

Electric field cell for SANS



General JRA Meeting

14th October 2015 Copenhagen

Task2: “Kinetics and Dynamics”

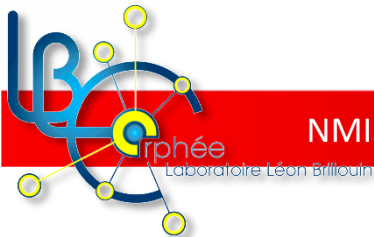


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NMI3-FP7-JRA-II-WP20 “Advanced neutron tools for Soft and Bio-Materials”



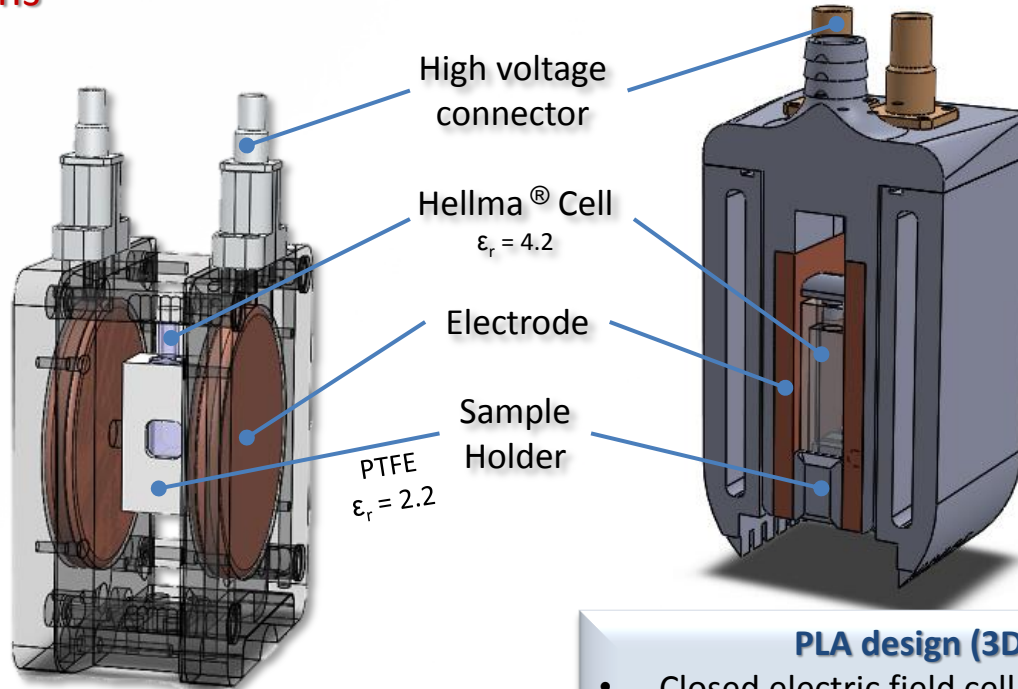
Bibliography

In the literature, the most commonly used configurations are:

- Range of electric field:
From 0.04 to 4 kV/cm
- Range of temperature:
From 10 to 60 °C
- Range of frequency:
From 0 to 60 kHz

Designs

Old and new designs



PVC design

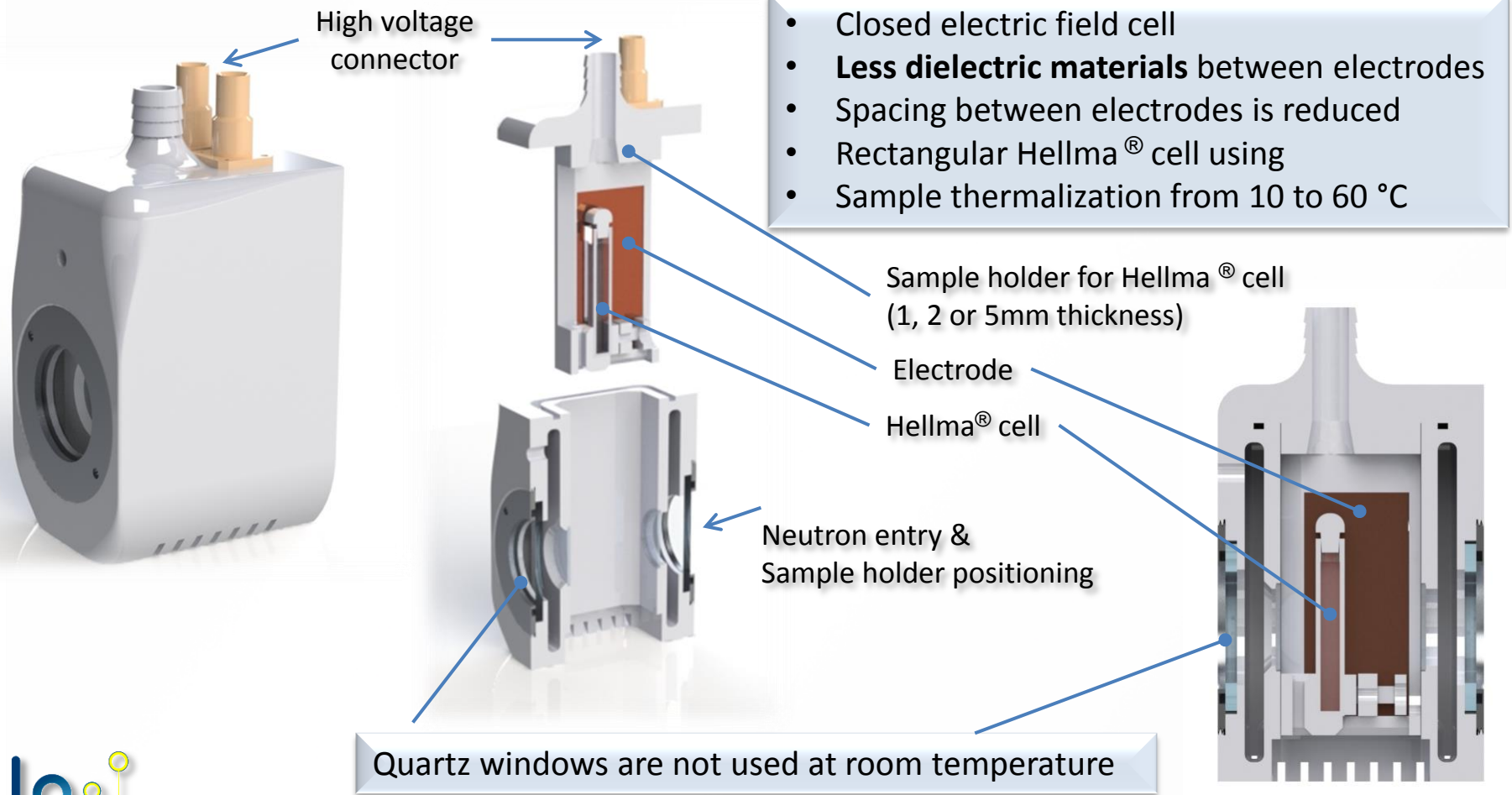
- External electrodes
- Rectangular and circular Hellma[®] cells
- Easy to use

PLA design (3D-printer)

- Closed electric field cell
- **Less dielectric materials** between electrodes
- Spacing between electrodes is reduced
- Rectangular Hellma[®] cell using
- Sample thermalization from 10 to 60 °C

New design

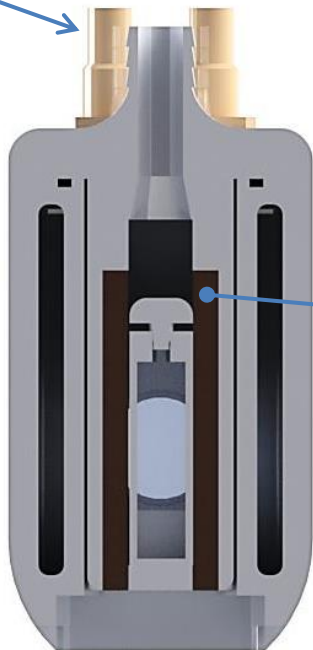
Closed and thermalized



New design

Closed and thermalized

High voltage connector



- Closed electric field cell
- **Less dielectric materials** between electrodes
- Spacing between electrodes is reduced
- Rectangular Hellma[®] cell using
- Sample thermalization from 10 to 60 °C

Electrode

Hellma[®] cell

22°

Large detector access

Neutron entry & Sample holder positioning

Empty cell transmission : 0.91 (6Å – 2m)

Improvements

Sample holder design

1 sample holder for 3 sizes of Hellma cells (1, 2 & 5mm)



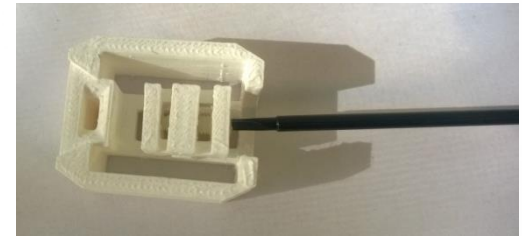
1mm hellma cell



2mm hellma cell



5mm hellma cell



Adjusting screw lock

Sealing



Fan

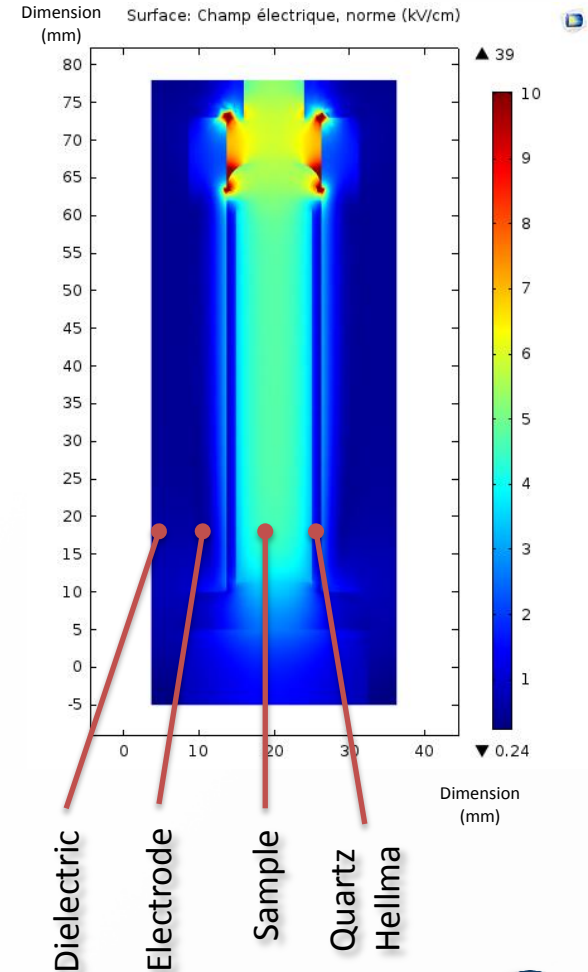
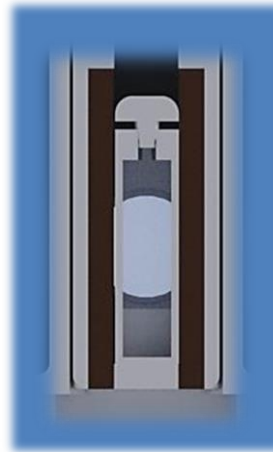
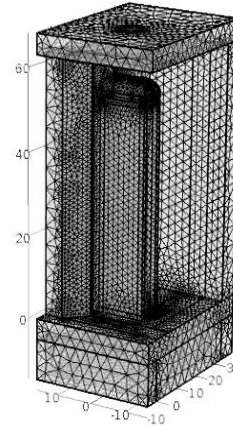
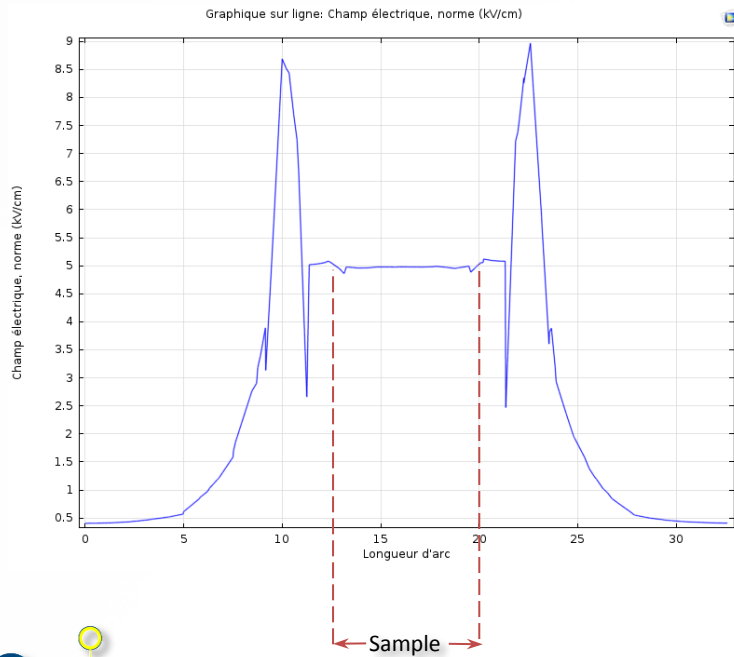
Heat dissipation



New design Simulation

Electric Field Simulation

- Sample thickness 9.6mm
- 5 kV/cm on the sample (toluene $\epsilon_r = 2.3$)
- with 8kV applied (1.6 kV/cm with 2kV)



New design

Thermalization

The sample is heated by using a stream of tempered gas.

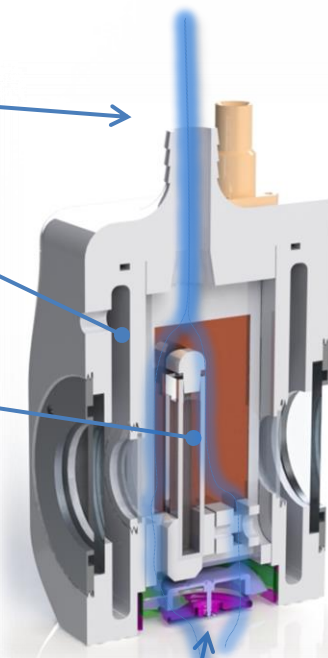


PLA (for 3D printer solution $\epsilon_r = 3$)

Gas inlet

Double-walled and vacuum to prevent condensation

Hellma® cell



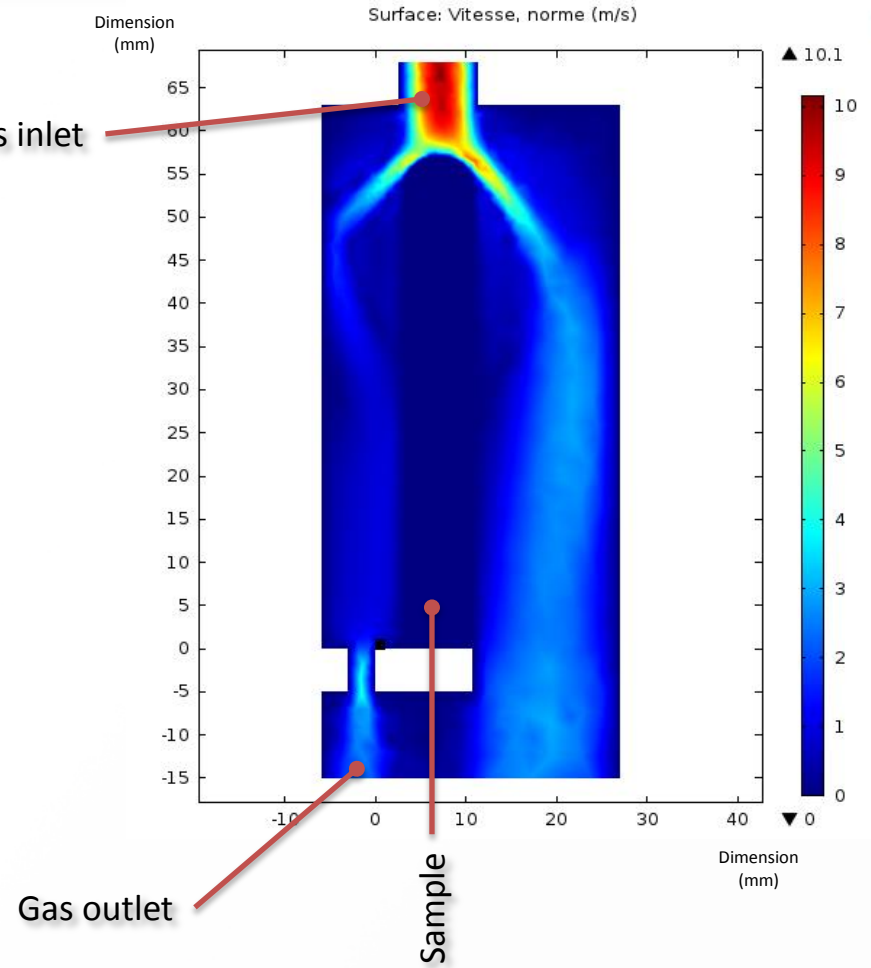
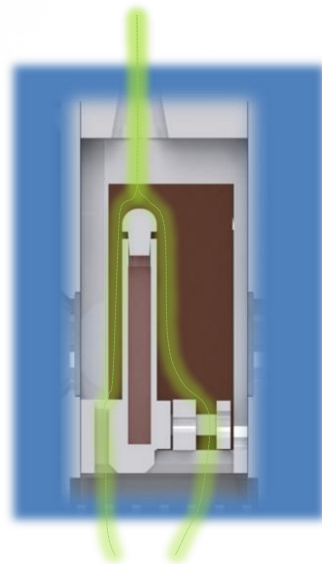
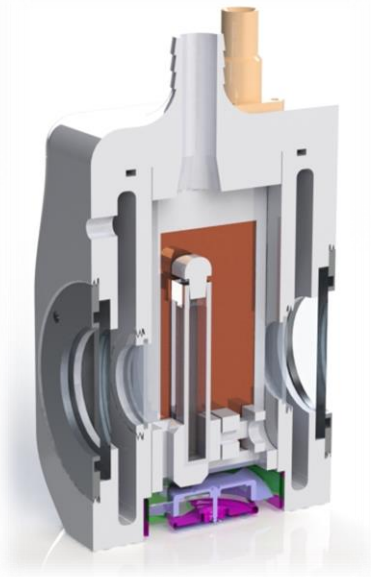
Gas outlet
(Fan)

The range of temperature extends from 10 to 60 °C.

New design Simulation

Air flow Simulation

- Hellma® cell of 5mm with aerodynamic plug for a better contact

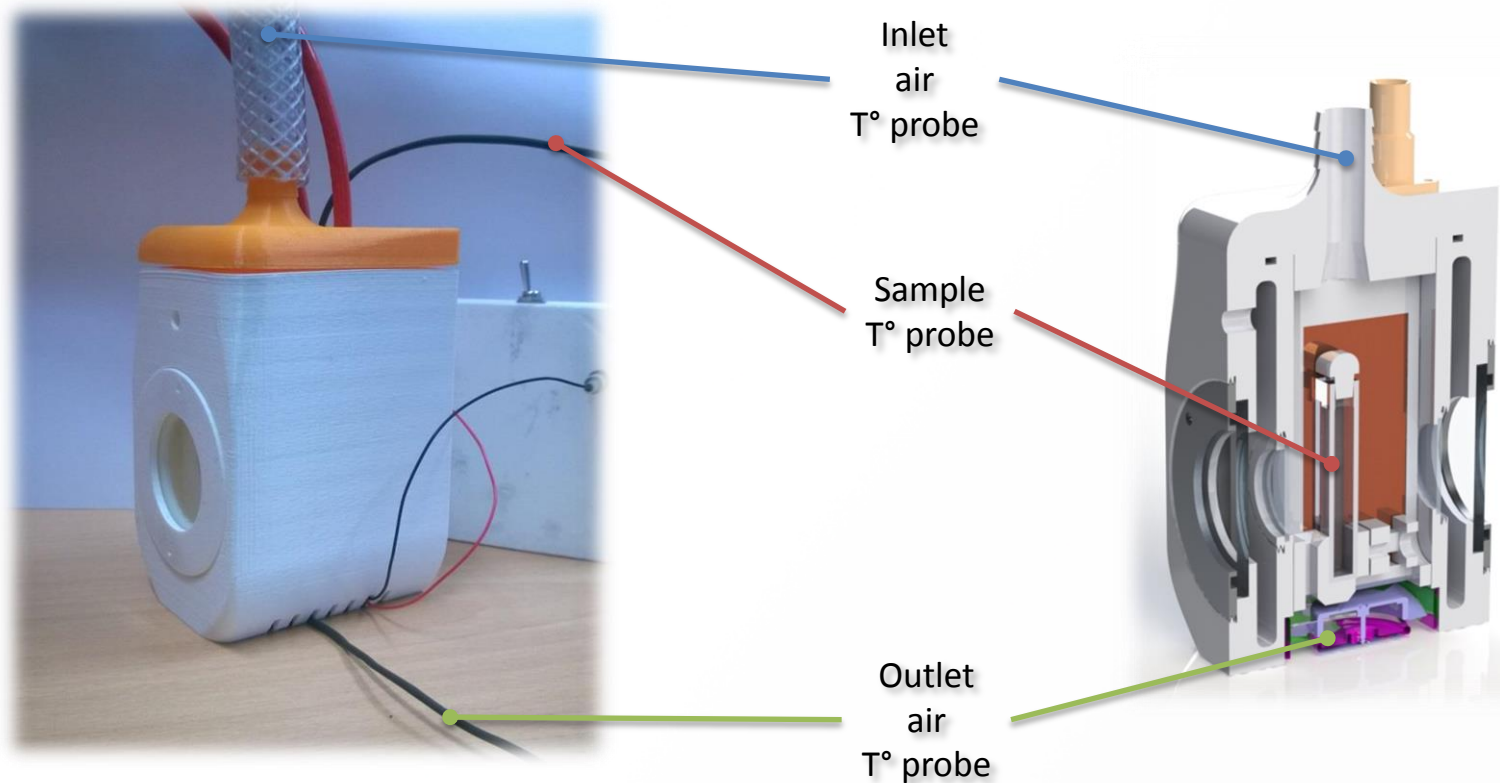


Thermalization

Test

Thermalization of a sample (water)

The heat air flow was supplied by a heat gun

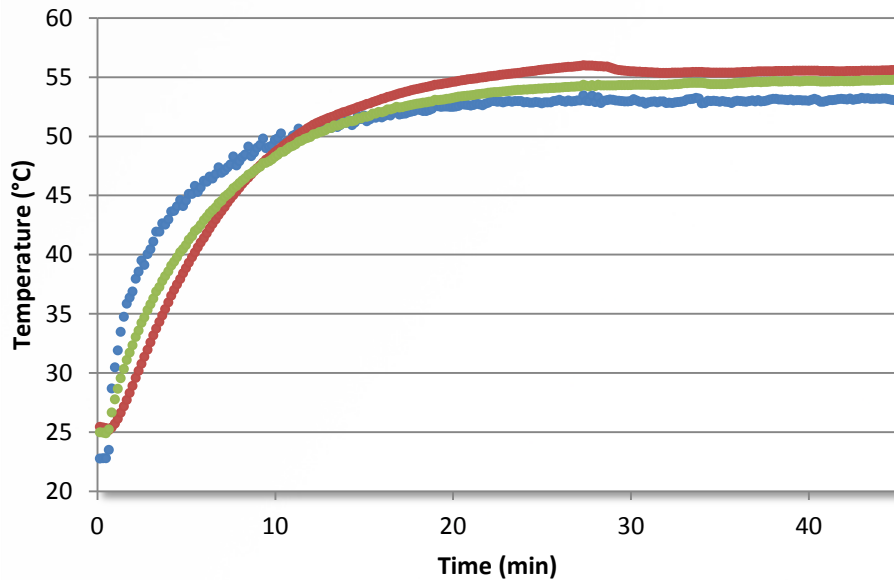


Thermalization

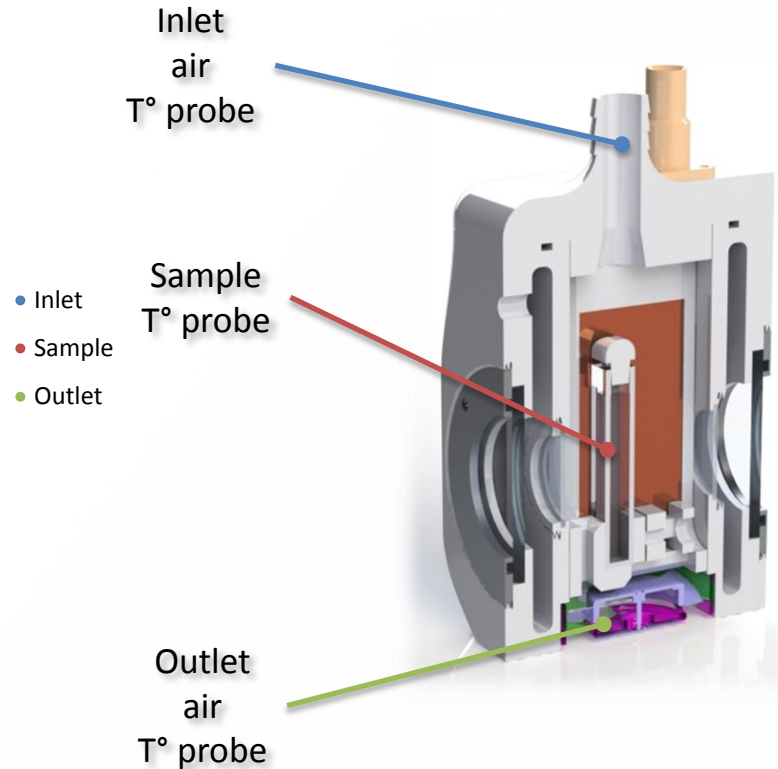
Test

Thermalization of a sample (water)

Thermalization



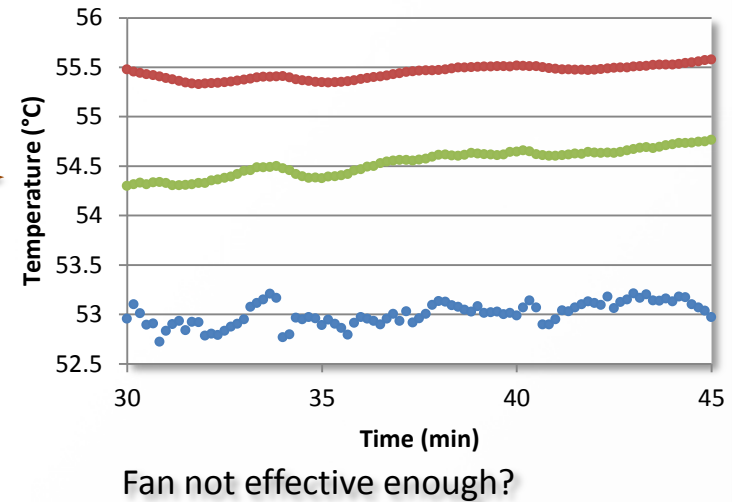
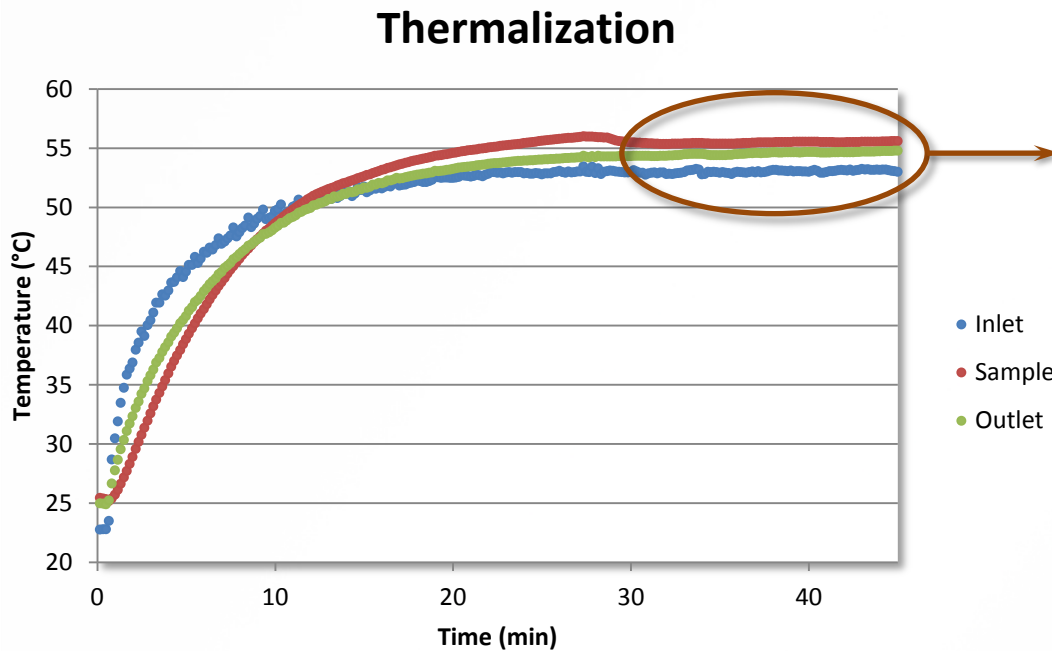
Temperature gradient: $\Delta T = T_{\text{sample}} - T_{\text{inlet}} = 2.44 \text{ }^{\circ}\text{C}$



Thermalization

Test

Thermalization of a sample (water)



$$\text{Temperature gradient: } \Delta T = T_{\text{sample}} - T_{\text{inlet}} = 2.44 \text{ } ^\circ\text{C}$$

Electric field cell for SANS

Final step

- Final improvement (heat dissipation, ...)
- Final design in resin to prevent air leak (PLA is a porous plastic)
- Neutron test

Thanks to



Burkhard ANNIGHÖFER
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Electric field cell for SANS

Thank you for your attention