KM3NeT INFRADEV – H2020 – 739560

KM3NeT report on virtual education centre and training meetings: Setup, material, tools

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Abstract

The KM3NeT Research Infrastructure will produce unique scientific data that are to be made available to the scientific communities concerned as well as to the broader general public. The use of KM3NeT data by external scientists requires training on the design and functionality of the instrument, and on how to access and scientifically exploit the KM3NeT data. This training is to be provided through a virtual education centre. In this document, we describe the setup of this centre, and the first educational material that has been prepared for training meetings.

I. Copyright notice

II. Delivery slip

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IV. Application area

This document is a deliverable for the grant agreement of the project, applicable to all members of the KM3NeT-INFRADEV project, beneficiaries and third parties, as well as its collaborating projects.

V. Terminology

ANTARES	=	Astronomy with a Neutrino Telescope and Abyss environmental RESearch (first deep-sea neutrino telescope)
ARCA	=	Astroparticle Research with Cosmics in the Abyss (KM3NeT neutrino astroparticle physics telescope)
ESFRI	=	European Strategy Forum on Research Infrastructures
IB	=	Institutional Board (KM3NeT governing body)
IVOA	=	International Virtual Observatory Alliance
GAVO	=	German Astrophysical Virtual Observatory
ORCA	=	Oscillation Research with Cosmics in the Abyss (KM3NeT neutrino particle physics detector)
PMB	=	Project Management Board
RI	=	Research Infrastructure
VEC	=	Virtual Education Centre
VO	=	Virtual Observatory

VI. List of figures

VII. List of tables

none

VIII. Project summary

KM3NeT-INFRADEV

KM3NeT is a large Research Infrastructure that will consist of a network of deep-sea neutrino telescopes in the Mediterranean Sea with user ports for Earth and Sea sciences. Following the appearance of KM3NeT 2.0 on the ESFRI roadmap 2016 and in line with the recommendations of the Assessment Expert Group in 2013, the KM3NeT-INFRADEV project addresses the Coordination and Support Actions (CSA) to prepare a legal entity and appropriate services for KM3NeT, thereby providing a sustainable solution for the operation of the research infrastructure during ten (or more) years. The KM3NeT-INFRADEV project is funded by the European Commission's Horizon 2020 framework and its objectives comprise, amongst others, the preparation of Open Data Access (work package 4).

IX. Executive summary

The KM3NeT Research Infrastructure will produce unique scientific data that are to be made available to the scientific communities concerned as well as to the broader general public. The use of KM3NeT data by external scientists requires training on the design and functionality of the instrument, including the simulation procedures and the event reconstruction algorithms, and on how to access and scientifically exploit the KM3NeT data. This training is to be provided through a virtual educational centre. Furthermore, both newcomers to the KM3NeT Collaboration and external scientists will be offered face-to-face training meetings and webinars. In this document, we describe the set-up of a virtual educational centre, and the first educational material that has been prepared for training meetings.

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1 Introduction

KM3NeT is a large Research Infrastructure (RI) that will consist of a network of deep-sea neutrino detectors in the Mediterranean Sea with user ports for Earth and Sea sciences. The main science objectives, a description of the technology and a summary of the costs are presented in the KM3NeT 2.0 Letter of Intent (Adrián-Martínez, 2016).

KM3NeT will open a new window on our Universe, but also forward the research into the properties of neutrinos. With the ARCA telescope, KM3NeT scientists will search for neutrinos from distant astrophysical sources such as supernovae, gamma ray bursts or active galactic nuclei. Using the exact same technology, the ORCA detector will provide data of unprecedented quality on neutrino oscillations, exploiting neutrinos generated by cosmic-ray interactions in the Earth's atmosphere. Arrays of thousands of optical sensors will detect the faint light generated in the deep sea from charged particles originating from collisions of the neutrinos with atomic nuclei. The facility will also house instrumentation for Earth and Sea sciences for long-term and on-line monitoring of the deep-sea environment and the sea bottom at depth of several kilometres (KM3NeT Collaboration, 2017).

The KM3NeT Collaboration has developed a data policy plan (KM3NeT-InfraDev, 2017) reflecting the research, educational and outreach goals of the facility. For a certain embargo time (e.g. two years, to be ratified by the KM3NeT Collaboration) after data taking, the processing, quality control and exploitation of the data is granted to the collaboration members as a return for constructing, maintaining and operating the facility. During this phase, each collaboration member has full access rights to all data, software and know-how. The collaboration commits itself to process the data during the embargo phase so as to generate high-quality calibrated and reconstructed event data suited for a wider user community. These data will be made publicly available after the embargo time under an open-access policy on a web-based service and will not only allow the public to validate the scientific results presented by the collaboration but also to perform individual analyses.

The prompt dissemination of scientific or methodological results achieved during the embargo time is in the responsibility of the KM3NeT Collaboration. The scientific responsibility and the publication rights for results derived from public data is with the scientists performing the corresponding analyses. The KM3NeT Collaboration offers analysis support to external analysers on their request, and after scrutinising the validity of the respective analyses. In this case, both the external scientists and the KM3NeT Collaboration will author the resulting publications.

This document reports on the setup of the virtual education centre, the educational material and tools for training meetings. A first version of the KM3NeT virtual education centre has been set up and is described. The centre includes a set of education material that has been prepared for future training meetings, as well as a tutorial for using neutrino data in the Virtual Observatory. This is of particular interest for external scientists who want to combine publicly available neutrino data with other astronomical data. Further work, including user tests and the development of a reference program for face-to-face training meetings, will be performed in close cooperation with NSCR Demokritos.

2 Virtual education centre

The goal of the KM3NeT virtual education centre (VEC) is to educate external scientists, on how to access and how to correctly use the KM3NeT data in their research. This requires information on the design and functionality of the instrument, procedures to generate simulated data and the algorithms for event reconstruction. Also, the means to scientifically exploit the resulting high-level data needs substantial training. All the necessary information will be collected in the openly accessible education centre. The same information is also very valuable for newcomers to the KM3NeT Collaboration, and can be used for KM3NeT-internal education.

It is expected that the VEC will become an integral part of the KM3NeT Open Data policy and that it will be implemented and sustained through the KM3NeT governance, most likely in the aspired ERIC framework.

2.1 Setup

To implement a first version of the KM3NeT virtual education centre, the CERN-hosted web-based Indico service was chosen. This service implements a flexible, open-access solution for conferences, workshops and meetings – both online, as needed for the mentioned webinars, and offline for face-to-face trainings. In addition to authentication and authorisation, timetable and material management, and an on-line interface, the chosen solution incorporates the Vidyo web meeting service. The choice for this service was made from the excellent experience with Indico in managing KM3NeT meetings. With more than 500,000 events hosted on the CERN instance and many more on other instances, Indico is a standard for web-based meetings. Indico also strongly supports a user-friendly environment for the VEC. All material is automatically converted to PDF format and web applications are available for all services (web site, calendar, video services).

A sub-category under the KM3NeT Indico category (see Figure 1) has been created with open access, so that the VEC is findable and accessible. One standard event (see Figure 2), including educational material on *KM3NeT in the Virtual Observatory*, was created that can be re-used for further training sessions.

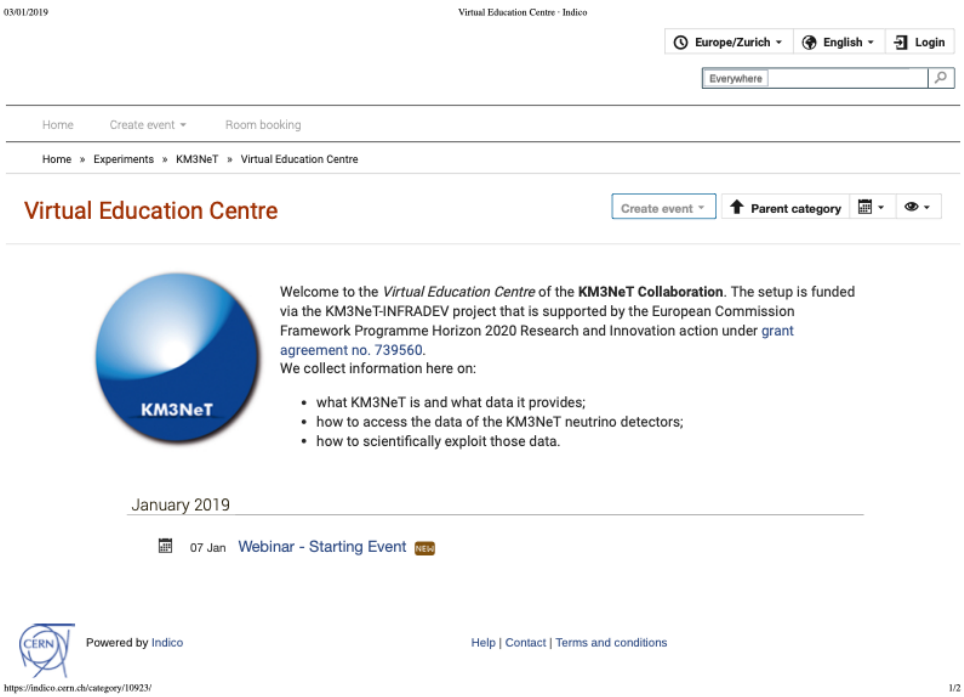

Figure 1 Virtual Education Centre on Indico - https://indico.cern.ch/category/10923/

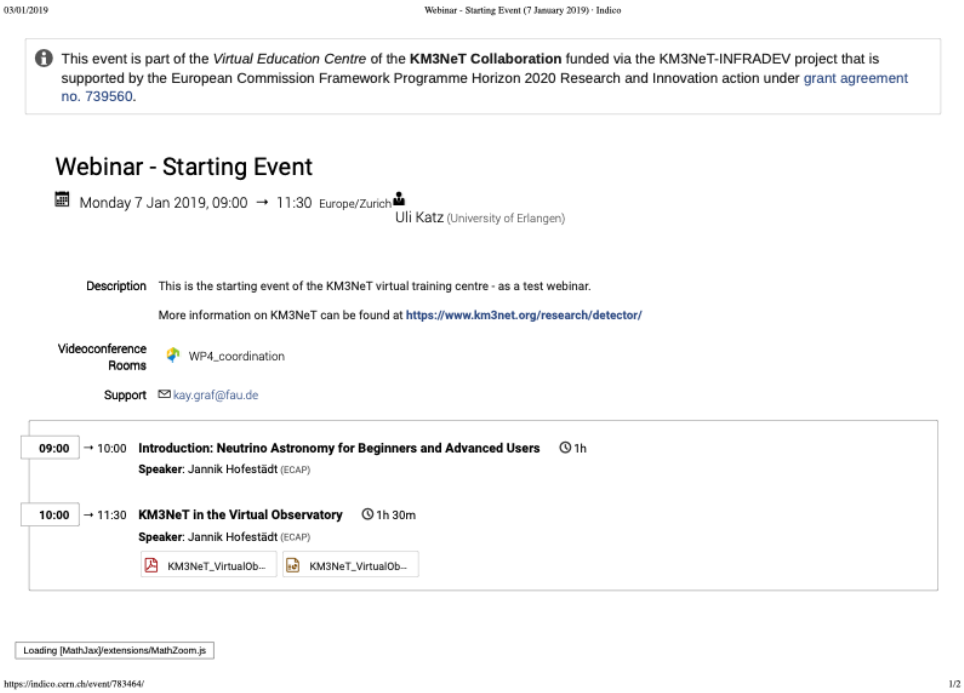

Figure 2 First Webinar on Indico - https://indico.cern.ch/event/783464/

2.2 Tutorial for using neutrino data in the Virtual Observatory

KM3NeT will provide high-level data in a Virtual Observatory (VO) using IVOA services (International Virtual Observatory Alliance, n.d.). The conceptual design of the open data generation and archiving is detailed in (KM3NeT-InfraDev).

As the KM3NeT detectors are currently in the commissioning phase and no KM3NeT data has been published yet, the use of neutrino data in the VO can only be explained using data from existing neutrino telescopes. Neutrino data from ANTARES (German Astrophysical Virtual Observatory, n.d.) as well as IceCube (German Astrophysical Virtual Observatory, n.d.) has been made available. The public KM3NeT will be made available using the same or similar services.

A tutorial introducing the usage of the widely-used VO tool *Aladin* (Strasbourg astronomical Data Center, n.d.) has been prepared and provided in the virtual education centre. The target group are both newcomers to the KM3NeT Collaboration as well as external scientists.

The Aladin software tool allows the user to visualise sky images (provided in the VO by sky surveys in any wavelength band) and superimpose entries from different astronomical catalogues and other databases. Furthermore, the user may perform actions based on the data given in the databases (select specific sources, find neutrinos with a given angular distance to certain sources etc.). This is of special interest for neutrino astronomy. For example, this allows for an easy way of finding sources correlated with neutrino events in space and time. Afterwards the results can easily be visualised. The Aladin tool provides a GUI that is easy to handle and offers a variety of built-in functionality. In addition, Aladin supports a script mode, which allows the setting up of a workflow that can then be repeated with different parameter values or can be executed on several types of sources etc.

The prepared Aladin tutorial is based on the GUI and considers two use cases relevant for neutrino astronomy. Firstly, visualising neutrino events around a sky position, and secondly, matching ANTARES and IceCube events in space and time. The sky position of the first known source of high-energy astrophysical neutrinos (IceCube Collaboration, Fermi-LAT, MAGIC, AGILE, ASAS-SN, HAWC, H.E.S.S., INTEGRAL, Kanata, Kiso, Kapteyn, Liverpool Telescope, Subaru, Swift/NuSTAR, VERITAS, VLA/17B-403 teams, 2018) is considered in the tutorial.

2.3 Outlook

Analysing data using the GUI interface of Aladin is very instrumental in getting familiar with the functionality of the tool, but functionality beyond the GUI is to be made available to users for advanced analyses, such as reproducible analysis and scans over different parameters or sources. Therefore, the user will be provided with an environment to perform analysis using the script mode of Aladin. It is planned to prepare a corresponding tutorial during the remaining time of the KM3NeT-INFRADEV project.

For an optimal use of open-access data and advanced analyses, also simulation expectations are required in order to directly compare with the experimental data. Hence, simulated data will be provided. The exact simulation strategy will be decided in summer 2019 (see deliverable 4.3). The preparation of tutorials about the proper usage of simulations and comparison with experimental data will hence be compatible with the duration of the KM3NeT-INFRADEV project.

3 Training meetings

Interactive training meetings ensure an optimal knowledge transfer, as the participants can ask questions. Hence, we will offer intense, face-to-face as well as remote training meetings.

A first internal training meeting with participants from ECAP has been performed. The goal of this meeting was to test the setup of the virtual education centre as well as to discuss and improve the prepared tutorial for using neutrino data in the VO (see Section 2.2).

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