Current Status and the Future for Automation and Monitoring of Calibration Procedures at the Belle II Experiment

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In March 2019 the Belle II detector began collecting data from e^+e^- collisions at the SuperKEKB collider. For Belle II analyses to be competitive it is crucial that calibration constants are calculated promptly so that the reconstructed datasets can be provided to analysts. A subset of calibration constants also benefit by being re-derived during yearly recalibration campaigns to give analysts the best possible reconstructed datasets for their final publications.

At the Belle II experiment a Python package, `b2cal`, has been developed to automate the running of Calibration and Alignment Framework (CAF) [1] processes for prompt calibration at Brookhaven National Laboratory (BNL) and to interface with the surrounding calibration procedures [2]. The open-source Apache Airflow workflow platform is used to schedule, run, and monitor the calibration procedures by describing them as Directed Acyclic Graphs (DAGs). The `b2cal` package acts as a plugin to create the DAGs and functionality to interface with Belle II data processing and collaborative services, as well as creating a separate set of Flask webpages for easier monitoring and management of the calibration processes. During 2020 this system was installed at the Deutsches Elektronen-Synchrotron Laboratory (DESY) in Germany using Docker containers; including the MariaDB SQL server, NginX reverse proxy server, and the Airflow scheduler + Flask webserver services.

This system has resulted in a successful reduction of both the time taken to produce constants and the human intervention required. Throughout 2021 and 2022 Belle II has expanded the scope of this system such that the recalibration on previous data with new algorithms is concurrently run at DESY, as well as the organisation of creating calibration constants for run-dependent Monte Carlo data. Development of the `b2cal` package is now focused on allowing experts to more easily recover from unexpected failures, and also improving the ability of the calibration group to monitor and interact with the CAF jobs directly. The current structure of the automated Belle II calibration system, lessons learned, and these new developments will be described.

[1] T. Bilka, K. Chilikin, D. Dossett, Y. Guan, J. Kandra, C. Kleinwort, and M. Sevior, *Alignment and Calibration of the Belle II Detector*, EPJ Web of Conferences **214** 01040 (2019), https://doi.org/10.1051/epjconf/201921401040

[2] F. Pham, D. Dossett and M. Sevior, *Improving the automated calibration at Belle II*, EPJ Web of Conferences **251** 03019 (2021), https://doi.org/10.1051/epjconf/202125103019