Input Coupler Study of STF Cryomodule

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Heat loads scaled from TESLA TDR by Tom Peterson

Heat Load @ 2 K

	Static	Dynamic
RF load	NA	7.46
Supports	0.6	NA
Input Coupler	0.55	0.16
Current Leads	0.28	0.28
Others	0.27	1.76
Total	1.70	9.66

Total : 11.36 W

Heat Load @ 40 K

	Static	Dynamic
Radiation	32.5	NA
Supports	6.0	NA
Input Coupler	15.5	60.1
Others	5.2	28.2
Total	59.2	94.3

Total : 153.5 W

Heat Load @ 5 K

	Static	Dynamic
Radiation	1.41	NA
Supports	2.40	NA
Input Coupler	1.48	1.32
HOM Coupler (cable)	0.29	1.82
HOM Absorber	3.13	0.76
Current Leads	0.47	0.47
Diagnostic Cable	1.39	NA
Total	10.56	4.37

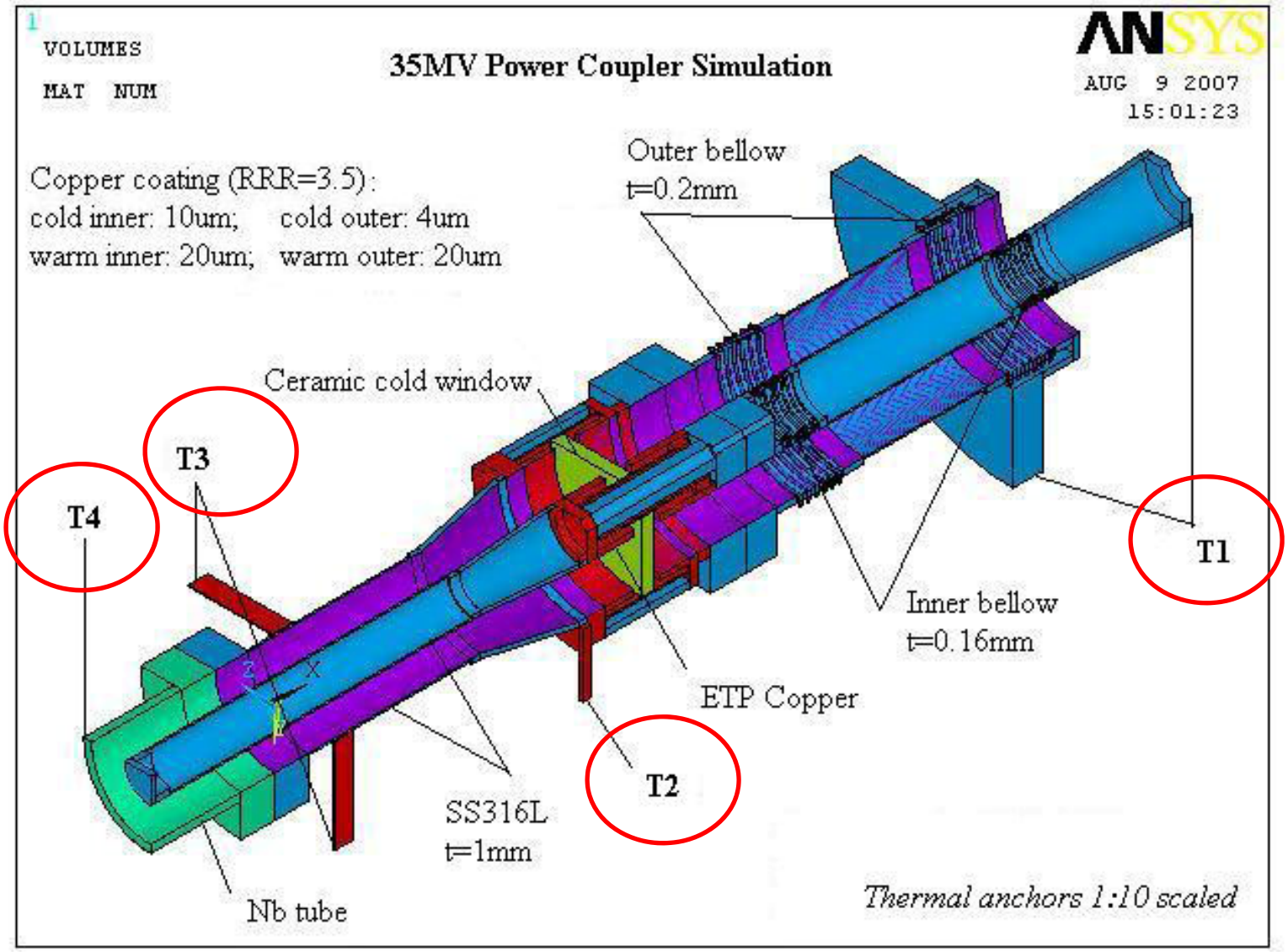
Total : 14.9 W

Heat Loss of Input Coupler for one cryomodule;

0.71W @ 2K, 2.8 W @ 5K , 75.5 W @40K

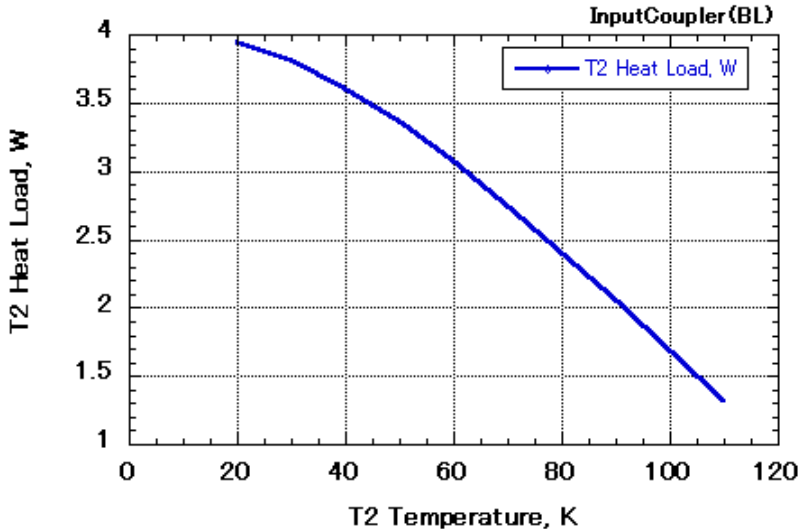
Total Loss @300K = 2.30 kW for one module

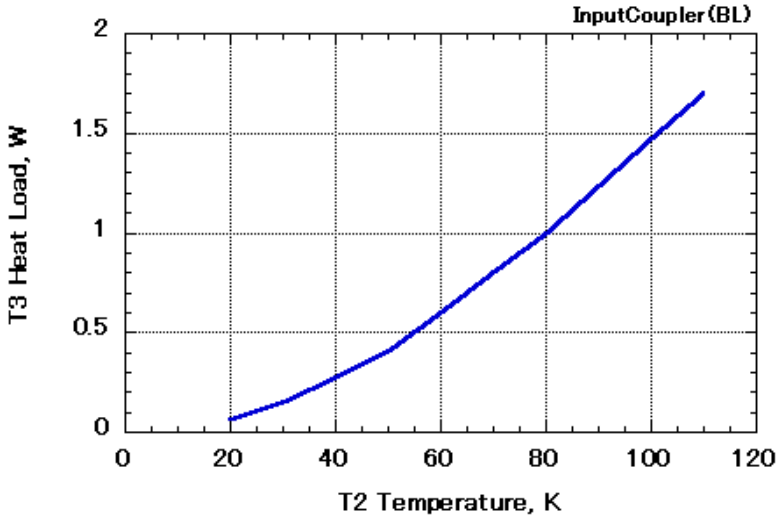
Input Coupler Model for BL Cavity

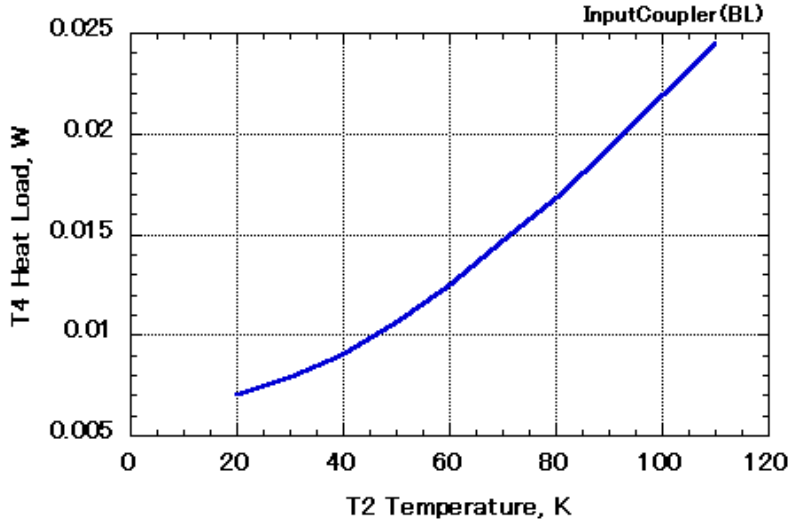


Calculated Heat Load by ANSYS

- **Thermal conditions;**
  - **T_1 = 300K, T_3 = 5K, T_4 = 2K, T_2 = parameter for calculation**







Thermal design of the input coupler;

T_1=300K, T_2 = 80 K, T_3=5K, T_4= 2K

Static Heat Load;

2.4W @80K, 1.0W@5K, 0.017W@2K

Dynamic Heat Load;

3.0W @80K, 0.2W@5K, 0.03W@2K

Total Loss @300K = 359W for one coupler

Total Loss @300K=3.12 kW for one module

From the T. P. cryogenic model

- **Cooling scheme for 40 K cryogenic line**
  - **Temperature increase by the shield and the interceptors: 40 K -> 80 K**
    - **Temp. rise by thermal shield : 12 K**
    - **Temp. rise by interceptors : 28 K**

Calculation for Static Heat Load (not including dynamic loss)

	40K gas: Shield → Interceptors		40K gas: Interceptors → Shield	
	Shield	Interceptors	Interceptors	Shield
Temp. range, K	40 K~52 K	52 K~80 K	40 K~68 K	68 K~80K
Average temp. K	46 K	66 K	54 K	74 K
Heat Load, W	0.22 @2K	0.121 @2K 6.24 @ 5K 24.97 @ 40K	0.098 @2K 4.25 @ 5K 28.09 @ 40K	1.37 @2K
Heat Load @300K, kW	0.155	1.73	1.37	0.96
Total H. L. @300K, kW	**1.89**		**2.33**	