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Tue-Mo-Po2.13-11 [117]: Dimensional Changes of Nb₃Sn Conductors During Heat Treatment Using Digital Image Correlation

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In order to develop future particle colliders such as the HiLumi - Large Hadron Collider (HL-LHC) and the Future Circular Collider (FCC), high field superconducting Nb₃Sn magnets are necessary. Following the winding, the conductor requires a heat treatment at 650 °C during which significant dimensional changes occur. If dimensional changes are not allowed by the tooling, mechanical stresses build up in the coils and the performances of the magnet degrade. Therefore, coil fabrication tooling must authorize these dimensional changes in order to prevent conductor degradation and improve magnet performances. However, quantitative dynamics of the thermomechanical behavior of Nb₃Sn conductors during heat treatment remains unknown. This study describes how a DIC (Digital Image Correlation) approach has been used for the first time to observe the displacements fields of Nb₃Sn samples during heat treatment at 650 °C. To do so, a furnace equipped of port-holes allows observing the sample at high temperature. Two digital cameras record the displacements at the surface of the sample (for example a Rutherford cable), from different viewing angles. Finally a DIC algorithm reconstructs the evolution of the displacements fields. The advantages of the method, compared to classical methods, are to have access to in-situ dimensional changes at high temperature, in the three directions of space, with the dynamics during the heat treatment cycle. An analysis of measurements on representative samples is given and data are compared to the literature.

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