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# Low-latency neutrino follow-up combining diverse IceCube selections

Neutrino observations are a crucial component of multi-messenger astronomy, but are currently limited by effective area and high atmospheric background. However, while other telescopes with limited field of view must be pointed in order to capture observations, IceCube's full-sky field of view and high uptime make it an excellent instrument for realtime follow-up of astrophysical transient sources.
IceCube searches for neutrino transients using an unbinned maximum likelihood method with parameters for the source's emission time period, extension, and energy spectrum. This Fast Response Analysis can provide analysis results within tens of minutes of an astrophysical transient. Besides the follow-up of astrophysical transients manually selected as candidates, it also routinely scans areas of the sky compatible with gravitational wave alerts from LIGO/Virgo/KAGRA and IceCube event singlets which have a high probability of originating from an astrophysical source.
Currently the analysis uses TeV muon neutrino candidate events whose track signature is especially suited for a precise angular reconstruction, selected and reconstructed at the South Pole and transmitted with low-latency over a satellite connection.
Recently, IceCube and the neutrino astronomy community are evolving to use event samples constructed with different selections. These efforts include the follow-up of gravitational wave events with GeV neutrinos detected by IceCube-DeepCore and the observation of the Galactic plane with cascade events produced by all neutrino flavors.
With plans to make IceCube-DeepCore GeV neutrino candidates and cascade events available on a day-scale latency, they can also be used in Fast Response Analyses. Moreso, multiple event samples can be combined in a Fast Response Analysis that is sensitive to a broader energy range of a neutrino transient spectrum and ensures the inclusion of all neutrino flavours.
We present the analysis method and technical aspects of such an extension of the existing framework.
This includes a proposed new pipeline allowing the inclusion of the more computationally-intensive reconstruction methods used by the aforementioned event selections.
The extension is validated using example analyses implemented in this framework.

## Collaboration(s)

IceCube

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