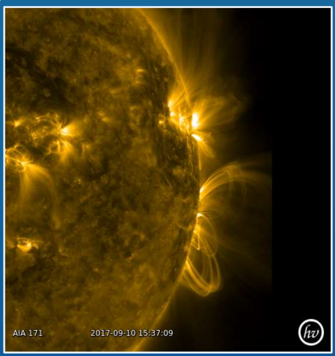
Searching for neutrinos from solar flares with KM3NeT

Neutrino Production



Solar flares are highly energetic explosions that occur in the solar atmosphere.

They are multi-messenger transient sources, and are known to be the site of particle acceleration.

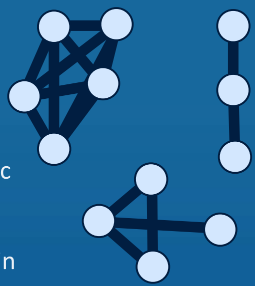
Although nature of the physical processes involved is not fully understood.

We can still infer neutrino production by looking in the γ-ray spectrum for pion decay emissions.

Solar-flare neutrinos are expected to range from

MeV to a few GeV.

Solar-flare clustering



Solar flares are observed as bright peaks in the γ-ray and/or X-ray flux.

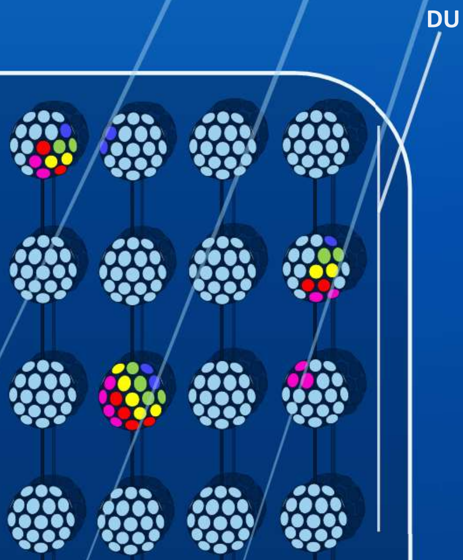
They are often accompanied by coronal mass ejections (CMEs), and solar energetic particle (SEP) emissions.

Measurements highlight a huge diversity in energy and time evolution between events, hinting at different underlying physical properties, and acceleration processes.

There are still similarities among the behaviours of solar flares. With the use of a similartiy graph we aim to identify groups and archetypes within the flares sample.

Finding the sub-populations of flares allows us to investigate the different processes by measuring or constraining the neutrino flux.

Detectors



KM3NeT detects the Cherenkhov light emitted by the products of the neutrino interacting with water.

It consists of two neutrino telescopes located at the bottom of the Mediterranean sea.

Each building block will be made out of **115** detector units (**DU**s),

with **18** digital optical modules (**DOM**s) per DU

and **31** photo-multiplier tubes (**PMT**s) on each DOM.

ARCA

~ 0.5 Gton of sea water
3500 m depth

ORCA

~ 7 Mton of sea water
2500 m depth

Analysis

Solar-flare neutrinos are usually too low in energy for track reconstruction in ARCA, while some events might be feasible for particle identification and angular reconstruction in ORCA.

However, the unique design of KM3NeT's DOMs allows for a multi-PMT analysis.

By looking at causally connected PMTs hits within a single DOM, we can distiguish low-energy neutrinos from background.

To identify the low-energy neutrino signatures, we optimize the search time-window for each event.

We then perform a stacking analysis within the sub-populations of flares, as we expect the same acceleration processes.

Neutrinos in the Multi-Messenger Era
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Jonathan Mauro[1]
Jonathan.mauro@uclouvain.be
[1]CP3, UCLouvain

UCLouvain