PAUL SCHERRER INSTITUT

PSI

GFA Accelerator Seminar

Application of multi-objective optimisation to match turn pattern measurements for cyclotrons

Monday, 15 April 2019, 16.00 h, WBGB/019

Matthias Frey, PSI

The usage of numerical models to study the evolution of particle beams is an essential step in the design process of particle accelerators. However, uncertainties of input quantities such as beam energy and magnetic field lead to simulation results that do not fully agree with measurements, hence the final machine will behave slightly differently than the simulations. In case of cyclotrons such discrepancies affect the overall turn pattern or may even alter the number of turns in the machine. Inaccuracies at the PSI Ring cyclotron facility that may harm the isochronism are compensated by additional magnetic fields provided by 18 trim coils. These are often absent from simulations or their implementation is very simplistic. A newly developed realistic trim coil model within the particle accelerator framework OPAL is presented that was used to match the turn pattern of the PSI Ring cyclotron. Due to the high-dimensional search space consisting of 48 design variables (simulation input parameters) and 182 objectives (i.e. turns) simulation and measurement cannot be matched in a straightforward manner. Instead, an evolutionary multi-objective optimisation with a population size of more than 8000 individuals per generation together with a local search approach were applied that reduced the maximum absolute error to 4.5 mm over all 182 turns.

For more details, contact Jochem Snuverink, 5434