Contribution ID: **2380** Contribution code: **WEPA182** Type: **Poster Presentation**

Multi-physics simulation of quadrupole resonators in the time domain under uncertainties

Wednesday, 10 May 2023 16:30 (2 hours)

Exploring the fundamental properties of materials, including niobium or Nb3Sn, in high-precision surface resistance measurements is relevant to superconducting radio-frequency (RF) technology. For the precise determination of the RF properties of such materials, the calorimetric measurement is carried out with a quadrupole resonator (QPR). Mathematically, a QPR model is governed by a set of electromagnetic-stress-heat (EM-S-T) equations in the time domain under geometric and material uncertainties. It allows for profound insight into the QPR physics phenomena, such as dynamic Lorentz force detuning and microphonics, potentially resulting in measurement bias observed for the third operating mode of the given HZB-QPR (1.3 GHz). On top of the coupled EM-S-T problem, due to manufacturing imperfections, the stochasticity of input parameters substantially affects the performance of QPRs. Thus, uncertainty quantification (UQ) becomes necessary to provide reliable and predictable simulations of QPRs. The generalized polynomial chaos (gPC) expansion technique with the stochastic collocation method is proposed to find the UQ propagation by the QPR model. This methodology offers a more realistic mathematical model of the QPR, providing statistical moments, local and variance-based sensitivity, and cumulative/probabilistic density functions. Based on that information, a physically-based approach can be proposed to re-design the QPR and improve the measurement accuracy.

Funding Agency

Founded by the German Federal Ministry for Research and Education BMBF under Contract No. 05H21HRRB1

Footnotes

I have read and accept the Privacy Policy Statement

Yes

Primary author: PUTEK, Piotr (Rostock University)

Co-authors: HALLILINGAIAH, Gowrishankar (Rostock University); WENSKAT, Marc (University of Hamburg); ADRIAN, Simon (Rostock University); VAN RIENEN, Ursula (Rostock University)

Presenter: PUTEK, Piotr (Rostock University)

Session Classification: Wednesday Poster Session

Track Classification: MC7: Accelerator Technology and Sustainability: MC7.T07: Superconducting RF