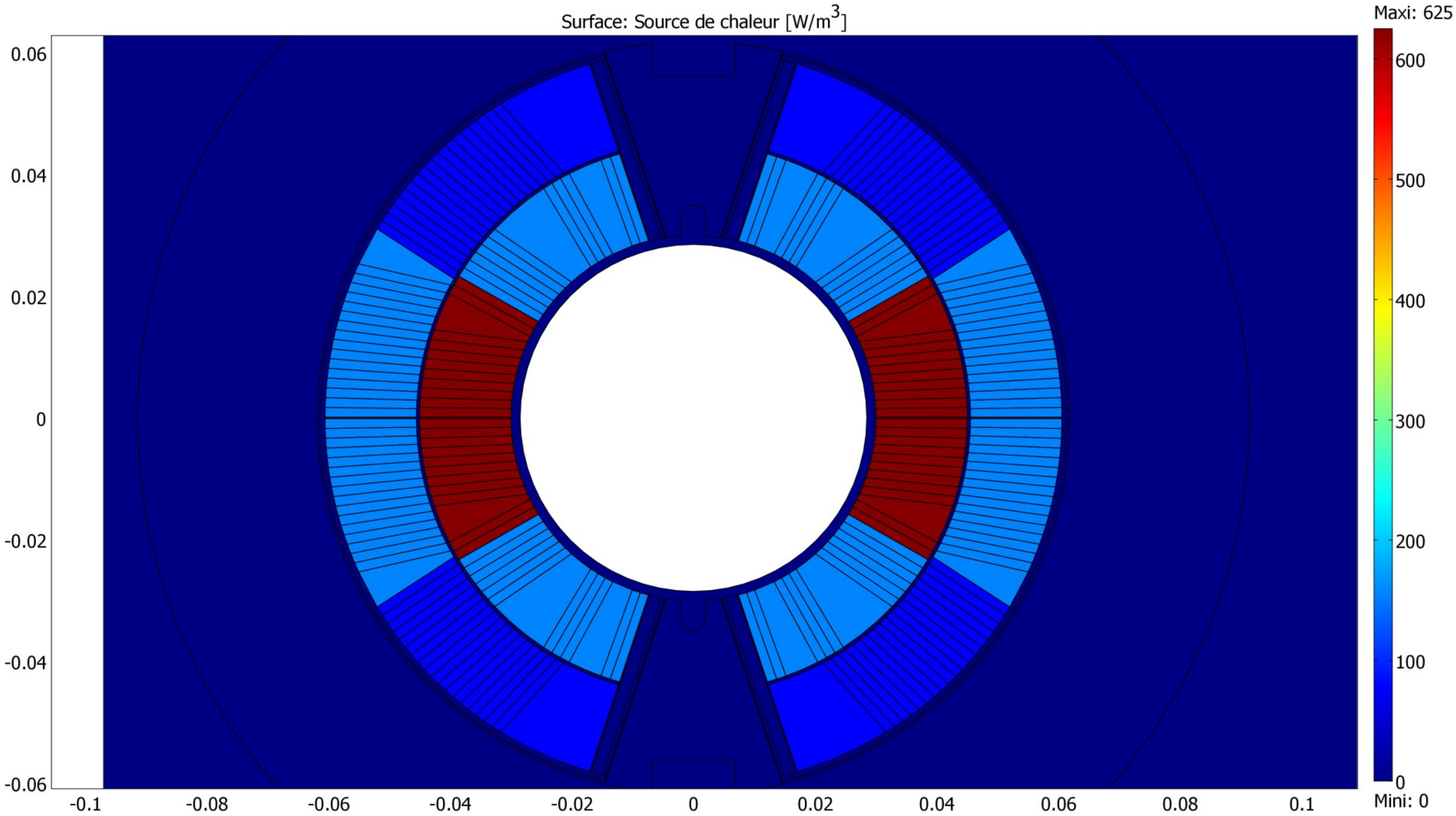
11 T Nb3Sn magnet thermal model (1/5)

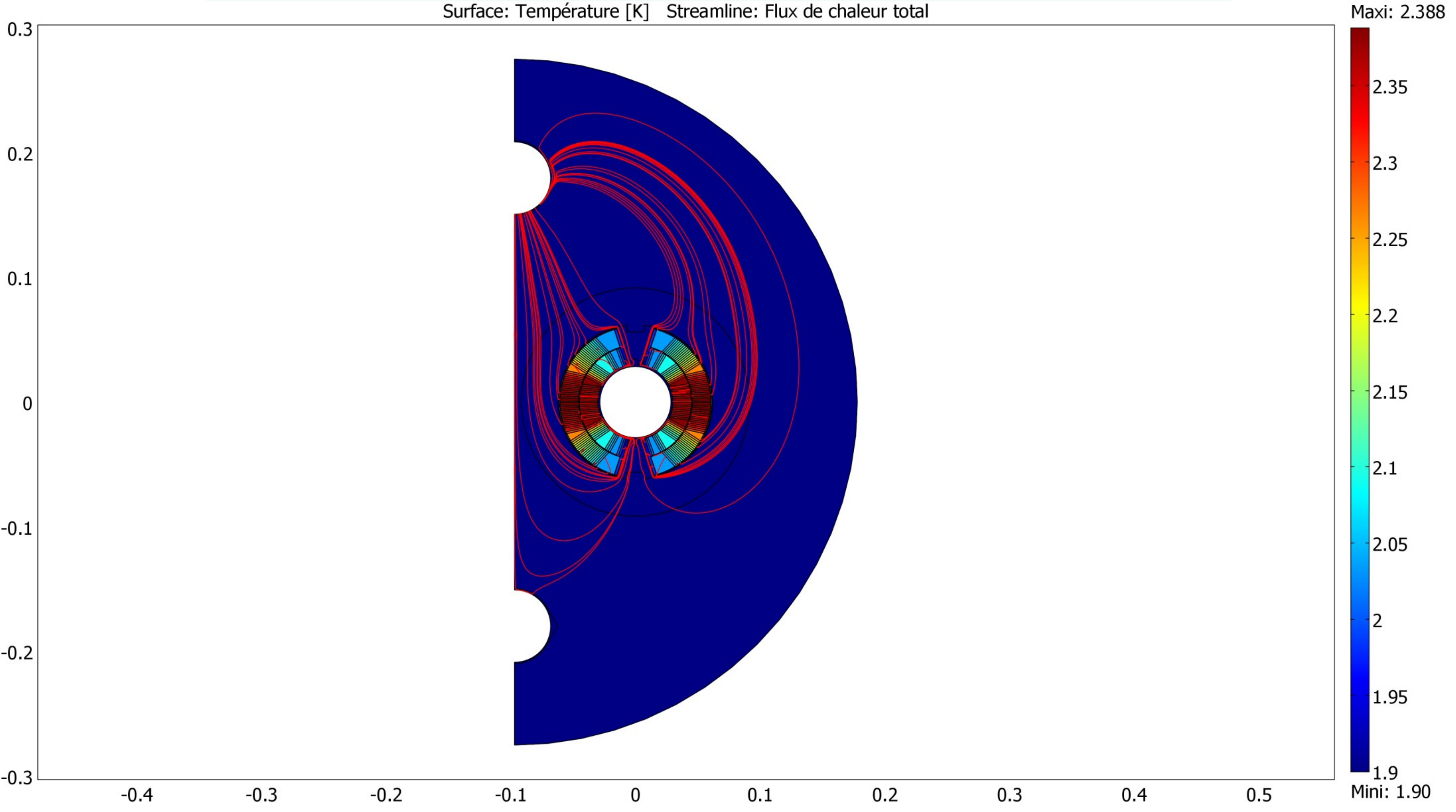
- Equations: energy equations considered for solid and superfluid helium
- One heat exchanger at 1.9 K 25 % wetted by liquid HeII
- Homogenization of the cable at the first order taking account of the copper, the Nb3Sn and the resin: effective thermal conductivity *kcable(T)*
- Cable insulation (G-10 – 100 µm thick) modeled by a thermal resistance
- Between inner/outer coil: 3 layers of G-10 168 µm thick modeled by one layer 504 µm thick
- Between the coils and collars: 5 layers of kapton 125 µm thick modeled by one layer 625 µm thick
- Titanium pole piece is taken 4 % open
- Collars and yoke laminations are taken 2 % open
- Annular space 1 – 1.5 mm

11 T Nb3Sn magnet thermal model (2/5)

Input: assumed heat load distribution corresponding to 1.5 W/m



11 T Nb3Sn magnet thermal model (3/5)



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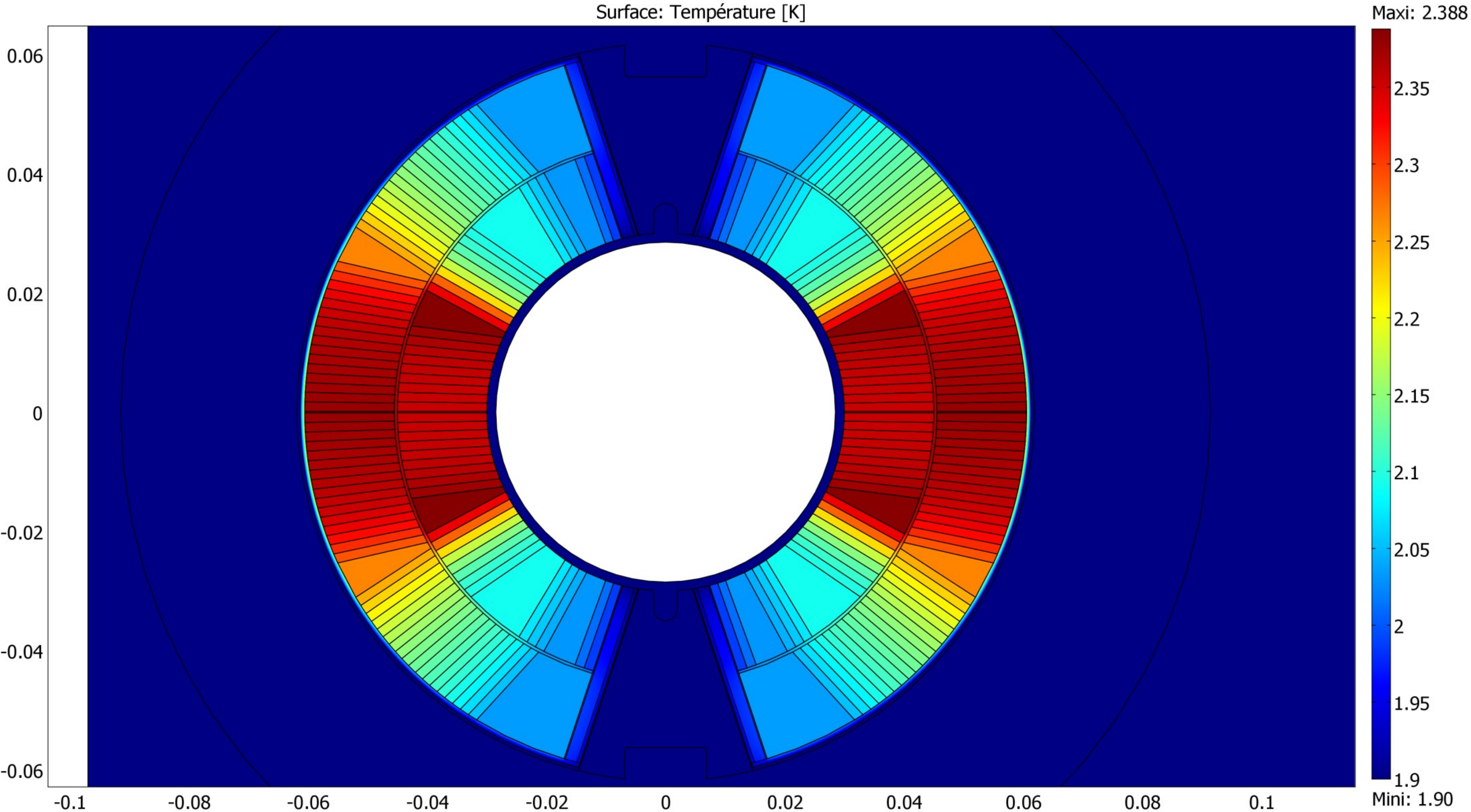
11 T Nb3Sn thermal model (4/5)



Maximum Temperature 2.39 K at midplane

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11 T Nb3Sn thermal model (5/5)

Conclusions:

T-map-results invariant of annular space in range 1 – 1.5 mm
T-map-results invariant pole piece opening in range 1 – 4 %

With respect to LHC main dipole construction we assume that 1.5 mm annular space and 4 % pole piece opening are safe to cope with quench overpressure.
Could be minimized, but would need verification (to be done)

Next to be done:

- simulations with the real heat load
- more precise homogenization of the cable
- quench analysis to determine:
  - holes in titanium piece needed
  - maximum pressure reached
- transient analysis