BESSY in collaboration with ACCEL Cornell University DESY FZR

Berliner Elektronenspeicherring-Gesellschaft für Synchrotronstrahlung m.b.H.

CW Operation of the TTF-III Input Coupler

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1. Objective

- To determine the average-power limit for operation of the TTF-III coupler and to identify the critical components.

2. Motivation

- Several proposed superconducting linacs are planning to use TESLA technology (e.g., Cornell ERL, BESSY FEL)
- TESLA technology was developed for pulsed operation
- It must be demonstrated that CW operation is feasible.

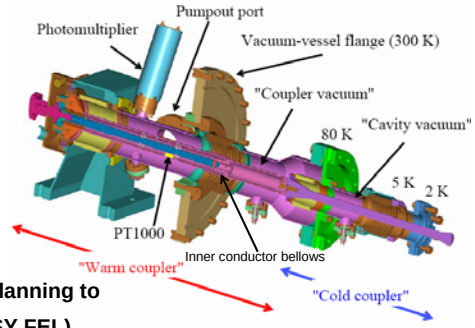
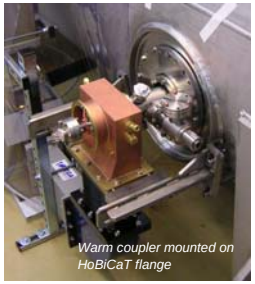


Figure 1: The TTF-III coupler

3. Requirements

- The proposed CW linacs will run at approx. 20 MV/m with little beam loading
- Typically the coupler must handle up to 10 kW *standing-wave* power
- So far the TTF-III coupler has been operated up to about 2 kW average power.

Figure 2: TTF-III coupler mounted on the test stand



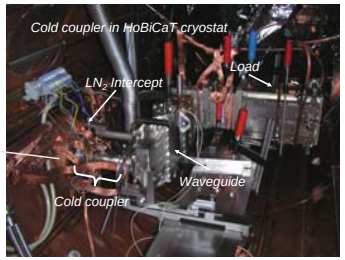


Figure 3: Configuration for cryogenic tests

4. TTF-III Coupler Test

- Coupler layout shown in Fig. 1
- Test the coupler at room temperature on test stand (Fig. 2) while measuring the temperature of ceramic windows (IR sensor) and inner conductor (PT 1000)
- Critical component is the inner-conductor bellow
- Thermal conductivity of ceramic thought to limit cooling of inner conductor, but this improves at LN_2 temp.
- → Also test under cryogenic (standard operating) conditions
- Mount coupler test stand in HoBiCaT Test Facility (Fig. 3) and operate at LN_2 temperature
- Standing wave and travelling wave tests

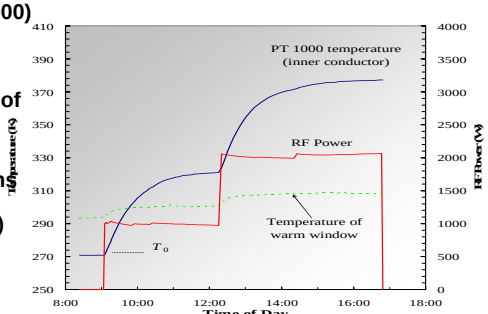


Figure 4: Example of the temperature rise as a function of time as RF power is applied.

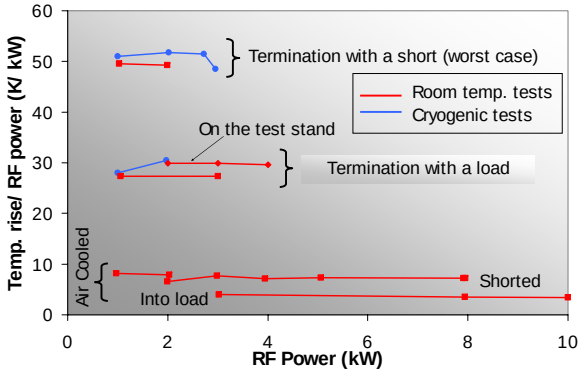


Figure 5: Temperature rise per kW of applied power at the PT1000 sensor in the inner conductor (see Fig. 1). All tests in HoBiCaT except the one marked „on the test stand."

5. Results and Conclusions

- Thermal time constant is very long (50 mins), see Fig. 4
- Inner conductor bellows region becomes very hot. We imposed a limit of 300 C.
- Interlock trips due to vacuum and reflected power limited the tests (but these are not a fundamental limit).
- Extrapolation of Fig. 5: 10 kW TW and 5 kW SW operation with existing coupler should be possible.
- *No significant difference seen between warm and cold tests* (Fig. 5) → Cold window ceramic is not the limiting item for heat conduction
- *Tests up to 10 kW (klystron limited) were also done with the inner conductor air cooled. If the results are extrapolated, 25 kW SW operation is feasible (Fig. 5)*

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