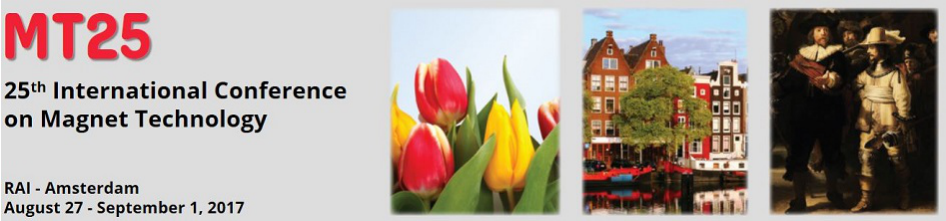

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Tuneable permanent magnets: Power saving solutions for the next generation of high energy accelerators.

Wednesday, 30 August 2017 12:00 (15 minutes)

Permanent magnet (PM) based systems offer a potential solution to one of the key issues in designing and running modern particle accelerators; the power draw from conventional electromagnet systems. A recent and ongoing collaboration between the CLIC project at CERN and STFC's Daresbury Laboratory has resulted in the ZEPTO (Zero Power Tuneable Optics) project, a drive to reduce the financial and environmental costs of accelerators. We have investigated the feasibility of creating large scale tuneable bending and focusing PM systems, initially for use on the proposed CLIC accelerator. The proposed magnets tune their field by moving components and so only draw power to the motors during the adjustment process, requiring no power during static operation and no cooling at any time. These systems would dramatically reduce the high electricity and water cooling costs introduced by conventional magnets, as well as the associated large scale infrastructure burden. The collaboration has previously reported on two prototype PM quadrupole systems (as presented at MT23)[1]. Within the last two years this work has continued into the development of a 1.6 T PM C-Dipole with a tuning range of over 50%. Significant finite-element simulations have been performed to identify an optimal solution and a 1.1 T scaled prototype has been constructed using a single 500x400x200 mm block of NdFeB which slides horizontally to provide tuning. We discuss the design, construction and measurement of the prototype dipole, whilst addressing challenges such as maintaining excellent field homogeneity over a large tuning range and managing the high and strongly varying magnetic forces. The infrastructure and financial implications for accelerator systems are demonstrated using the example of CLIC.
[1] J.A. Clarke et al, Novel Tunable Permanent Magnet Quadrupoles for the CLIC Drive Beam, IEEE Transactions on Applied Superconductivity (4003205,- Volume: 24, Issue: 3, June 2014)

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