

THE THERMAL MEASUREMENT SYSTEM FOR THE SPIDER BEAM SOURCE

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The SPIDER test facility is under construction in Padova to verify the ion beam characteristics and to test the Beam Source operation under conditions consistent with the ITER Neutral Beam requirements.

Thermal measurements will be performed on the Beam Source by installing thermocouples that will be used for different purposes: (a) diagnostic, such as for the reconstruction of the thermal map on the component surface for the evaluation of the thermal load distribution, plasma generation and beam extraction uniformity, (b) operational for the recognition of different experiment conditions such as the determination of the beginning of plasma extraction and acceleration related to Caesium monolayer deposition, and (c) protective, for the verification of the components thermal reliability under the allowed maximum temperatures.

The thermal measurements will be made with N type thermocouples based on mineral insulated cables 0.8 mm outer diameter, with grounded (not insulated) junctions. This specific thermocouple type guarantees minimal characteristic response time and also ensures that the electric potential of the thermal sensor is always the same as that of the component, thus avoiding dangerous over-voltages in particular during grid-to-grid breakdowns.

The thermocouples will be installed on the Beam Source and their layout is supported by thermal analyses presented in this work. The paper also describes the thermocouple fixing systems that have been developed in detail and tested with prototypes in order to guarantee the thermal contact between the sensing junction and the component material.

The signal isolation and conditioning systems have been designed considering the different voltages of the components with respect to ground and the response time of thermal sensors.

Furthermore, the possibility to perform voltage measurements integrated with thermal measurements is under investigation in order to develop a robust measurement system by correlating signals obtained from different transducers.