Contribution ID: **1575** Contribution code: **THPS113**   Type: **Poster Presentation**

Automated control and monitoring system for the Crocker Nuclear Laboratory cyclotron

Thursday 5 June 2025 15:30 (2 hours)

The Crocker Nuclear Laboratory at UC Davis operates a 72-inch isochronous cyclotron capable of accelerating protons, deuterons, and alpha particles to variable energies up to a maximum of 67.5 MeV for protons. The cyclotron is primarily used for proton therapy, conducting radiation effects testing, and supporting academic research. We describe the upgrade of its original analog control system to a modern digital system capable of integrating AI-based control. This upgrade involves new hardware and software infrastructure to manage subsystems such as the ion beam source, isochronous magnetic field, beam extraction, and beam transport lines. The integrated monitoring and actuator systems are currently being implemented and validated, featuring real-time visualization, a database, and a web application. The new system aims to enhance operations through improved data visualization, database accessibility, and the implementation of autonomous AI-based control, incorporating techniques like artificial neural networks for anomaly detection and automated tuning for efficiency. This document details the hardware and software architecture of the PLC-LabVIEW-Python AI-based control system.

Footnotes

Paper preparation format

LaTeX

Region represented

America

Funding Agency

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Session Classification: Thursday Poster Session