

# Challenges of a Twice-Recirculating ERL Mode

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In a multi-recirculating energy-recovery LINAC (ERL), electrons are accelerated several times in the same LINAC and are decelerated afterwards in the very same LINAC just as often. Even in the case of a twice-recirculating ERL, there are challenges compared to a single-recirculating ERL: When low injector energies are used, phase slippage leads to significantly different energy gains per LINAC pass for the beam to be accelerated for the first time and the beam to be accelerated for the second time. If the cost-efficient sharing model is used, the once-accelerated and the once-decelerated beam share the same recirculation beamline. This case poses a particular challenge for finding a transverse confinement due to the lack of degrees of freedom for the once-decelerated beam: the beam optics adjusted to the once-accelerated beam must also ensure the guidance of the once-decelerated beam. The presence of phase slippage and the low number of degrees of freedom requires a sophisticated setup of the machine, which had to be determined in advance via beam dynamics simulations. We address challenges of a twice-recirculating ERL mode in the sharing model by presenting experiences and measured data obtained during the successful realization of that mode at S-DALINAC in 2021.

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