

# *Online radio frequency characterization of water content in liquid biofuels*

*Floriane SPARMA and Pierre SABOUROUX*

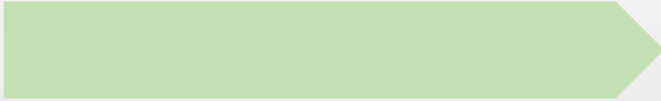
*Aix Marseille University*

*Institut Fresnel, Marseille*

*France*

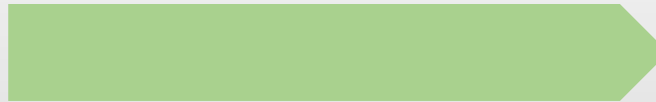
# Outline of project :

2020



*Proof of concept :  
First Prototype*

2022



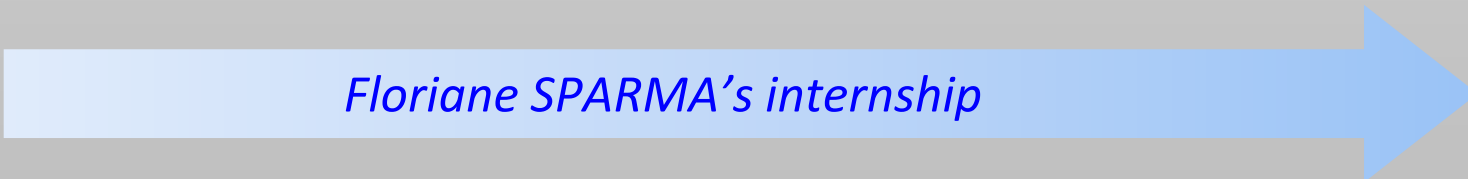
*Toward a smaller sensor*

2023

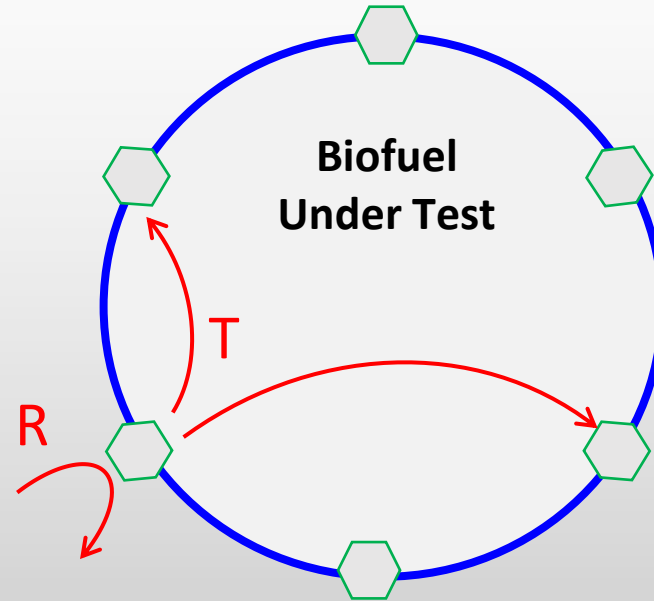
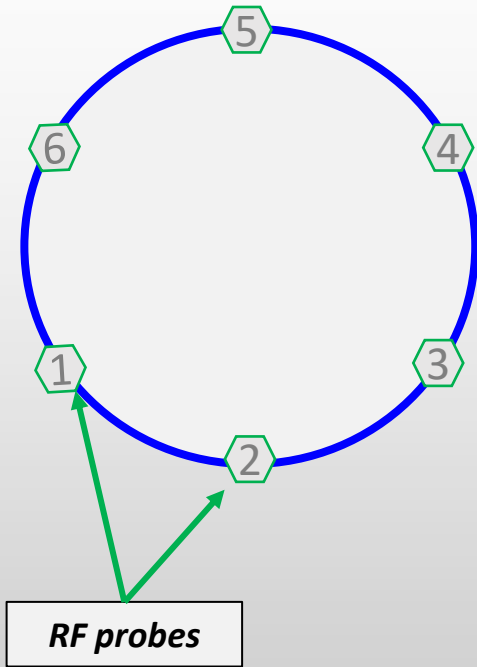


*Validation of the  
final prototype*

*Floriane SPARMA's internship*



## Theoretical approach

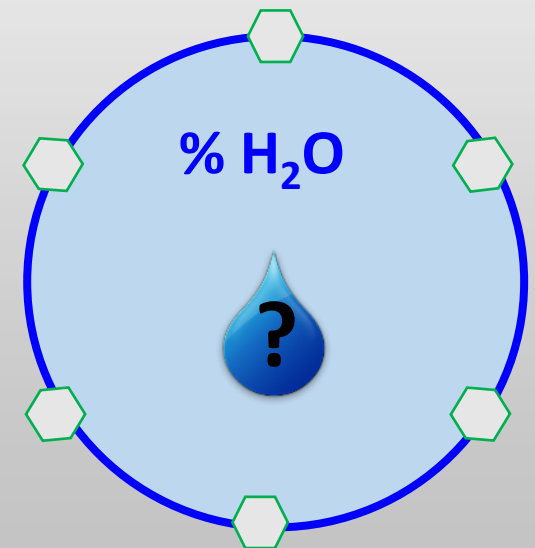


### Microwave Domain

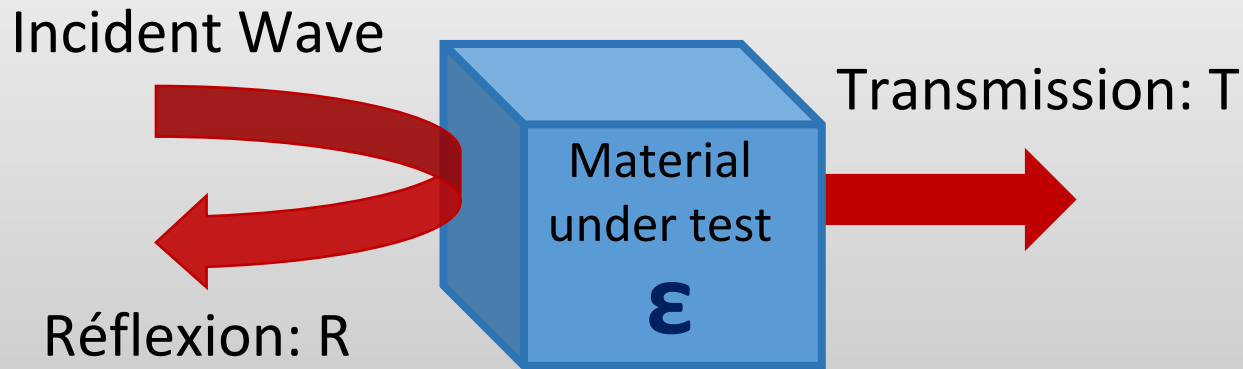
Reflection **R** (%WC) ?

Transmission **T** (%WC) ?


## Main Goal



## Microwave/materials Interactions



R and T = Function ( $\epsilon$ )

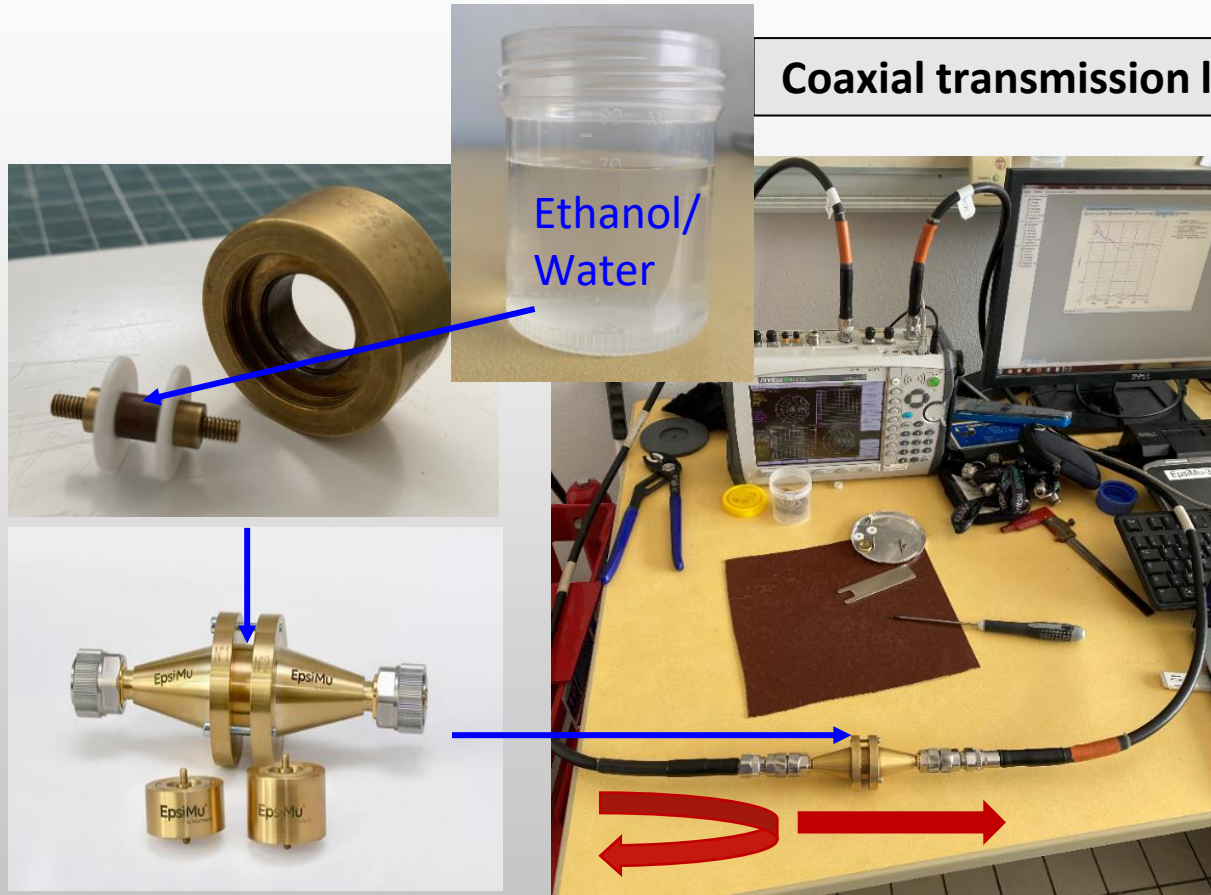
  $\epsilon_{\text{water}} \sim 80$



$\epsilon_{\text{ethanol}} \sim 10 \text{ à } 12$

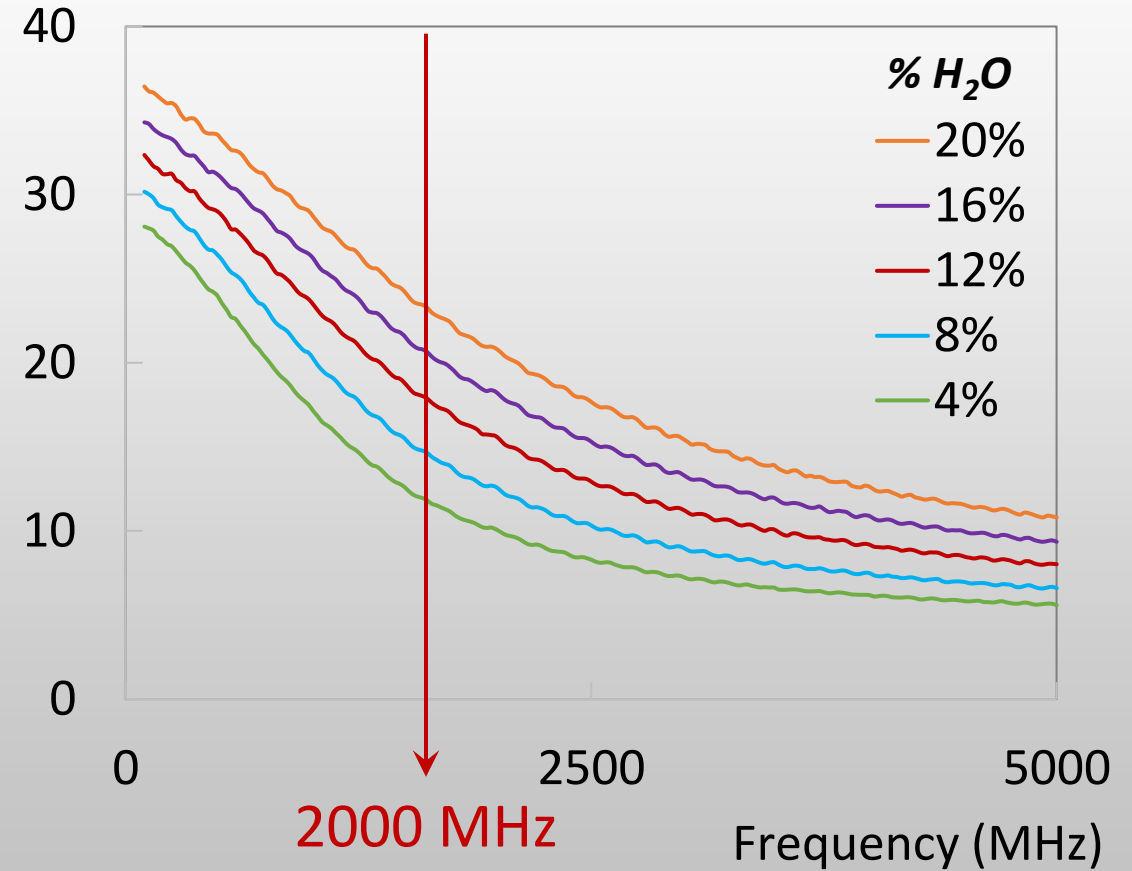
$\epsilon_{\text{Mixture}} = \text{Function } (\%H_2O)$

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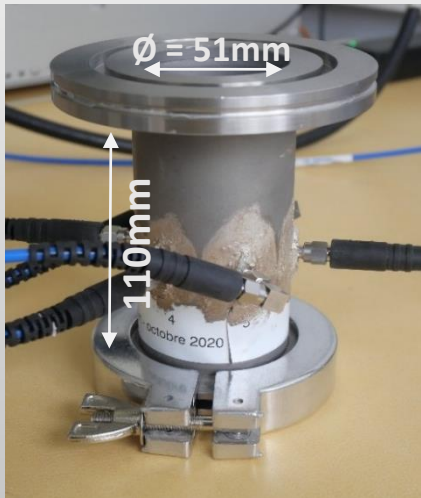
Coaxial transmission line

Real part of permittivity  $\epsilon'$



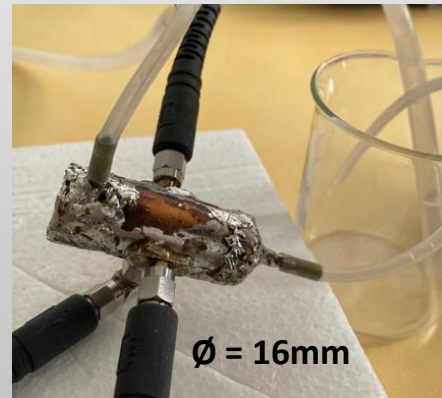
2020

*Proof of concept :  
First Prototype*



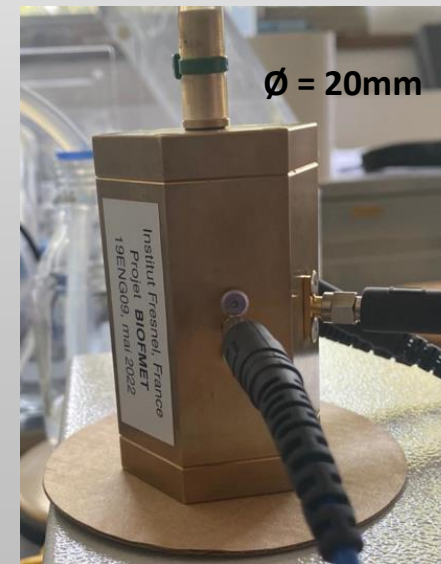
2022

*Toward a smaller sensor*



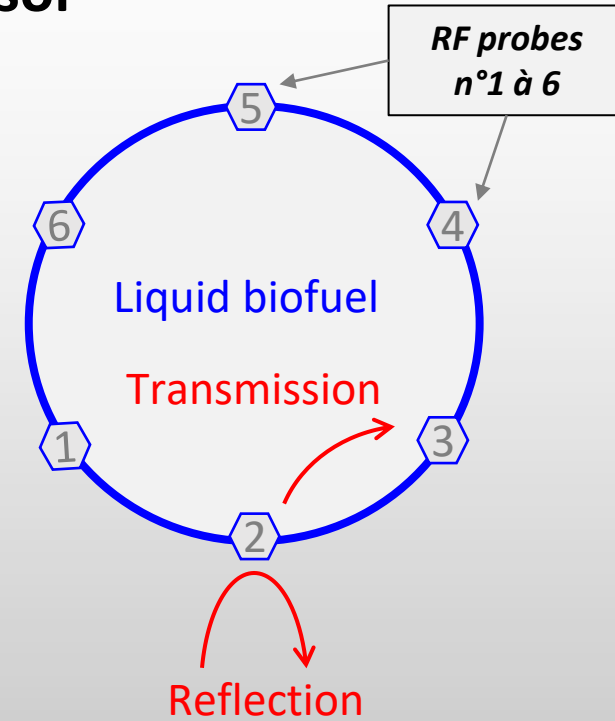
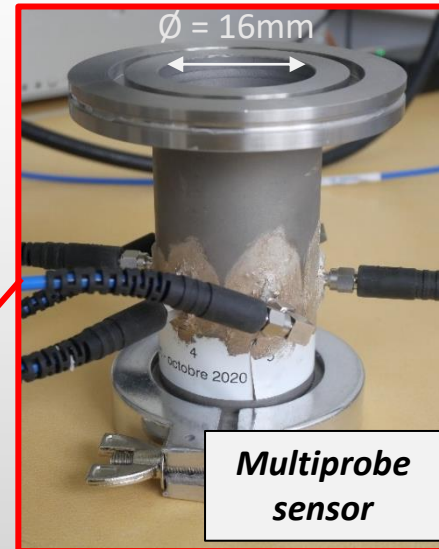
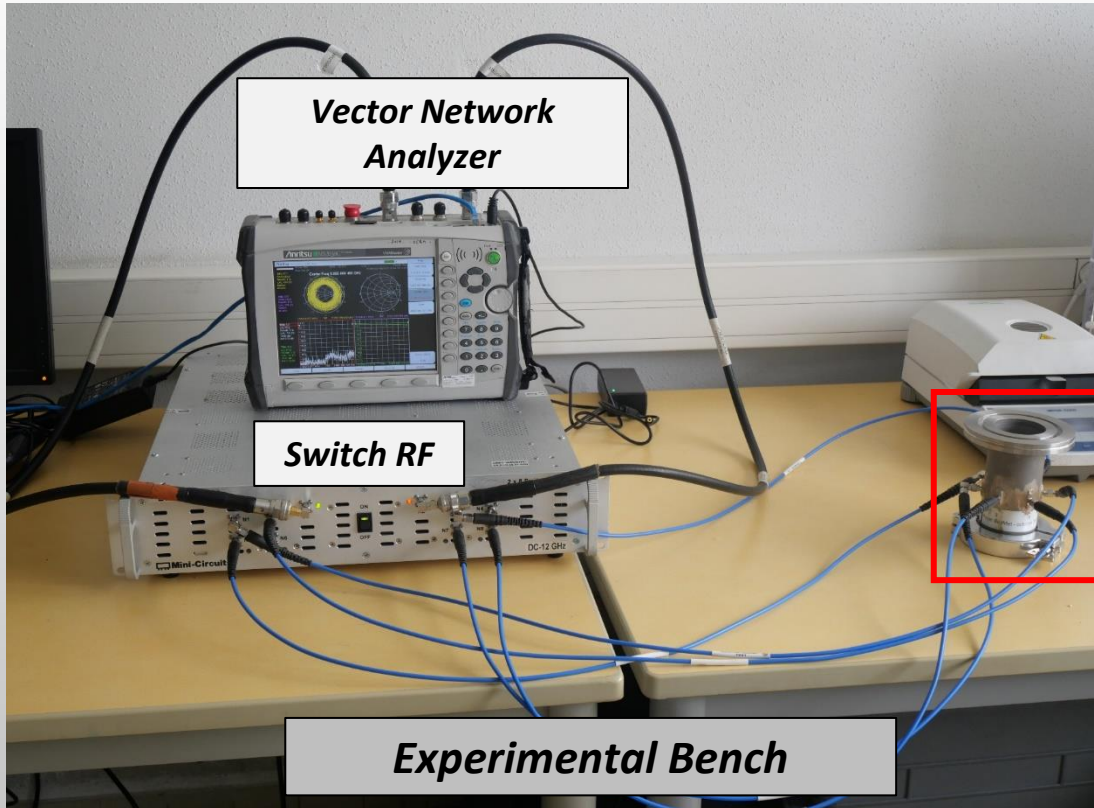
2023

*Validation of the  
final prototype*



*Floriane SPARMA's internship*

# 1st prototype of proof of concept of the multi-probe sensor

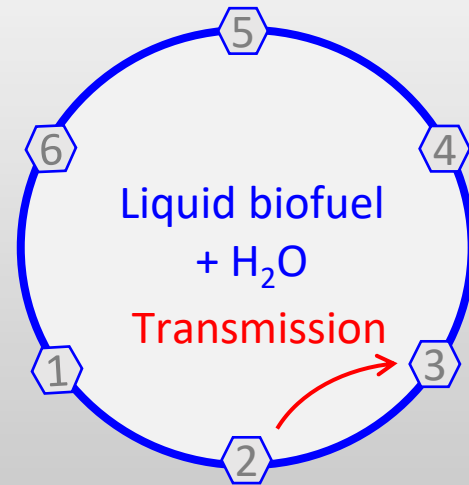


Control of the bench by a Python software

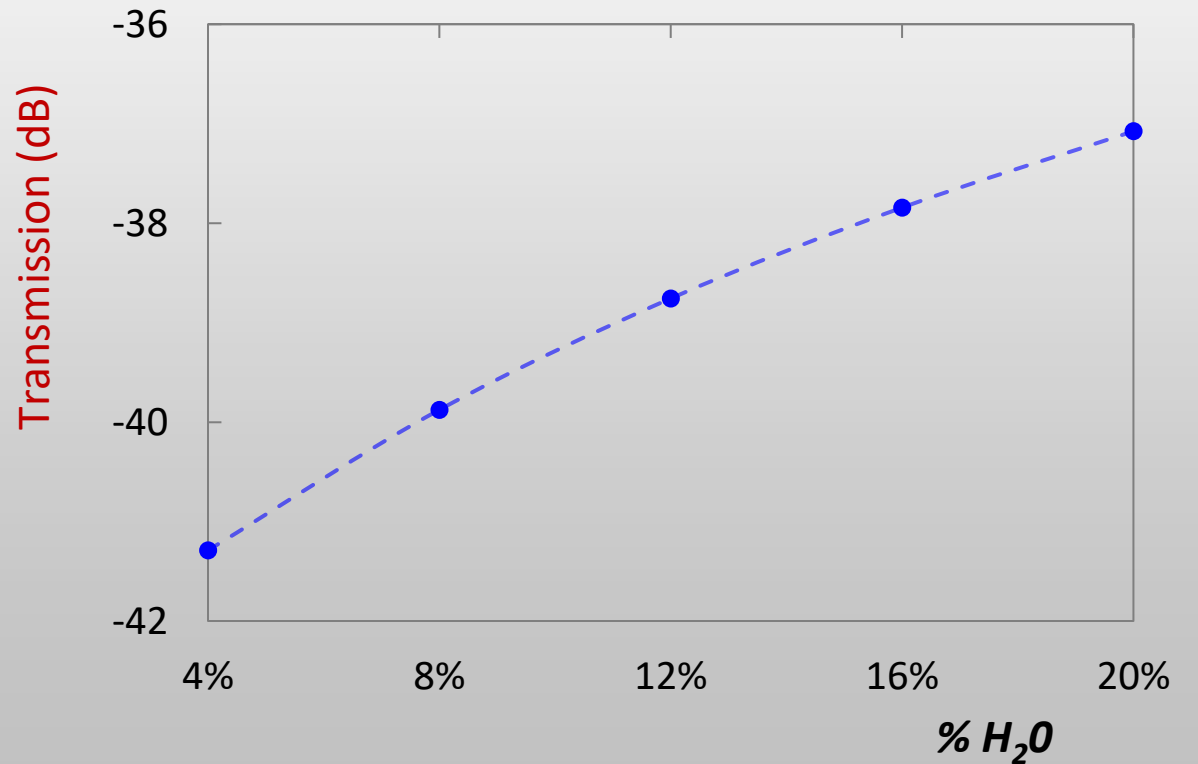
# “Static” measurements of ethanol/water mixtures



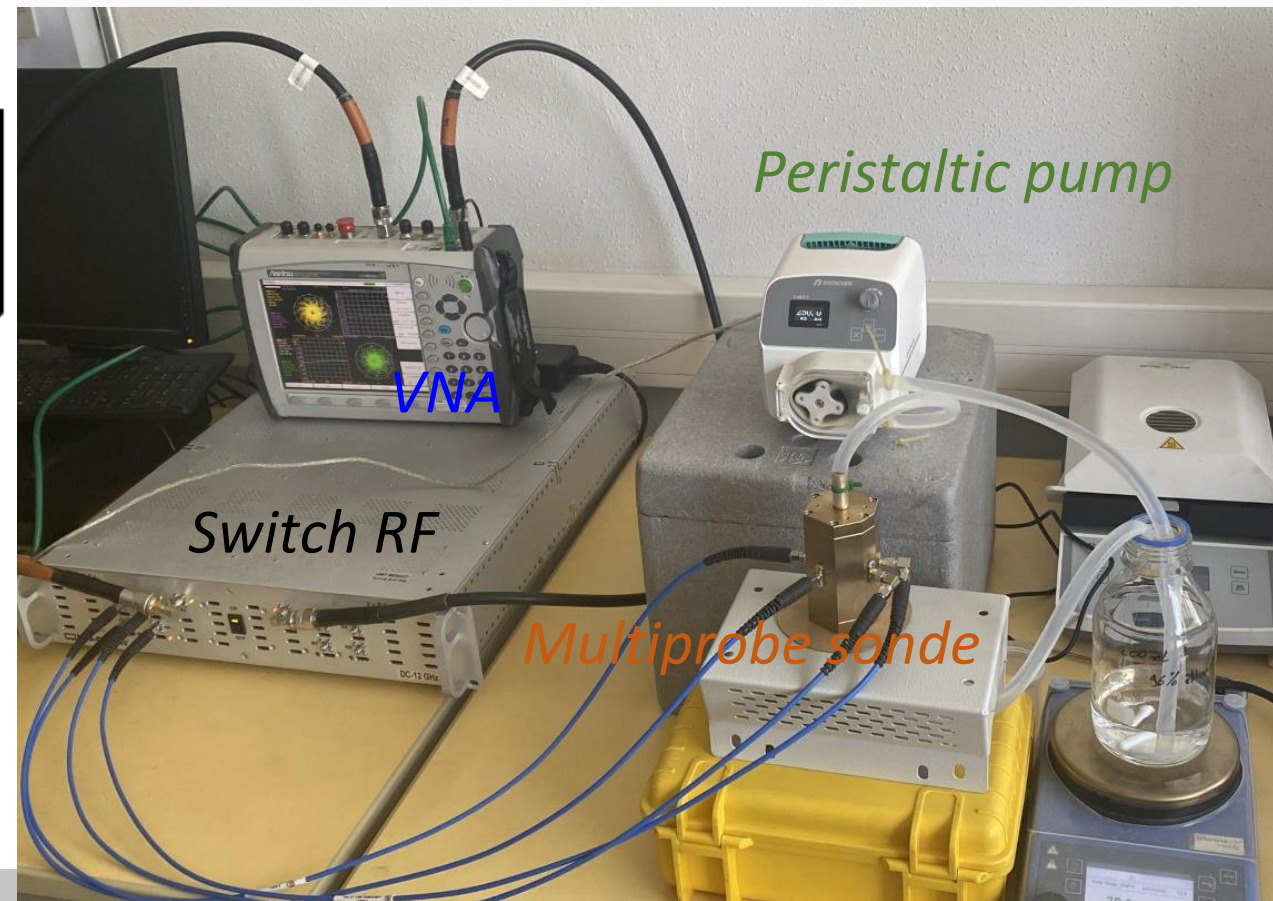
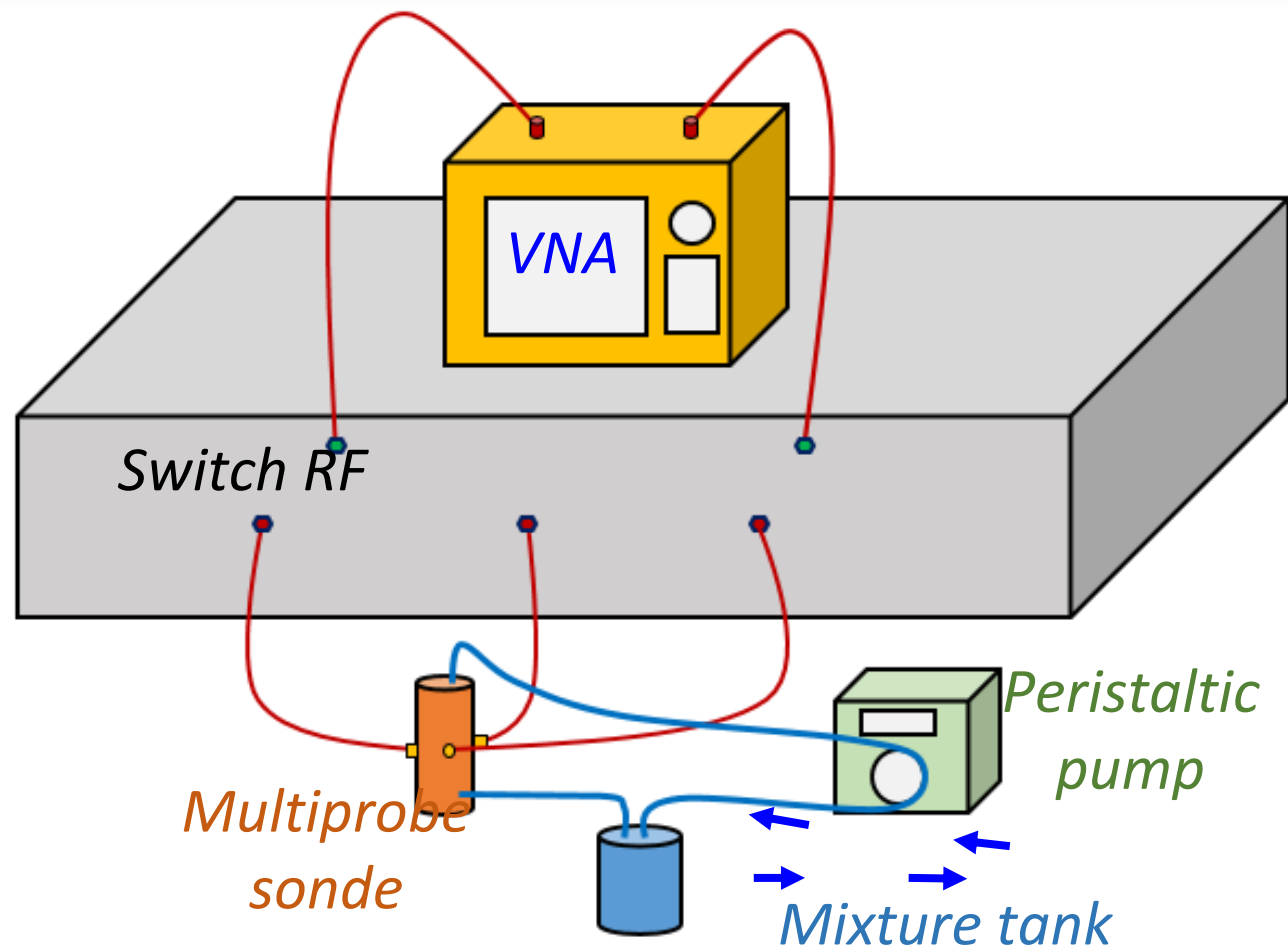
Multiprobe sensor (first prototype)



**Variation Transmission (%H<sub>2</sub>O) of ethanol/water mixture at 2000 MHz**



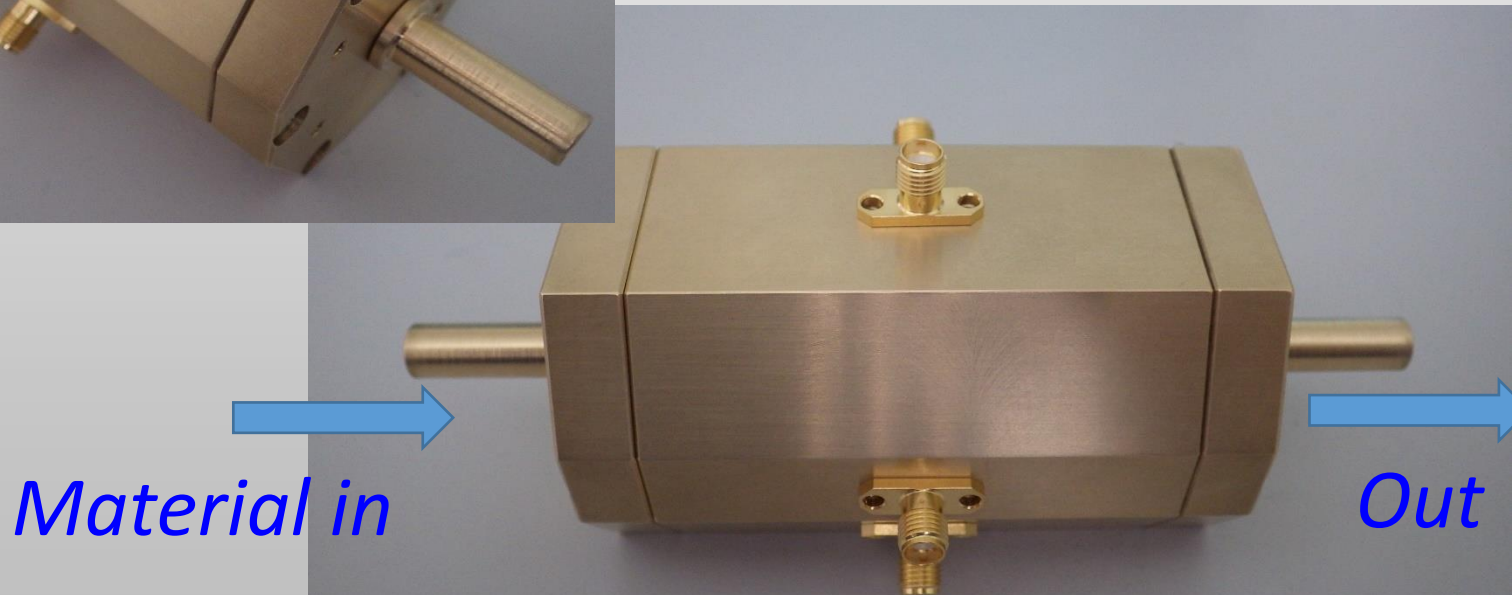
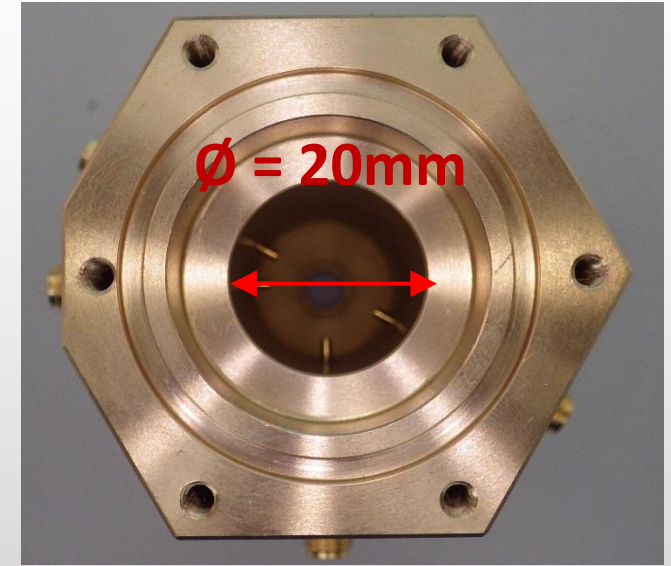
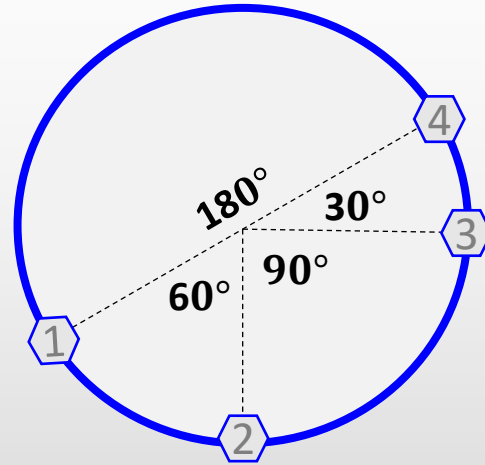
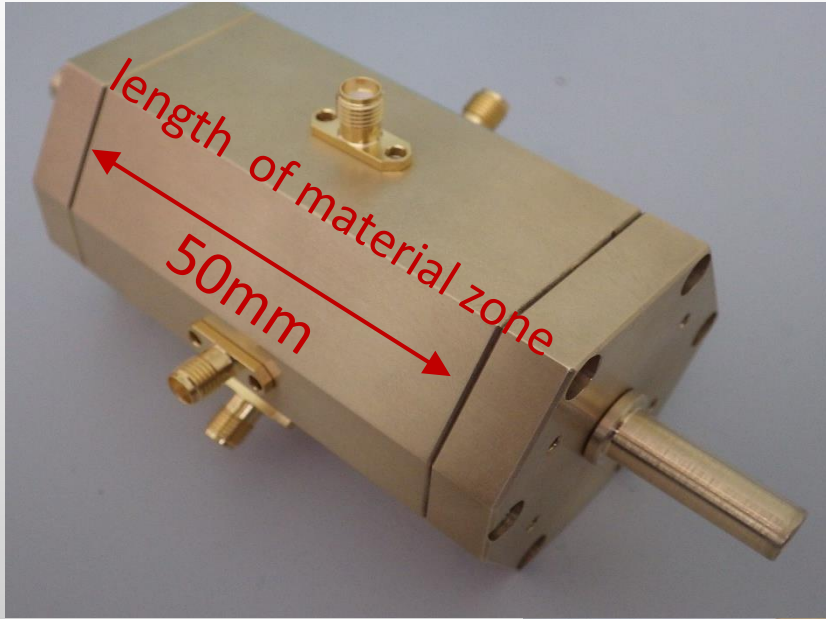


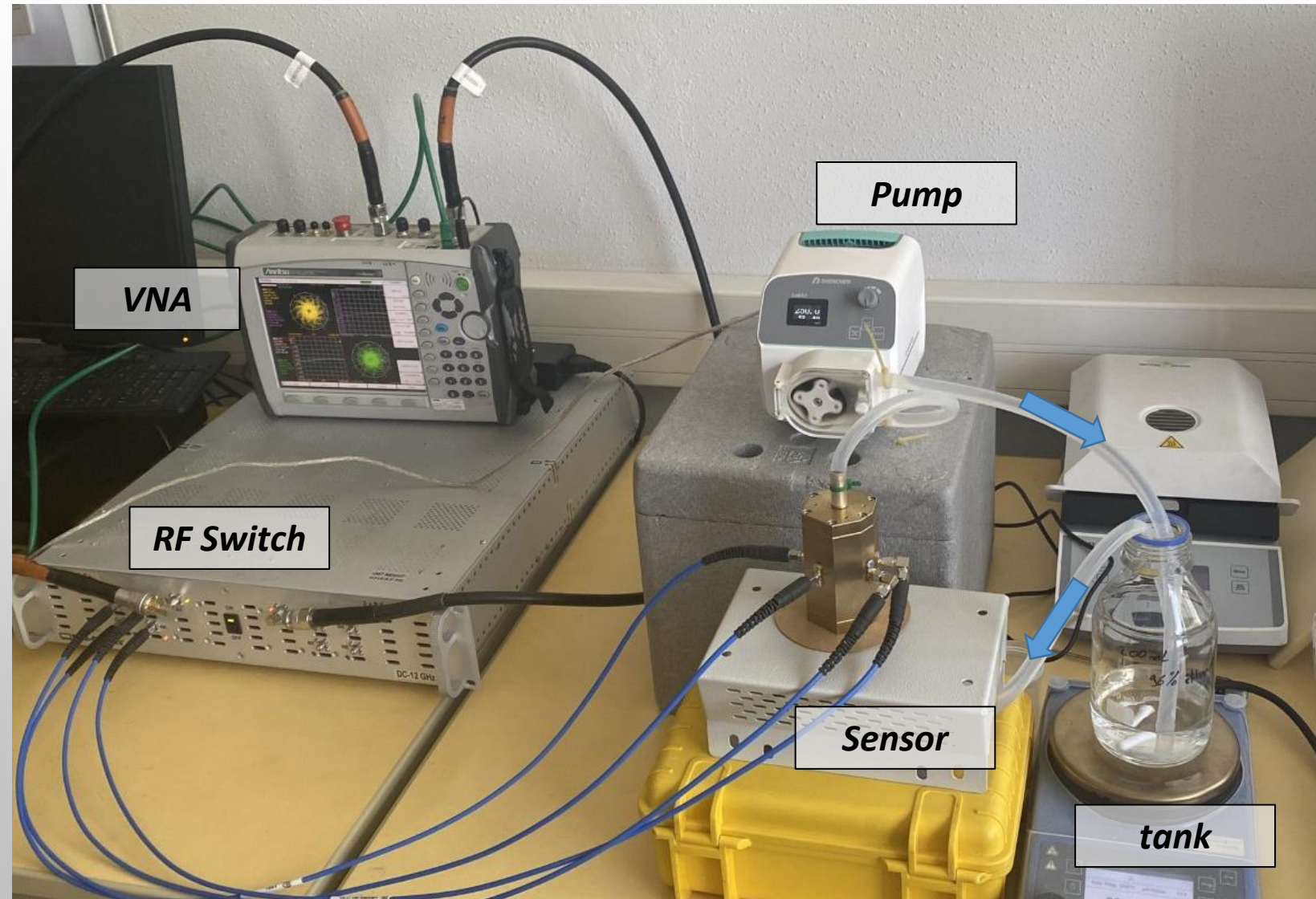
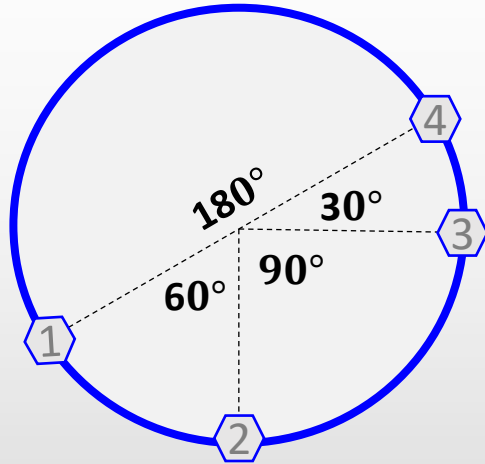


— RF cables  
— Liquid circulation (silicon hoses)

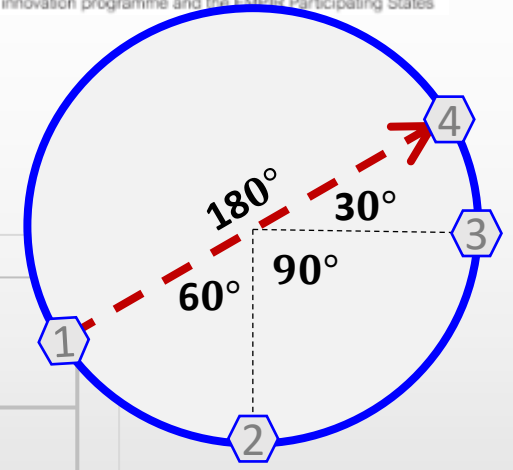
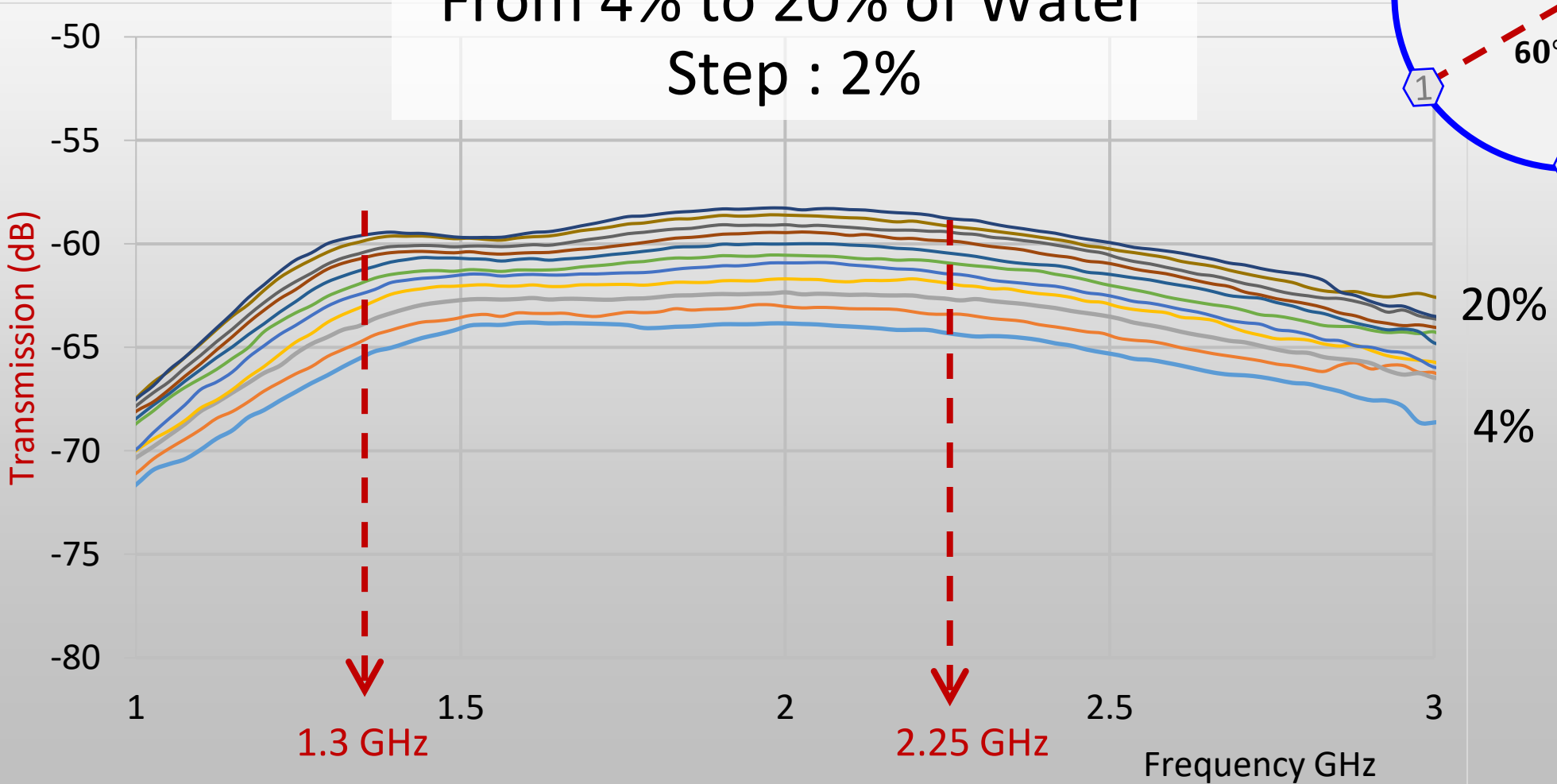
Mixture tank

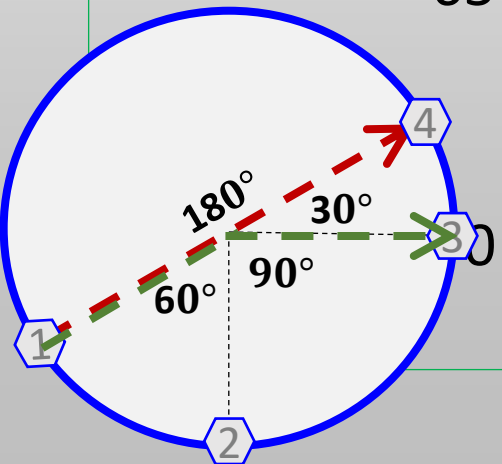
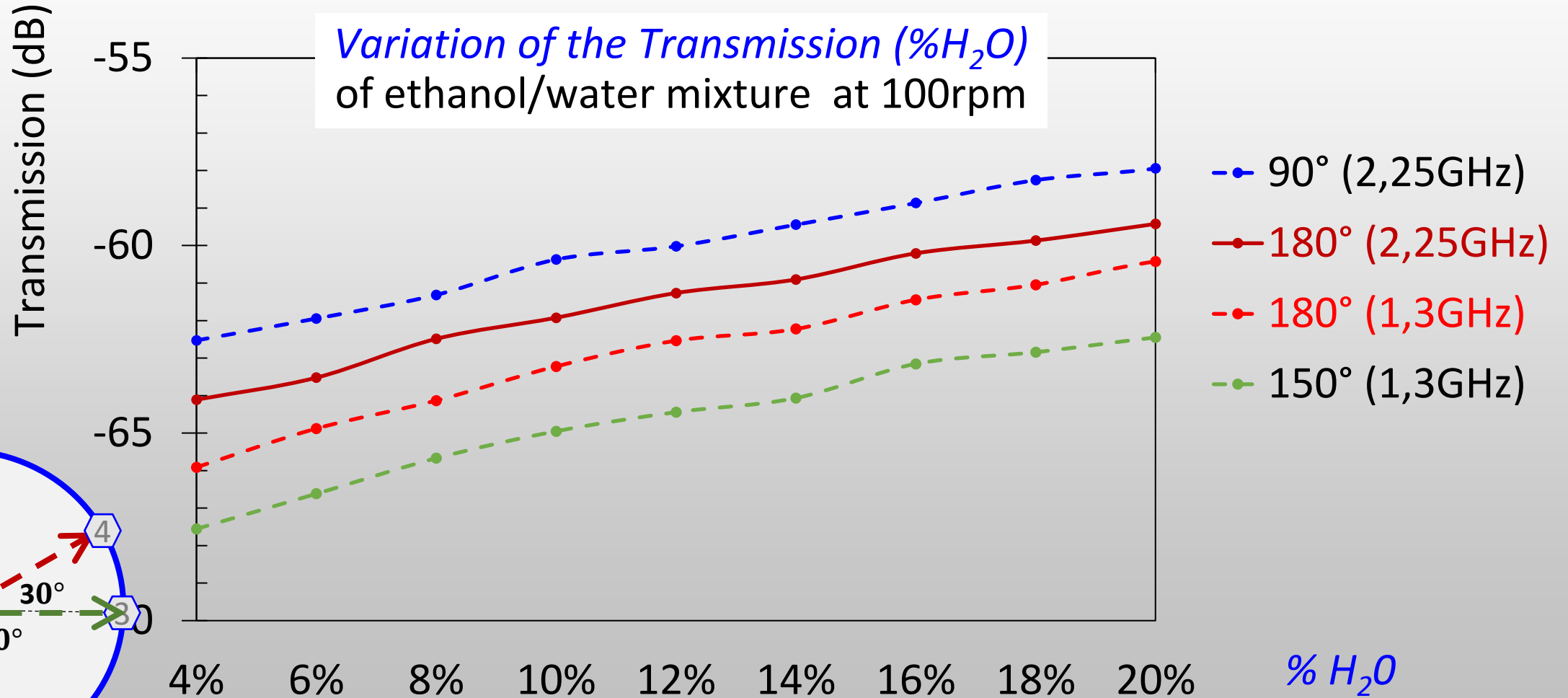
# Toward a sensor for on-line measurements





Transmission  
From 4% to 20% of Water  
Step : 2%





## Today

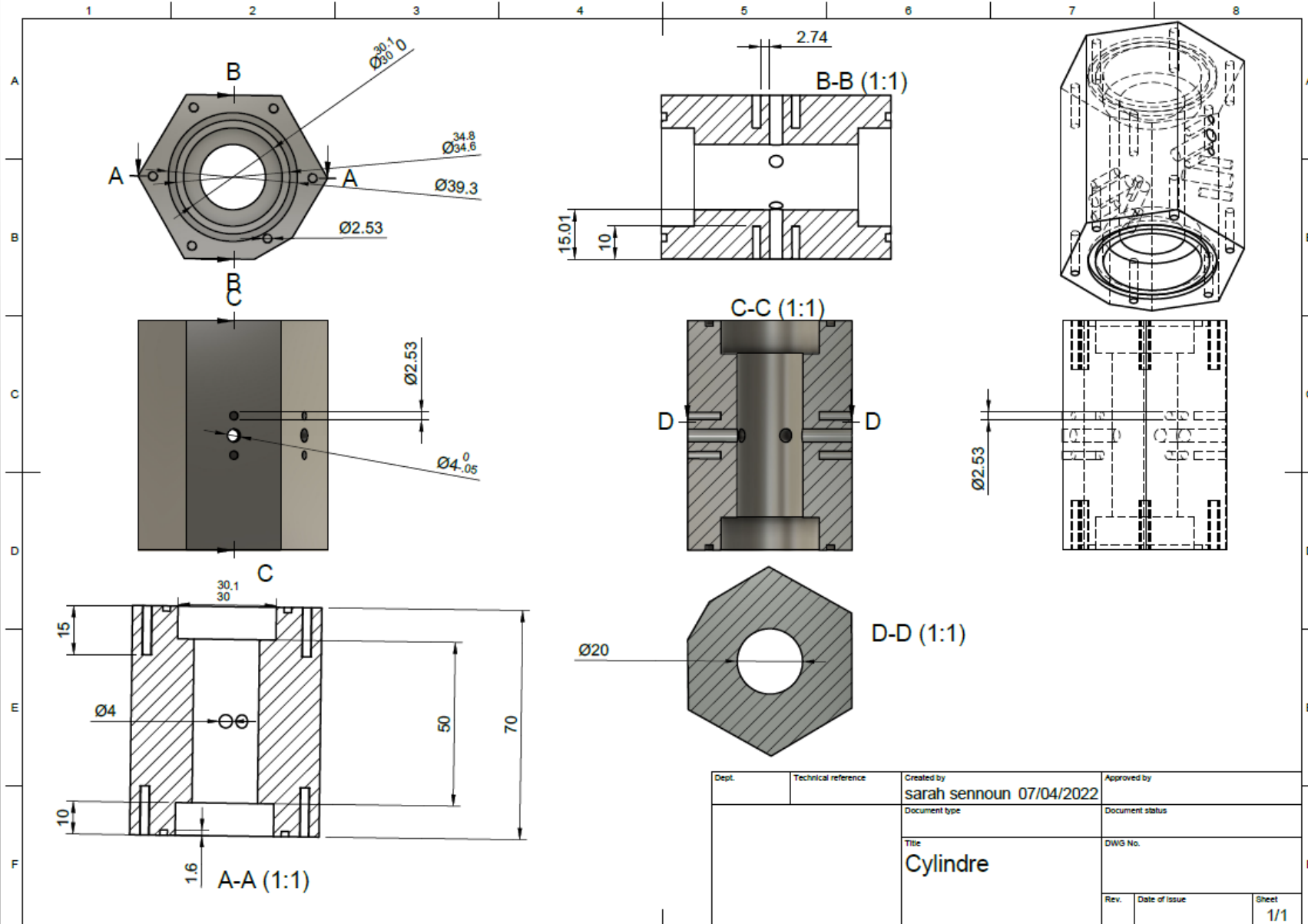
- 1- Proof of Concept of **multiprobe sensor**
- 2- Evaluation of **threshold** for water content in ethanol

OK

OK

## For the future

- 3- Evaluation of **homogeneity** of material under test
- 4- Optimisation of the measurement procedure by using the full measurement potential with all probes by applying a circular permutation
- 5- Optimisation of inverse problem
- 6- Implementation and testing on a real system.



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		Rev.	Date of issue
		Sheet	1/1

