

# **Thermosyphon cryogenic system for RED-100 detector**

**A. V. Shakirov (MEPhI)  
Moscow**

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# The challenges for the cryostatting system

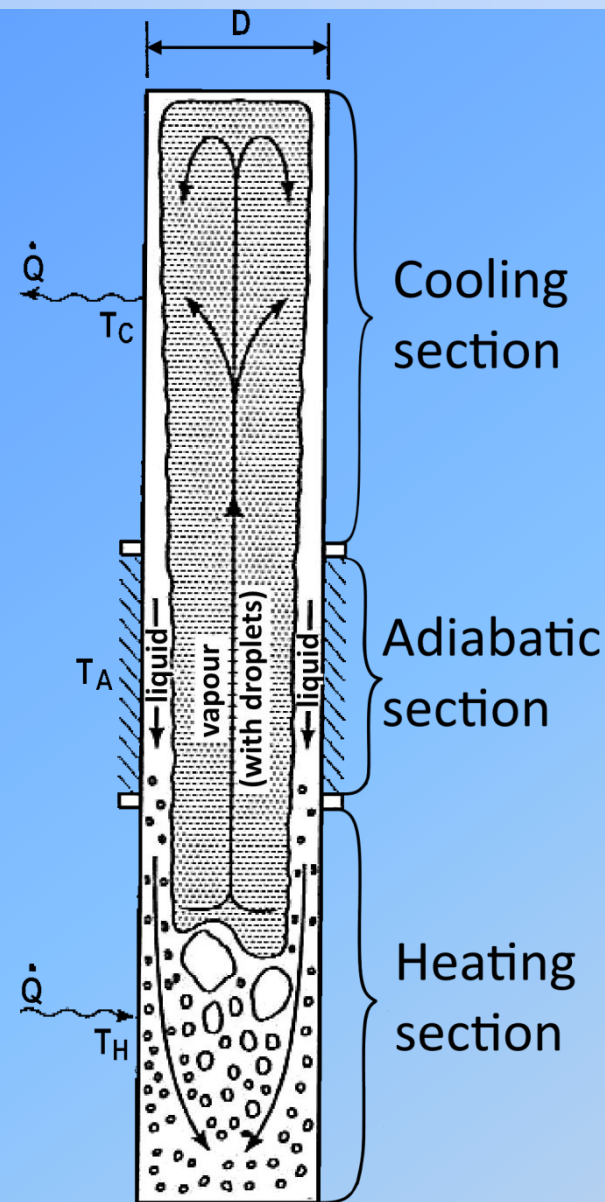
1. The detector should be placed inside a massive shield for providing low-background experiment
2. System should provide condensing of 200 kg of xenon and maintaining a stable temperature of the liquid with an accuracy of about 1K in the range of 160-170K during long time required for the experiment



The goal is to develop a powerful cryostatting system with most of the mass located at a distance and with the possibility of precise temperature control

**The thermosyphon technology meets the requirements**

# The principle of thermosyphon operation

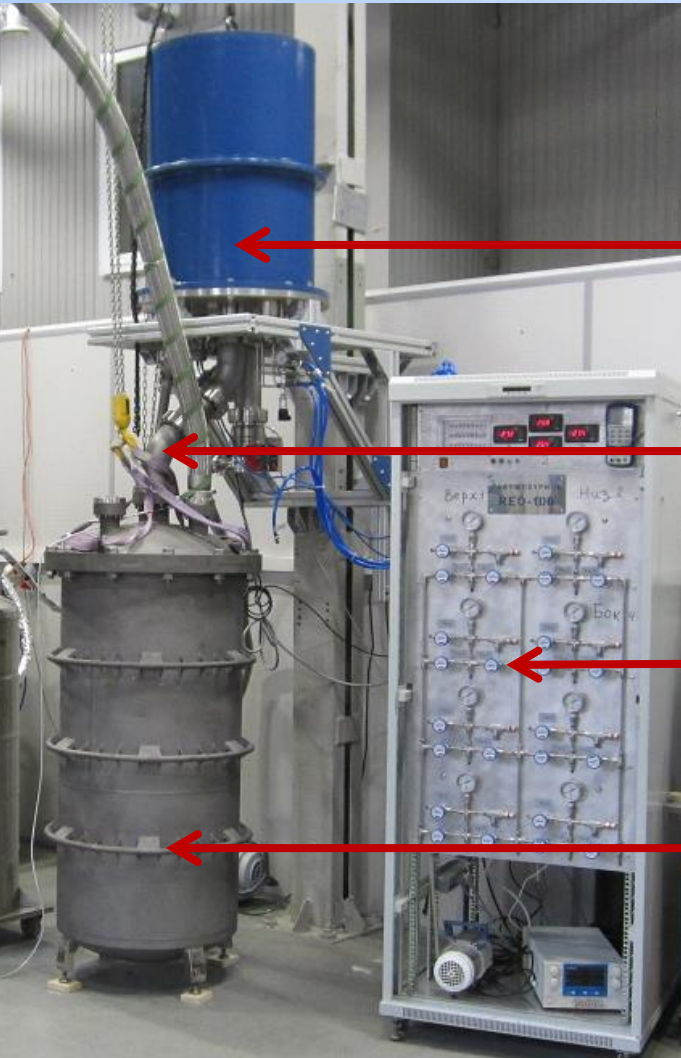


- A two-phase closed tubular thermosyphon is a device developed for transfer the large heat energies
- A heat exchange takes place along heat pipe by condensation and evaporation of  $N_2$  in the top and bottom parts of pipe
- The gravity division of the working substance in liquid and gaseous states is possible.

A thermosyphon or a gravity-assisted heat pipe consists of three basic sections:

1. A cooling section (condenser)
2. A passive adiabatic section connecting the two active sections
3. A heating section (evaporator)

# The cryostatting system

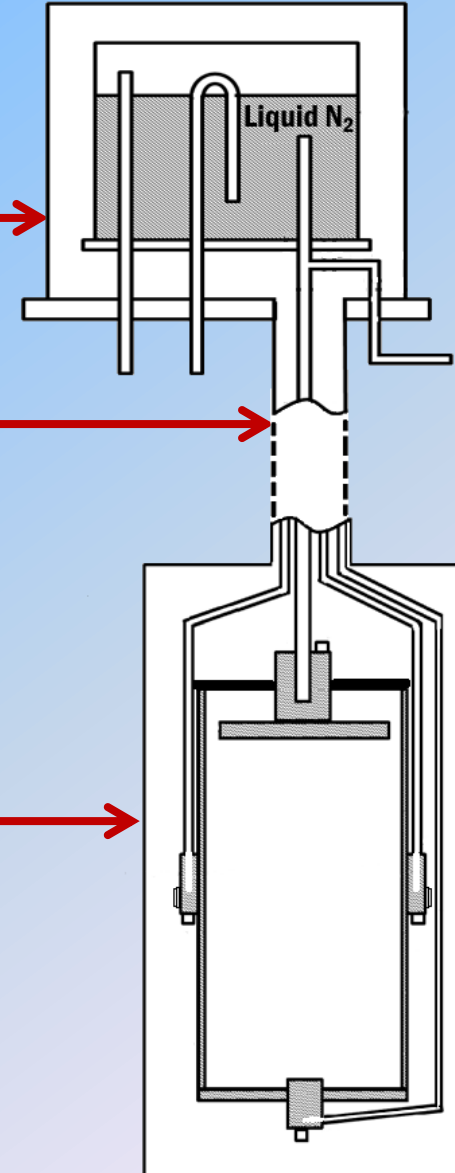


Dewar with liquid N<sub>2</sub>

Thermosyphon  
in metal hose

Control system

Titanium cryostat



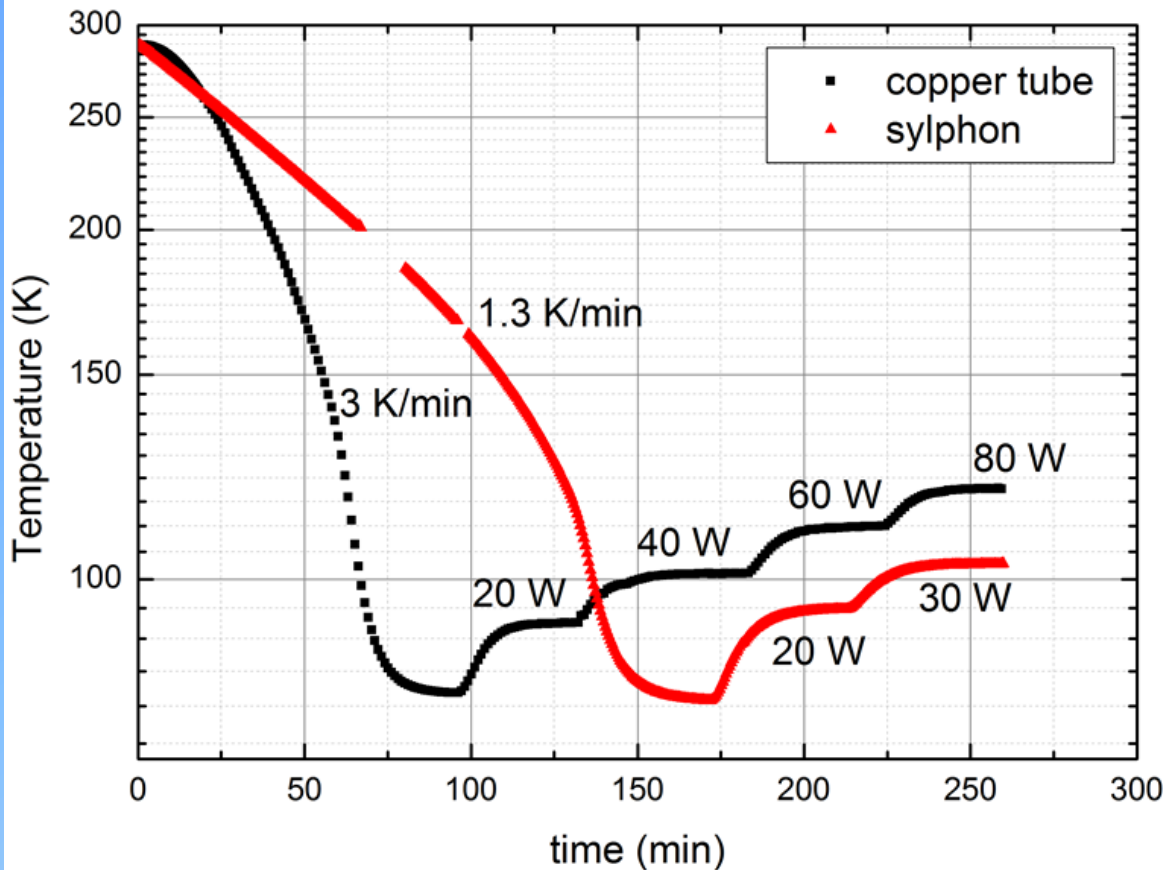


# Thermosyphon types and characteristics

- **Bellow flex hose thermosyphon**
- **Tubular thermosyphon made of copper pipe**

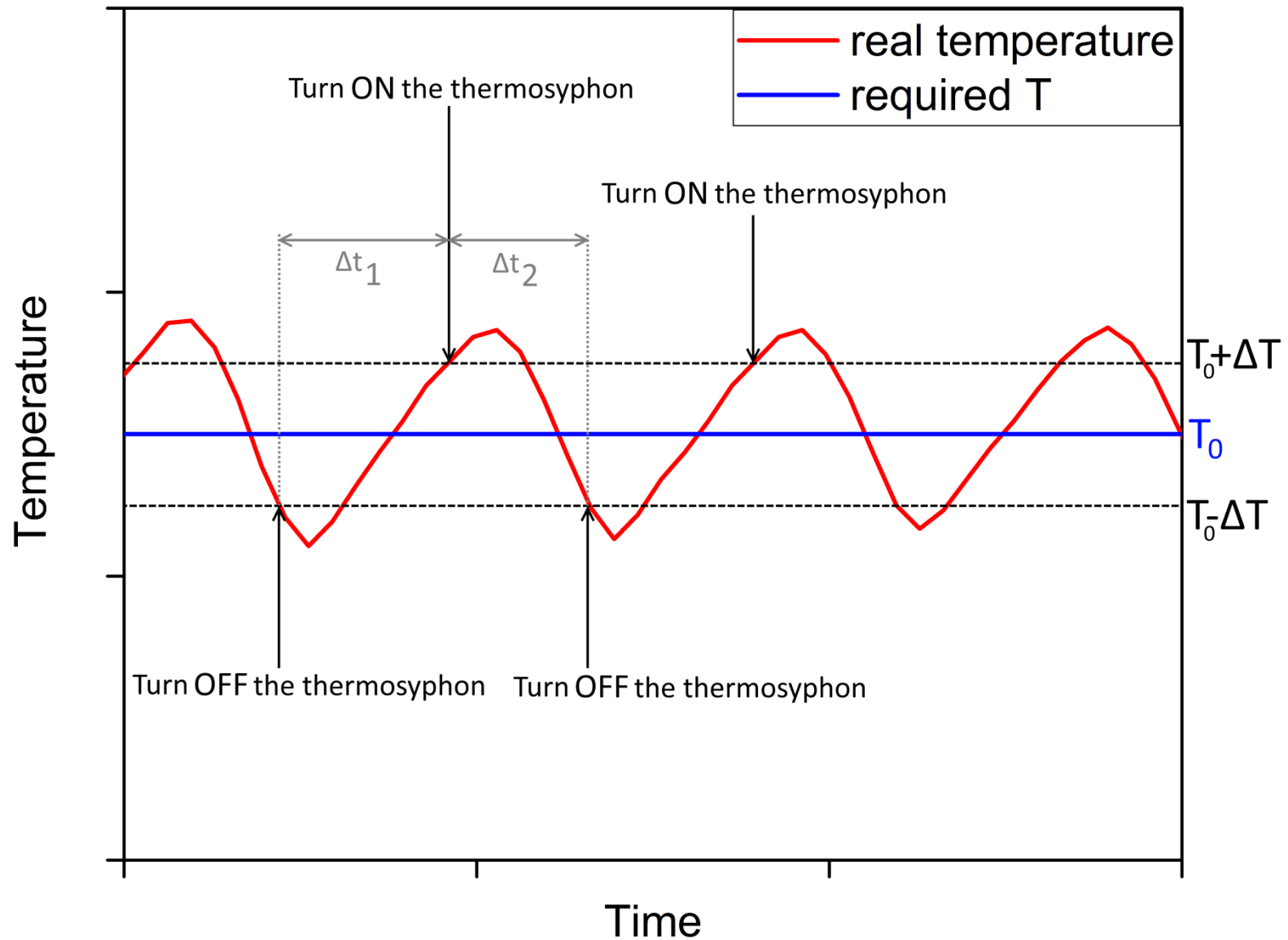
## The comparison of the two types of thermosyphon

	Copper pipe	Sylphon
Cooling rate	3 K/min	1.3 K/min
The heat transfer limit	100W	60W

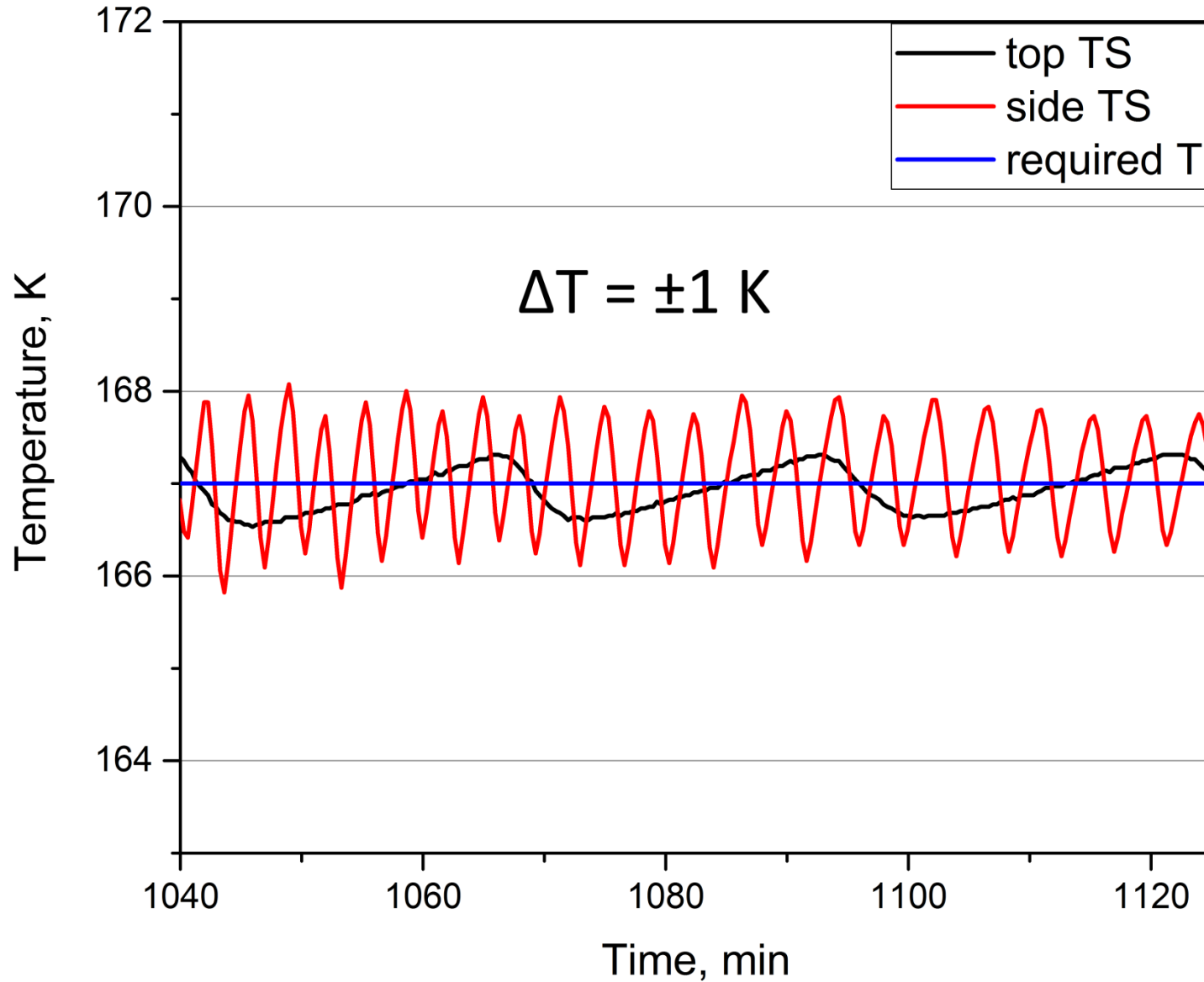


✓ Thermosyphon based on copper pipe is more powerful and should be used in experiment

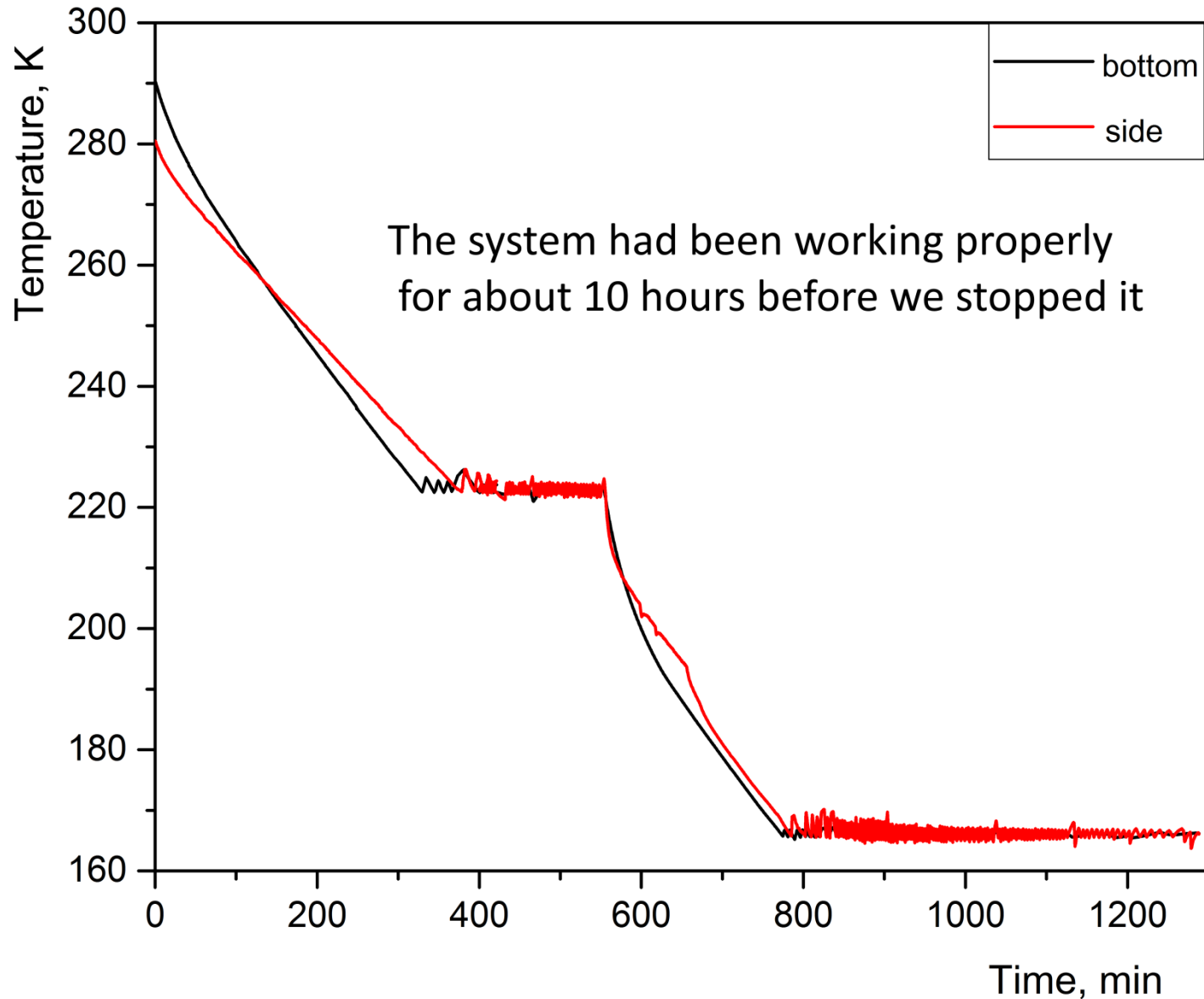
# Thermal stabilizing control system



# Thermal stabilization results



# Summary cooling and stabilization results





# Conclusions

- The cryogenic system based on closed two-phase thermosyphon using nitrogen as an active medium was developed
- This system provide thermal stabilization of the emission detector based on a liquid xenon at required temperature with an accuracy of 1K .
- Such a system may be used in the RED100 detector