



Contribution ID: 15

Type: **Poster + Talk**

Reinforcement Learning for Laser Alignment

Friday, April 4, 2025 9:20 AM (20 minutes)

Manual alignment of optical systems can be time consuming and the achieved performance of the system varies depending on the operator doing the alignment. A reinforcement learning approach using the PPO algorithm was used to train agents to align simple two-mirror optical setups, as well as a full regenerative laser amplifier. The goal is to produce agents that can reproducibly align the setup faster than a human and can correct long-term drifts in laser energy (time scale of approx. one hour) during operation. The work is still ongoing. Agents have been successfully implemented on hardware in the two-mirror setup, showing “super-human” performance in alignment time. The agents successfully “learn” to handle a significant amount of mechanical backlash in the used stepper motors and mirror mounts. Currently, the necessary hardware is being installed on a regenerative amplifier and agents are being further developed for this use case.

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Session Classification: Talks