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Development of a programmable PID thermal control system for a laboratory cryostat

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A programmable PID thermal control system, implemented using Python with a user interface, has been developed for a laboratory cryostat, enabling precise regulation of multiple temperature stages. The system allows each stage to reach commanded setpoints and maintain them for a defined dwell time or until the target temperature is achieved. Users can fully configure setpoints, PID parameters, and tolerances, providing flexible control over temperature ramps and stabilization criteria.

The control system was validated with two independent heater channels executing programmed thermal cycles. Heater currents were adjusted to achieve the desired thermal trajectories, demonstrating that the system can synchronize multiple plates at the same temperature even when individual heaters require different power levels. Combined plots of heater power and stage temperatures confirm accurate implementation of setpoints, dwell times, and configurable tolerance.

These results show that the developed PID thermal control system enables precise, flexible, and effective temperature management in a laboratory cryostat. The system provides a practical platform for experiments requiring controlled thermal cycling and demonstrates the effectiveness of independently configurable heater control for consistent thermal performance across multiple stages.

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Author: Ms PÉREZ BARRIO, Sandra (INTA)

Co-authors: Ms MARTÍN, Carolina (INTA); GONZÁLEZ, Cristóbal (INTA); FERNÁNDEZ SÁNCHEZ, Miguel (INTA)

Presenter: Ms PÉREZ BARRIO, Sandra (INTA)

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