

DE LA RECHERCHE À L'INDUSTRIE



OUT-OF-PILE TESTING OF THE CALIPSO IRRADIATION DEVICE FOR THE JULES HOROWITZ REACTOR

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1) DESCRIPTION OF CALIPSO

2) OPERATING PRINCIPLE

3) EXPERIMENTAL PROTOTYPE

4) RESULTS

DESCRIPTION OF CALIPSO



Samples



Electromagnetic pump

Head

Total length
6800 mm

Heat
exchanger

Electrical
heater

Zone with NaK
(L = 2700 mm)

ID 24 mm
OD 33 mm

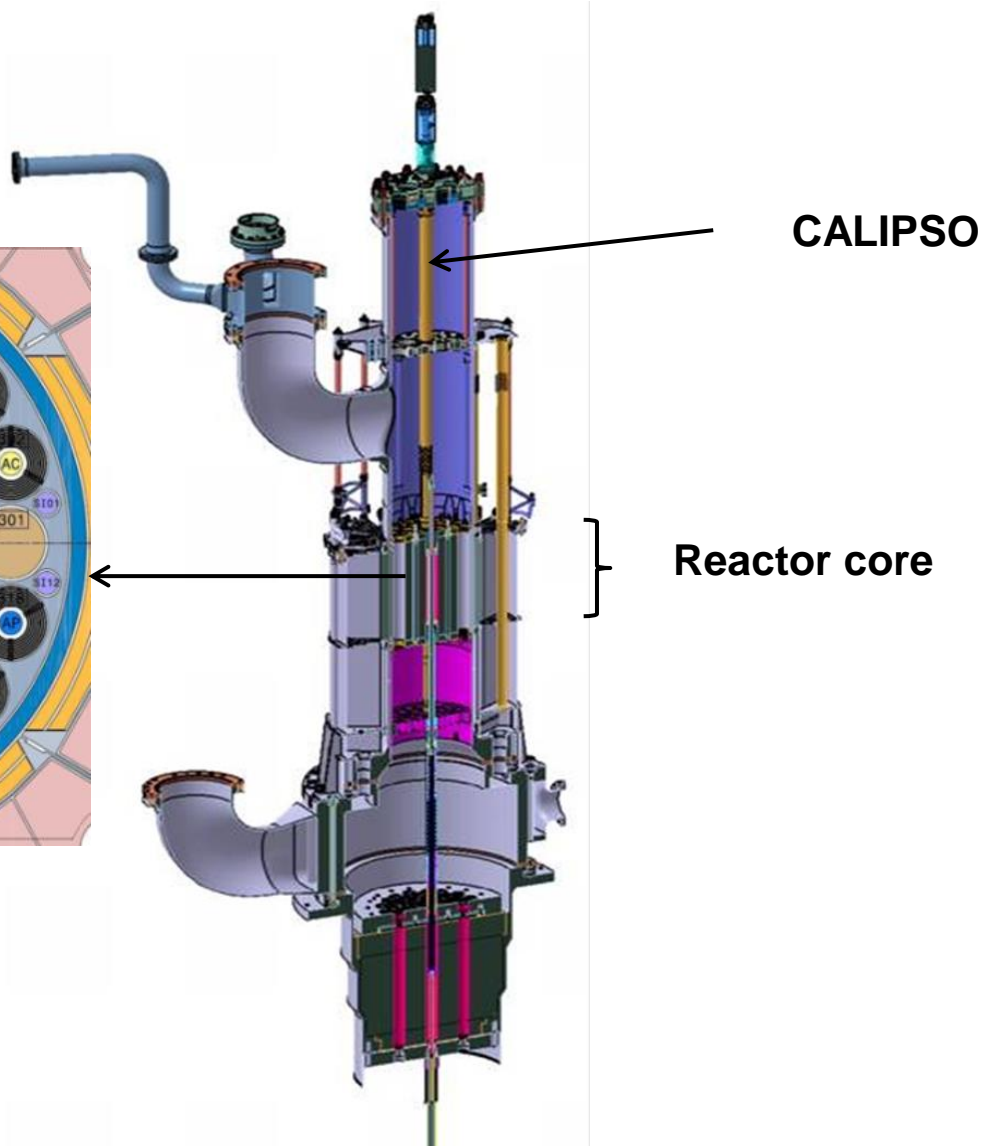


CALIPSO : In Core Advanced Loop for
Irradiation in Potassium Sodium

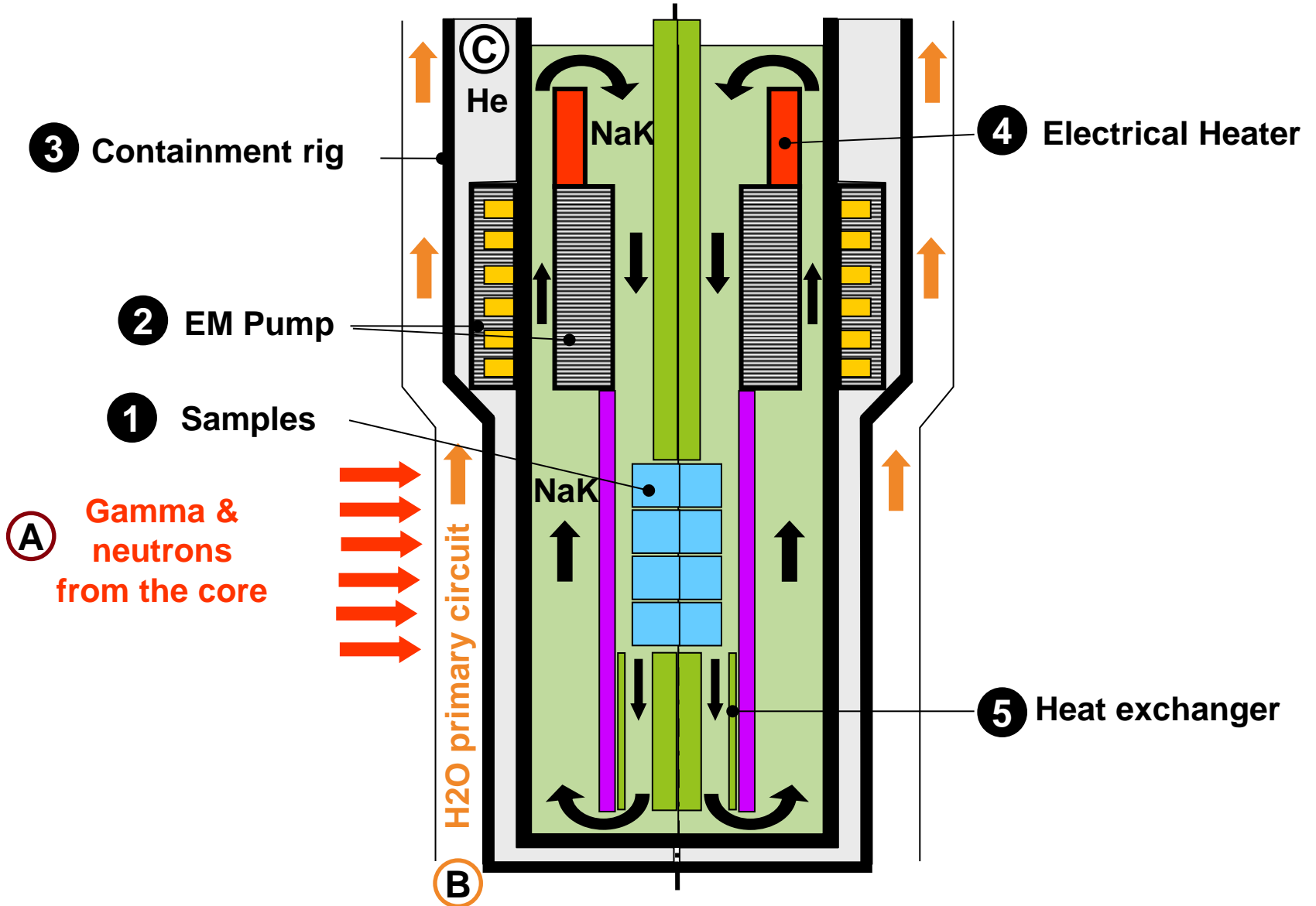
LOCATION IN THE JHR



Into the central hole of fuel elements



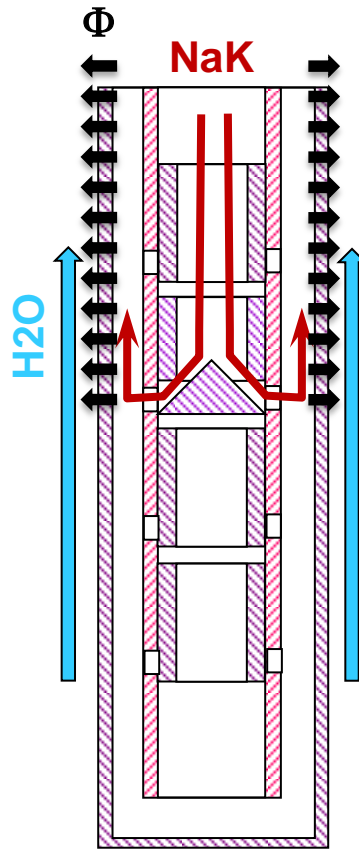
OPERATING PRINCIPLE OF CALIPSO



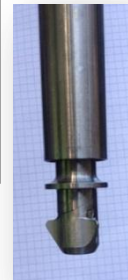
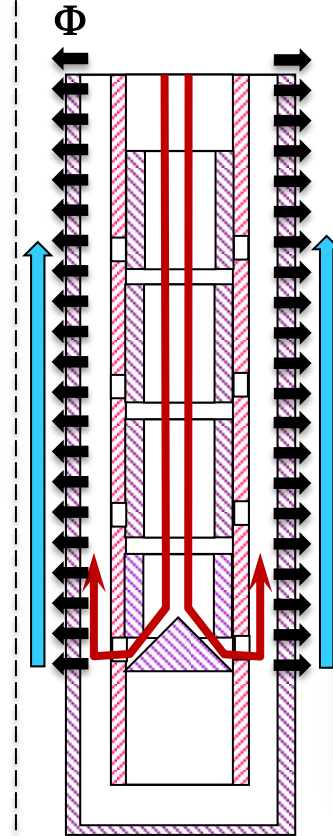
MODULAR HEAT EXCHANGER



upper flow reversal
=
lower heat loss

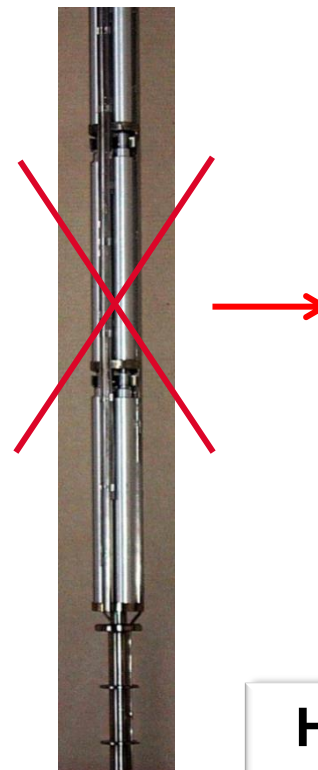
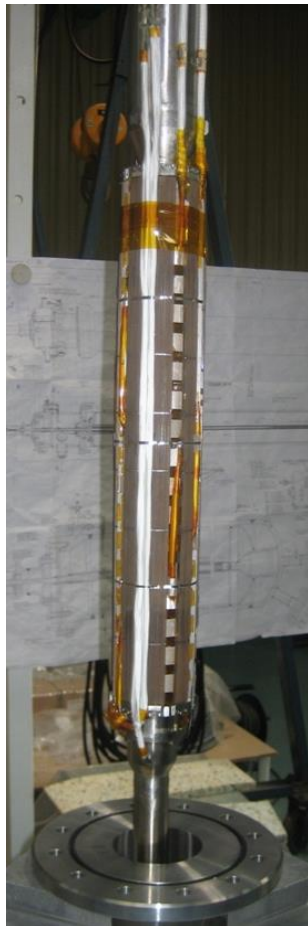


lower flow reversal
=
higher heat loss



Heat exchanger with 1 "U turn" module + 6 forward modules

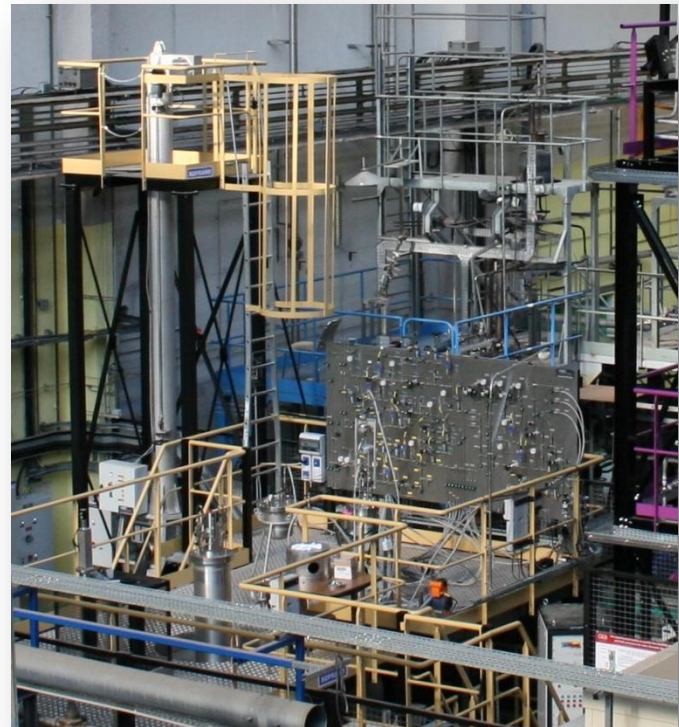
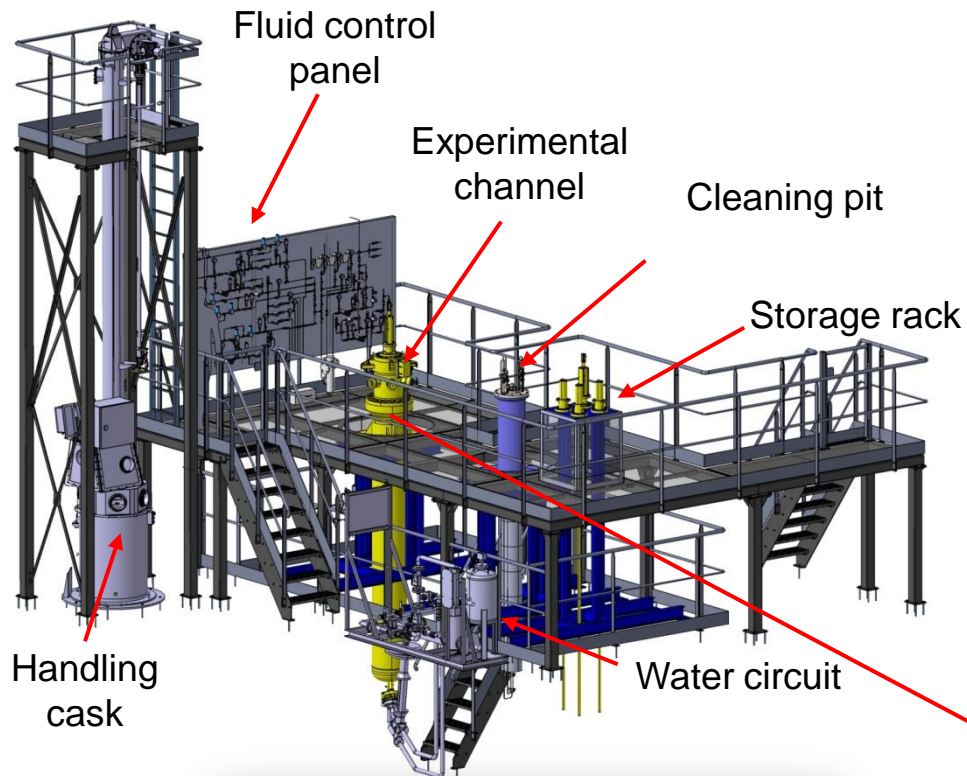
PROTOTYPE OF CALIPSO



EMP into the outer flask

Heating rod with TCs

THE SOPRANO OPERATING PLATFORM



TWO MAIN OBJECTIVES

1) CHARACTERIZATION OF THE EMP

- NaK differential pressure monitoring
- Setting the power supply of the pump
- Large range of NaK flowrate

2) EVALUATION OF THE THERMAL BEHAVIOR OF THE DEVICE

- Setting the power supply of each electrical heater
- Thermocouples
- Accurate monitoring of temperatures

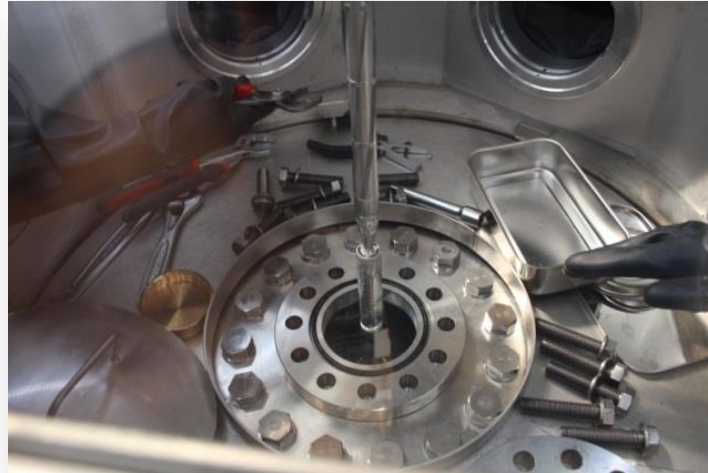
EXPERIMENTAL PROGRAM

**1st campaign
Sep.- Oct. 2013**



**Long-length
heat exchanger**

**2nd campaign
Jan.- Apr. 2014**



**Short-length
heat exchanger**

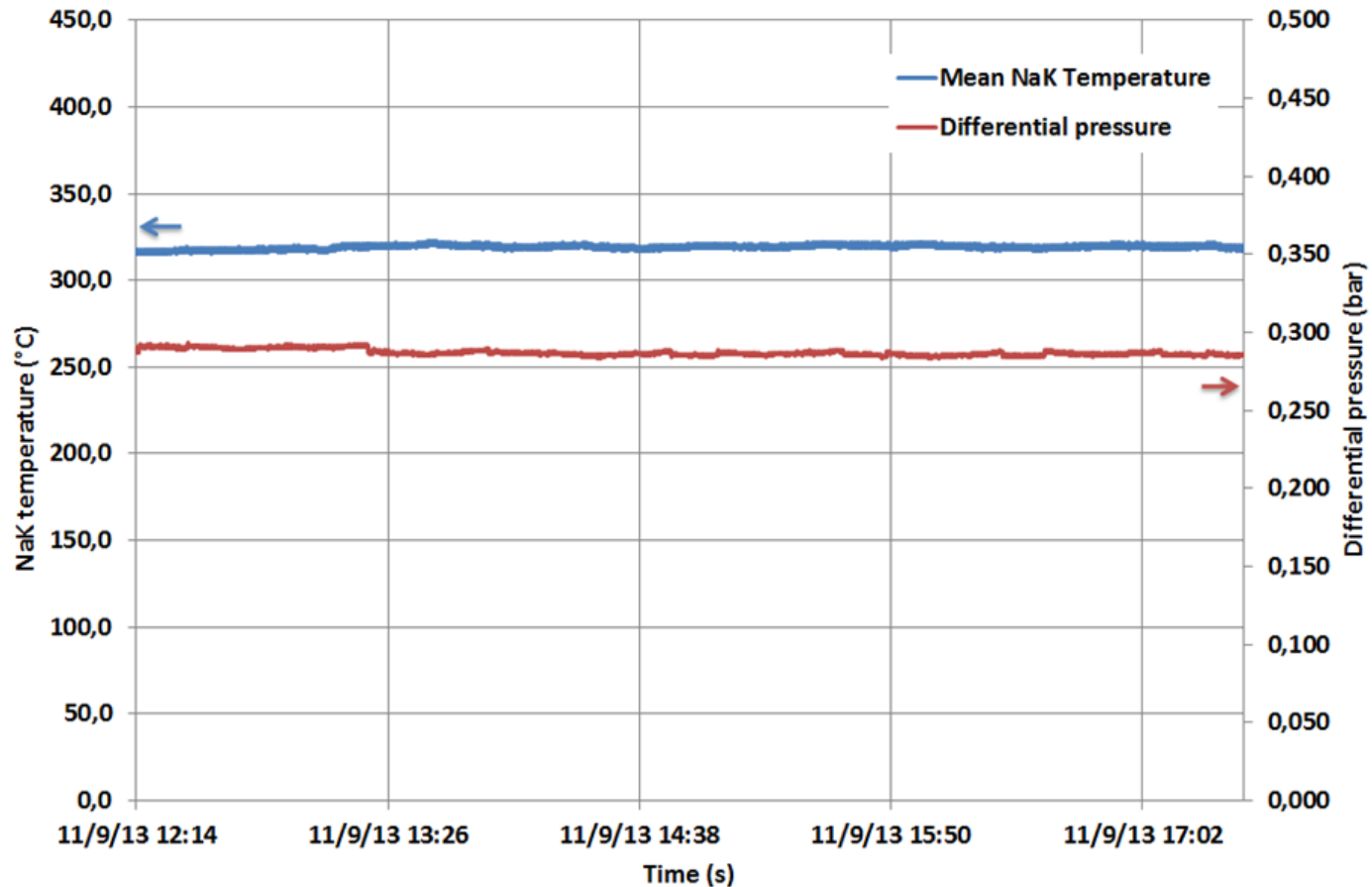
**3rd campaign
Oct.- Dec. 2014**



**Medium-length
heat exchanger**

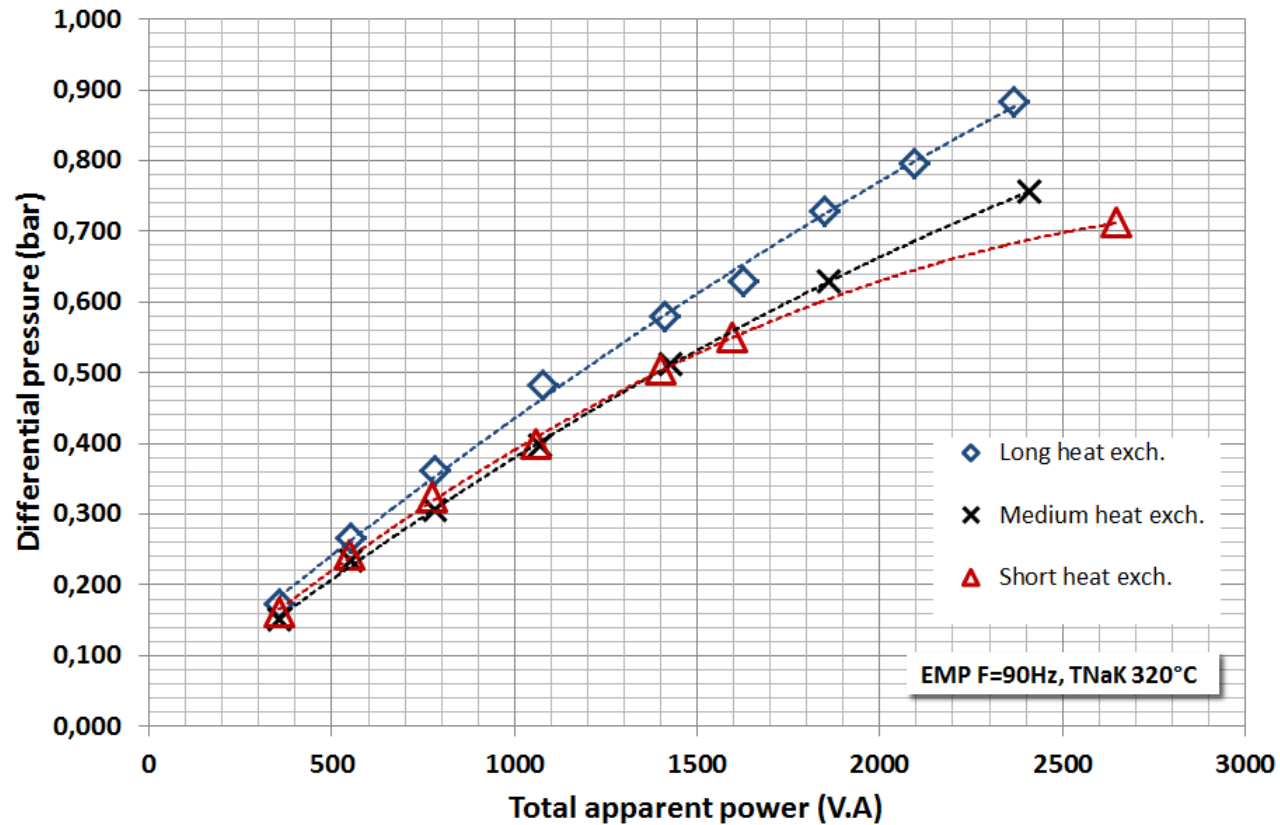


ELECTROMAGNETIC PUMP CHARACTERISTICS



Good time stability all along the campaigns

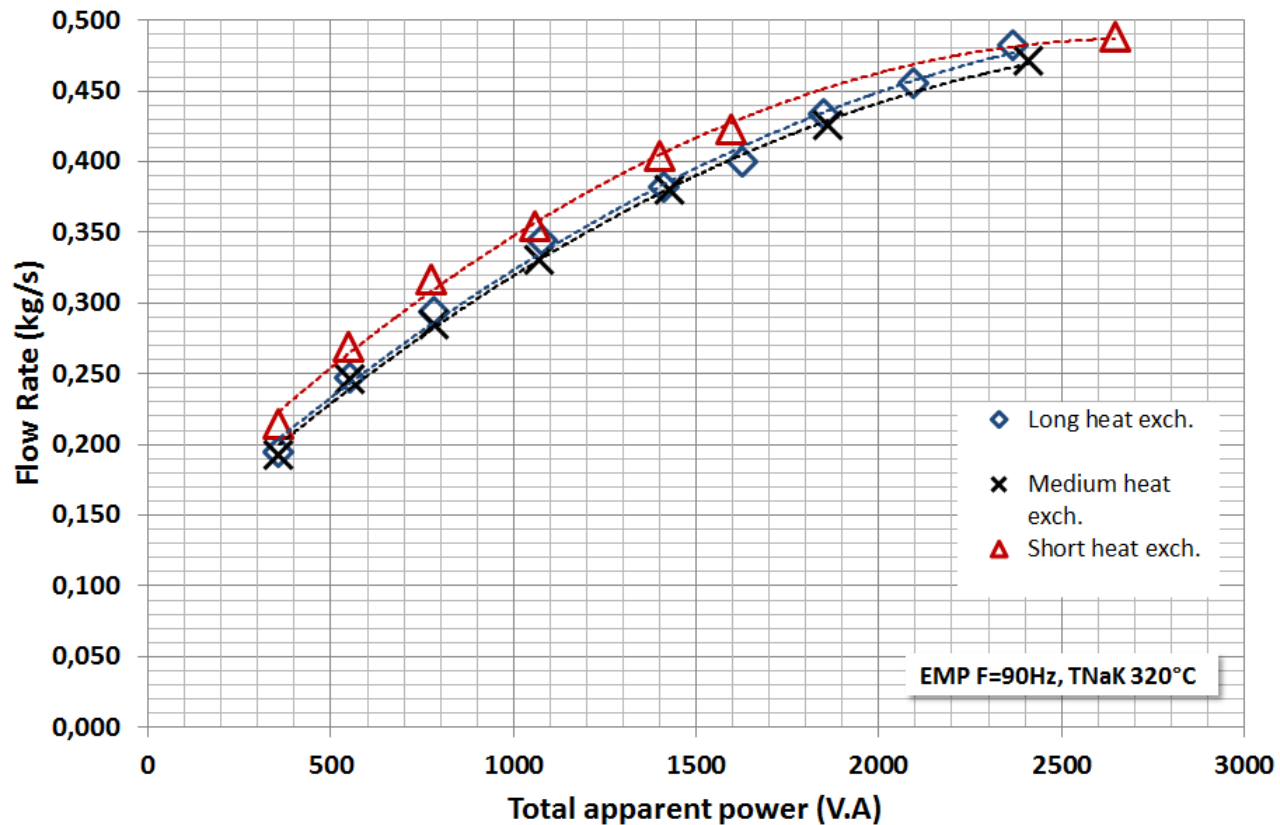
ELECTROMAGNETIC PUMP CHARACTERISTICS



Consistency of differential pressure measurements

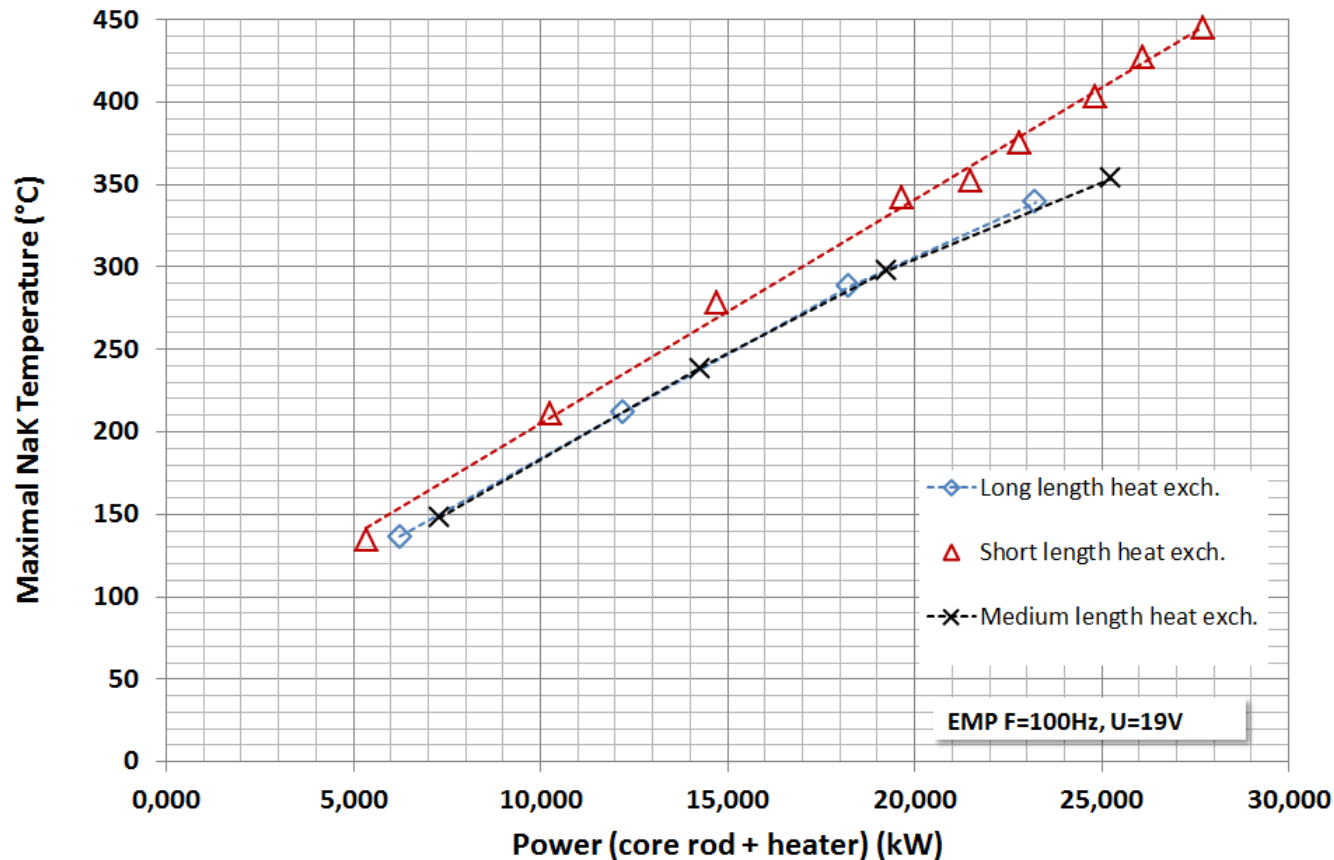
Max. value 0.9 bar

ELECTROMAGNETIC PUMP CHARACTERISTICS



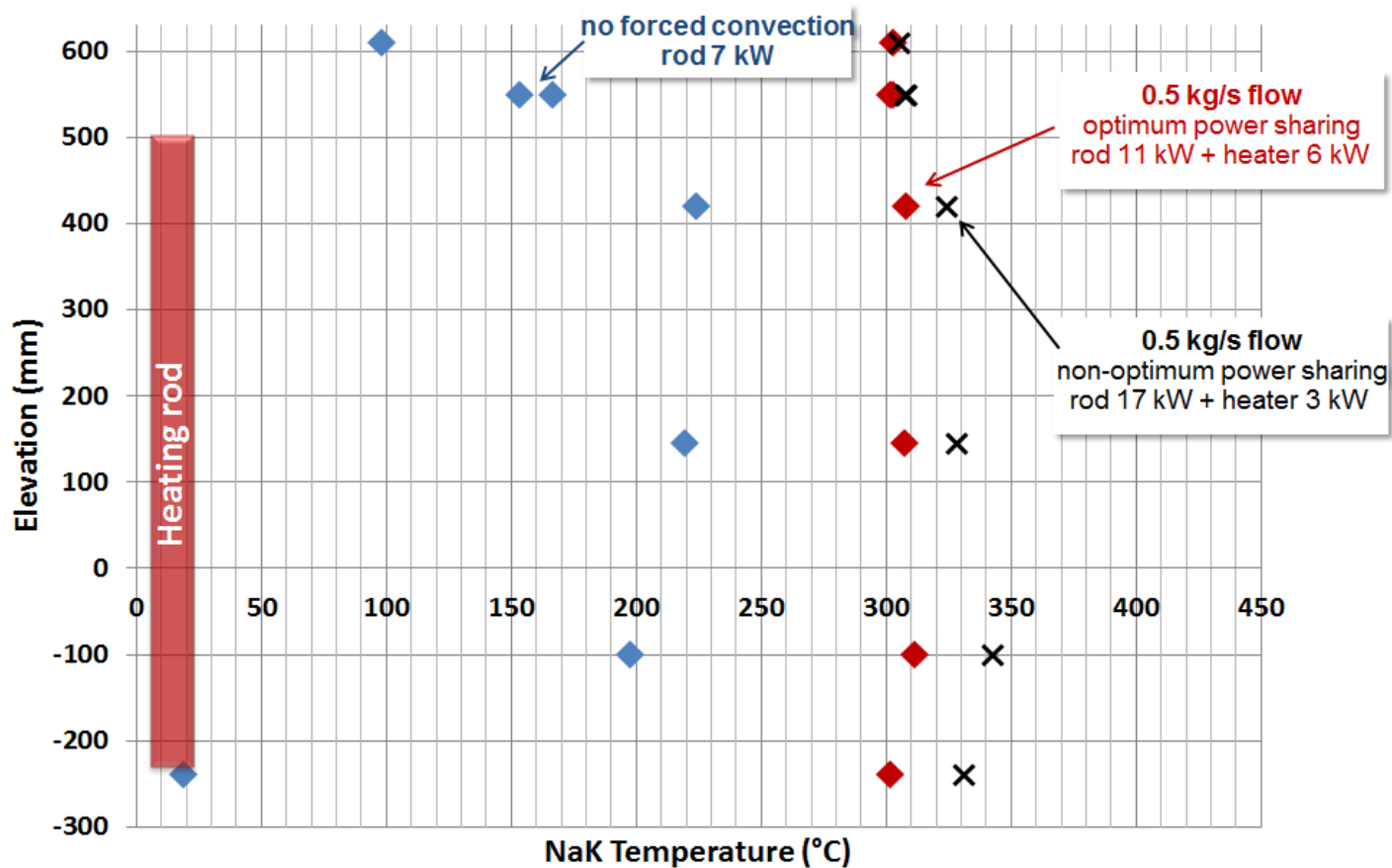
Flowrate evaluation based on CFD pressure drop calculations
Max. value 0.5 kg/s

THERMAL PERFORMANCES



Efficiency and consistency of the modular heat exchanger
Max. temperature 450°C

NAK TEMPERATURE PROFILE



Flat NaK temperature profile in the sample zone
Optimum power sharing : 1/3 elec. heater and 2/3 heating rod

RESULTS ARE CONSISTENT WITH THE EXPECTED VALUES

- Max. flowrate 0.5 kg/s
- Max. temperature 450°C
- Flat NaK temperature profile

THE DESIGN OF CALIPSO IS VALIDATED

- To perform irradiation of material samples
- With accurate control of the coolant temperature conditions
- Over a large range of heating power

FUTURE WORK

- Experimental : component reliability under long operating time
- Design : feedback form the manufacturing and the testing of the CALIPSO prototype

Thank you for your attention

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