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Evaluation and validation of PyOrbit cavity models for online simulations at ESS

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In a linear accelerator (linac), having a reliable model of the accelerating cavity is critical, as it is the primary element influencing particle dynamics. At the European Spallation Source (ESS), the TraceWin software is used for linac design, implementing thin-gap and multi-cell models, with both linearized matrix-based and field-map solvers. However, these models cannot be used online, as TraceWin is not integrated with the ESS control system, EPICS. To enable online simulations, PyOrbit—a code developed in collaboration with the Spallation Neutron Source (SNS)—is being considered. This paper evaluates and compares the six cavity models available in PyOrbit—Simplified Matrix Model, Base RF Gap Model, Transit Time Factors RF Gap Model, Three Point TTF Model, Direct Tracking through 3D RF Gap Field Model, and OpenXAL RF Gap Model—against the TraceWin cavity models to validate their suitability for ESS requirements.

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