

博士論文公聴会の公示 (物理学専攻)

学位申請者：Mario Gonzalez

論文題目：Development of a GPU-based High Level Trigger for the J-PARC KOTO experiment

J-PARC KOTO実験におけるGPUを用いたハイレベルトリガーの開発

日時：2024年12月20日（金） 8:50 – 10:30

場所：理学研究科 H 棟 7 階セミナー室（H701 号室）

オンラインでの聴講も可能。URL等については学内の方は下記を参照。

<https://www.phys.sci.osaka-u.ac.jp/naibu/info/detail.php?id=9156>

学外の方は主査：南條（nanjo[at]champ.hep.sci.osaka-u.ac.jp [at]=@）

に問い合わせること。

主査：南條 創

副査：青木 正治、川畑 貴裕、大田 晋輔、増渕 達也

論文要旨

The main aim of the J-PARC KOTO experiment is to measure the branching ratio of the CP-violating $K_L \rightarrow \pi^0 \nu \bar{\nu}$ decay. To improve our understanding of its background contributions and to enhance the precision of this measurement, several categories of physics events need to be collected on top of the $K_L \rightarrow \pi^0 \nu \bar{\nu}$ candidates. To cope with these demands, the KOTO data acquisition system has been upgraded before the beam-time in 2024. Particularly, a GPU-based High Level Trigger (HLT) has been developed.

The new HLT could capture incoming data with a negligible packet loss. Event reconstruction, selection, and compression could be performed on GPUs to reduce the data size to 18% of itself. The event loss due to HLT inefficiencies was decreased from 3.5% at the beginning of the 2024 beam-time to 0.4% at the end.

The new HLT in 2024 allowed for the collection of enough data to improve the precision of the $K_L \rightarrow 2\pi^0$ background estimation by an expected factor of 3. K^+ candidate decays were also collected to measure the K^+ flux into the KOTO detector. $K_L \rightarrow \pi^0 e^+ e^-$ candidates were continuously recorded too to study the feasibility of a future $K_L \rightarrow \pi^0 e^+ e^-$ search.

The usage of GPUs in the HLT allowed it to cope in real-time with the high data rate and computing demands. The development of the KOTO GPU-based HLT, as well as its performance during the 2024 beam-time are presented in this thesis.