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Experimental proof of principle of the Neutrino Tagging technique at NA62

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Neutrino tagging is a new experimental method for accelerator based neutrino experiments. The method consists in associating a neutrino interaction with the meson decay (e.g. $\pi^{\pm} \to \mu^{\pm}\nu_{\mu}$ or $K^{\pm} \to \mu^{\pm}\nu_{\mu}$) in which the neutrino was originally produced. The properties of the neutrino can then be estimated kinematically from the decay incoming and outgoing charged particles. The reconstruction of these particles relies on the recent progress and developments in silicon particle detector technology. The method is particularly suited to study neutrino interactions at short baseline experiments, and preliminary works indicate that they could also be used to study neutrino oscillations at long baseline experiments.
A proof-of-principle of this method has been performed using the NA62 experiment as a miniature tagged neutrino experiment. Indeed, the intense Kaon beam of NA62 abundantly produces neutrinos through the $K^{+} \to \mu^{+}\nu_{\mu}$ decay. The two spectrometers of the experiment are used to reconstruct the K^{+} and μ^{+} and the neutrino interaction is detected in the 20 ton of liquid krypton of the electro-magnetic calorimeter. The results of the analysis based on the data collected in 2022 are presented, where few tagged neutrino candidates have been detected for the first time in history.

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