



# Study of the Micro Oven for the Linac3 Heavy Ion Source

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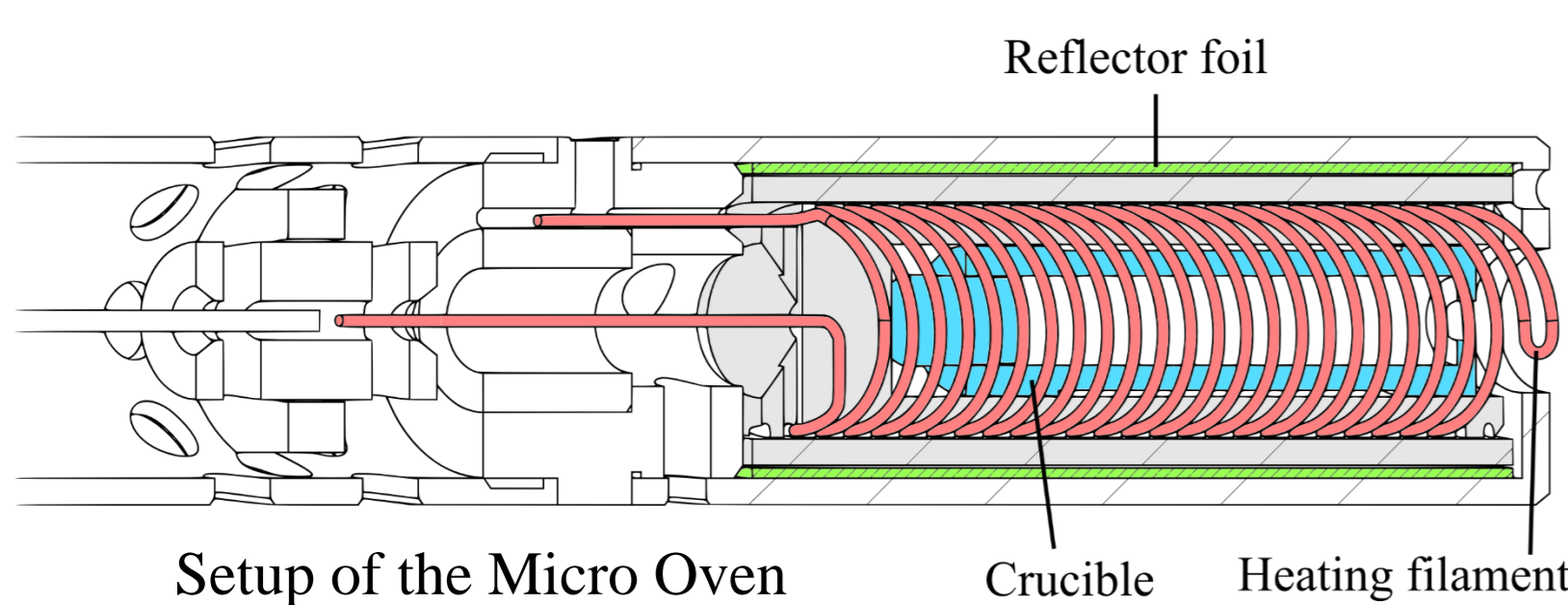


## Introduction

Ovens at the GTS-LHC ECR ion source show instabilities and do not evaporate all lead in the crucibles.

➔ A dedicated study shall help to improve the oven performance.

## The GTS-LHC Micro Oven

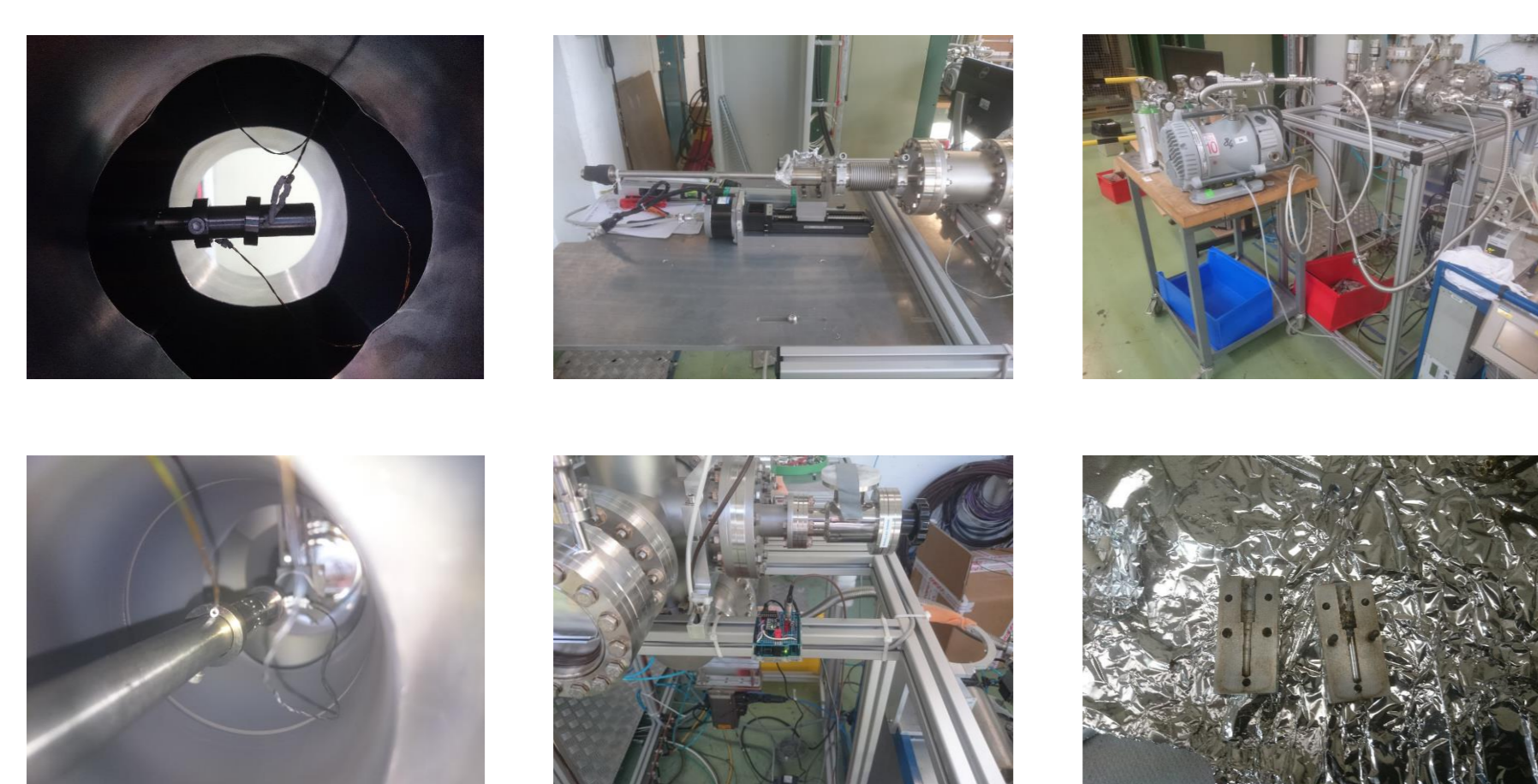
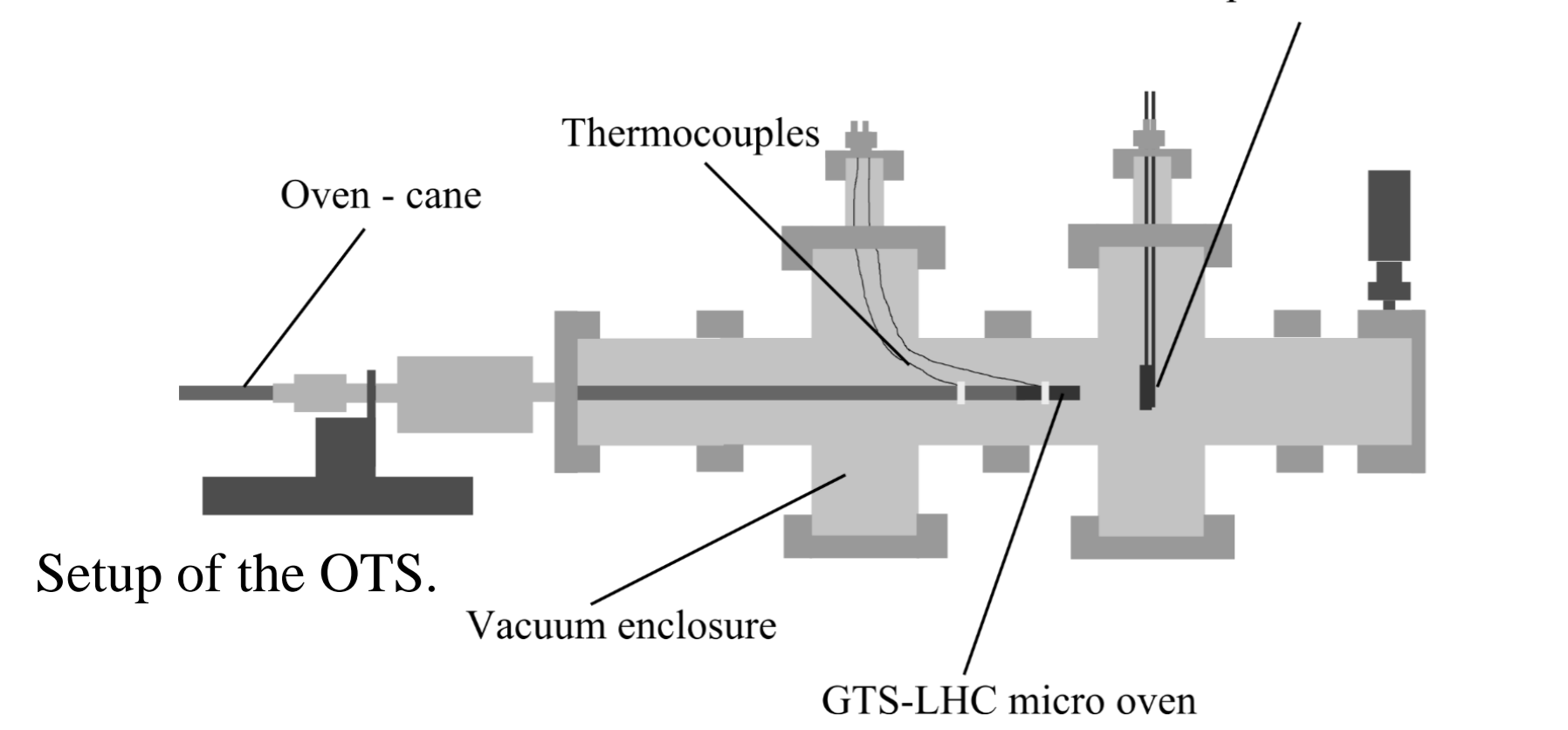
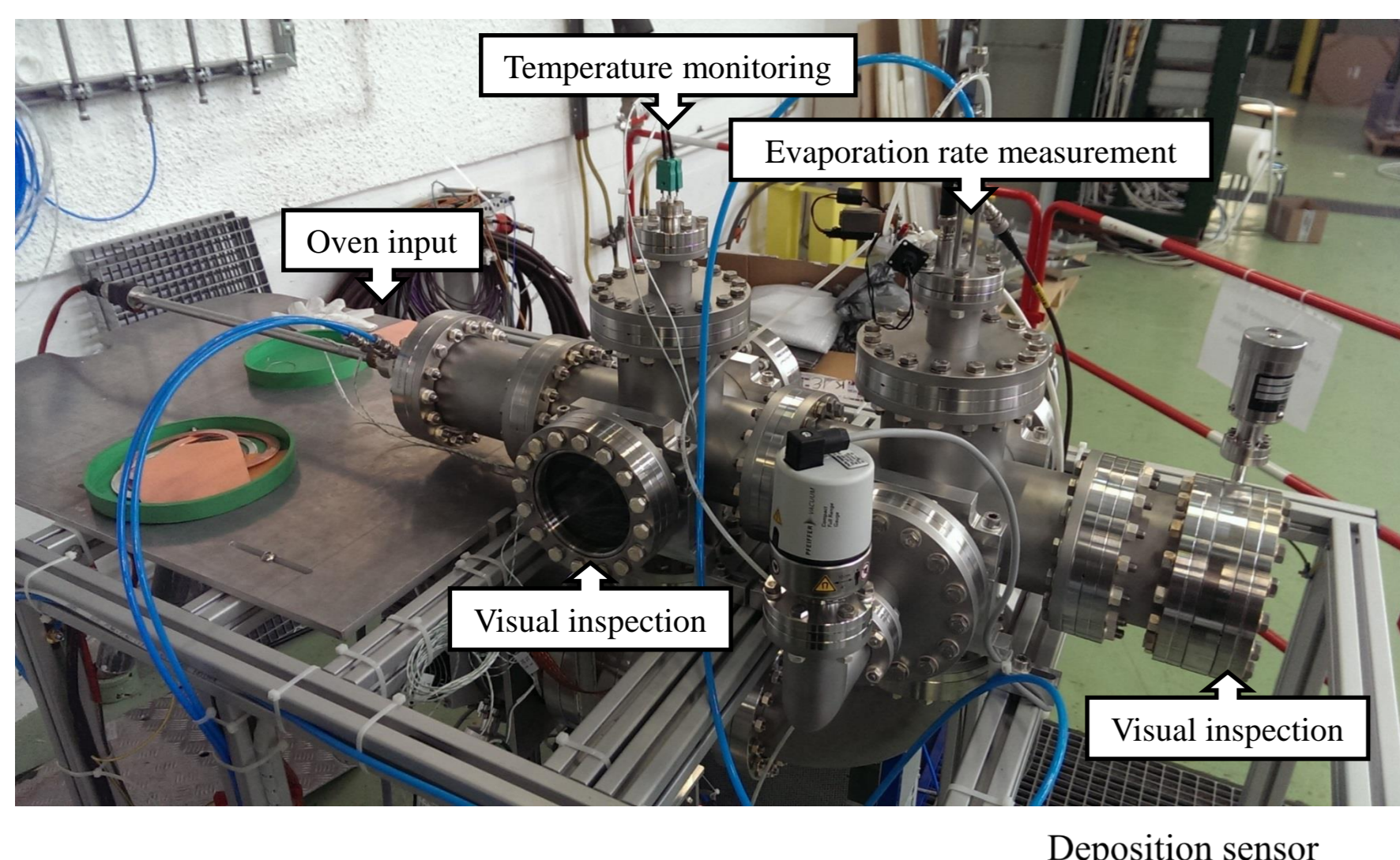


- Lead for evaporation is inside a manually filled crucible.
- Resistively heated with a tantalum filament wound as a double helix.
- Outside layers help to insulate and distribute heat evenly over crucible.

### Problems :

1. The oven seems to be a source of instabilities in the GTS-LHC ion source.
2. Crucible needs to be refilled even though there is still lead inside.

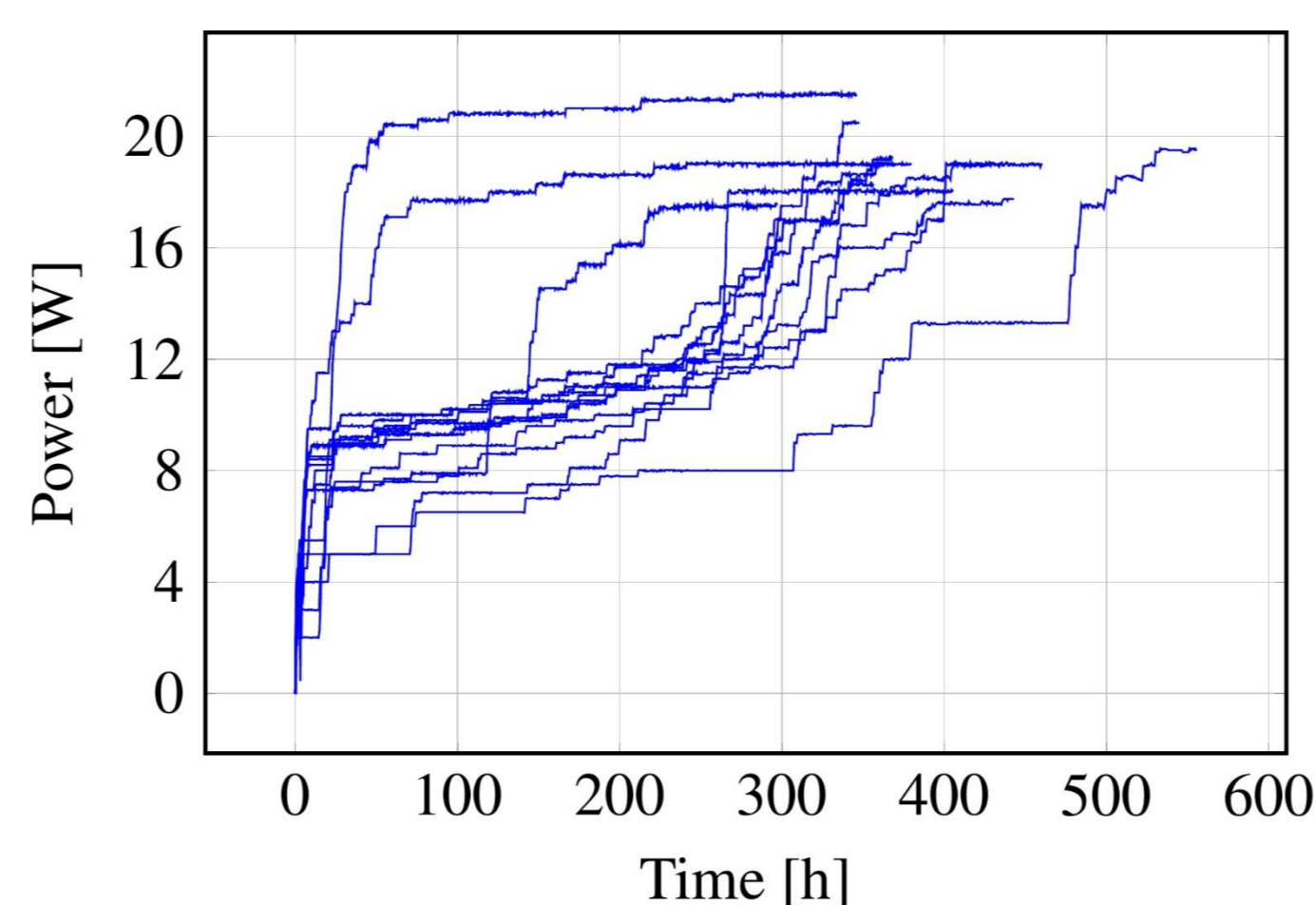
## The Oven Test Stand (OTS)



## Operation Simulation at the OTS

- Lead evaporation rate of oven in GTS-LHC ion source is unknown.
- Oven power is tuned by ion source operator to maintain a stable ion beam output.

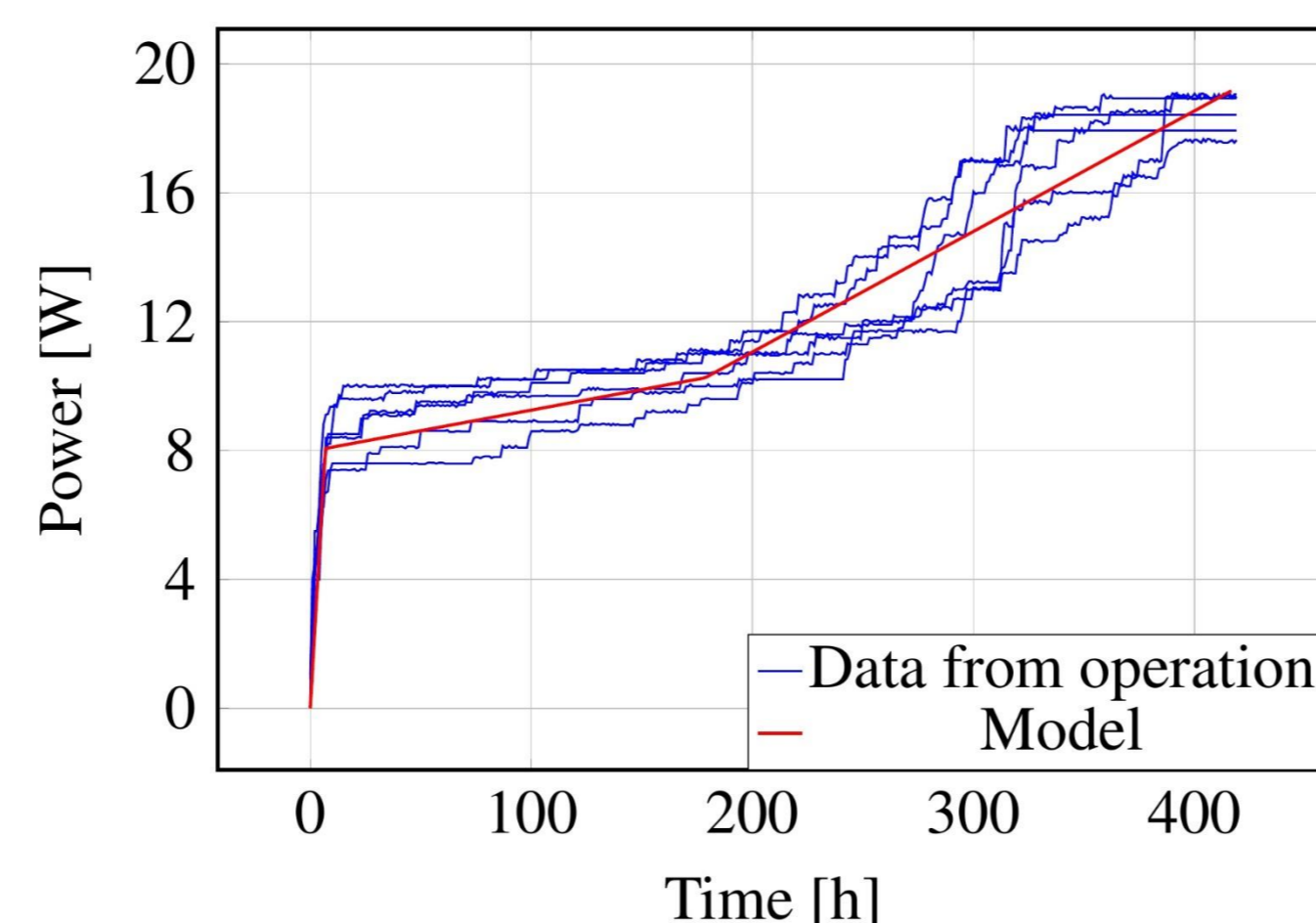
**Needed :** Power-time curve that resembles oven power at the GTS-LHC source during typical operations.



Power-time relation of individual oven runs at the GTS-LHC ion source in 2016 with each representing one crucible filling.



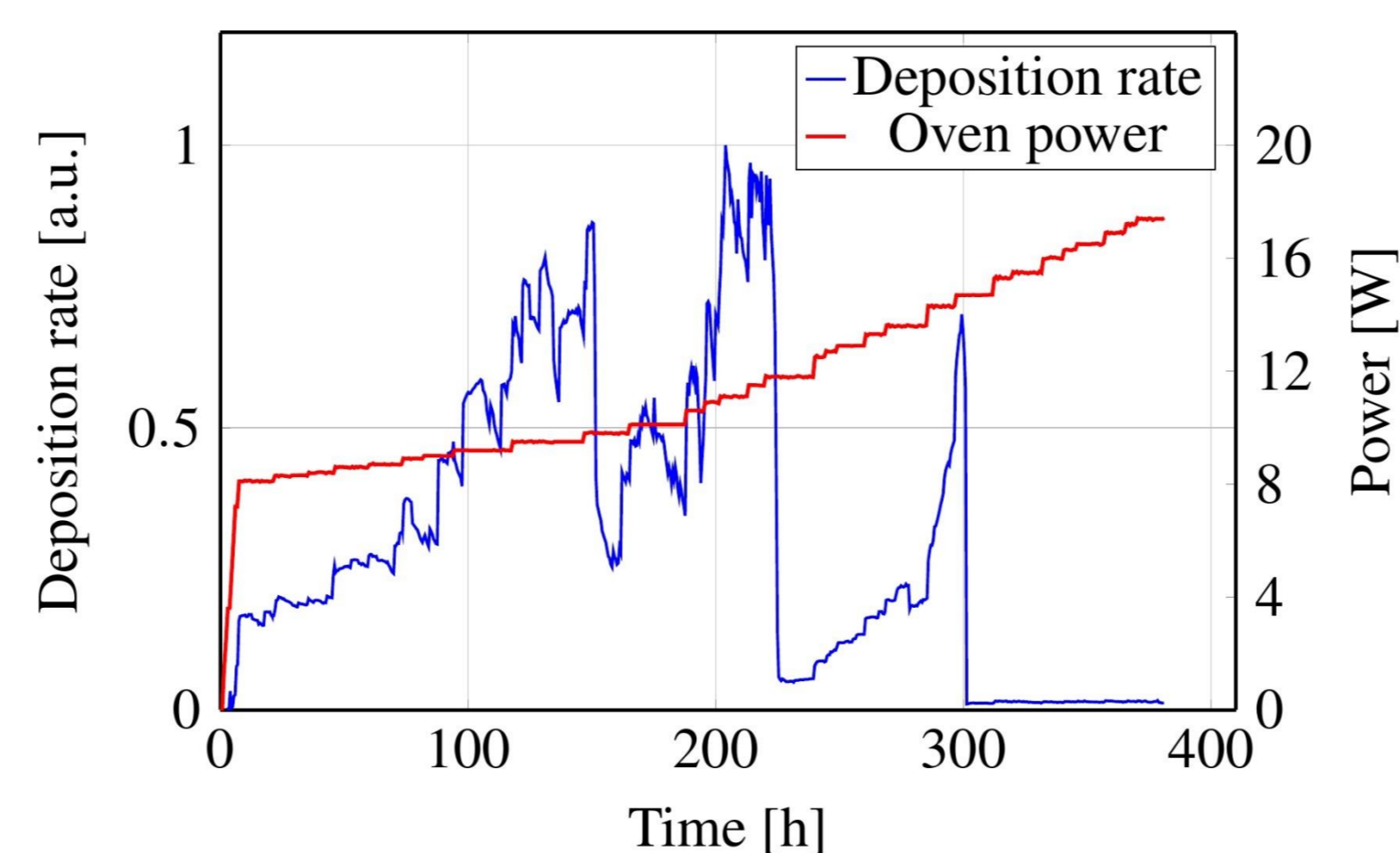
Select typical runs to apply model.



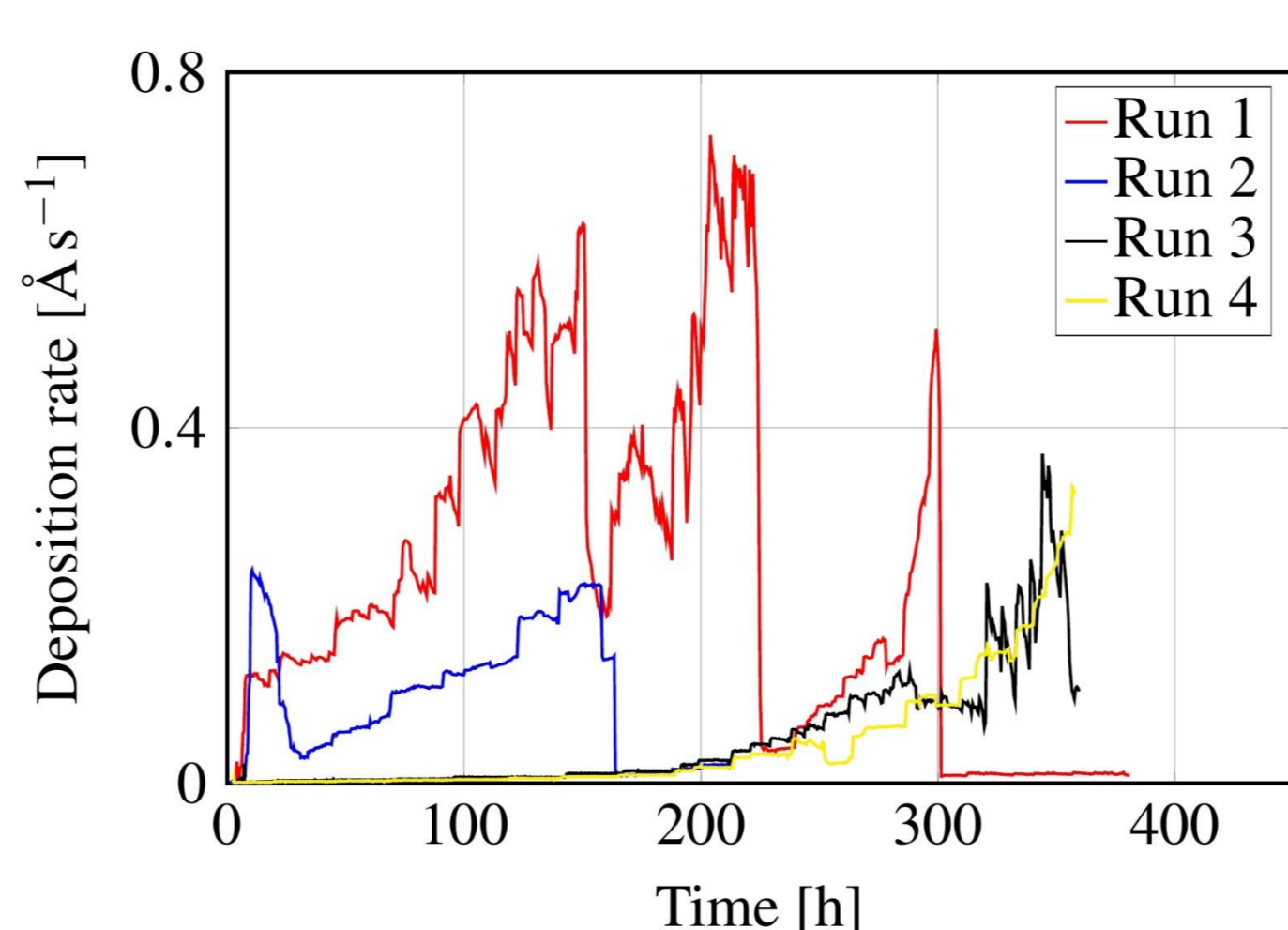
Plot of the selected power-time relation curves from individual fills and a fitted model consisting of a piecewise linear function with three different slopes.



Use model at OTS to characterize lead gas output.



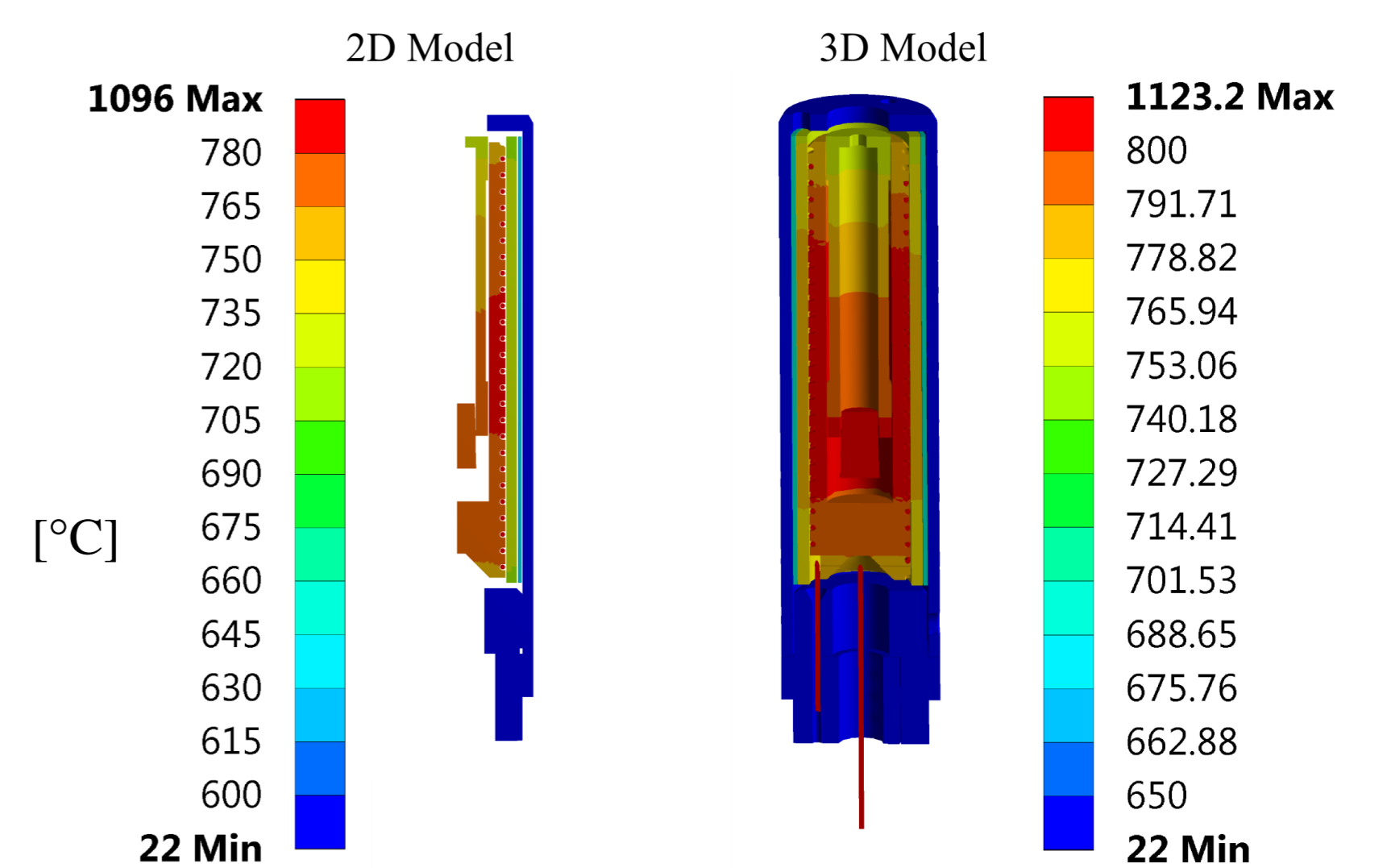
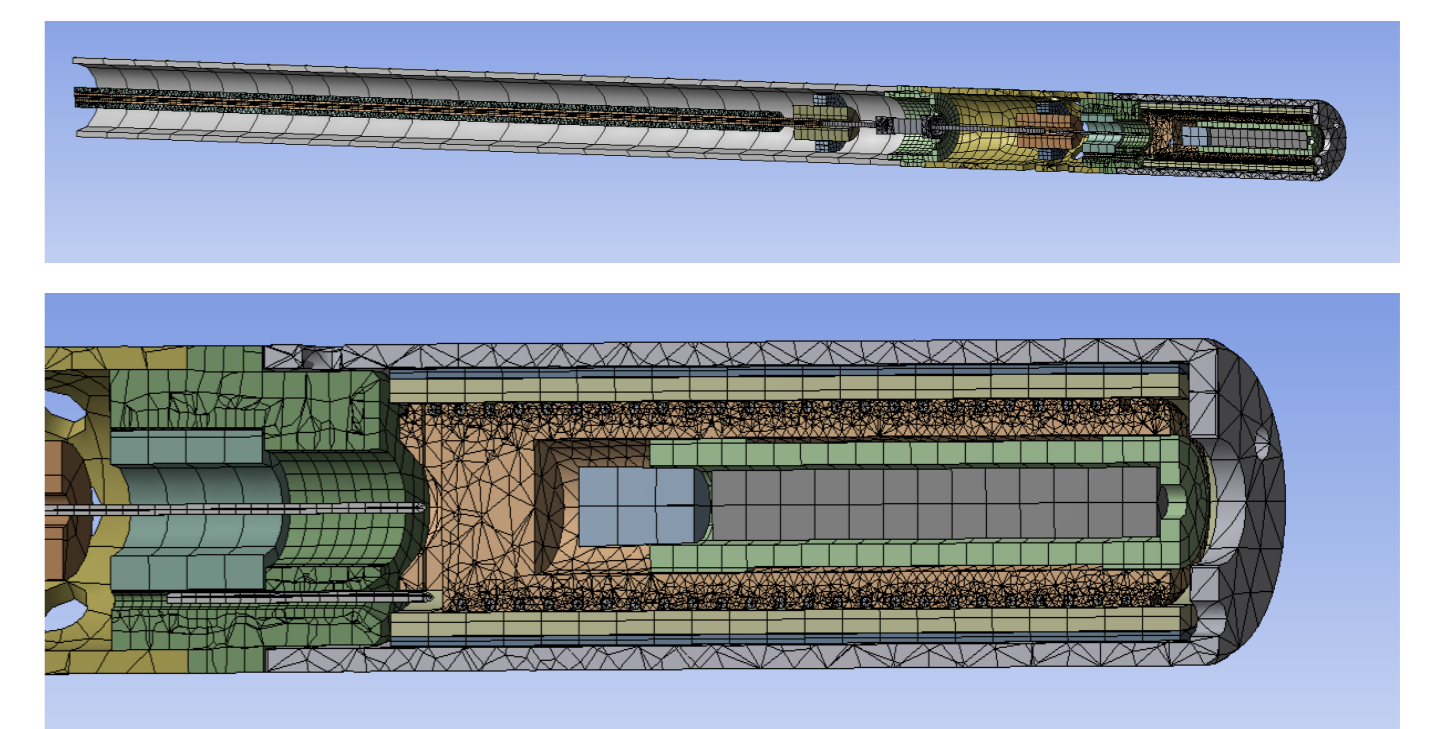
Measurement result at the OTS. The plot shows the applied power values together with the resulting deposition rates.



- The results show heavy fluctuations.

## Thermal Oven Simulations

- To understand the thermal distribution inside the oven, simulations using ANSYS were made.
- One result: A temperature profile in the crucible is a possible reason for instabilities.
- As the oven is not axisymmetric, 2D geometry is only a simplification.
- To study design changes for a better temperature distribution a 3D model is being developed.



Comparison of the two thermal models.

- Temperatures in the 3D model are generally higher but the distribution is similar.
- 3D model still under development.

## Outlook

- The operation simulation reproduced the instabilities seen at the GTS-LHC ion source.
- The time-power model for the operation simulation at the OTS is an oversimplification and might also be a cause for the fluctuations.
- Measures to improve the oven stability could have a positive impact on the beam itself.
- Ongoing measurements will study the influence of the crucible filling level on the stability of the lead vapour production.
- Also the influence of an oxygen atmosphere will be investigated.
- The 3D simulation will be refined and used to study possible design changes in order to improve the temperature uniformity in the crucible.