JOINT INSTITUTE FOR NUCLEAR RESEARCH
Veksler and Baldin Laboratory of High Energy Physics

FINAL REPORT ON THE INTEREST PROGRAMME

Simulation of the cooling system for the RACK cabinet

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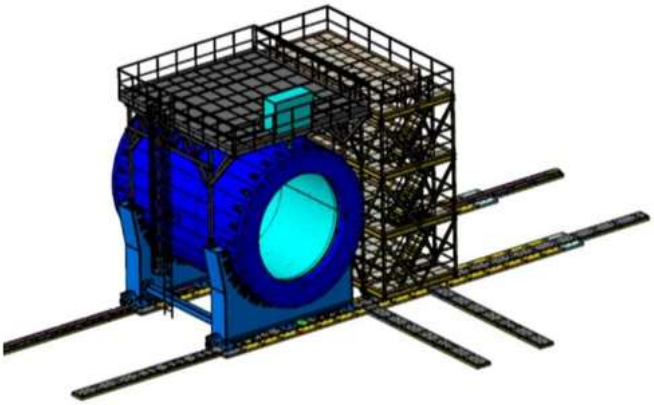
Abstract

NICA-MPD-Platform Rack Cabinet houses temperature sensitive equipment. In order to provide with high quality data, excellence in thermostabilisation requirments must be performed. A Printed Circuit Base heat transfer simulation has been performed in order to asses heat transfer properties of the design and offer a good understanding of the temperature distribution in such layouts. Moreover, a simplified cooling system for the easy3000 CAEN· power supply solution for operation in magnetic field and radioactive environment, has been designed.

Introduction

NICA (**N**uclotron-based **I**on **C**ollider f**A**cility) is an accelerator complex designed at the Joint Institute for Nuclear Research (Dubna, Russia). Its main goal is to study properties of dense baryonic matter.

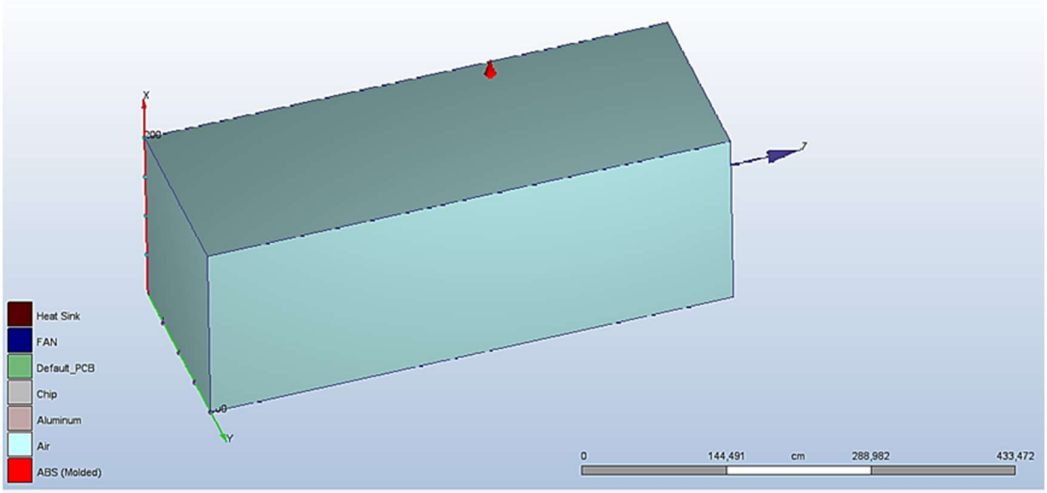
Picture 1: Schematic view of the NICA complex.



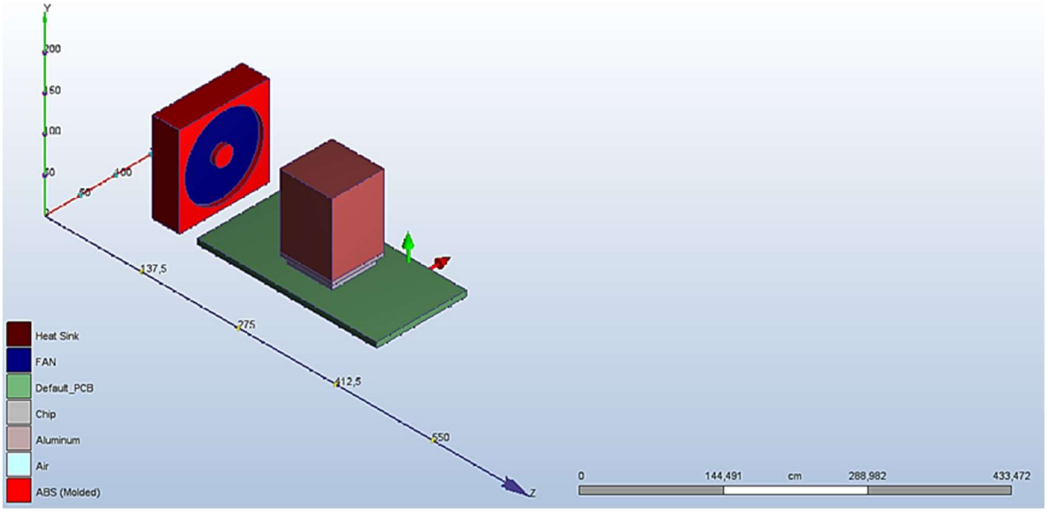
Picture 2: Multi Purpose Detector (blue) and the Rack Platform

Printed Circuit Heat Transfer Simulation

The design of the PCB was created in Autodesk Inventor Professional 2021 and the Simulation was conducted in Autodesk CFD 2021.



Picture 3: The environment volume of the PCB.



Picture 4: The 3D module in CFD.

Materials

Heat Sink

- Type: Heat Sink
- Name: Heat Sink
- Approach Surface: 15
- Base Surface: 11

Heat Sink Base

- Type: Solid
- Name: Aluminum
- Environment: Fixed

Fan Blades

- Type: Internal Fan/Pump
- Name: FAN
- Flow Direction: 0,0,1 (Global Z)

Fan Case

- Type: Solid
- Name: ABS (Molded)
- Environment: Fixed

PCB

- Type: Printed Circuit Boards
- Name: Default_PCB

Air

- Type: Fluid
- Name: Air
- Environment: Variable

Chip

- Type: Solid
- Name: Silicone

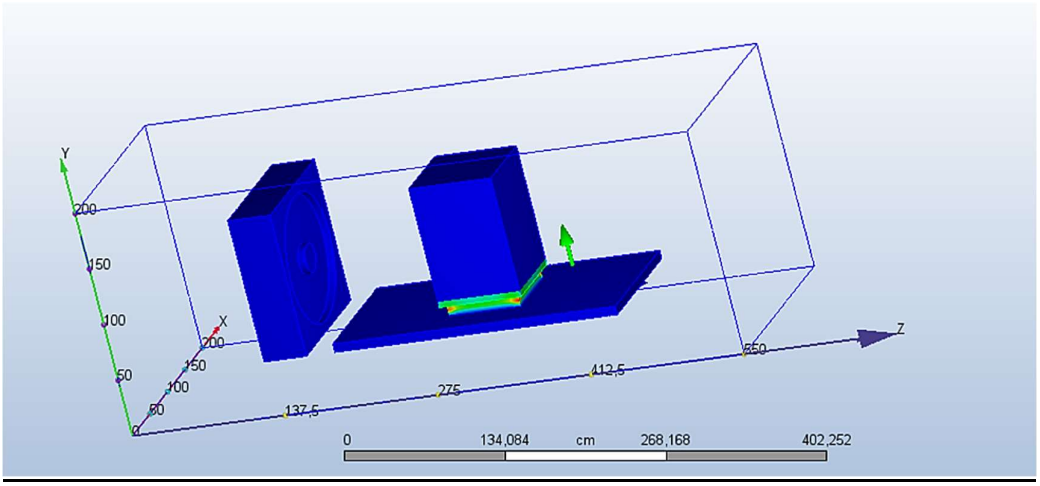
Boundary Conditions

- The Total Heat Generation from the Chip is 20W.
- The temperature at the back side of the fan and at the four bigger sides is zero.
- The pressure at the two smaller sides is zero.

External Volume

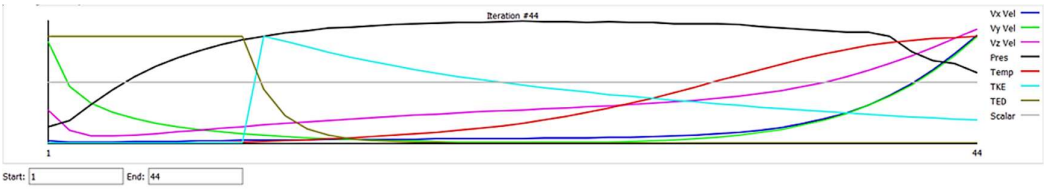
External volume

X Offset	-57,5483
Y Offset	80,4189
Z Offset	-82,2372
X Length	220
Y Length	220
Z Length	605
+X Angle	0
+Y Angle	0
+Z Angle	0



Picture 5: Snapshot S22 of the simulation.

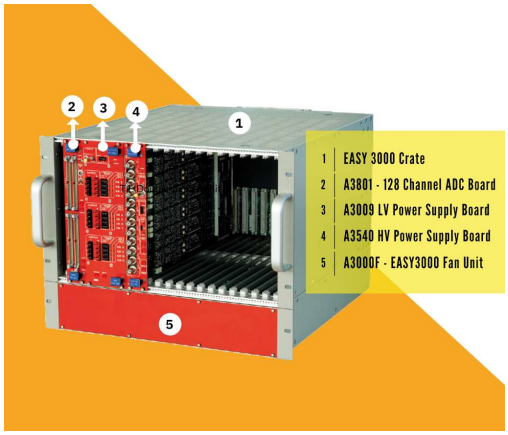
Due to a computer server problem, the simulation could not run properly so there is no complete analysis of the temperature distribution.



Picture 6: Plot of the simulation.

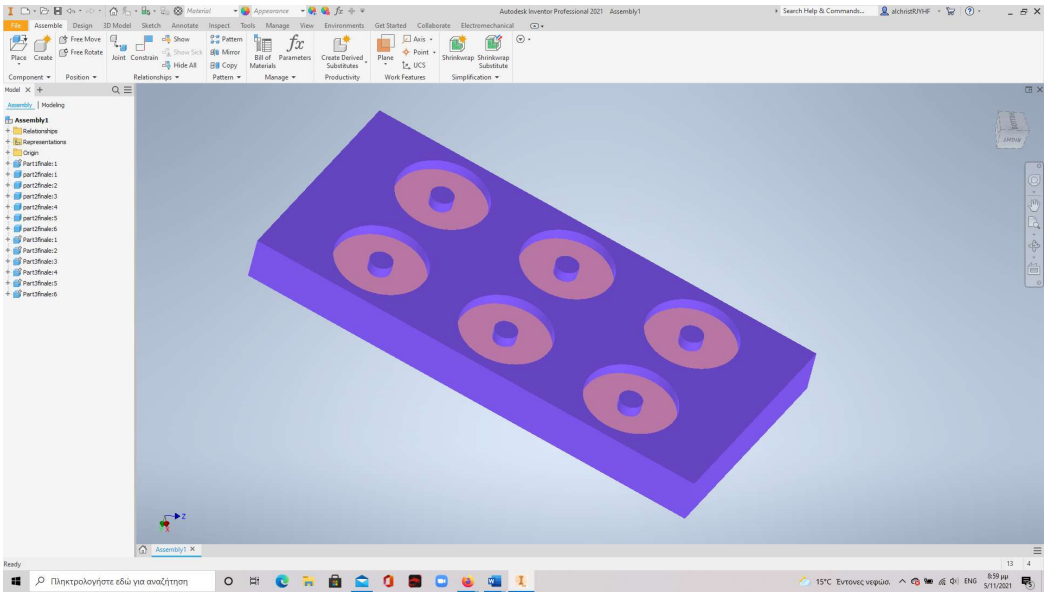
Easy3000 cooling unit

EASY3000 (Embedded Assembly SYstem) is a power supply solution, able to operate in magnetic field and radioactive environment.



Picture 7: Photo of easy3000.

The cooling unit of easy3000 consists of six fans. The dimensions are assumed so the are not mentioned. The following 3D model has been designed in Autodesk CFD Inventor 2021.



Picture 8: Simplified model of easy3000 fan unit, designed in Inventor.

References

- https://knowledge.autodesk.com/support/cfd/learn-explore/caas/CloudHelp/cloudhelp/2019/ENU/SimCFD-UsersGuide/files/GUID-CA55BFDB-B6BE-4F24-90C4-4E9C56367E4C-htm.html
- https://www.caen.it/products/easy3000/
- https://nica.jinr.ru/