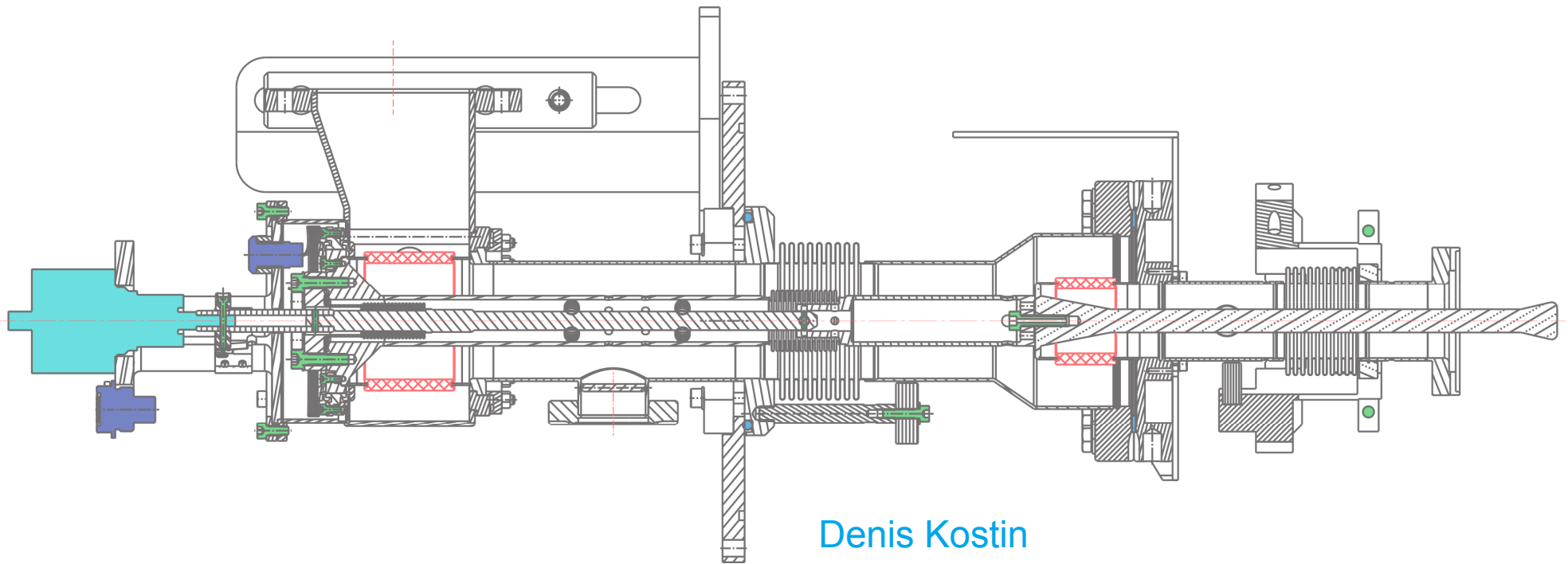


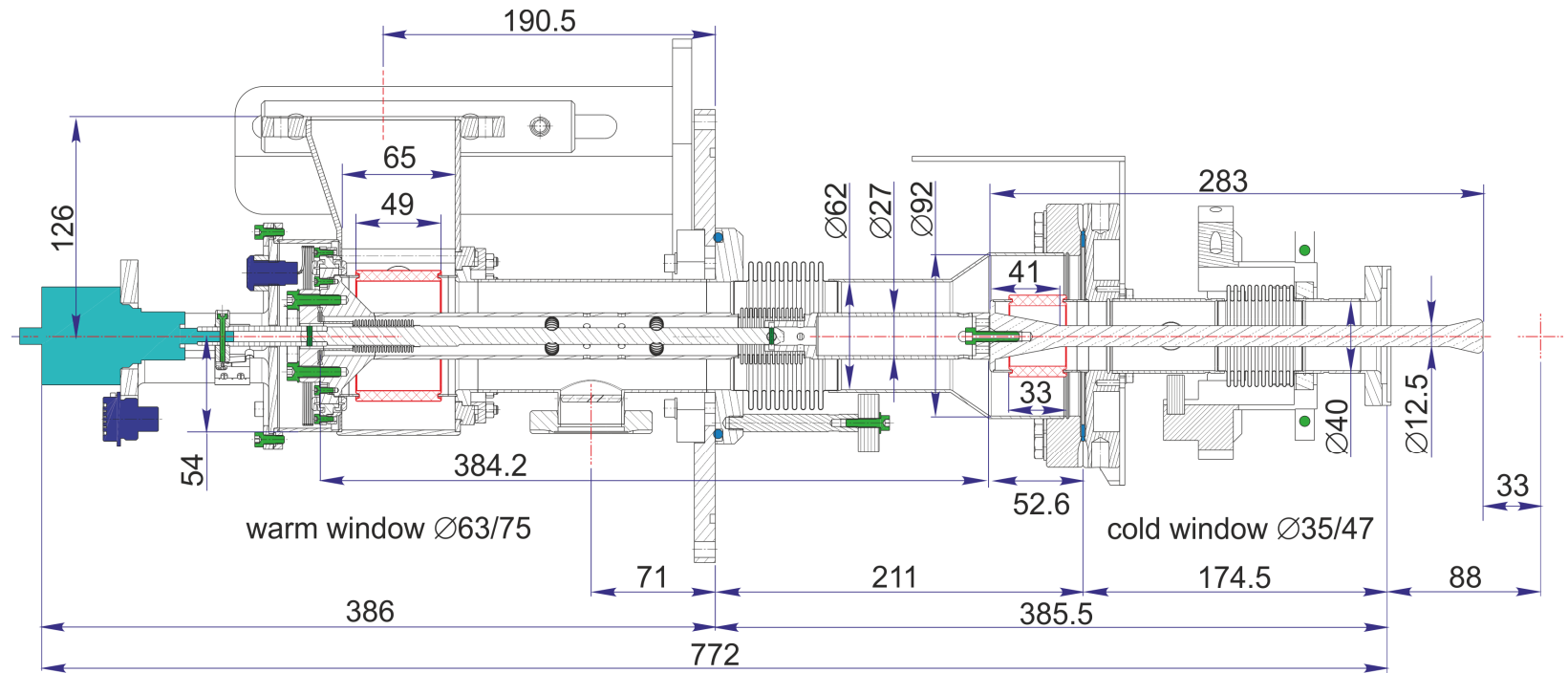
XFEL RF Input Power Coupler Thermal Analysis

copper plating aspects



Denis Kostin
TTC Meeting
DESY, 25.03.2014

XFEL Coupler Parameters and Specification



> Geometry

> Copper Plating

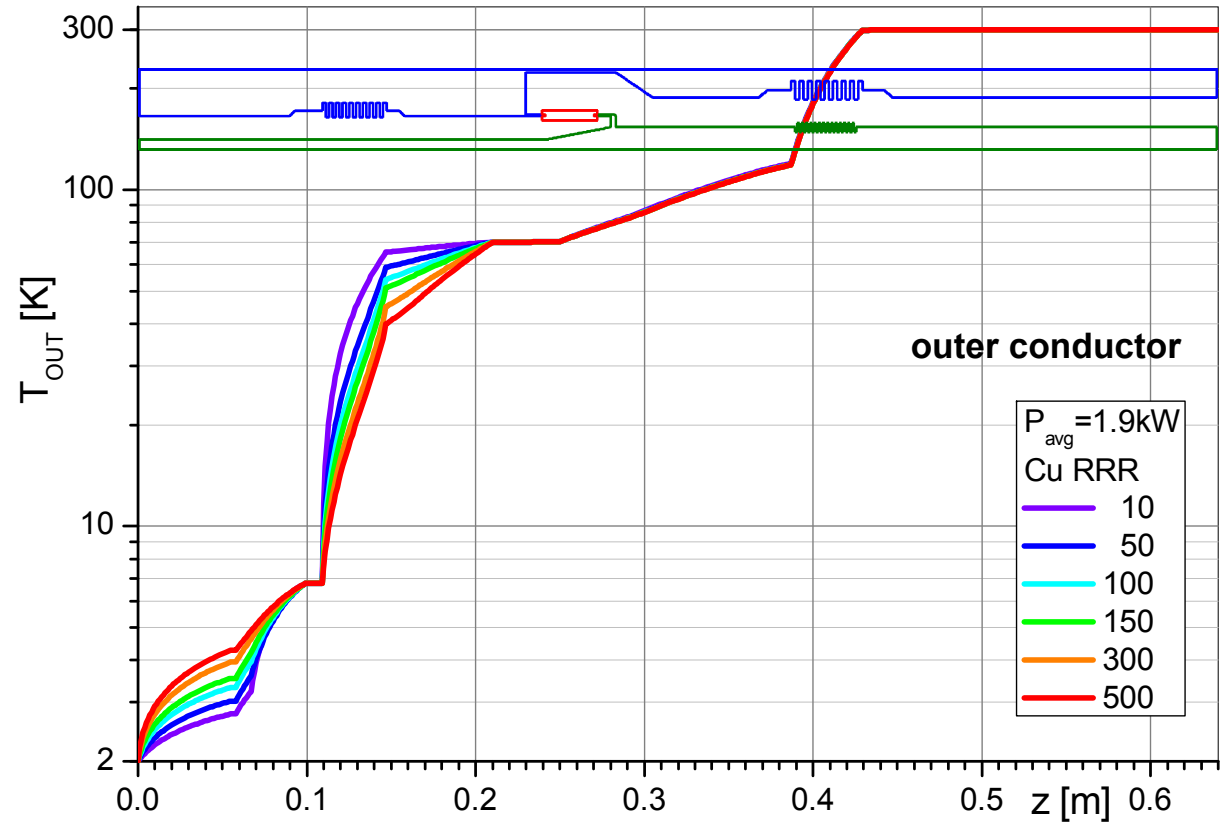
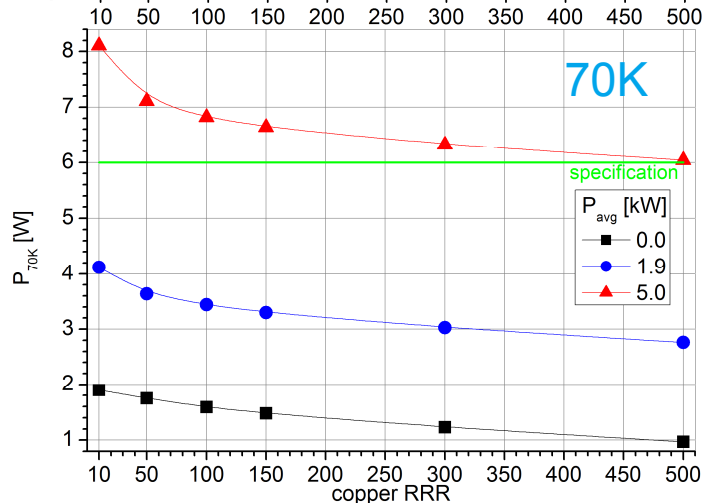
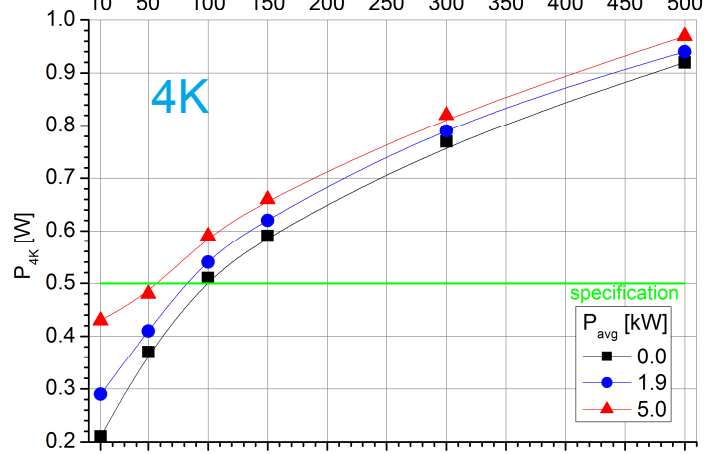
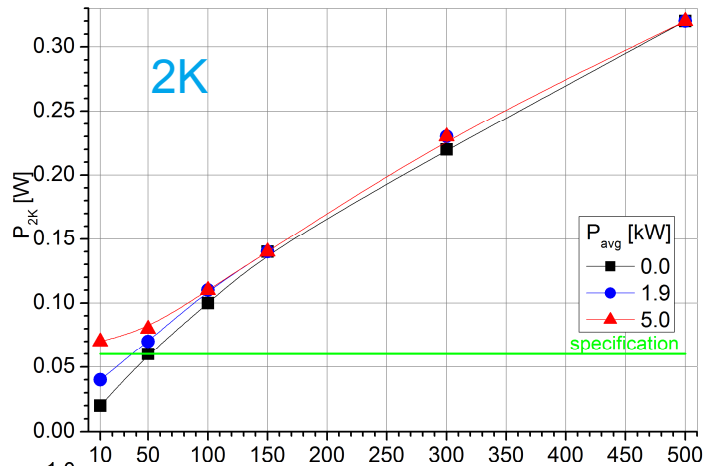
part	inner [μm]	inner RRR	outer [μm]	outer RRR
cold	solid Cu	solid Cu	10 \pm 20% bellow: \pm 30%	30..80
warm	30 \pm 20% bellow: \pm 30%	30..80	10 \pm 20% bellow: \pm 30%	30..80

> RF Power

peak power	rep.rate	equivalent CW power
150 kW	10 Hz	1.9 kW

Coupler Copper Plating RRR

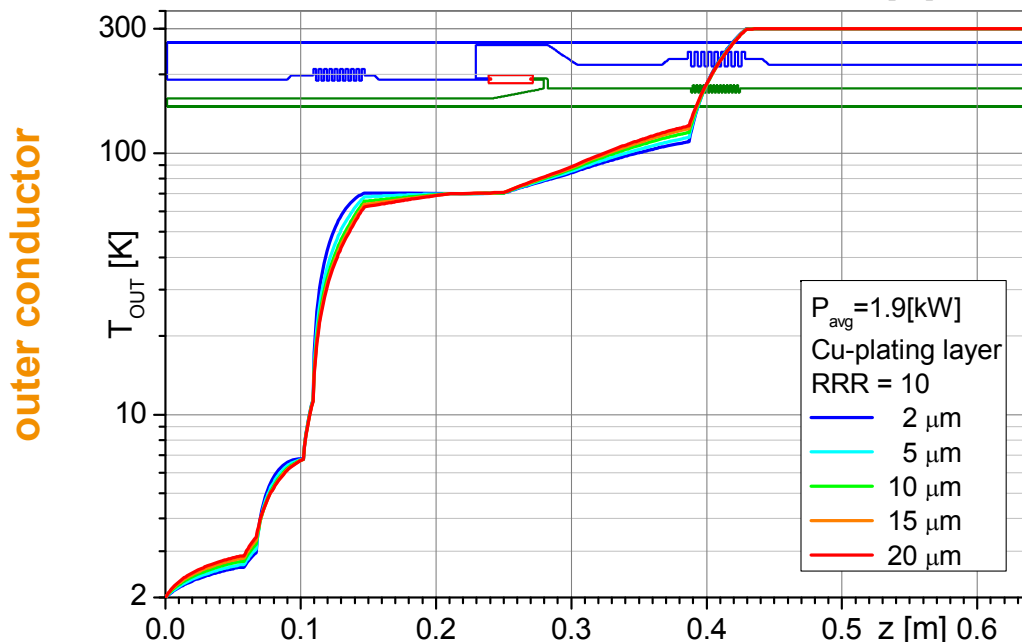
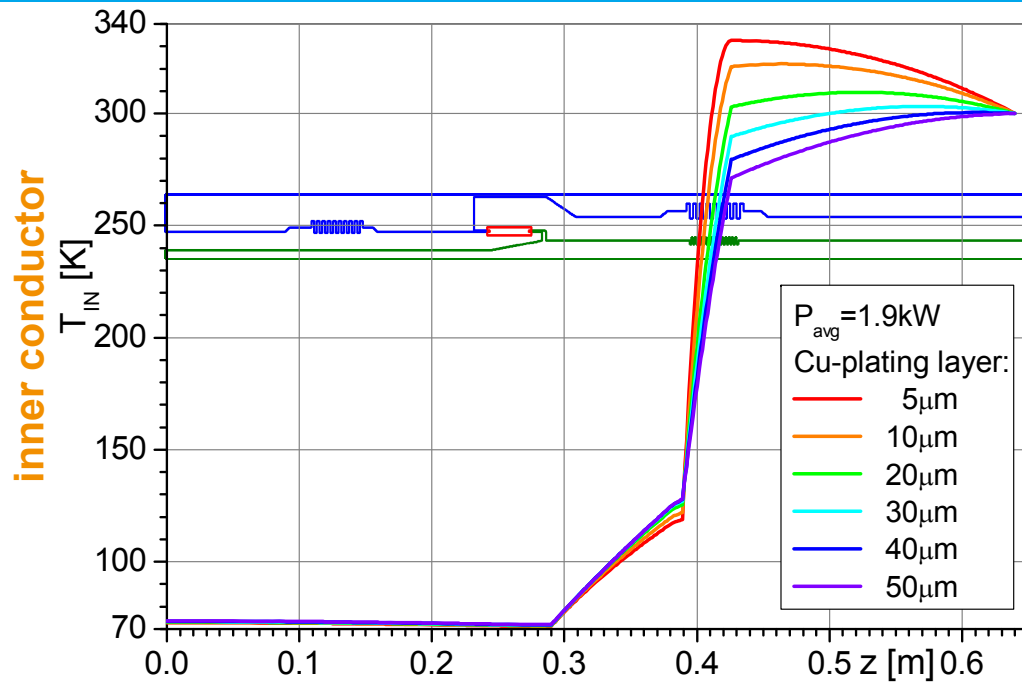
cryogenic losses



- Static cryogenic losses play major role.
- Copper coating RRR is limited by maximum of 50 with 2K zone cryogenic losses specified by maximum of 0.06 W. This RRR limit is applied to the cold outer conductor only. Inner conductor contributes mostly to 70K zone and its RRR is not limited. Warm part copper RRR is also not limited

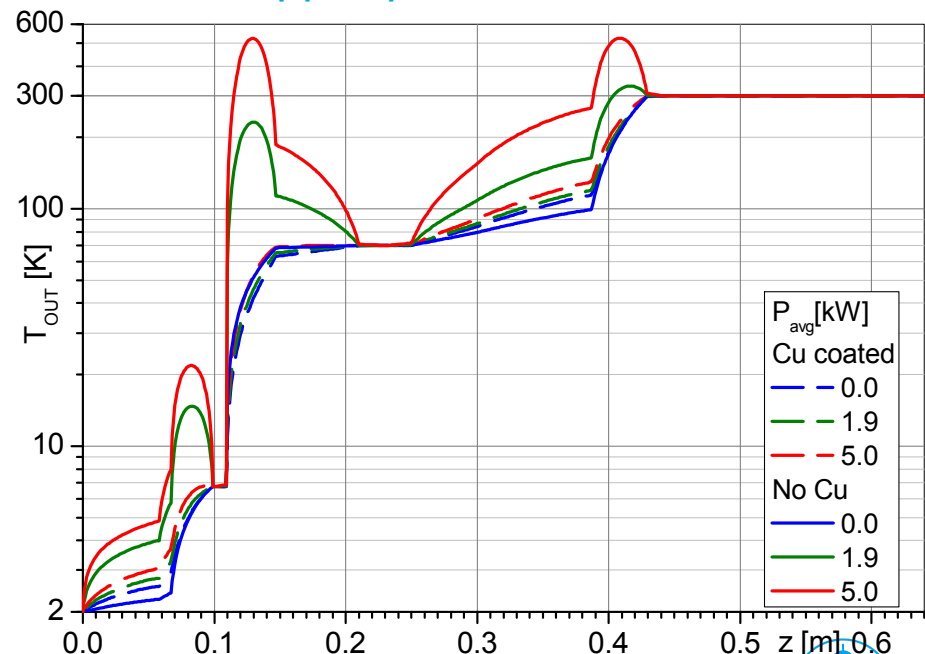


Coupler Copper Plating Layer Thickness

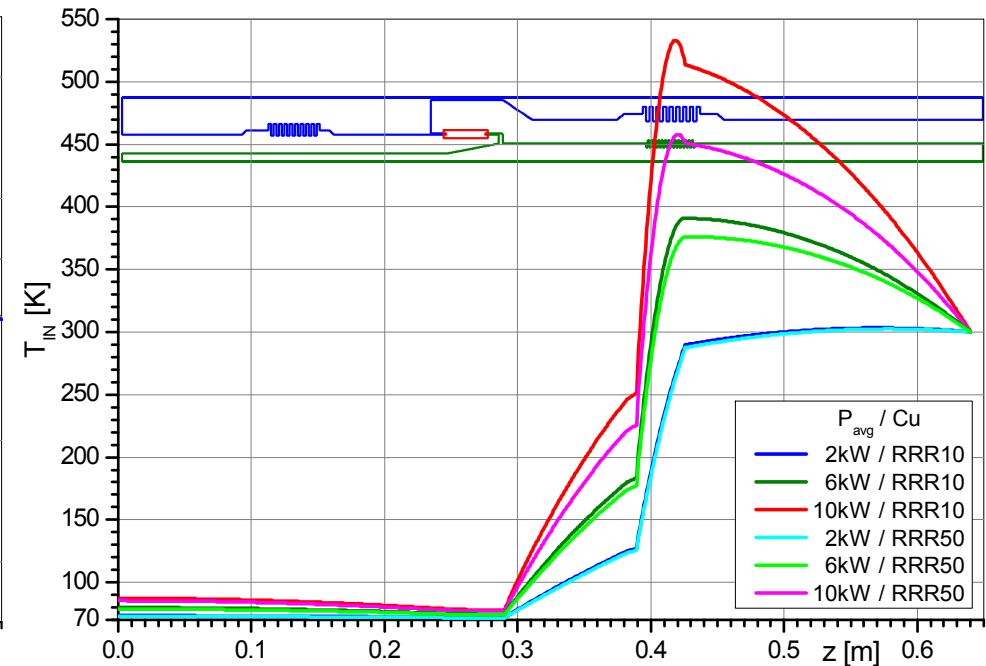
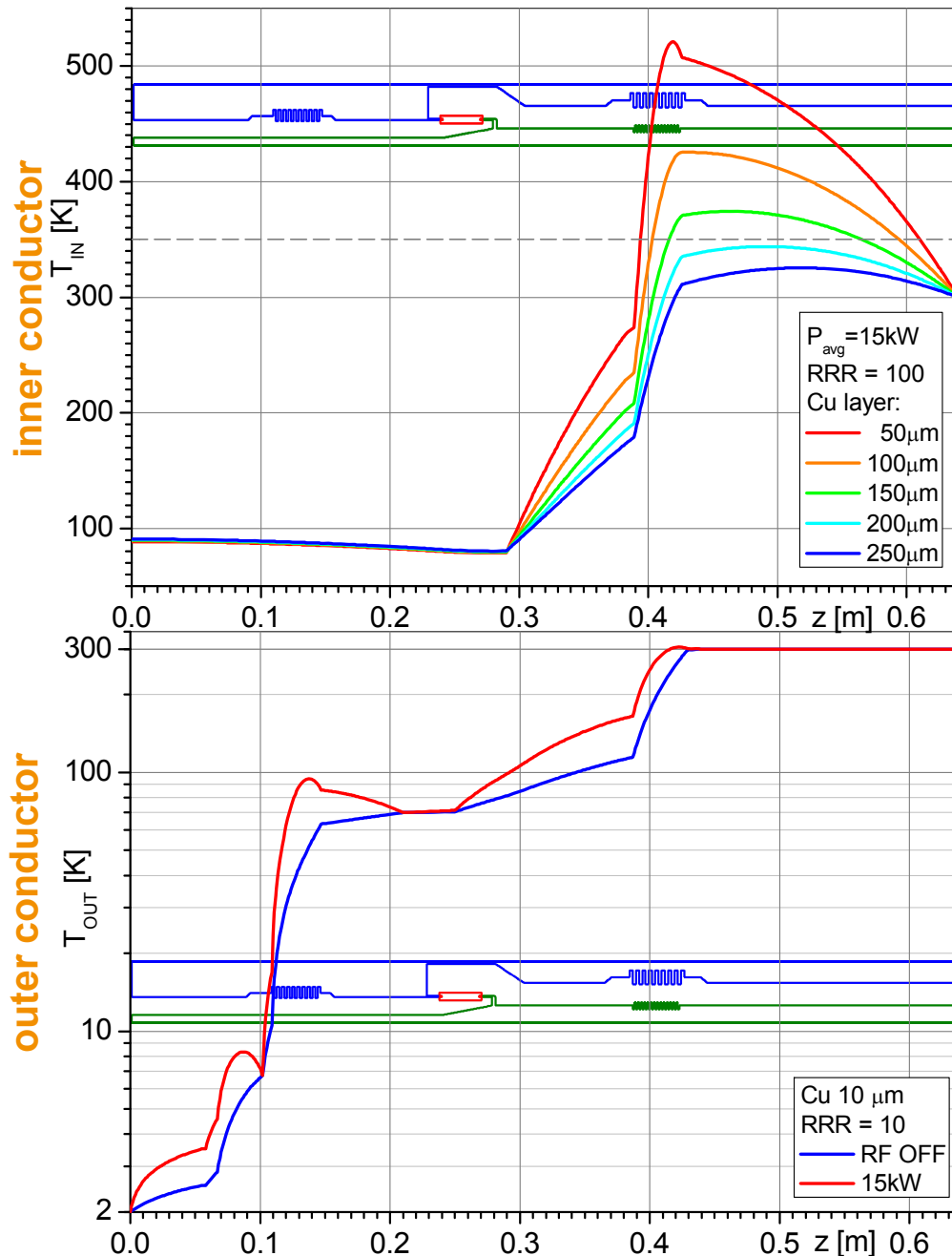


- > copper plating layer thickness variation is mostly seen on the inner conductor with a warm inner bellow temperature variation.
- > outer conductor plating layer thickness seems to be less important, save it must be at least 2 μm because of a skin depth effect.
- > omitting the outer conductor plating is not a solution, dynamic losses at cold end increase drastically and temperature distribution is not acceptable.

not copper-plated outer conductor



XFEL Coupler: CW application



- with the CW RF power in a range of 10..15 kW inner conductor overheating will be an issue, with a maximum temperature on the warm inner bellow.
- to decrease the inner conductor temperature it must be gas cooled from inside or copper-plated with increased layer thickness (200 μm).

