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.

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.

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.

The Oven Test Stand (OTS)

- Powers of individual oven runs at the GTS-LHC ion source in 2016 with each representing one crucible filling.
- Select typical runs to apply model.
- Use model at OTS to characterize lead gas output.
- The results show heavy fluctuations.

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.