



Calibration of relative humidity instruments in low pressure, low temperature, CO₂ environment

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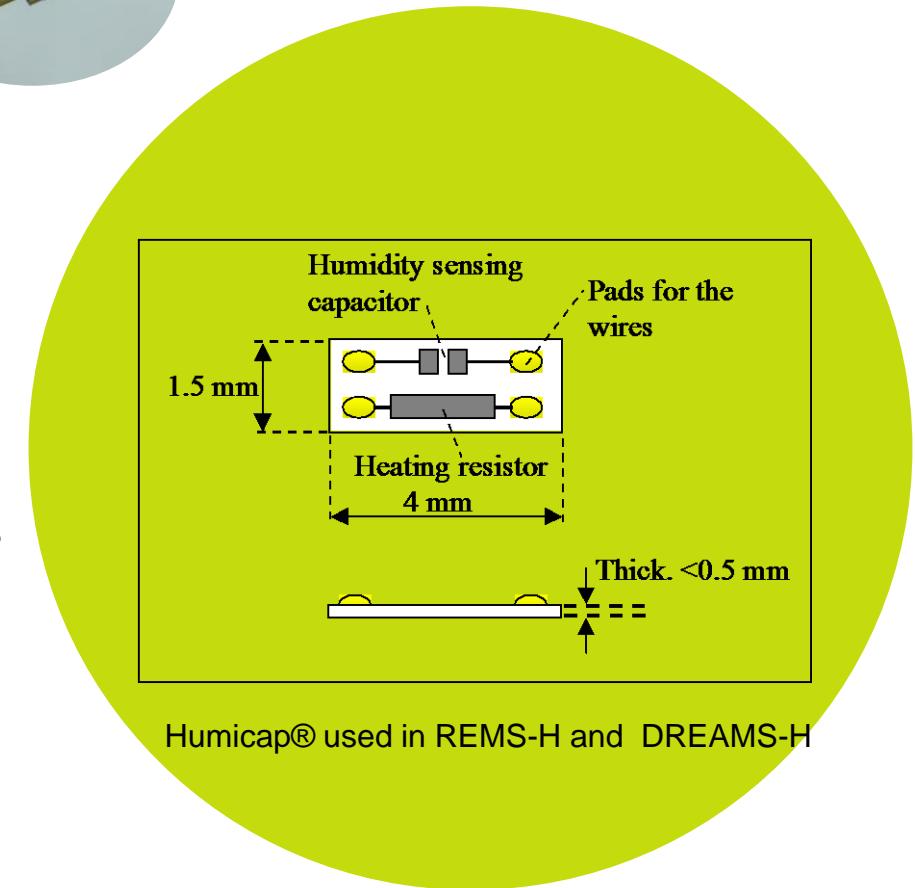
Humicap®



Humicap® humidity sensor chip is a capacitive sensor. It contains an active polymer film that changes capacitance as function of relative humidity and temperature. **The capacitance is also affected by CO₂ gas, and the magnitude of the effect is dependent on both temperature and pressure.**

Accurate housekeeping temperature measurements as close to Humicap® as possible are needed to interpret the humidity results.

Humicap® can be regenerated or defrosted with an integrated heating resistor.



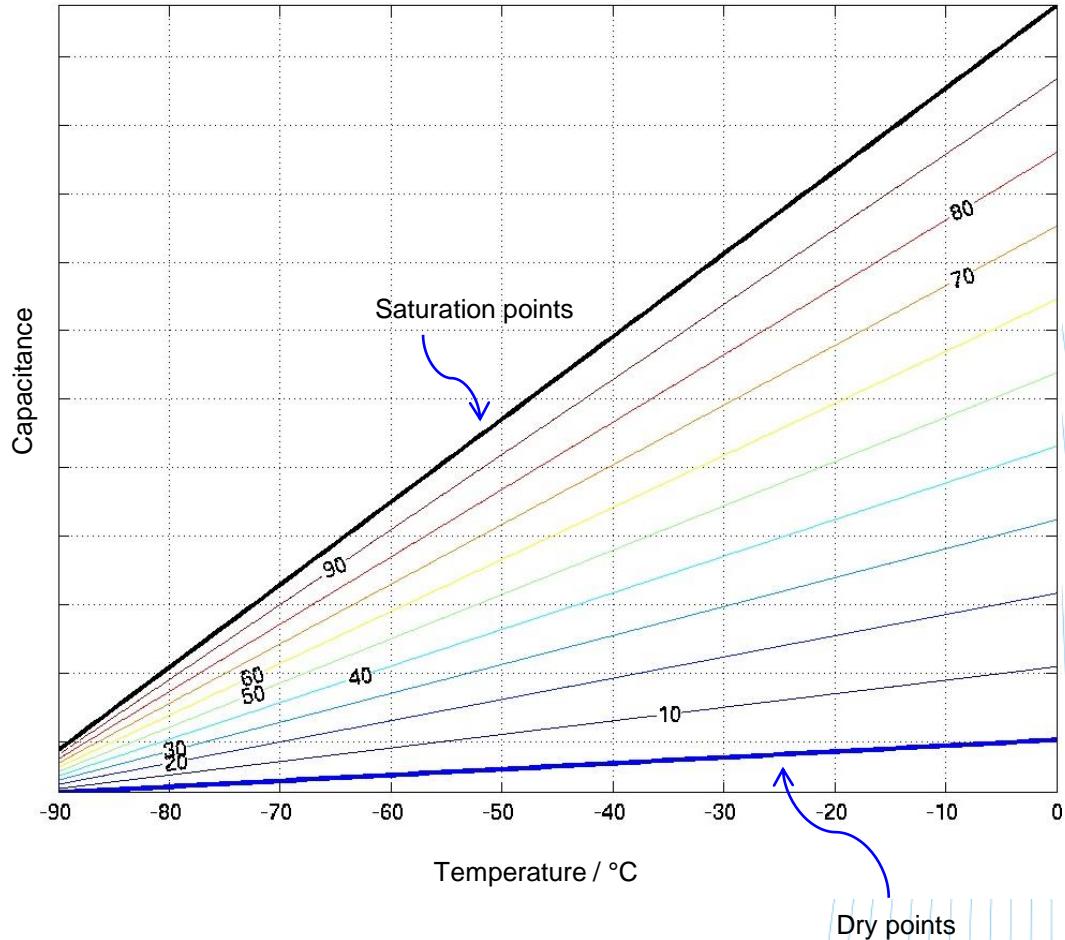
Humicap® used in REMS-H and DREAMS-H



Humicap® behavior in cold

Humicap® capacitance varies as function of temperature and relative humidity. Dry point (~0%RH) capacitance changes only a little with temperature, while saturation point (~100% RH_{ice}) capacitance falls as temperature gets colder, thus narrowing the dynamic range. Also time response of the Humicap® gets longer in cold temperatures.

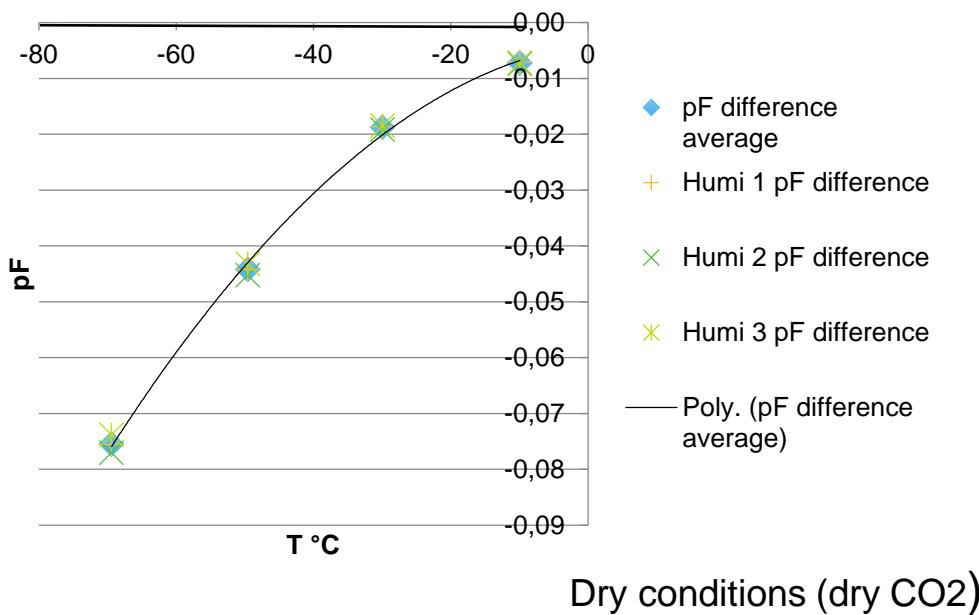
In each temperature point, capacitance between dry point and saturation point is nearly linear.



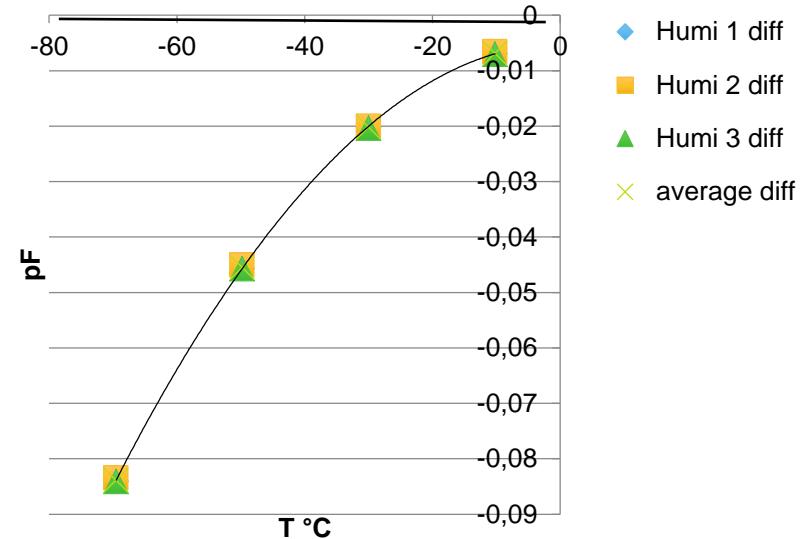


CO₂ effect on Humicap

DREAMS-H 'd' Difference in capacitance
between vacuum
and ~8 hPa CO₂



REMS-H REF difference in capacitance
between vacuum and ~8 hPa CO₂

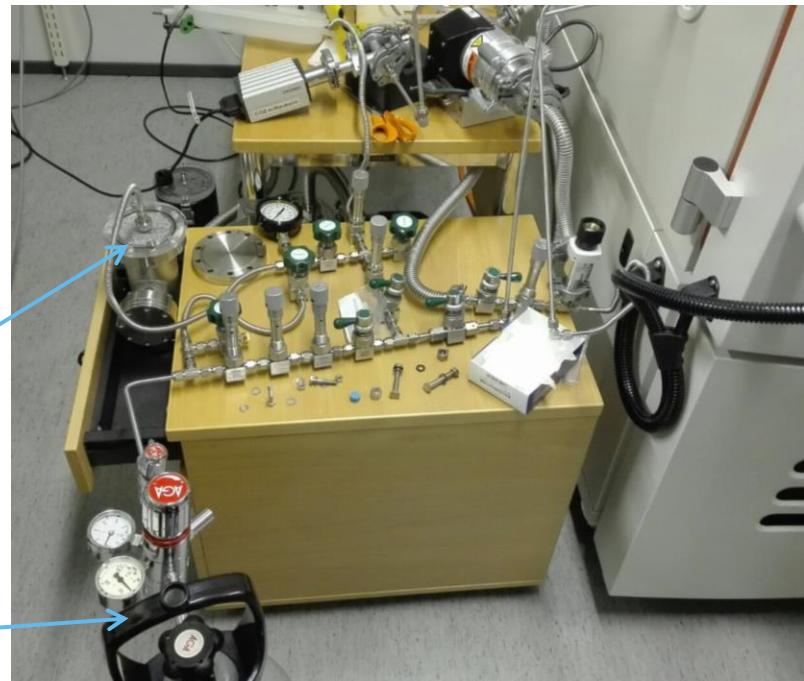
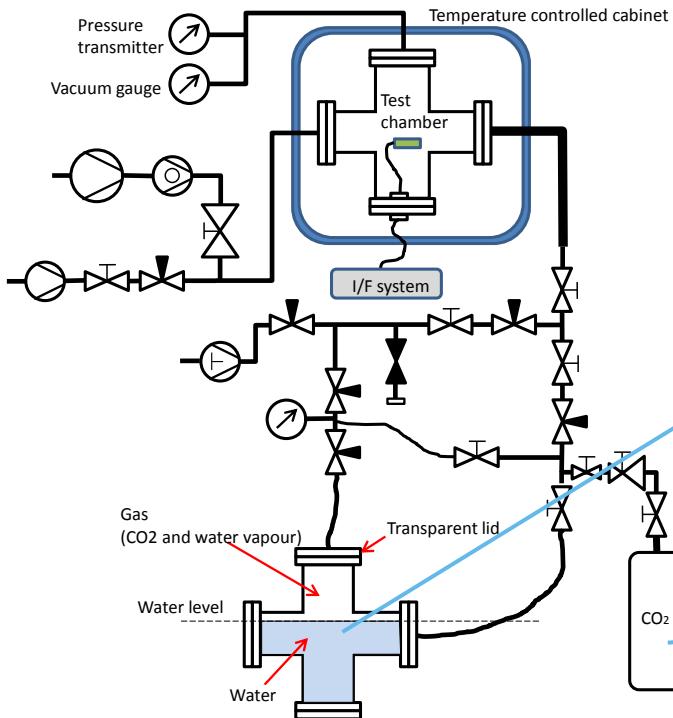


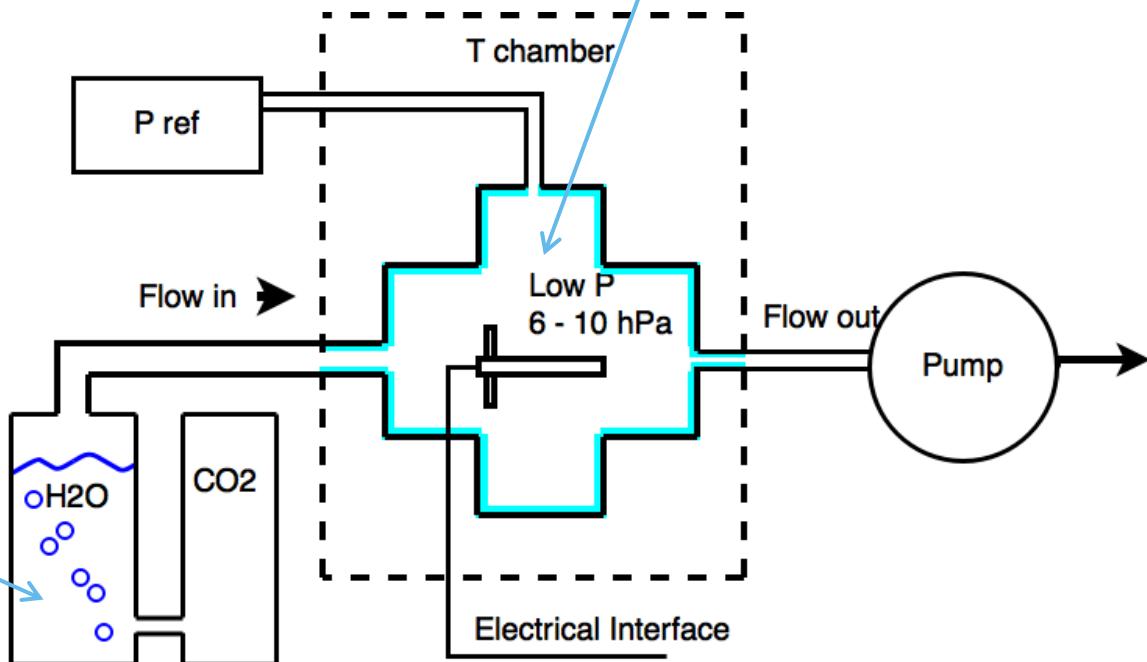
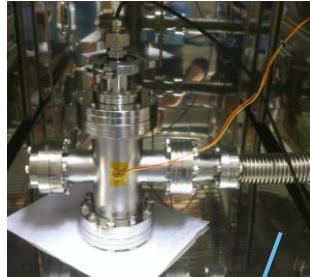
The CO₂ effect is larger in higher pressures and cold temperatures. Taking into account also the dynamic range of the Humicap®, in Martian pressure range the effect is negligible in temperatures > ~ -10°C.



Humidity in CO₂ testing system set-up

J. Polkko, FMI, 23.3.-17

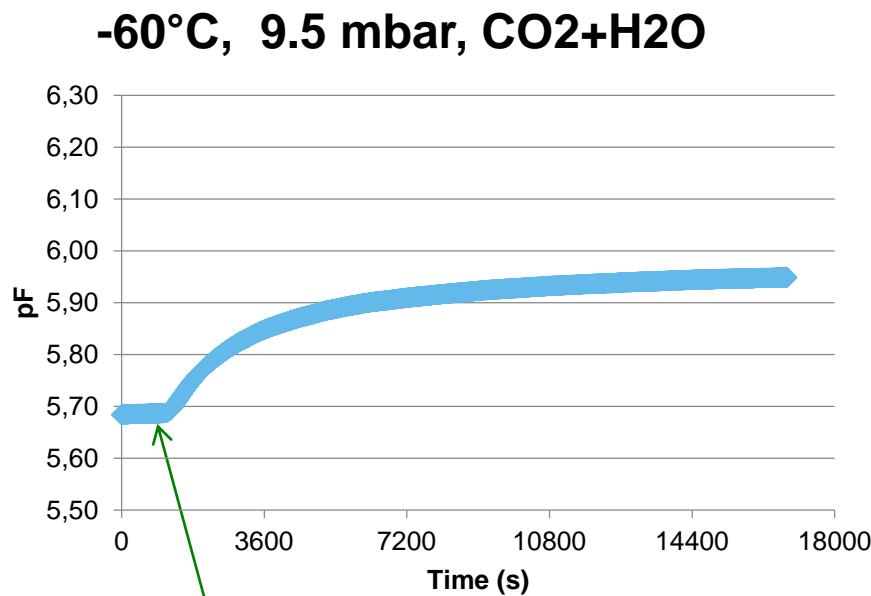




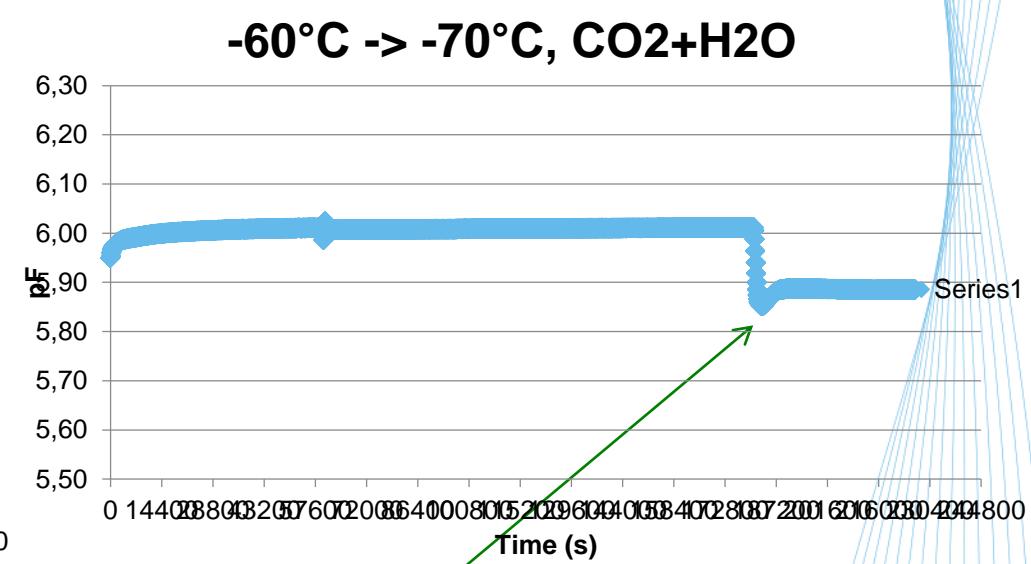
Saturated conditions



Humicap capacitance reaction to wet gas



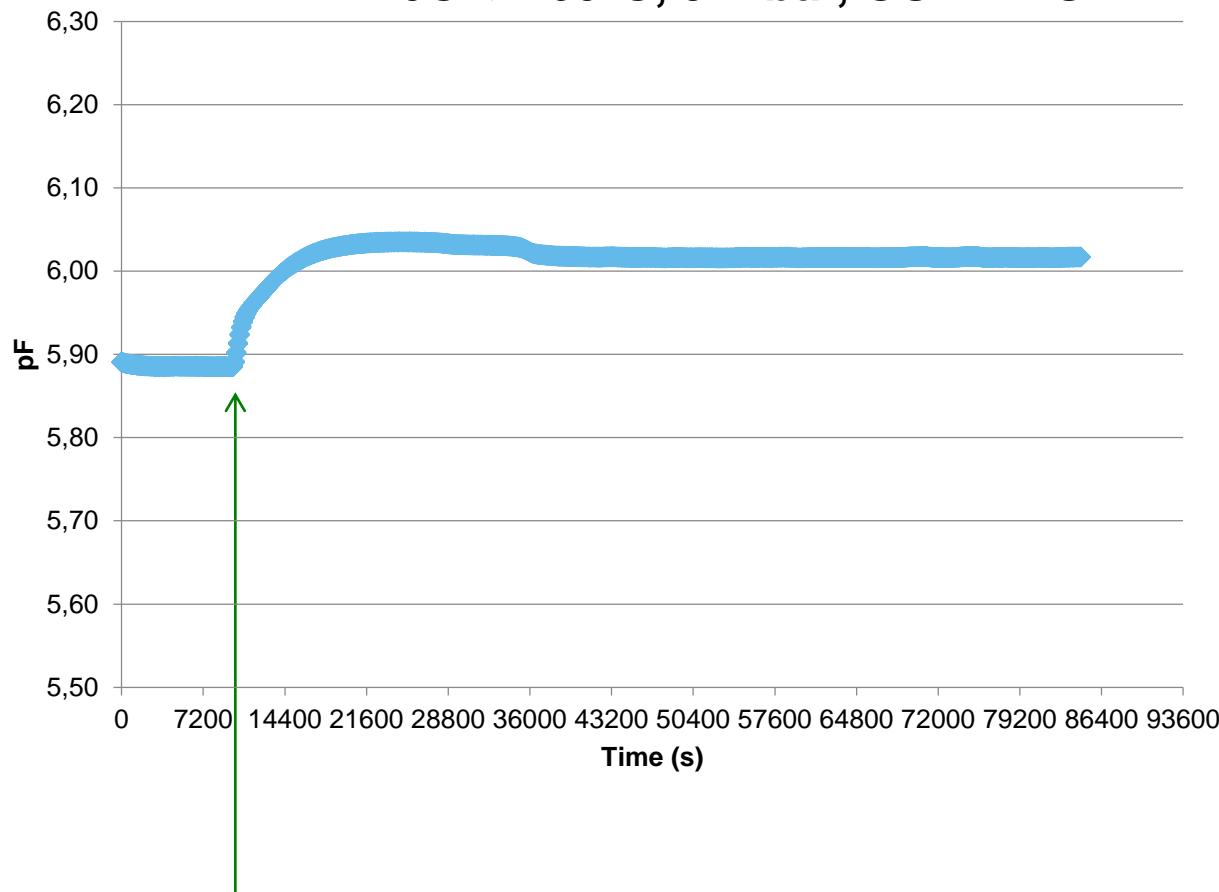
Switch from dry to wet gas



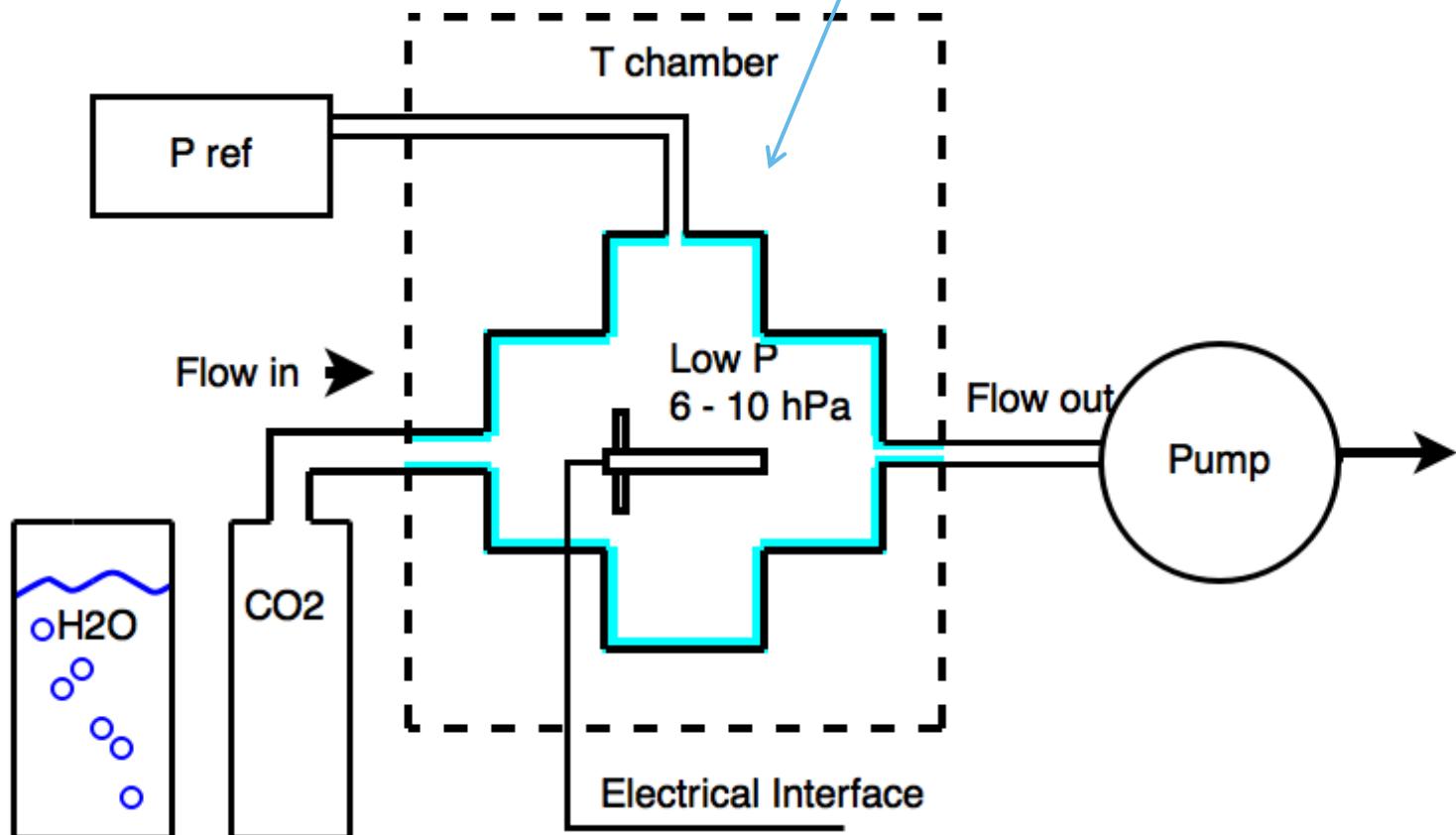
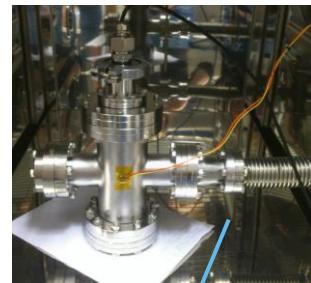
Temp switch -60C...-70C



-70°C -> -60°C, 9 mbar, CO₂+H₂O



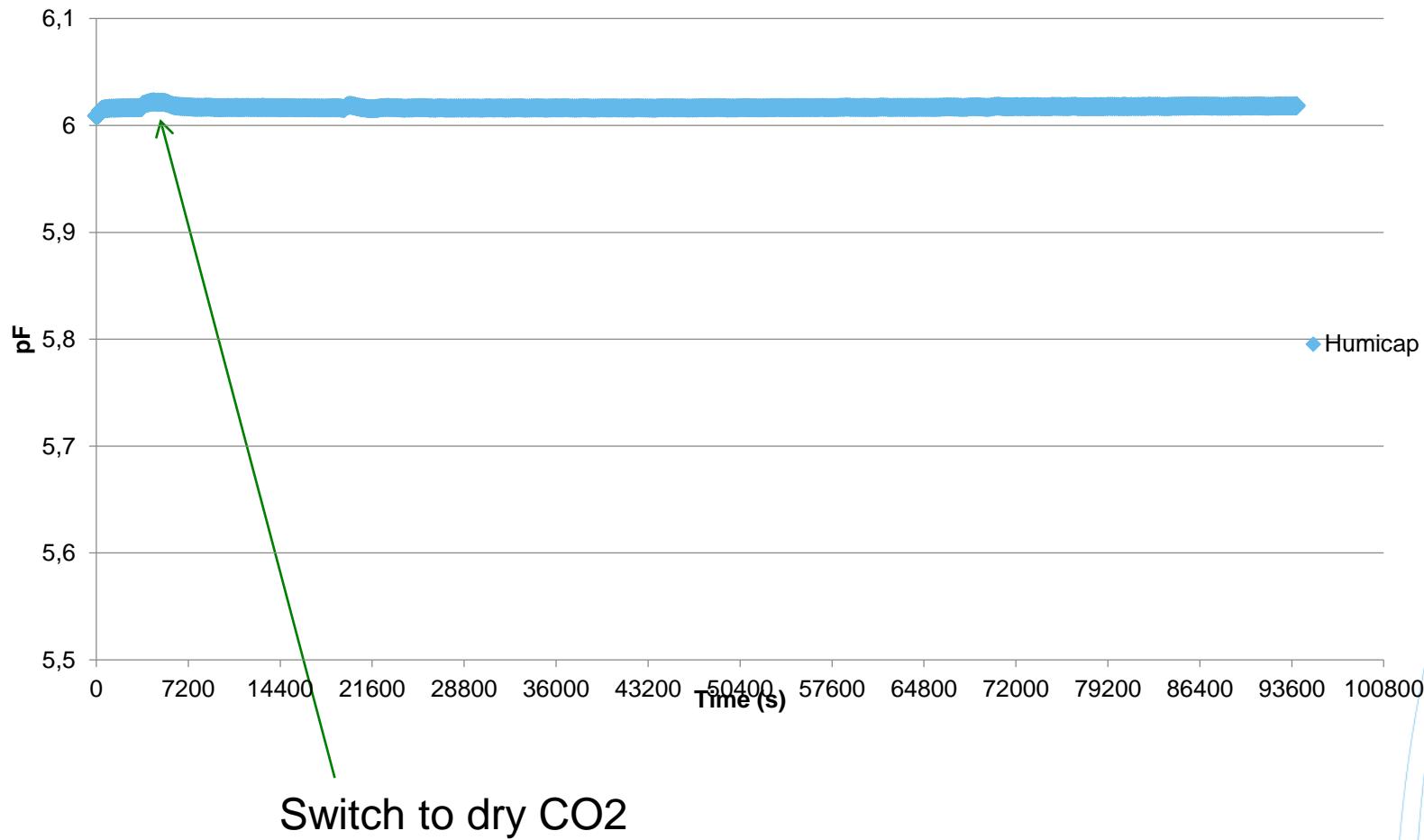
Temp switch -70C...-60C



Dry CO₂ flow through the chamber

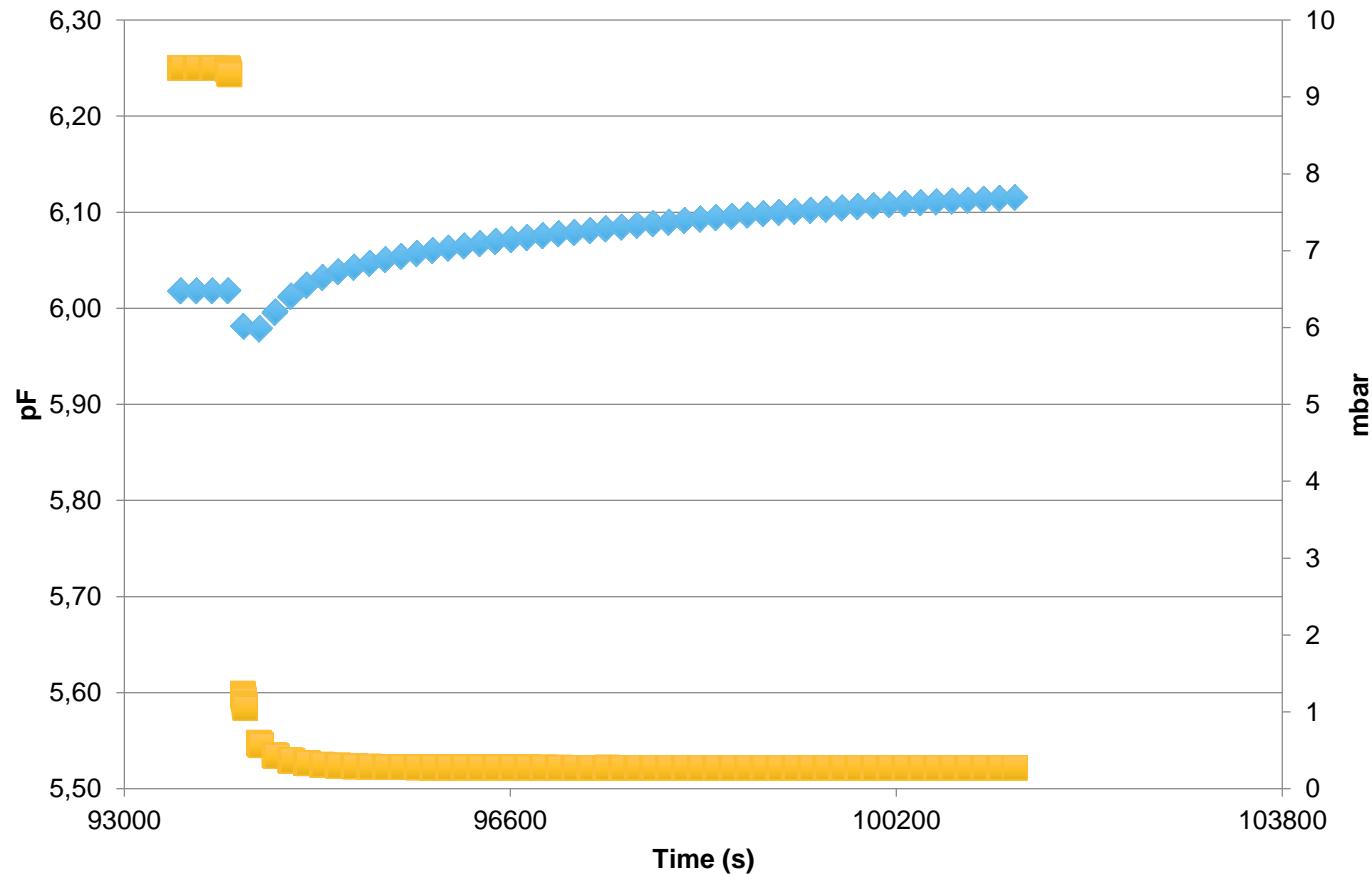


-60°C, 9.5 mbar, switch to dry CO₂



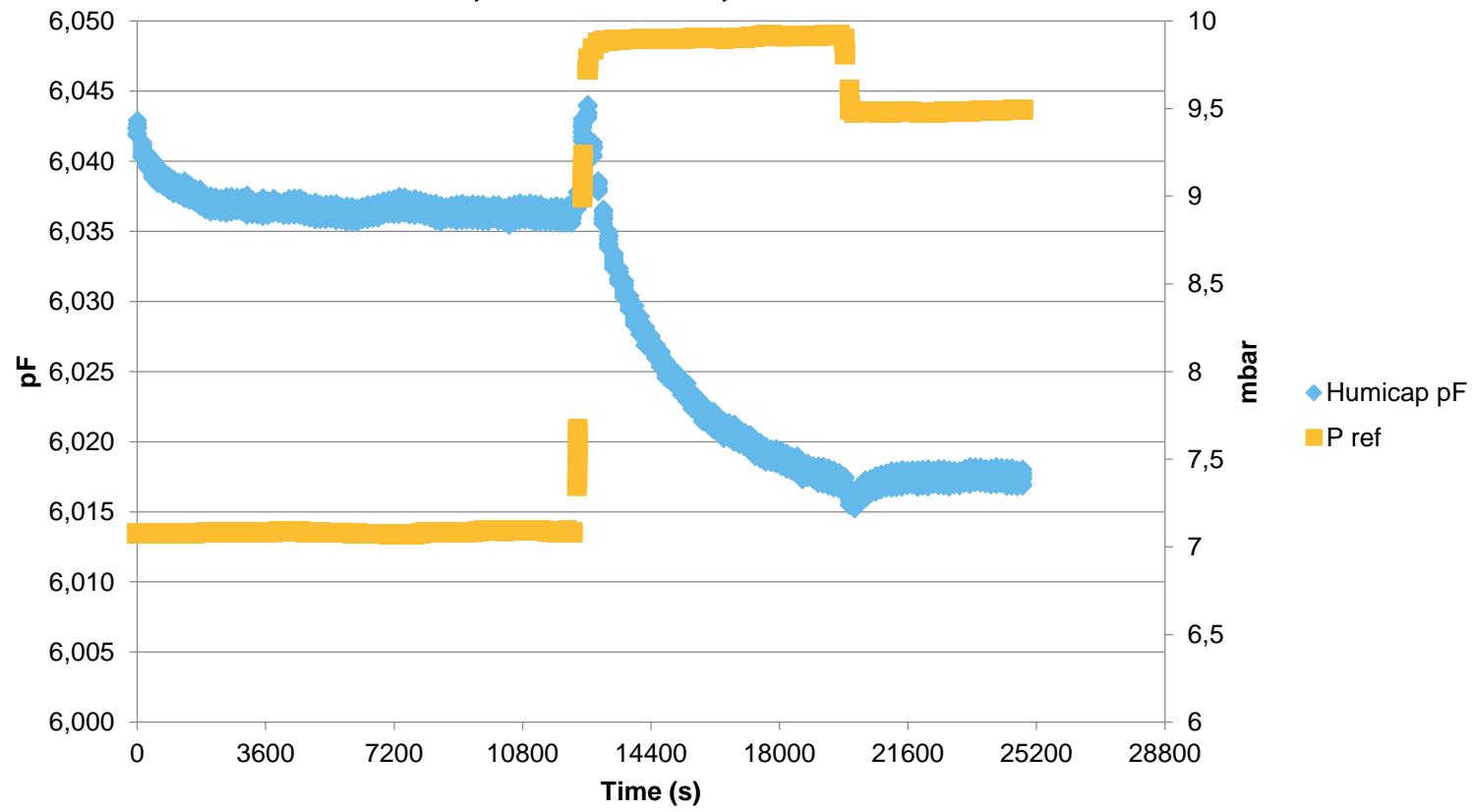


-60°C, 9.5 mbar CO₂ → vacuum





-60°C, CO₂+H₂O, 7 mbar -> 9.5 mbar





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