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AI-powered scientific chatbot for accelerator operations

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We present the design of a retrieval-augmented generation (RAG) based scientific chatbot, tailored for control room operators at particle accelerators and laser facilities. The chatbot integrates with institutional knowledge bases, including operational manuals, control system documentation, incident logs, and structured machine data, to provide real-time, context-aware responses to operator queries. This tool is designed to support critical operational workflows such as troubleshooting, shift handovers, beamline setup, and safety procedures. By leveraging secure deployment options (e.g. on-premise or cloud environments), it ensures compliance with data governance and cybersecurity policies typical in large-scale research infrastructures. The system reduces cognitive load, improves onboarding of new staff, and enhances efficiency by enabling intuitive natural language access to complex technical knowledge, automatic logs and reports creation, and many other optimizations of daily responsibilities. We will discuss the system architecture, data integration challenges, evaluation with pilot users, and the broader potential of AI assistants in control room environments.

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Footnotes

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