Technology

Gero Pflanz

Carbon Fibre Reinforced Composites for the Tuning Structure of LHC RF Cavaties

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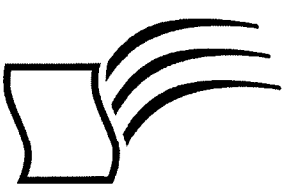

***Diplomarbeiten* Agentur**
Dipl. Kfm. Dipl. Hdl. Björn Bedey
Dipl. Wi.-Ing. Martin Haschke
und Guido Meyer GbR

Hermannstal 119 k
22119 Hamburg

agentur@diplom.de
www.diplom.de

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Dipl. Kfm. Dipl. Hdl. Björn Bedey, Dipl. Wi.-Ing. Martin Haschke & Guido Meyer GbR
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Abstract

The suitability of different materials for the tuning structure of the LHC rf cavities is evaluated. The structure spanning the temperature interval from room to cryogenic is subjected to mechanical loading, and radiation.
A filament wound tube reinforced with high-strength carbon fibres is considered to be most appropriate.

Design calculations are performed using laminate theory. The safety margin for a cylindric filament wound tube under the given mechanical and thermal loading conditions is calculated for different winding angles.
The calculations indicate that the thermal load is causing shear and transverse stresses which are more critical than the stresses due to the mechanical load.

A fatigue test is performed with a prototype tube under thermal and mechanical working conditions as they are estimated for LHC.
Before and after the fatigue test, non-destructive testing methods (ultrasonic examination, microscopy, and geometry measurements) are employed to evaluate the material condition before and after the fatigue test.
All three non-destructive tests indicate that the prototype tube withstood the fatigue test damage free. No advice on fibre breakage, delaminations, or matrix micro-cracking has been found.

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I am grateful to my supervisor Prof. E. Steck from the Technical University of Braunschweig, who accepted and made it possible that this work could be done outside the university.

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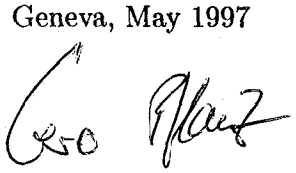

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