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RF Breakdowns in the SPIDER experiment during its first operational phase

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SPIDER is the full-size prototype of ITER Neutral Beam Injector ion source, in operation since June 2018 as part of the ITER Neutral Beam Test Facility located in Padova, Italy. The ion source of SPIDER is composed of eight Radio Frequency drivers operated in low hydrogen gas pressure, 0.3 Pa, driven at 1 MHz with a total power of 800 kW, an extraction and acceleration system is the used to produce a negative ion beam with an energy up to 100 keV.

RF breakdowns outside the ion source beset the SPIDER experimentation since the beginning of the operations. Such breakdowns could be sustained by the power supplies but in many cases cause the plasma pulses to stop and might cause of source damages. Scope of this work is to summarize the experimental evidences, to classify the type of breakdowns and to identify the operational scenarios which seem to be free from this problem.

Three classes of diagnostics have been used to investigate the RF breakdowns: electrical measurements from the Ion Source and Extraction Power Supply, visible cameras (both fast and slow) and optical fibers which collect lights from the rear of the SPIDER experiment. Each of these signals is somehow affected by the RF breakdowns; their comparative analysis allows improving the understanding of this issue and helped the identifications of different types of breakdowns that can occur outside the SPIDER Ion Source.

A statistical analysis of the pulses performed so far concludes the work; it gives an overview RF breakdowns in the SPIDER experiment and tries to assess the breakdown probability in the conditions relevant for normal plasma operations.

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