

B) On the accuracy of thermal simulations using GCODIS

In order to check the accuracy of GCODIS [7], a computer program to do thermal simulations of coax transmission lines and rectangular waveguides (which uses empirical formulas to calculate effects of convection but treats conduction and radiation exact), simulation results have been compared with measurements.

Therefore an experimental setup as shown in the following picture was used to perform the temperature measurement of a 1 5/8 inch transmission line operated with power upto 7 kW at 858 MHz (channel 69 in band V with highest frequency and largest losses, VSWR=1):



Fig. 9: A 1 5/8 " transmission line loop embedded into the ring resonator at Spinner test facility. Shown are different points of measurement (M-Ps) where temperature sensors are attached to the outer conductor. At M-P 2 one can see an infrared camera mounted on a tripod to measure the temperature of the inner conductor.

The maximum allowed length of 2.5 m has been used for the long side of the 1 5/8" loop to reduce the effect of the discontinuity of the support disks and the 90°-bends. In the center of the long side (M-P 2) the temperature of an (almost) infinitely long line can be measured.



Fig. 10: Detail of the slotted and partially blackened transmission line at M-P2 with temperature sensor attached to outer conductor.

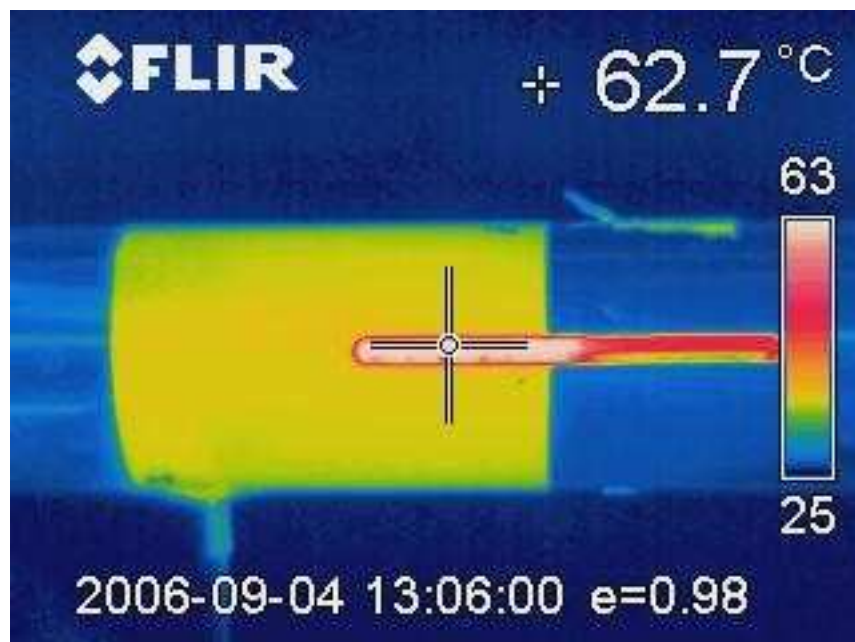


Fig. 11: Infrared picture of 1 5/8" transmission line at 2kW showing the absolute necessity to blacken the copper tubes in order to measure their temperature, and not the temperature of the lab walls being reflected at metallic surfaces.



The temperature displayed by the IR camera is calibrated by the temperature measured with the conventional sensor attached to the outer conductor.

Finally, the excellent agreement between measurement and simulation for the temperature of both inner and outer conductors is shown in Fig. 12:

Comparison GCODIS-Measurement for 1 5/8" Transmission Line

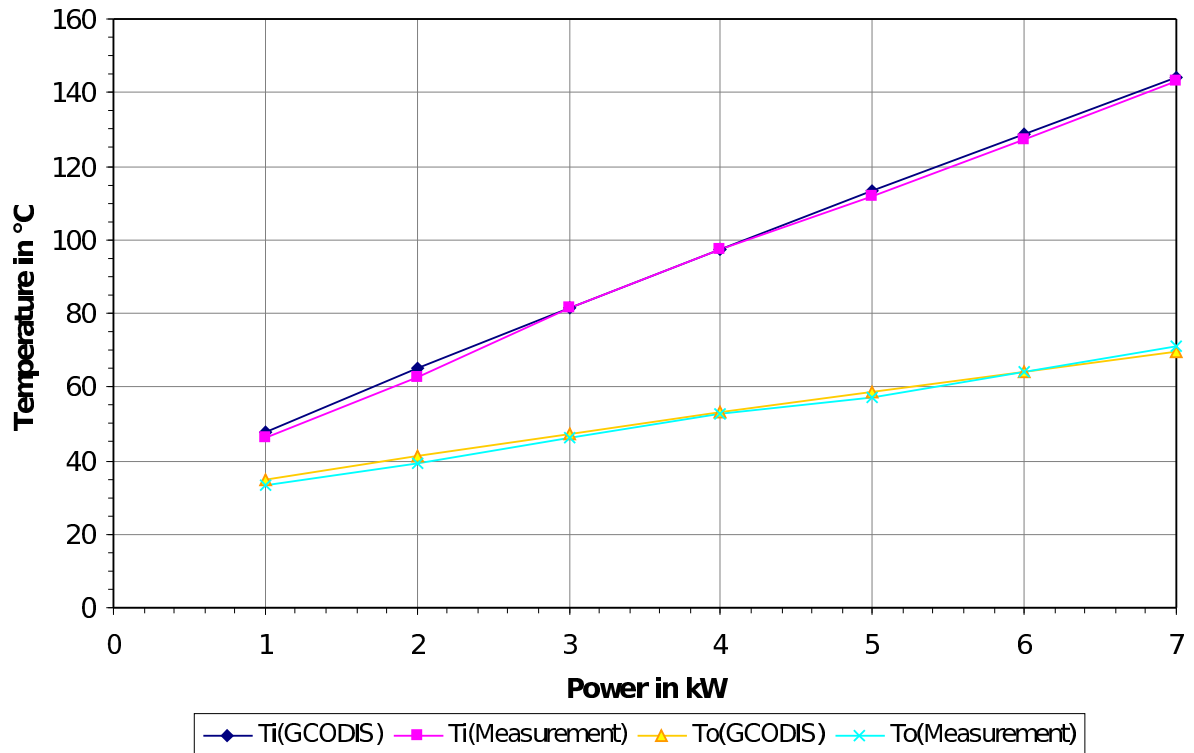


Fig 12: Simulated and measured temperature of inner and outer conductors of a 1 5/8" transmission line operated at different powers from 1 to 7 kW at 858 MHz.
The room temperature was 27 °C, as one can see from the extrapolation of the two curves to $P = 0$.