Progress on Pulsed Multipole Injection for the MAX IV Storage Rings

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In a Nutshell
- MAX IV facility employs a 3 GeV linac as a full-energy injector for two storage rings (via vertical transfer lines)
- Injection into MAX IV storage rings will make use of pulsed multipole injection (PMI)
- Previously a single pulsed sextupole magnet (PSM) was foreseen in each ring
- Recently: nonlinear injection kicker (NLK) prototype developed for BESSY II
- MAX IV and SOLEIL have recently launched a collaboration to design and build a new nonlinear kicker magnet based on the BESSY II design: "multipole injection kicker" (MIK)

Previously: Pulsed Sextupole Magnet
- Pulsed sextupole magnet (PSM) in each MAX IV storage ring was foreseen for top-up injection (as demonstrated at KEK PF)
- PSM reference design called for 32 mm magnet bore leading to ~ 21 J stored energy, 2125 A required current
- Combined with 640 ns pulse duration in MAX IV 1.5 GeV storage ring this leads to ~ 93 kV required pulser voltage
- Need lower-inductance design to reduce required voltage

New: Nonlinear Injection Kicker
- Prototype nonlinear injection kicker (NLK) recently developed for BESSY II
- Stripline-like design: flat zero-field area for stored beam, high-field area for injected beam
- Much lower inductance than a solid-iron PSM: drastically reduces required pulser voltage
- Perturbation of the stored beam further reduced compared to PSM
- In MAX IV cannot inject at field maximum (inner rods would limit vertical acceptance); instead inject on slope (tracking shows negligible degradation of capture)
- Reference design calls for < 2855 A current and < 19.5 kV pulser voltage

Injection and Capture Process
- Tracking of capture and first five turns in the MAX IV 3 GeV storage ring. Injection with NLK (blue) compared to PSM (red) as well as pure dipole kick (green).
- Tracking of the stored beam in the MAX IV 3 GeV storage ring through the SOLEIL MIK in single-turn injection mode.

MAX IV Project → http://www.maxlab.lu.se/maxiv

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NLK reference design for the MAX IV 3 GeV storage ring. Upper half geometry (top) and resulting field profile in the midplane (bottom).