided to the researchers of other experiments will be listed.

Deliverable D-7.10.1 - Report with the list of transient sources and their follow-ups. The results will be presented in meetings and workshops and the list of these meetings will be reported.

KM3NeT4RR - WP7 Indicator

I-7.1.1 - Availability of Factory Acceptance Test
I-7.2.1 - Availability of the functioning test
I-7.3.1 - Number of talks with the results presented
I-7.4.1 - Availability of the functioning test

KM3NeT4RR - WP7 meetings

2 WP7 meeting already done

- In presence @Bologna 24-25 May 2023 https://agenda.infn.it/event/35878/ 👉 focused on organizing future work 👉 33 participants

- Remote 9 October 2023 https://agenda.infn.it/event/37512/ 👉 discussed the work done and main criticalities

The next one to be organized first months of 2024