

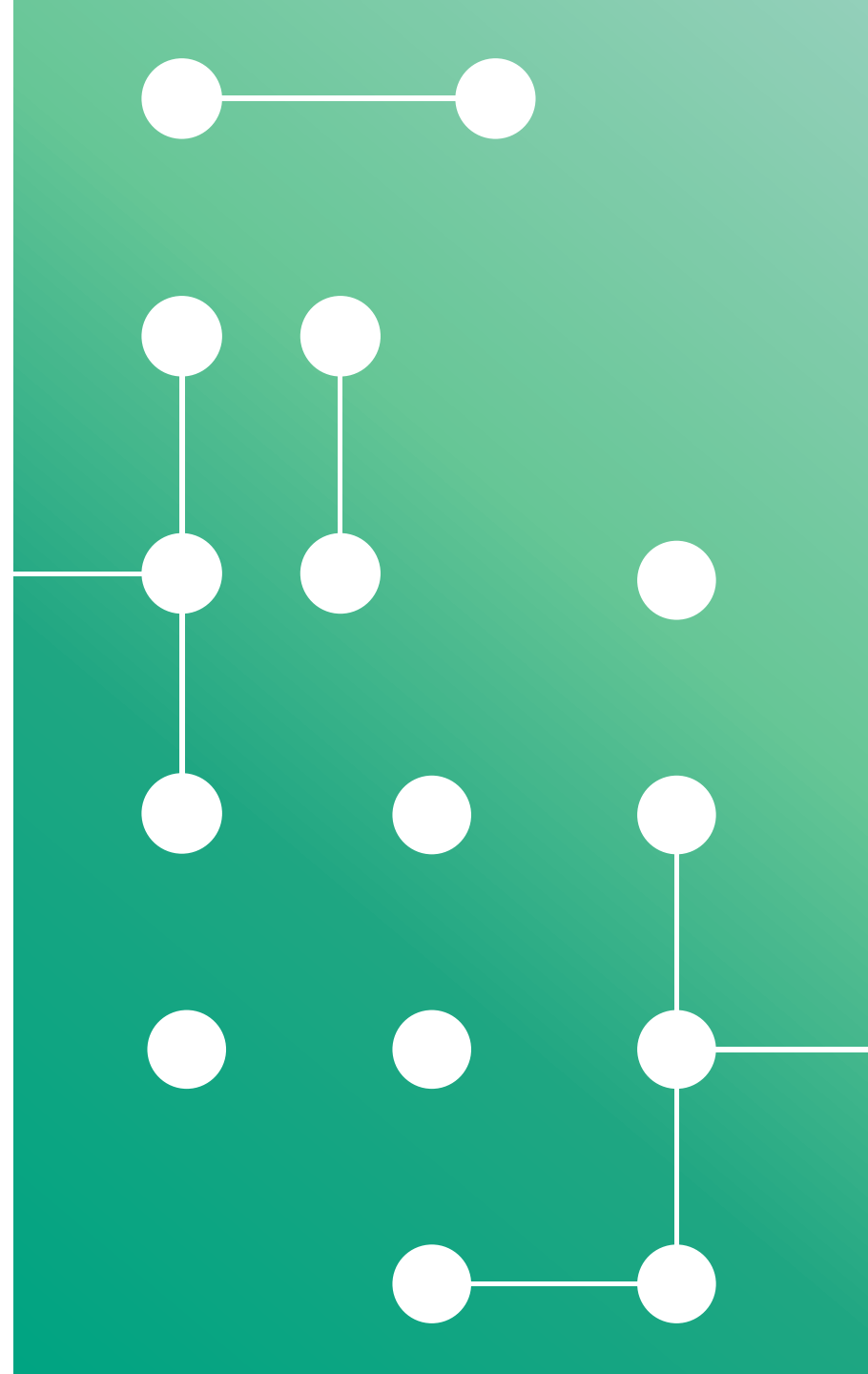
Mesures du champ électrique par E-FISH

Electric Field Induced Second Harmonic

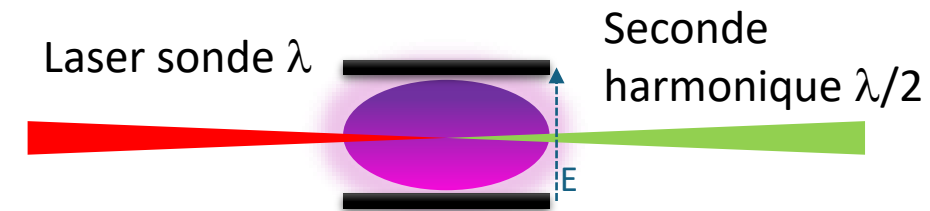
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R. JEAN-MARIE-DESIREE

Atelier diagnostics optiques des plasmas

GDR EMILI 27-30 octobre 2025



- E-FISH *Electric Field Induced Second Harmonic*
- processus non linéaire du 3^e ordre : deux photons du faisceau laser sonde (λ) se mélangent avec le dipôle induit $\rightarrow$ polarisation oscillante induite à la fréquence de la deuxième harmonique

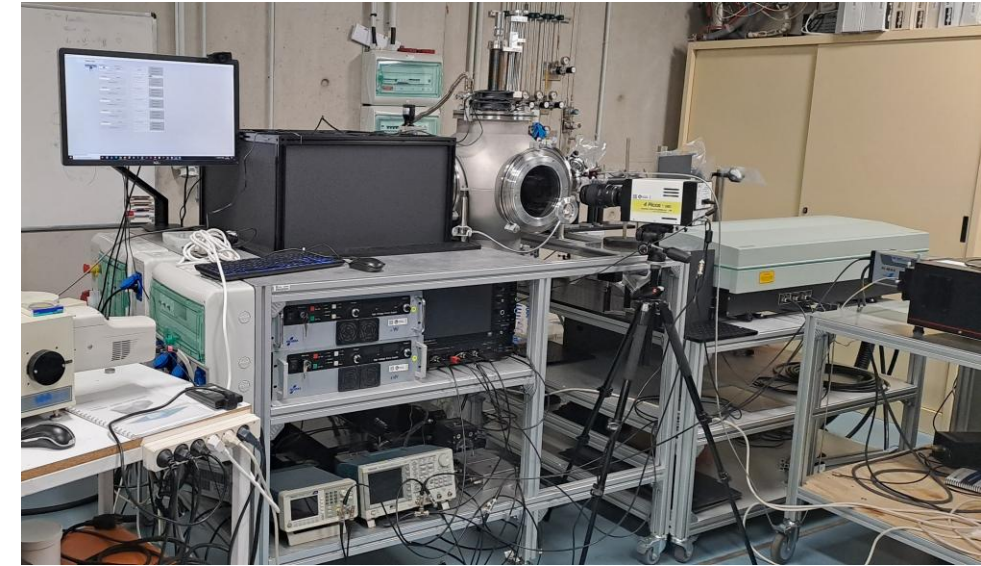
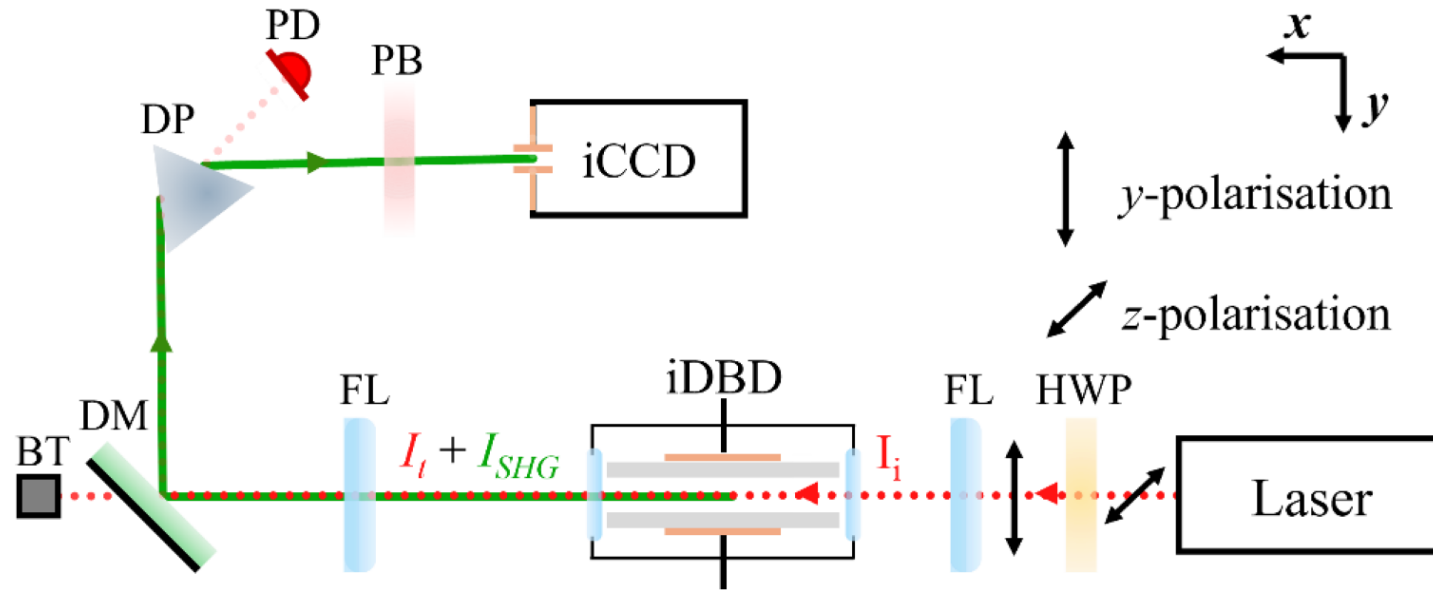


$$\text{gas} : P_i^{(2\omega)} = \frac{3}{2} N \chi_{i,g,k,l}^{(3)}(-2\omega, 0, \omega, \omega) E_k^{(\omega)} E_l^{(\omega)} E_g^{(F)} \quad [1]$$

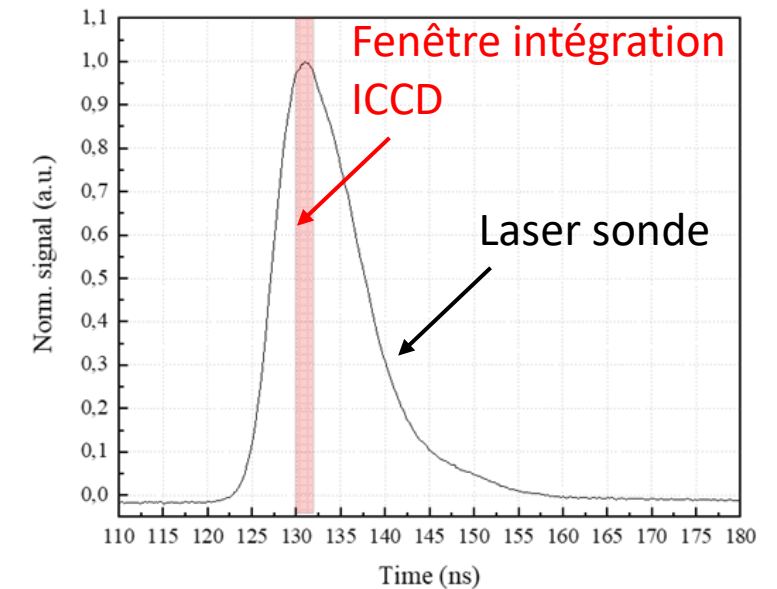
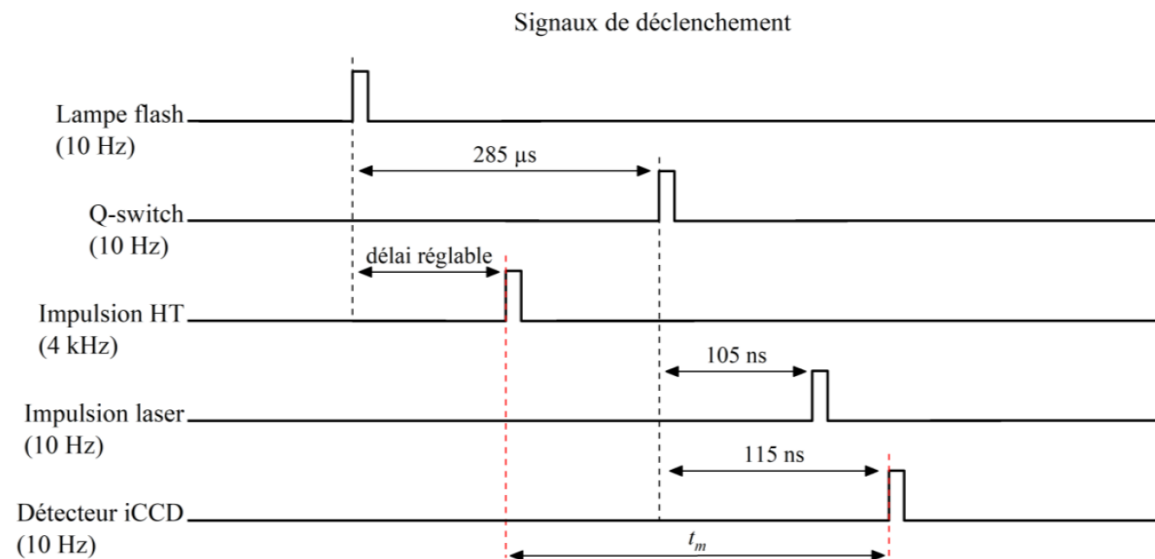
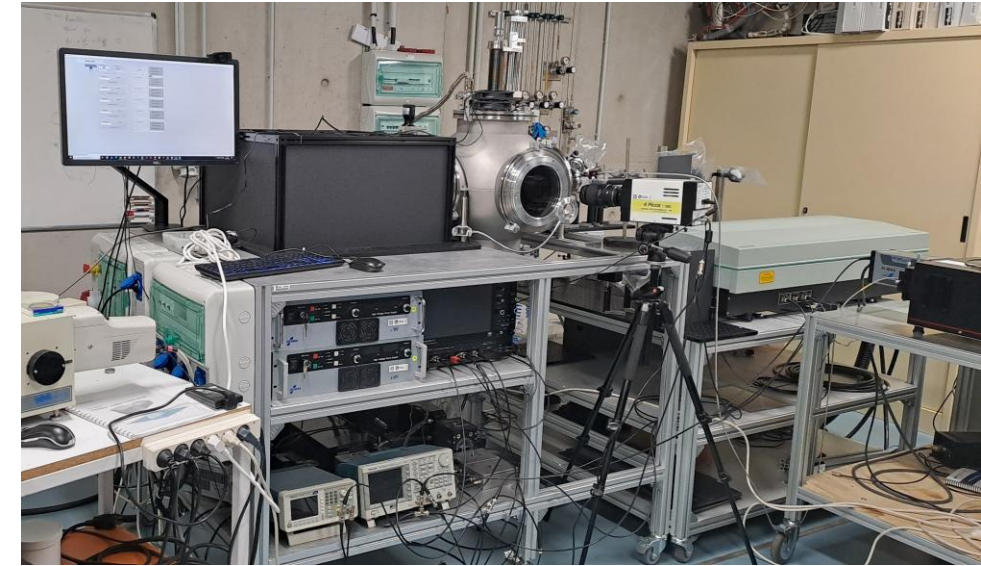
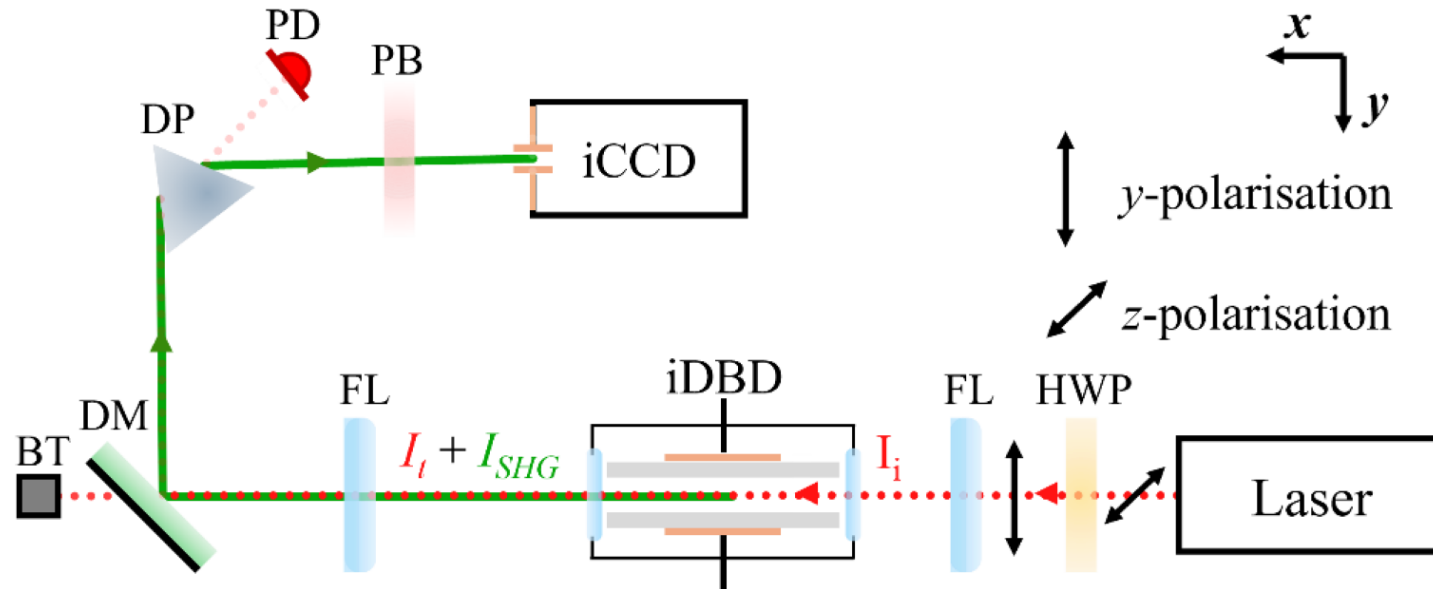
Densité (points to N)
Susceptibilité non-linéaire (points to $\chi_{i,g,k,l}^{(3)}$)
Champ électrique laser sonde (points to $E_k^{(\omega)} E_l^{(\omega)}$)
Champ électrique à mesurer (points to $E_g^{(F)}$)



$$I_{SH} = A. [N. E_g. I_{laser}]^2 \propto E_g^2$$



Impulsions laser	$f=10\text{ Hz}$, $t=12\text{ ns}$, $E=60\text{ mJ}$
Longueur d'onde	1064 nm
Diamètre beam waist	68 μm

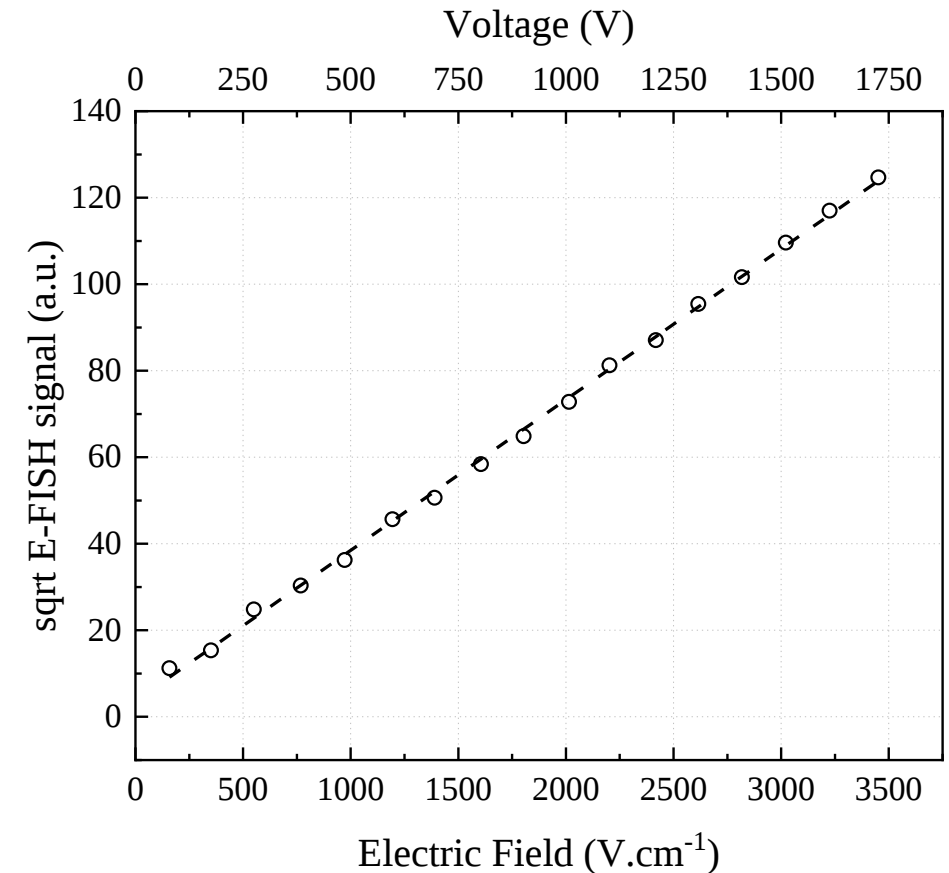
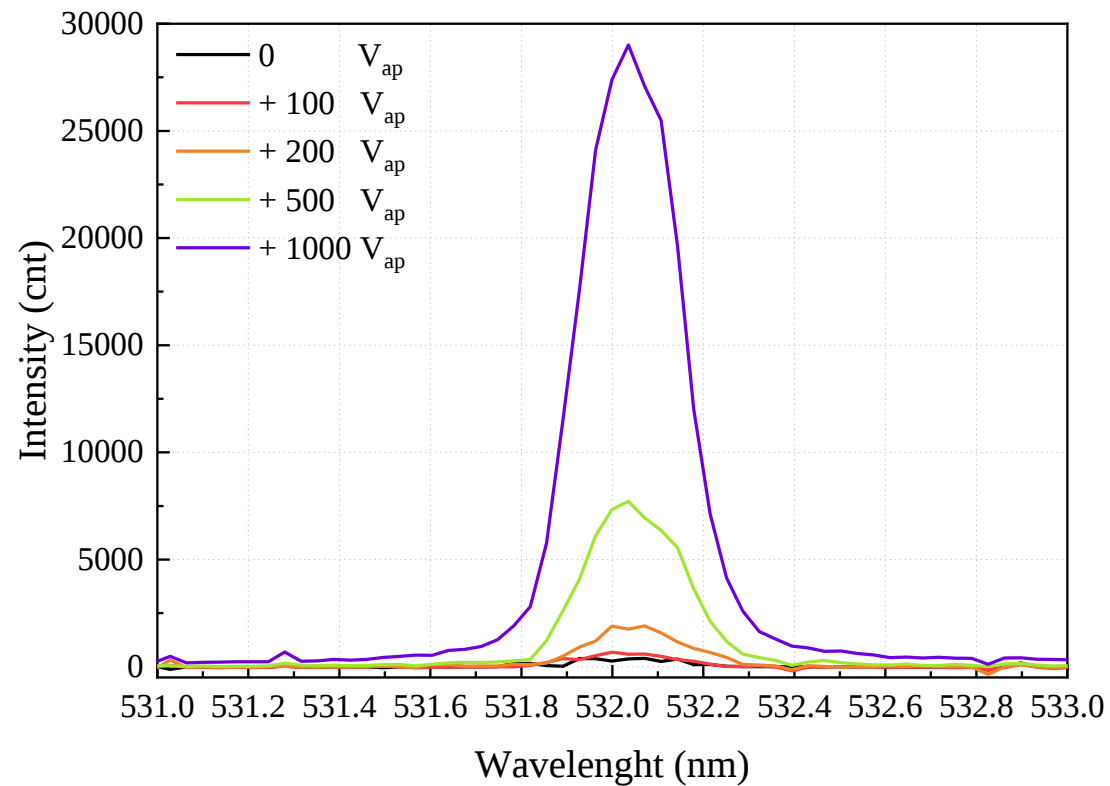




Gaz seul, sans plasma

$$I_{SH} = A \cdot [N \cdot E_g \cdot I_{laser}]^2 = k(A, N, I_{laser}) \cdot E_g^2$$

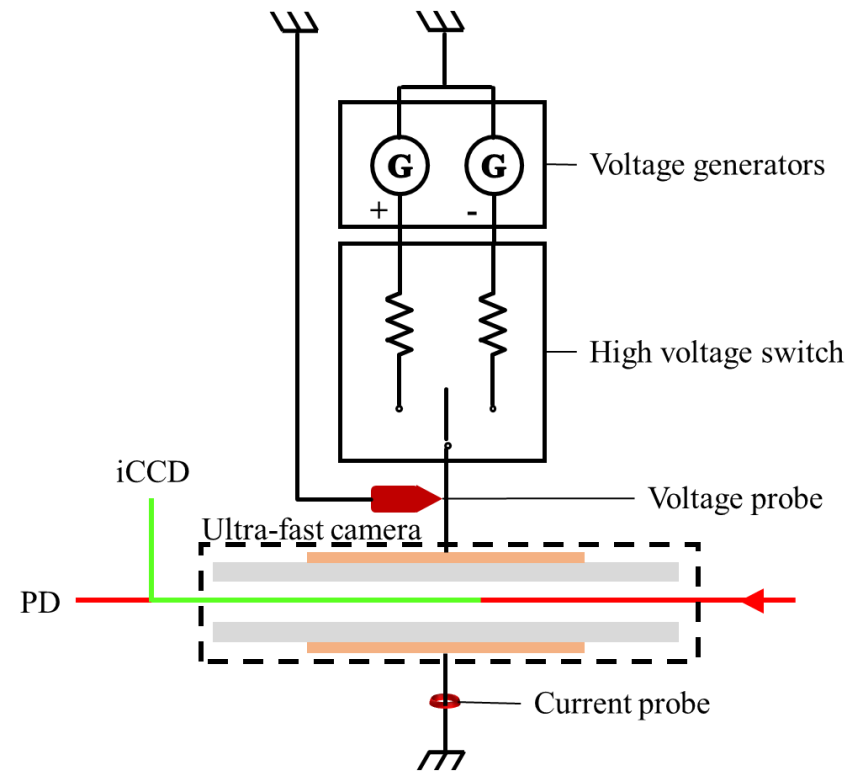
$P(\text{NH}_3)$	$1.0 \times 10^4 \text{ Pa}$
V	$\sim V - \text{DC}$
d_{ie}	5 mm



Calibration nécessaire pour déterminer la valeur absolue de E_g , valable uniquement un jeu de conditions expérimentales



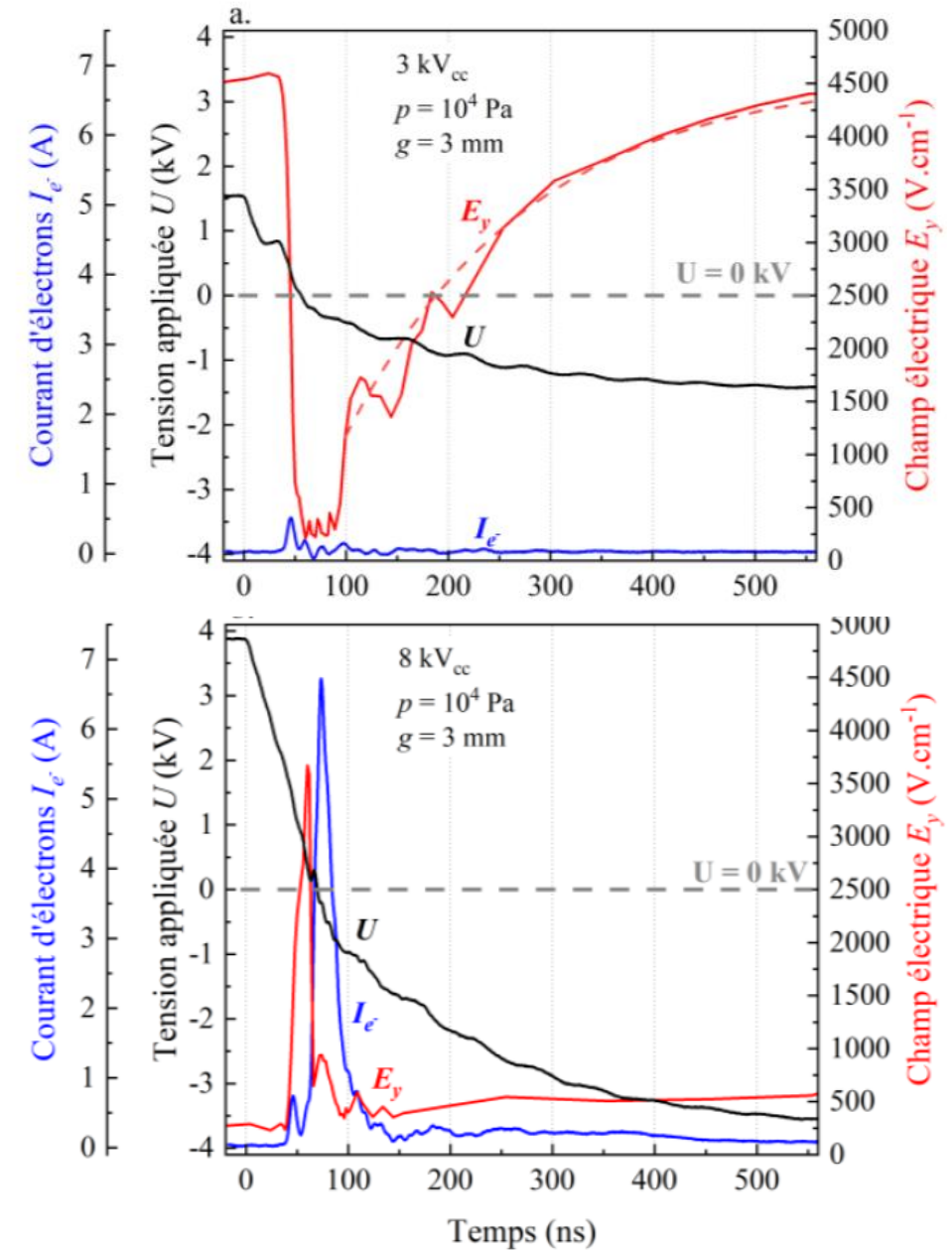
Exemple 1 : iDBD

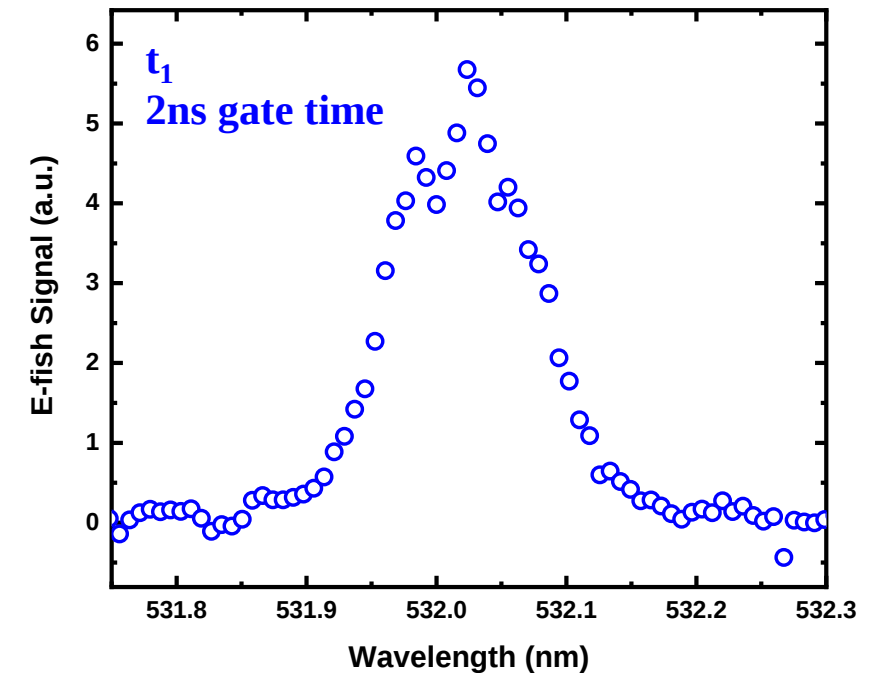
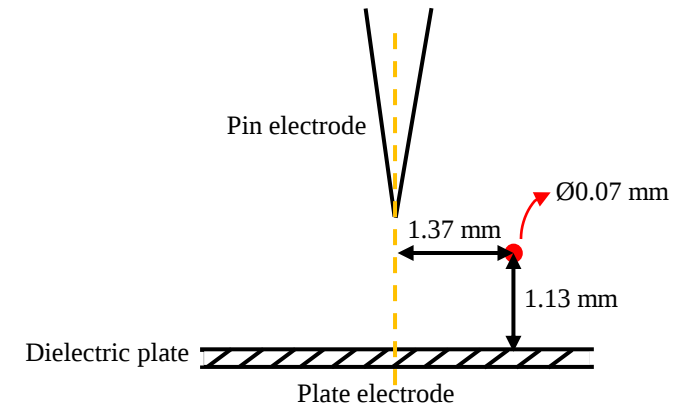
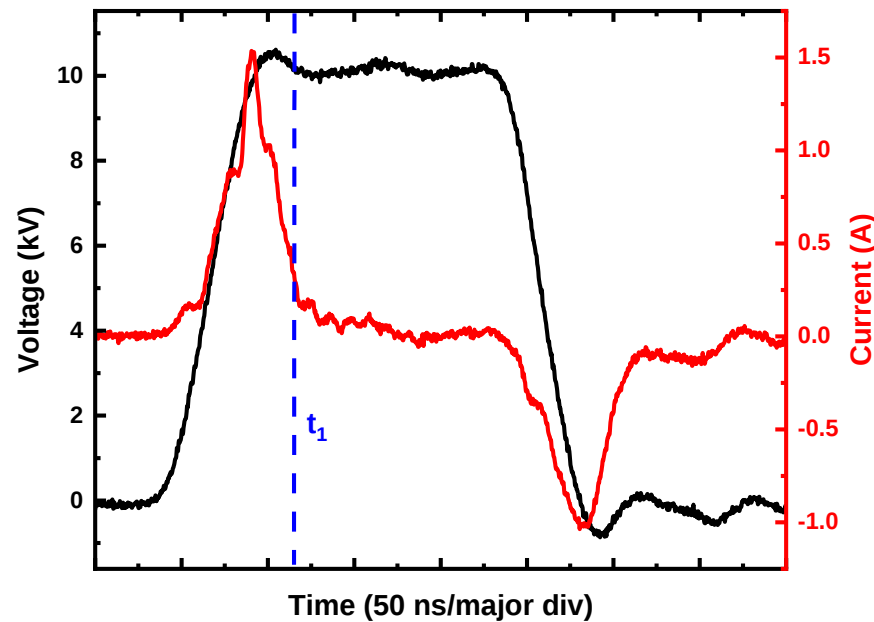
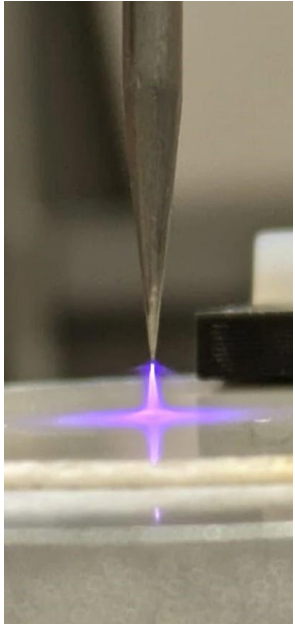


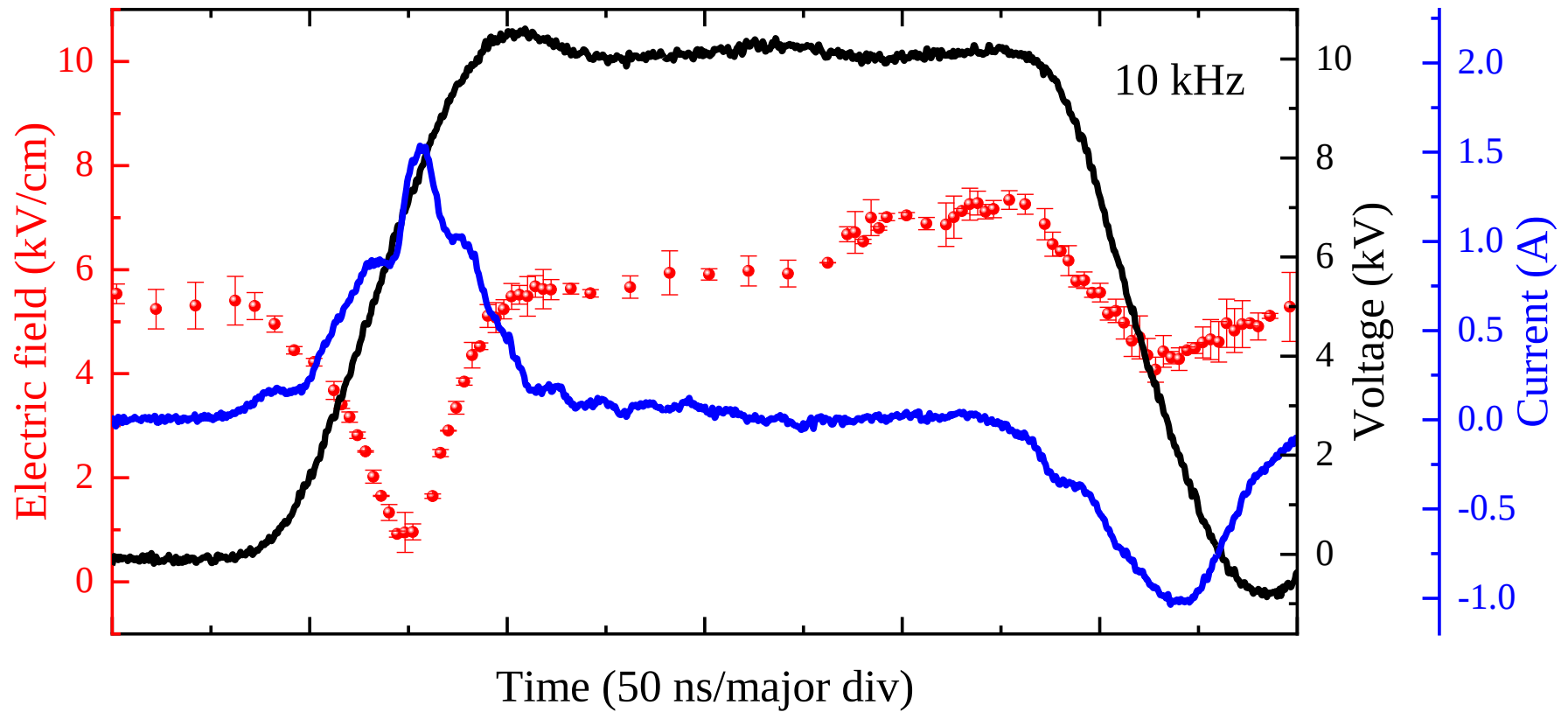
$P(\text{NH}_3)$ 1.0×10^4 Pa
 V_{pp} 3 and 8 kV_{pp} @4 kHz
Gap 3 mm

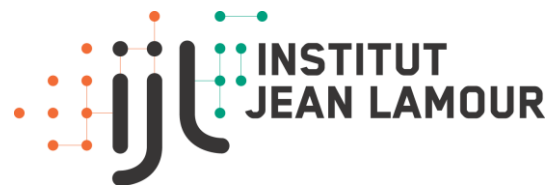
3 kV_{pp} : **No breakdown**
Without plasma

8 kV_{pp} : **Breakdown**
With plasma









Questions?





**Thank you for your
attention**