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Status Update on the Open-Source Synchronous Multi-Axis Motion Controller Solution for Large-Scale Experimental Physics Projects

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Synchronous multi-axis motion control systems integrated with diagnostic and data acquisition subsystems are critical components in large experimental physics projects. To meet these specific requirements, DESY has developed an open-source motion control solution based on the DAMC-MOTCTRL board. Designed for projects like PETRA IV, this system enables synchronized control of up to 48 stepper motors on a single AMC board, interfacing with established control systems such as DOOCS, EPICS, and TANGO, or through a direct ASCII interface.

After presenting the alpha firmware version of this controller last year, significant milestones have been achieved. In March, a firmware update addressed a long-standing limitation of commercial off-the-shelf motion controllers by enabling precise trigger signal generation for data acquisition, a critical feature for experimental timing. Shortly afterwards, the motion controller was confidently deployed in a multi-day live experiment at PETRA III, where it operated reliably and performed as expected. The latest firmware release now fully supports synchronous control of up to 16 motors through the first of three optical connectors, paving the way to scale up to 48 motors in the near future. Alongside this, development is underway to implement an industry-standard interface to synchronize the motion controller with other experimental devices.

This presentation will provide an overview of the hardware and firmware architecture, introduce the latest features, and outline the roadmap for the PETRA IV motion controller.

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