

## 3-beam (broadband) laser interaction with stored relativistic ions

*Wednesday, 1 June 2022 14:00 (5 minutes)*

The ultimate scheme for laser cooling of stored relativistic ions is to use a bunched ion beam and 3 independent laser beams. Here, the entire longitudinal momentum distribution of the ion beam should be addressed simultaneously using the unique combination of one cw and two pulsed laser beams\*. Each beam will be produced by a separate laser system, but the 3 laser beams are all in the UV range (all at 257 nm). The pulsed laser beams are “short” in time and therefore “broad” in frequency and should cover the large width of the ion momentum distribution (after injection into the ring). The cw laser is “narrow” in frequency and therefore has a very high spectral power, which is perfect for final cooling and keeping the ion beam cold. This scheme is also planned for laser cooling at the SIS100 and is therefore highly relevant for FAIR. The main challenge is to spatially, timely and spectrally overlap the 3 laser beams. To demonstrate this scheme, we will request one week (21 shifts) of beamtime at the ESR, using  $^{12}\text{C}^{3+}$  at  $\sim 122$  MeV/u. Alternatively, we could also use a  $^{14}\text{N}^{4+}$  at  $\sim 260$  MeV/u. (Laser cooling of  $\text{N}^{4+}$  was never done before.)

\*The cw laser system and one pulsed laser system (50 - 740 ps) will be provided by the TU Darmstadt. The other pulsed laser system (1 - 100 ps) will come from the HZDR / TU Dresden.

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