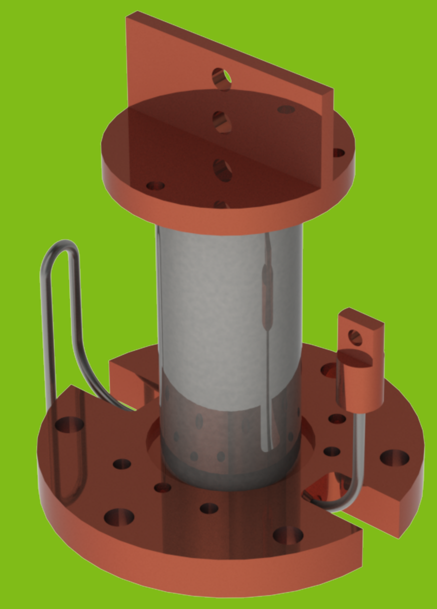
Gas Gap Heat Switch
for a cryogen-free magnet system

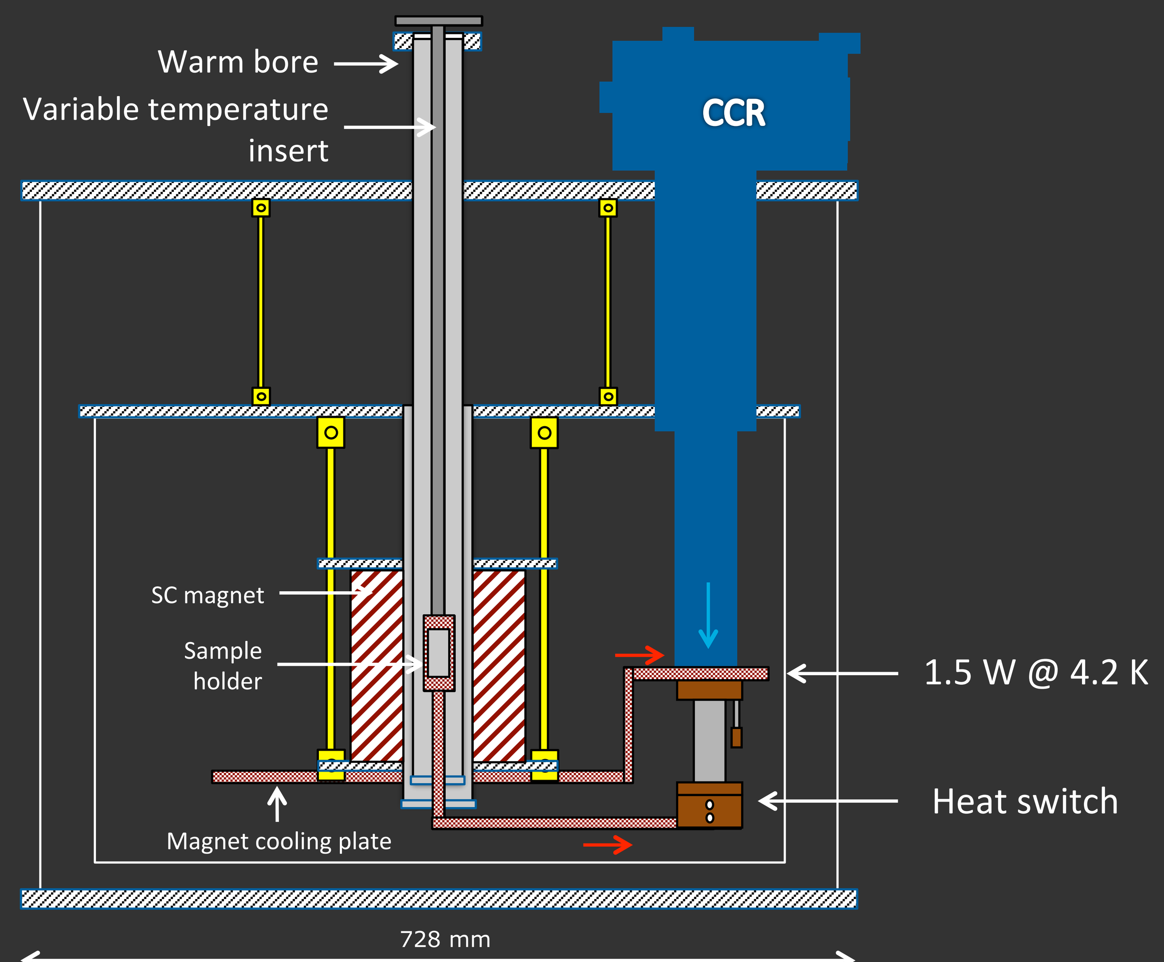


J Barreto[1], P Borges de Sousa[1], D Martins[1], S Kar[2], G Bonfait[1], I Catarino[1]

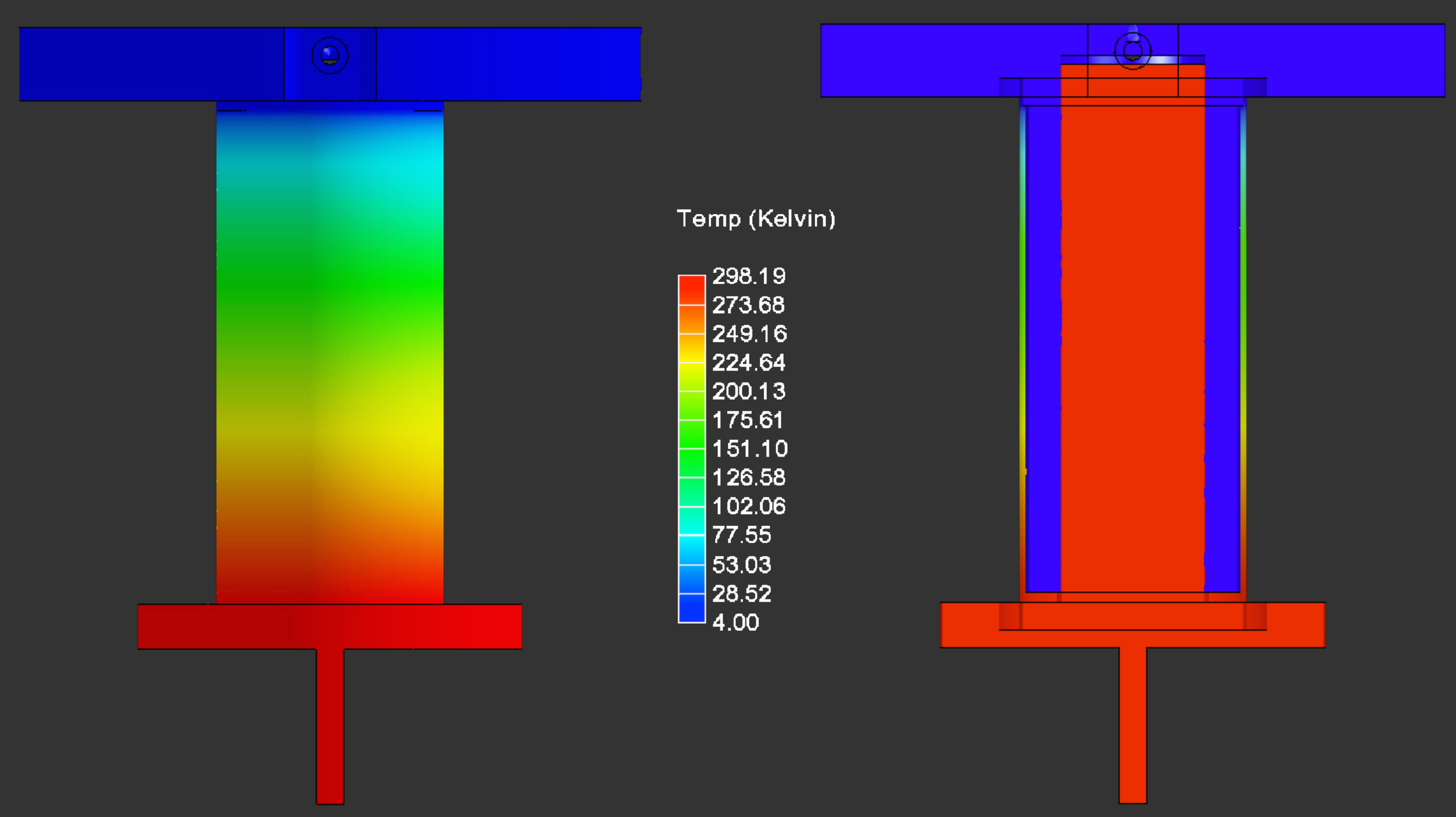
[1]LIBPhys-UNL, Departamento de Física, Faculdade de Ciências e Tecnologia - UNL, 2829-516 Caparica, Portugal

[2]Inter-University Accelerator Centre, New Delhi, 110067, India

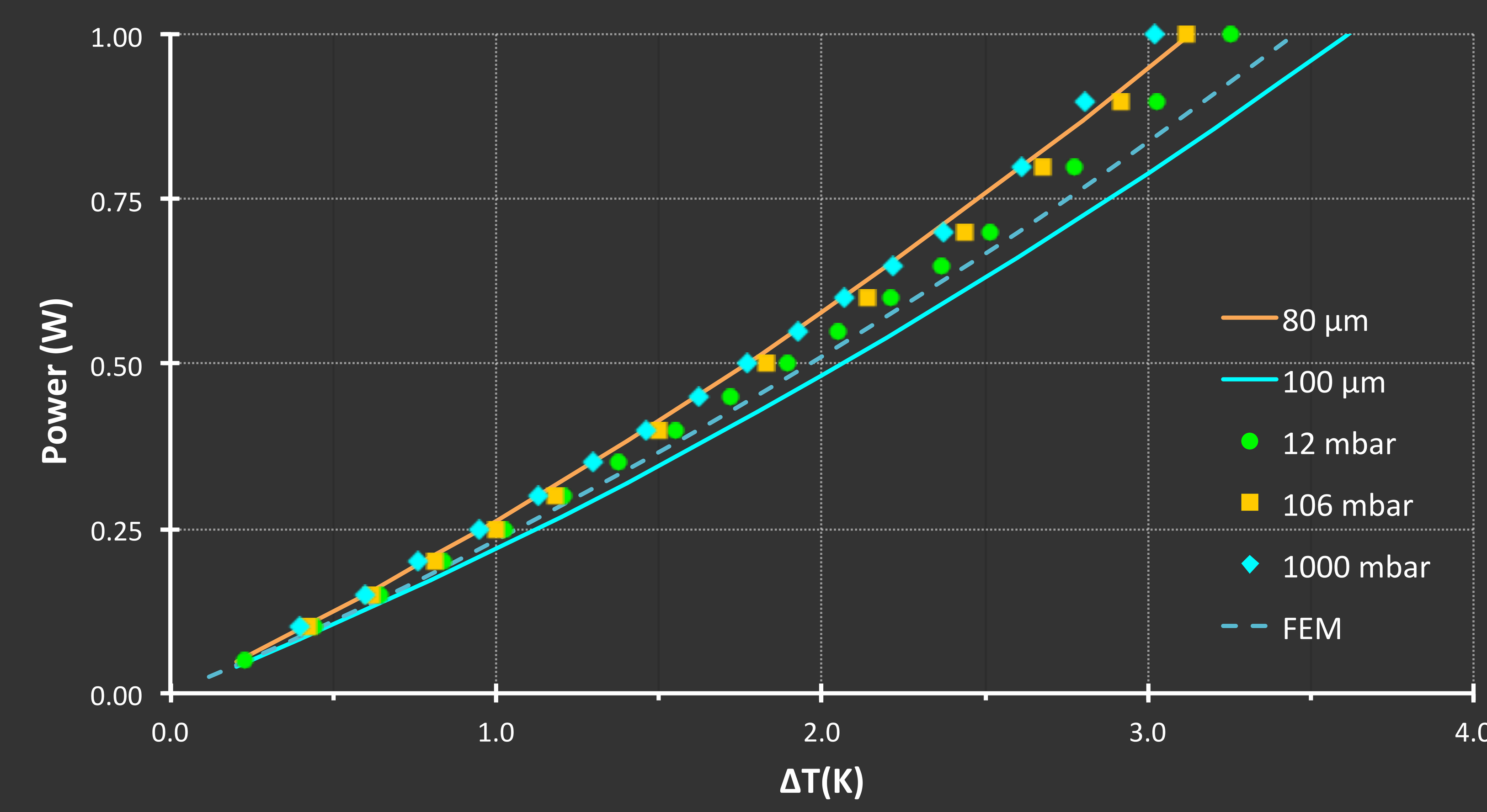
A cryogen-free superconducting magnet system (CFMS) will use a **gas gap heat switch** (GGHS) to cool down the variable temperature insert (VTI) of a magnet cryostat system. Some available CFMS use a mechanic cryocooler as its cold source. However, some of those systems are not completely cryogen-free when they include a VTI, as they are still based on helium gas circulation through the sample space. The idea is to **replace that gas flow with a GGHS** with the purpose of diverting some of the available cooling power to the sample while **keeping the superconducting magnet working at 4 K**.



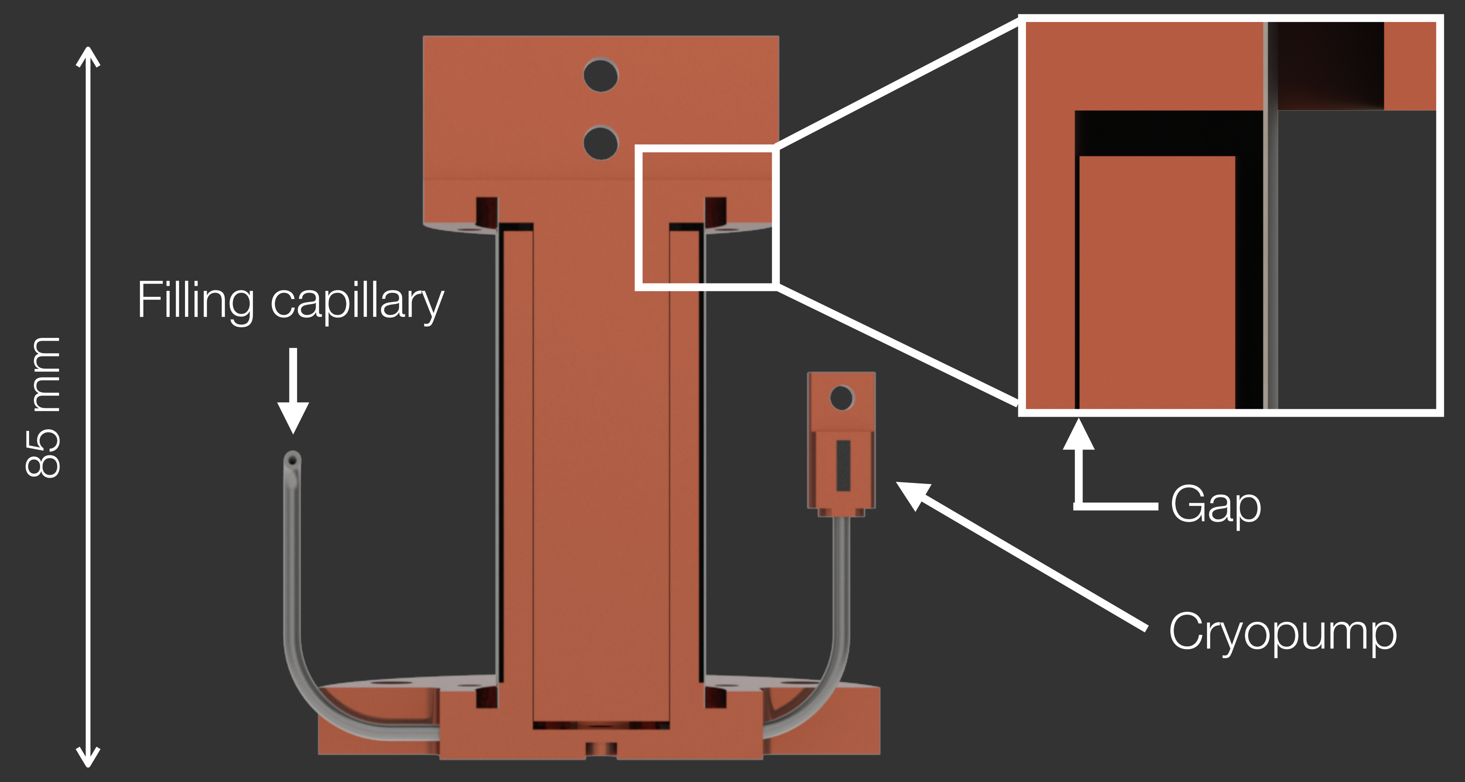
Schema of the magnet cryostat along with the GGHS thermally coupled to the cryocooler (CCR) and to the VTI through a thermal link. Only the excess cooling power is diverted to the VTI through the GGHS.

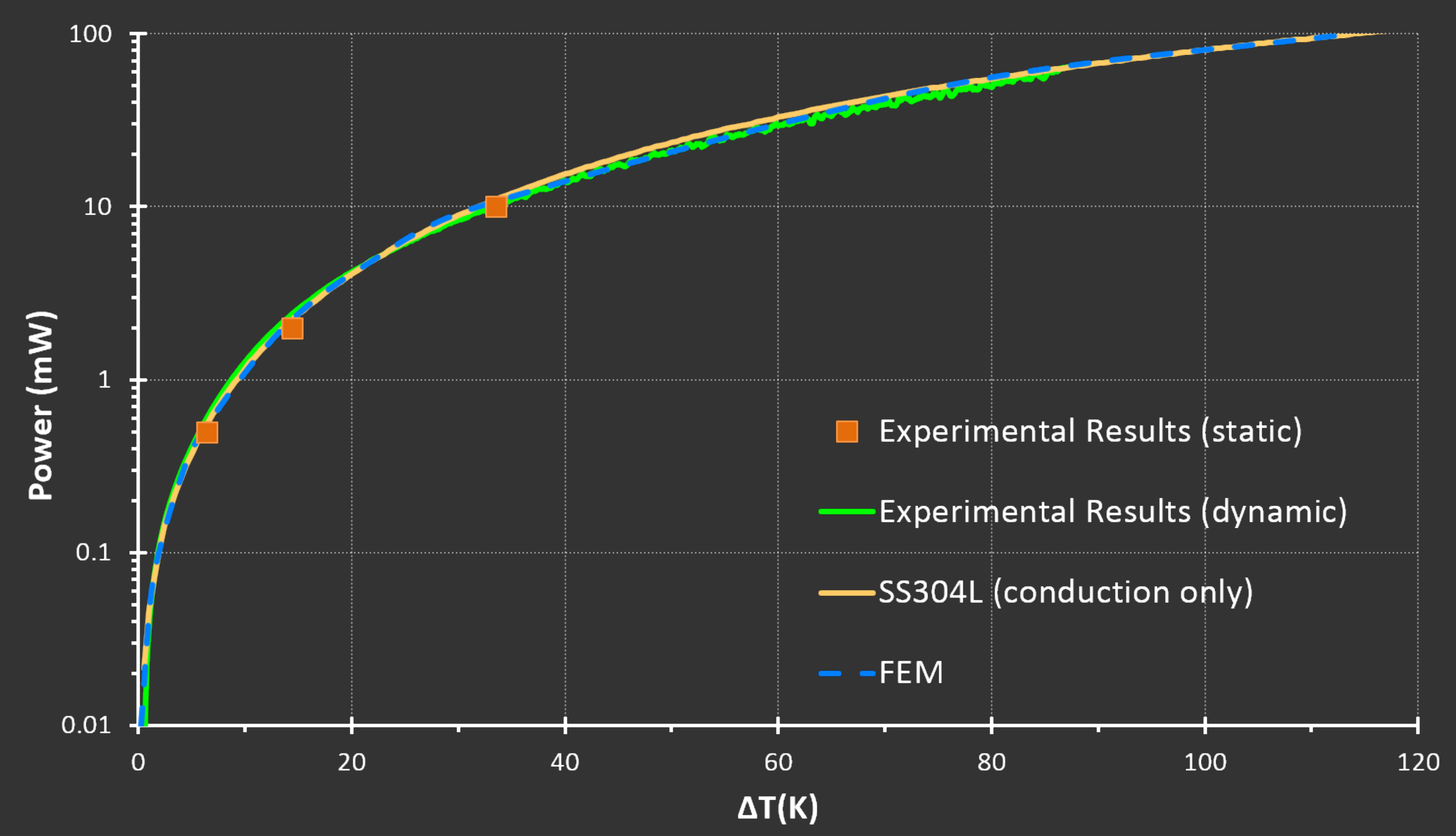


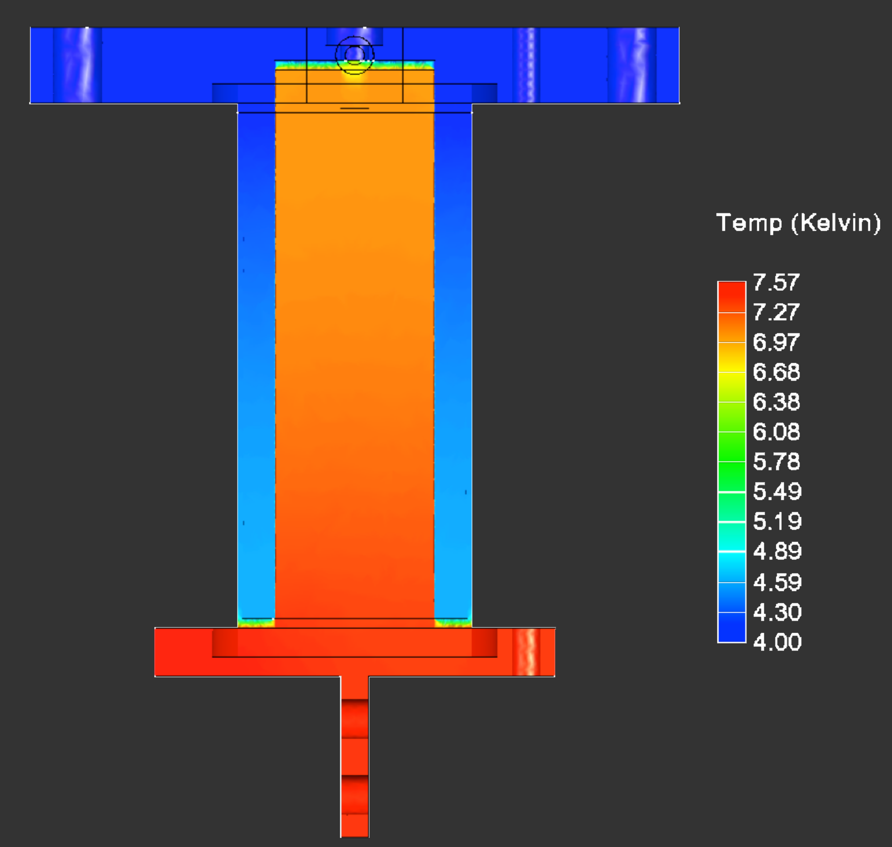
A pre-dimensioning thermal model was developed and the finite element method allowed us to validate it.



Experimental results at 4 K in the OFF and ON states. We obtained an OFF thermal conductance of 90 μW/K and for ON a value of 290 mW/K, using helium as the exchange gas. An ON/OFF ratio of 3200 was obtained.







Conclusions

A gas gap heat switch was designed, built, assembled and tested at 4 K upon the requirements established as per IUAC cryogen-free magnet properties setup.

The good agreement between the calculated and measured values enables a useful extrapolation for several and new applications, such as the one described in this document, where a completely cryogen-free magnet system is envisaged.

FACULDADE DE CIÊNCIAS E TECNOLOGIA UNIVERSIDADE NOVA DE LISBOA
LIBPhys-UNL
Inter-University Accelarator Centre

This work was supported by Fundação para a Ciência e Tecnologia (PTDC/EMS-PRO/1065/2012)