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Laser cooling taken to the extreme: cold relativistic intense beams of highly-charged heavy ions

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Recent storage ring experiments have demonstrated the power and the potential of laser cooling of bunched relativistic ion beams. Encouraged by this, the heavy-ion synchrotron SIS100 at FAIR (Darmstadt, Germany) will be equipped with a truly unique laser cooling facility. A sophisticated combination of 3 newly developed UV (257 nm) laser systems and modest rf-bunching will allow for fast cooling of injected intense heavy-ion beams. There will be two powerful pulsed laser systems with MHz repetition rates and variable pulse duration (1-50 ps and 50-740 ps) and one powerful tunable cw laser system. The picosecond laser pulses are broad in frequency and will enable fast cooling of injected ion beams with a large initial longitudinal momentum spread. The cw laser can be rapidly tuned over a large frequency range and has high spectral power density, forcing the ion beams to remain cold during storage. This combination of 3 UV laser beams should be up to the challenge of suppressing intra-beam scattering and space charge effects. We will present new experimental results from the ESR storage ring and the status of the SIS100 laser cooling facility.

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