



# Antennes optiques RX

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pour champ E et H

# Our raison d'être

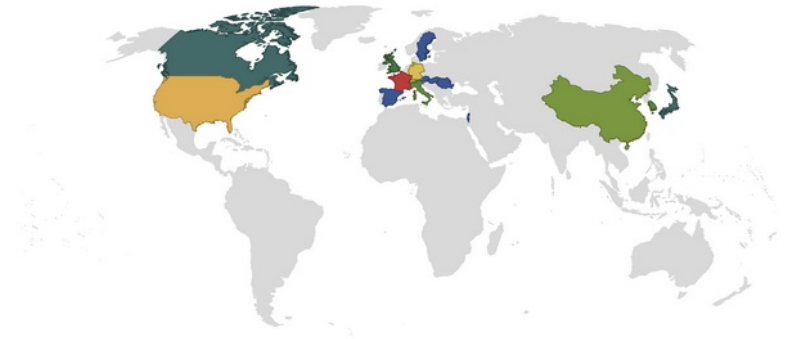
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Providing solutions to issues of  
EM field measurement in any  
environment.



# Kapteos in figures

- ◆ 14 years of experience
- ◆ A presence on 3 continents
- ◆ 100+ customers in 16 countries
- ◆ Portfolio of 8 patent families
- ◆ 145+ scientific publications
- ◆ >80% export turnover

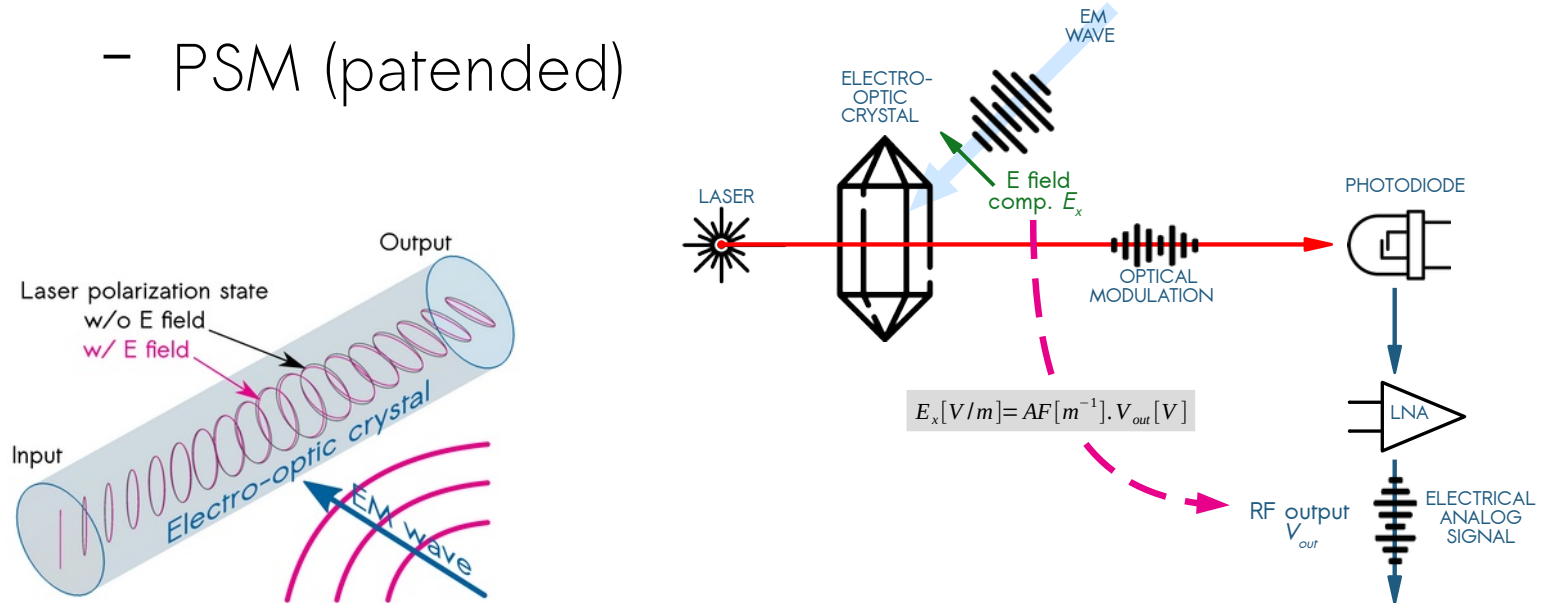


# Field probe specifications

- ◆ Linear response vs field - single axis vector meas.
- ◆ Flat response vs frequency (in modulus & phase)
- ◆ Ultra high dynamic range vs field strength & freq.
- ◆ Compliant with all media (gases, liquids, plasmas...)
- ◆ No induced interference (even in near field)
- ◆ Local measurement with high spatial resolution
- ◆ Compliant with harsh environment (P, T, UV & X rays...)
- ◆ Immune to radiated & conducted disturbances
- ◆ Long distance remote measurement

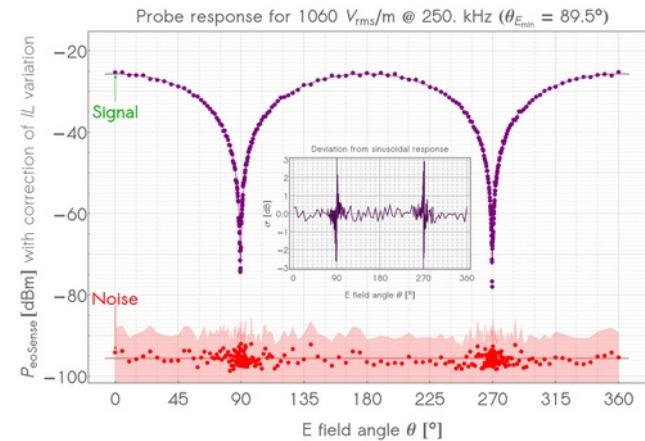
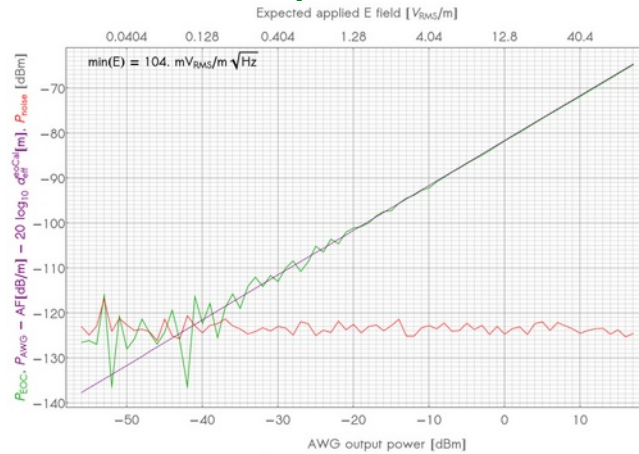
# Principle of optical E-field probes

- ◆ Based on Pockels effect (1893)
  - Refractive index variation induced by E field
  - PSM (patented)



# Field probe specifications: validation

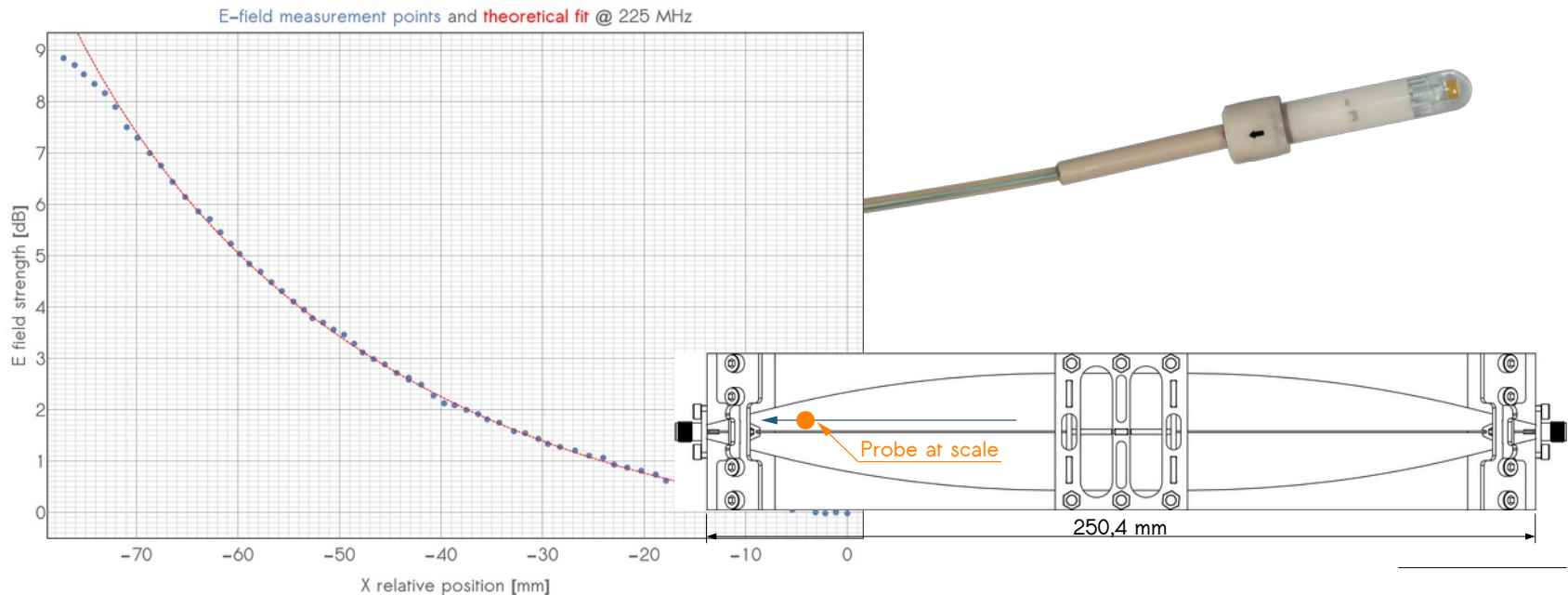
- ◆ Linear response vs field - single axis vector meas.



- ◆ Immune to radiated & conducted disturbances
- ◆ Long distance remote measurement:  $IL \sim 0.1$  dB/km

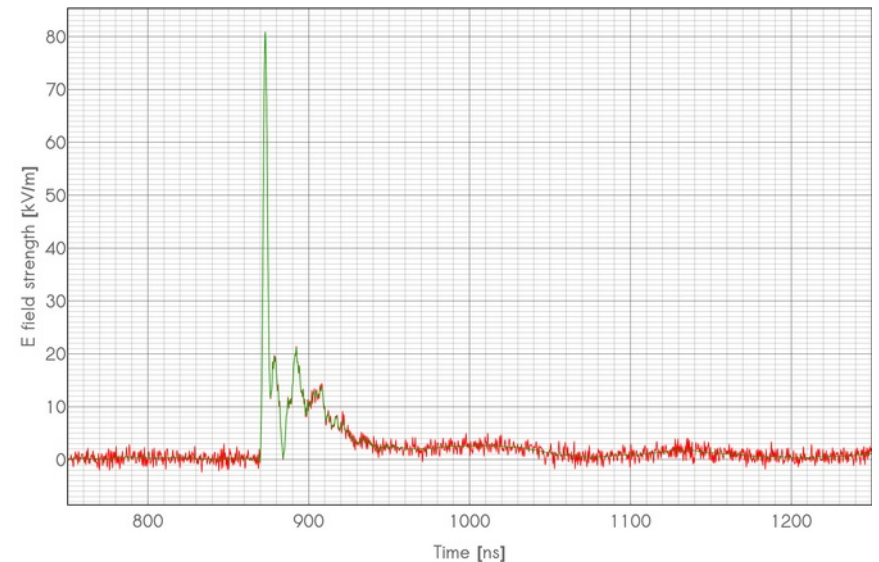
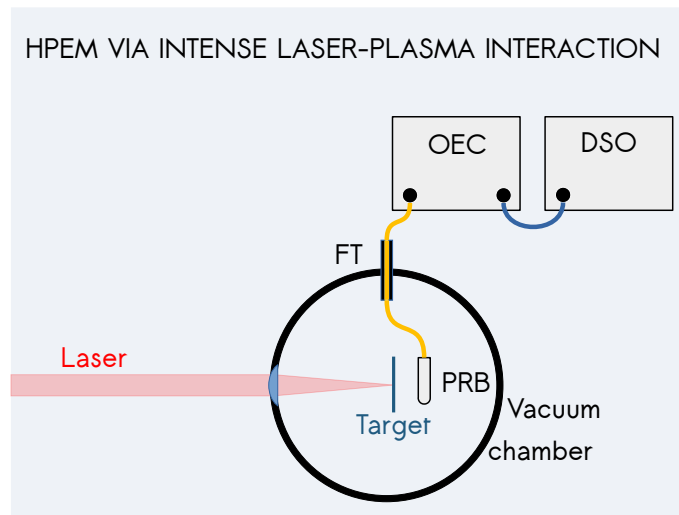
# Field probe specifications: validation

- ◆ Local measurement with high spatial resolution
- ◆ No induced interference (even in near field)



# Field probe specifications: validation

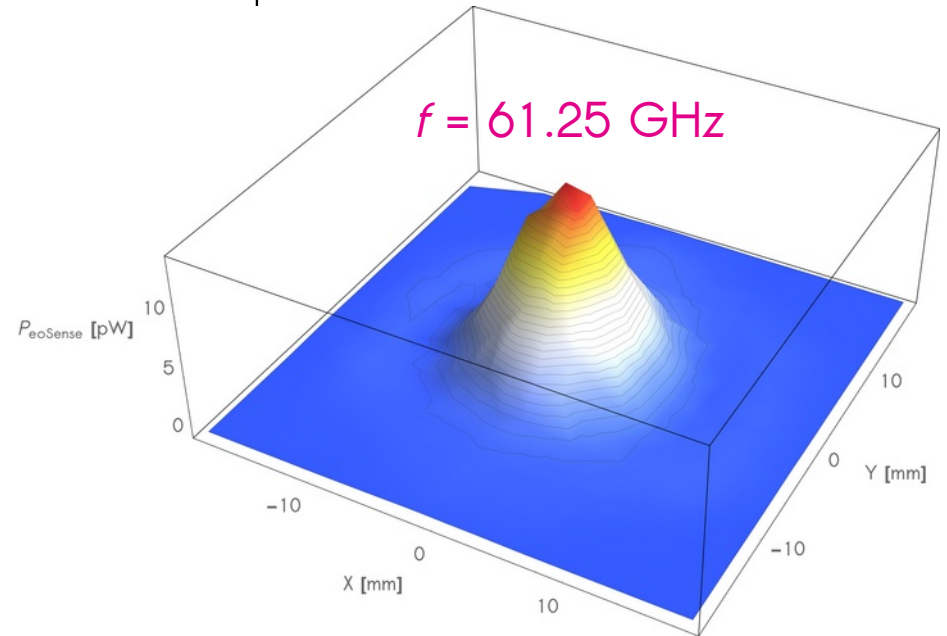
- ◆ Compliant with harsh environment (P, T, UV & X rays...)
  - 5 ns laser pulse on Al target with 33.8 J (ENEA Frascati)





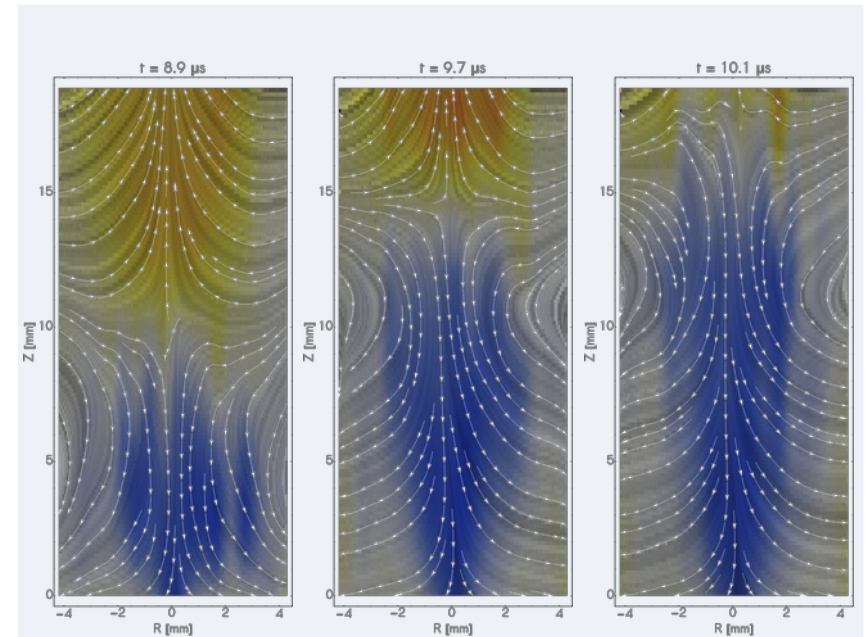
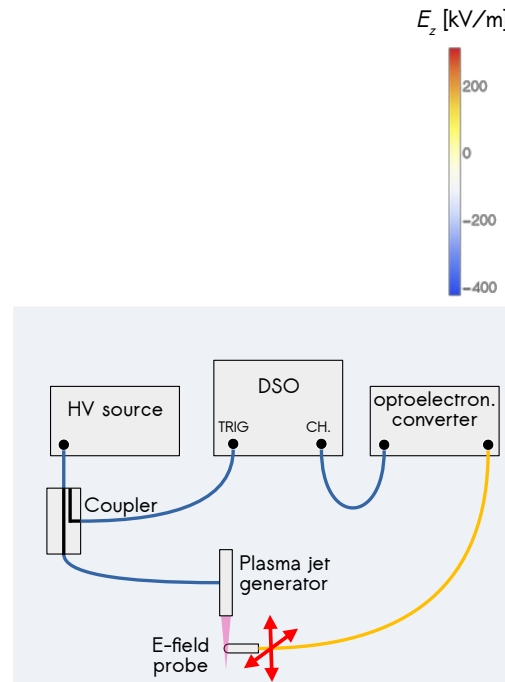
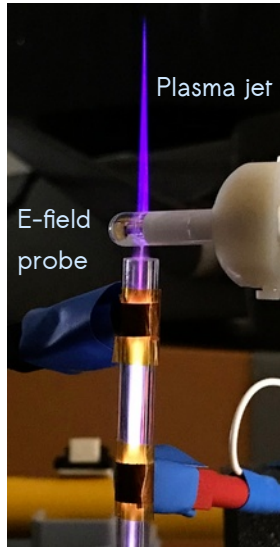
# Field probe specifications: validation

- ♦ Ultra high dynamic range vs field strength & freq.
  - E-field measurement from 10 Hz up to 60+ GHz
  - Dynamic range of 130+



# Field probe specifications: validation

- ◆ Compliant with all media (gases, liquids, plasmas...)



# Field probe specifications: validation

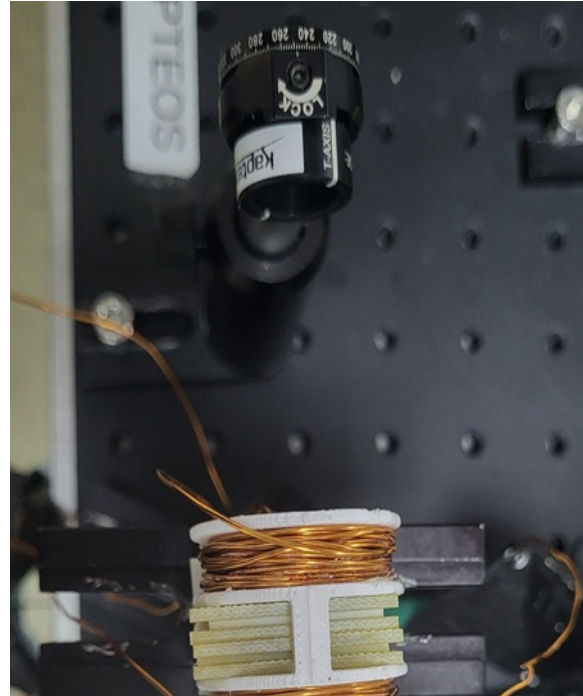
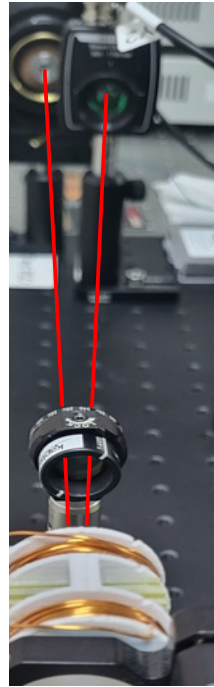
- ♦ Flat response vs frequency (in modulus & phase)?
  - Flat on 10 Hz → 500 kHz
  - Piezoelectric resonances in the 500 kHz - 10 MHz freq. range
  - Flat on 10 MHz → 10 GHz
  - Mie-type diffusion effect above 10 GHz (periodically enhanced sensitivity vs frequency)

# What about H field?

- ♦ Pockels effect: linear variation of  $n$  vs  $E_x$ 
  - Longitudinal & transverse E-field probe
  - Pockels effect is **doubled during a forth-&-back path**
- ♦ Faraday effect: linear variation of  $n$  vs  $H_z$ 
  - Longitudinal H-field probe only
  - Faraday effect is **cancelled during a forth-&-back path**

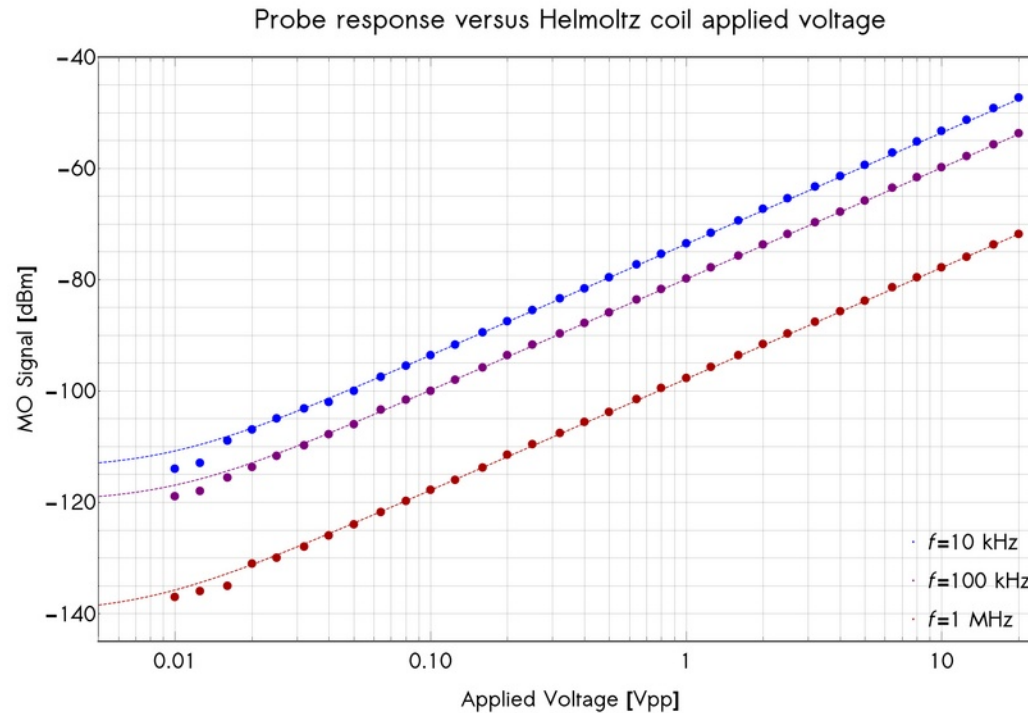
# H-field probe POC

- ♦ with COTS: same forth-&-back config. as E-field probe



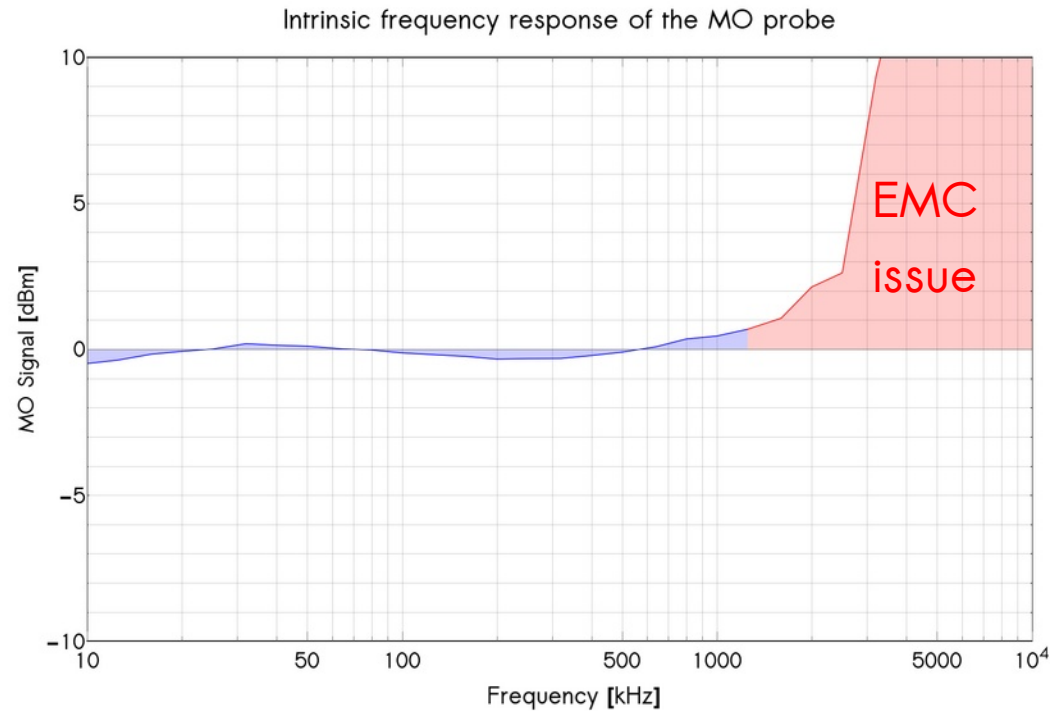
# H-field probe POC

- ◆ POC response vs appl. volt. to Helmholtz coils



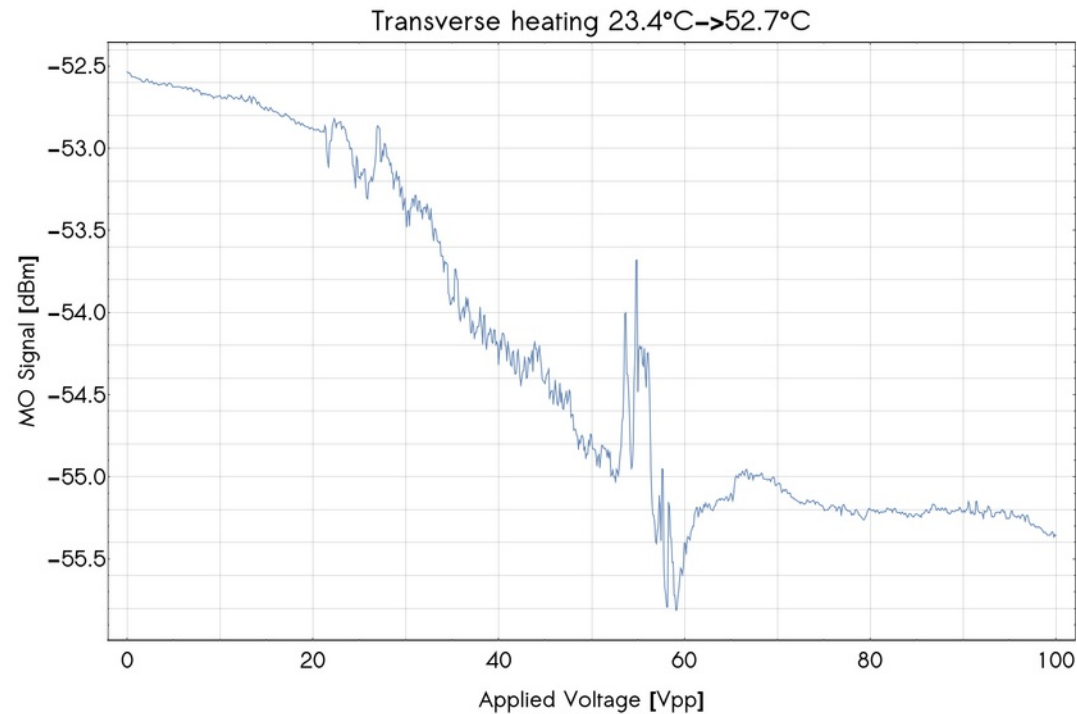
# H-field probe POC

- ◆ Intrinsic POC response vs frequency



# POC response vs temperature

- ◆ Acceptable variation of  $\sim 0.1 \text{ dB}/^\circ\text{C}$





# Résumé

- ♦ E-field probe
  - Freq. BW: 10 Hz → 60 GHz
  - E-field (1Hz RBW): 25 mV<sub>peak</sub>/m → 1.4 MV<sub>peak</sub>/m
- ♦ H-field probe
  - Freq. BW: 10 kHz → 1 MHz DC → 1 GHz expected
  - H-field (1Hz RBW): 0.025 → 250 A<sub>peak</sub>/m x 200 expected
  - B-field (1Hz RBW): 0.03 → 300 μT x 200 expected