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EPICS SUMMER SCHOOL: TRAINING FUTURE SCIENTIFIC CONTROL SYSTEM EXPERTS

L. Porzio*[1], S. Vadilonga[1], W. Smith[1], M. Bajdel[1], M. Montis[2], M. Giacchini[2]
[1]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Berlin, Germany
[2]Istituto Nazionale di Fisica Nucleare - Laboratori Nazionali di Legnaro, Legnaro, Italy

Abstract

The EPICS Summer School addresses the persistent demand for expertise in control systems for advanced scientific facilities by providing a crucial training platform for university students and young professionals. The highly successful inaugural event at BESSY II in Berlin offered an effective learning experience through a structured two-week program encompassing one week of foundational lectures and one week of practical application in a hands-on group project with real scientific hardware. This approach demonstrated a significant positive impact, empowering a new cohort from these groups with essential EPICS and distributed control system skills. In an effort to make the event sustainable, a collaborative framework has been established with other institutes, paving the way for a future where hosting the summer school cycles between facilities. This aims to make this training accessible to a wider audience of future scientific leaders, ensuring a continuous supply of skilled engineers capable of supporting and advancing groundbreaking scientific research across multiple facilities.

INTRODUCTION

Scientific facilities worldwide face an unprecedented challenge in securing qualified control systems engineers. The demand for expertise in frameworks like EPICS (Experimental Physics and Industrial Control System) for distributed scientific control systems far exceeds supply, creating a bottleneck that threatens the operational efficiency of major scientific installations. This shortage stems from three primary factors: insufficient promotion of scientific control systems in universities, facilities preference for experienced engineers due to costly on-the-job training requirements, and documentation that presents steep learning curves for newcomers. The complexity of modern scientific control systems demands specialized knowledge that traditional academic programs struggle to provide.

THE LEARNING PLATFORM

The Idea

To directly address the identified challenges limiting control systems workforce development, we established a learning platform structured as a two-week intensive summer school format. This event was specifically designed to address the key training challenges hindering the pipeline of qualified engineers. First, to address the lack of promotion and advertisement, we created a highly visible, international program that actively recruits students from diverse academic backgrounds, providing them with exposure to career opportunities in large-scale scientific facilities that they might otherwise never encounter. The program's application process, requiring CVs and motivational letters from a global applicant pool, effectively bridges the gap between traditional industrial control systems education and the specialized requirements of scientific research environments. This approach positions scientific facilities as a viable and compelling professional trajectory distinct from conventional industry roles.

Second, recognizing that facilities often prefer candidates with prior experience due to the high costs of training, our platform front-loads the essential training in an intensive, structured environment. The two-week format provides facilities with candidates who have already overcome the steepest part of the learning curve, making them significantly more attractive hires. This approach effectively socializes the training costs across the community while delivering more job-ready candidates.

The Structure

The summer school is structured into two intensive weeks, each with a distinct educational focus. The first week is dedicated to lectures and training sessions delivered by control system engineers from the hosting institute and participating external laboratories. These sessions present a range of control system implementations in large-scale facilities, demonstrating the broad applicability of these skills to various scientific and technical challenges. A significant portion of the week is devoted to comprehensive EPICS training, where theoretical principles are reinforced through practical exercises, guiding students from working in a simulated environment to hands-on experience with real hardware. Additional hours focus on data acquisition, experiment orchestration, and best practices in scientific data management, including the FAIR principles.

The second week is entirely project-based. Students are divided into small teams and assigned group projects. Each team integrates real scientific hardware into EPICS (Fig. 1), performs calibration, sensor conditioning, and implements graphical user interfaces. They also orchestrate the devices to enable experimental data collection. The summer school concludes with final presentations, where student teams showcase their work to an audience of teachers, tutors, and expert guests from the host and external laboratories (Fig. 2).

* luca.porzio@helmholtz-berlin.de

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Figure 1: Students working with a picoammeter and piezoelectric motors.

Figure 2: A student presenting his work on Graphical User Interface. The presentation is streamed online.

THE COMMUNITY'S RESPONSE

The response from the scientific community to address this skills gap has been remarkable. Multiple international laboratories have demonstrated unprecedented collaboration, offering financial contributions, hardware resources, and personnel expertise to support educational initiatives. This community engagement reflects the collective recognition that the control systems workforce shortage poses a fundamental threat to the advancement of scientific research across facilities. The willingness of established laboratories to share resources and expertise demonstrates the community's understanding that investing in education benefits the entire scientific ecosystem.

A LinkedIn page has also been launched to connect students and contributors, serving as the main hub for updates and information on future editions of the Summer School [1].

THE RESULTS

The EPICS Summer School has achieved three significant outcomes that validate the community-driven educational approach. First, it demonstrated that students with no prior experience in scientific control systems can acquire functional skills that enable them to contribute to the development of distributed control systems, including hardware connection, EPICS integration, data collection, and experiment orchestration, within just two weeks.

Second, the active community participation confirms the existence of a robust, collaborative network ready to support educational initiatives, providing both validation of the approach and a sustainable model for future programs.

Third, the program successfully inspired students to pursue careers in large-scale scientific facilities while establishing an efficient recruitment channel that benefits the entire community. These results demonstrate that targeted, community-supported educational interventions can effectively address workforce shortages in specialized technical fields, providing a replicable model for other scientific disciplines facing similar challenges.

Figure 3 shows the students and tutors involved in the last EPICS Summer School, which took place in August 2025.

Figure 3: The group picture outside BESSY II's Experimental Hall.

In addition, an anonymous feedback survey was submitted to the students to evaluate the overall quality of the event and to identify its strengths and weaknesses. The responses were generally very positive, providing valuable insights for future improvements. Table 1 presents the average grades given by the students on a selected subset of survey questions, scored on a scale from 1 to 5 (1 = lowest; 5 = highest). The topics covered were rated positively, indicating good alignment with participants' interests and needs. The practical sessions received high marks, underscoring the effectiveness of the hands-on learning approach. Finally, while the group project was considered rather straightforward, it was deemed very helpful in applying theoretical knowledge and understanding real-life challenges in scientific control systems.

FUTURE DEVELOPMENTS

Based on the success of the inaugural event, a long-term framework has been established in which the EPICS Summer School will rotate between different host facilities. This approach not only shares the organizational effort among participating institutes but also makes the event more accessible

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Table 1: EPICS Summer School Anonymous Feedback Results (Scale 1-5)

Question	Average Grade
How would you rate the the pace of the event?	3.65
How relevant were the topics covered in the event to your interests and needs?	3.96
How would you rate the quality of the exercises for practicing EPICS?	3.89
How would you rate the difficulty level of the group project?	3.10
Did you find the group project helpful in applying the knowledge gained from the event?	4.55
To what extent did the group project help you understand real-life engineering challenges?	4.07

to students from geographically diverse regions. Moreover, given the remarkable response from the community, there is strong confidence in expanding collaboration with more laboratories, which will enable the acceptance of additional students and broaden the scope of hands-on projects, including new practical laboratories from a variety of scientific and technical backgrounds.

CONCLUSION

The EPICS Summer School has shown that, with strong community involvement and a carefully structured curriculum, it is possible to equip students in a short period with practical, industry-relevant skills in scientific control systems. This initiative not only addresses a critical workforce need but also creates new, accessible pathways for students interested in contributing to large-scale scientific research. The ongoing commitment to collaboration and program expansion ensures lasting impact and continued opportunities for future scientific leaders.

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