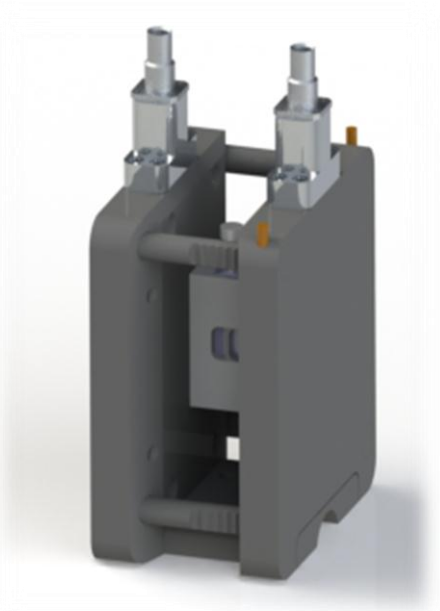


Electric field cell for SANS

A. Hélyary (LLB)

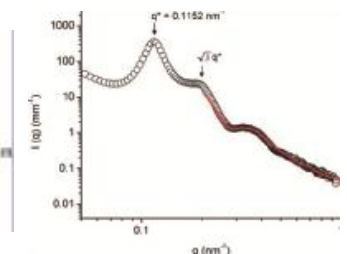
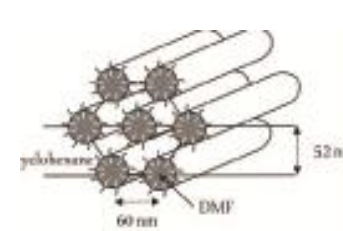
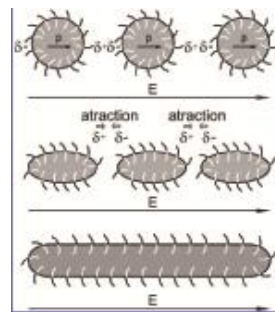
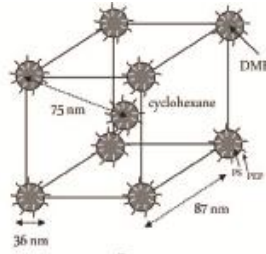
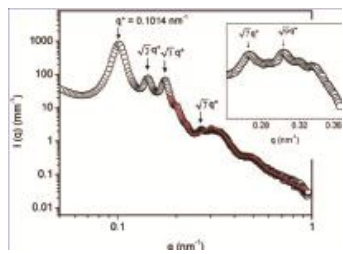
- ▶ Previous experiments on electric field at LLB
- ▶ Prototype presentation
- ▶ Experiment
- ▶ Problem: what is the exact value of the electric field?
- ▶ Next steps



Previous experiments on electric field at LLB

- ▶ Stepanek Nallet et al. Macromolecules, 2010 (PAXY)

Diblock copolymer PS-*b*-PEP (polystyrene-*block*-poly(ethylene-*co*-propylene))
 + mixture of cyclohexane (C₁₂H₁₂) and dimethylformamide (DMF).



Spherical microdomains of DMF
 into a liquid C₁₂H₁₂ matrix
 with the liquid-liquid interfaces
 covered by
 PS-*b*-PEP diblock copolymer chains.

1.5kV/mm

E → generates dipole moments
 in DMF-spheres
 → deformed and
 interconnected.

→ Hexagonal packed
 cylinder structure

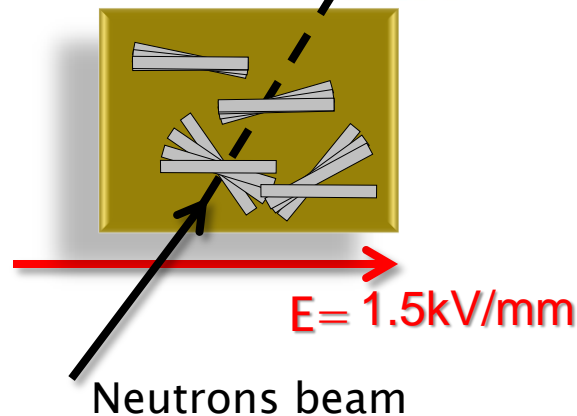
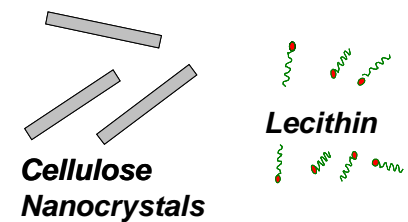
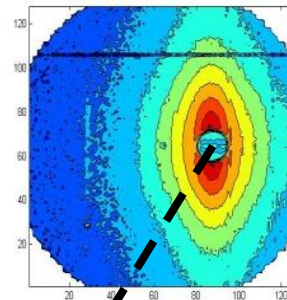
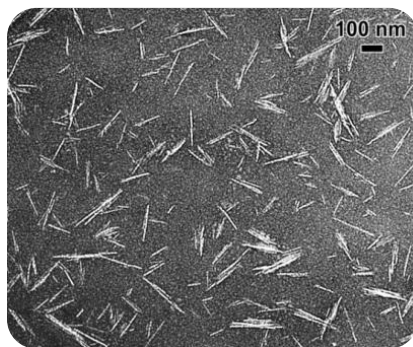
3D cubic structure



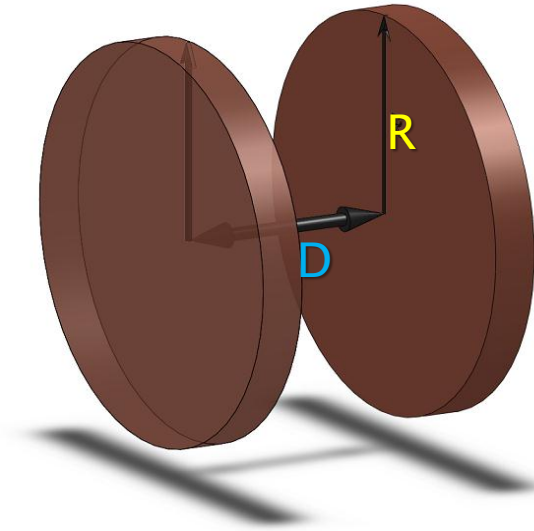
Previous experiments on electric field at LLB

- ▶ Stepanek Nallet et al. *Macromolecules*, 2010 (PAXY)
- ▶ Laurent Heux et al. CERMAV, 2012 (PAXY)

Mixture lecithin/ deuterated cellulose nanocrystals (WD lecithin) in toluene ($\epsilon_r = 3$)



Prototype presentation



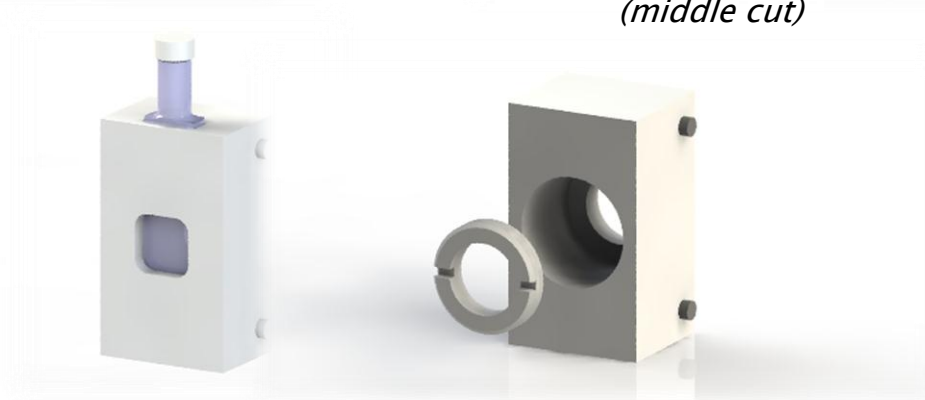
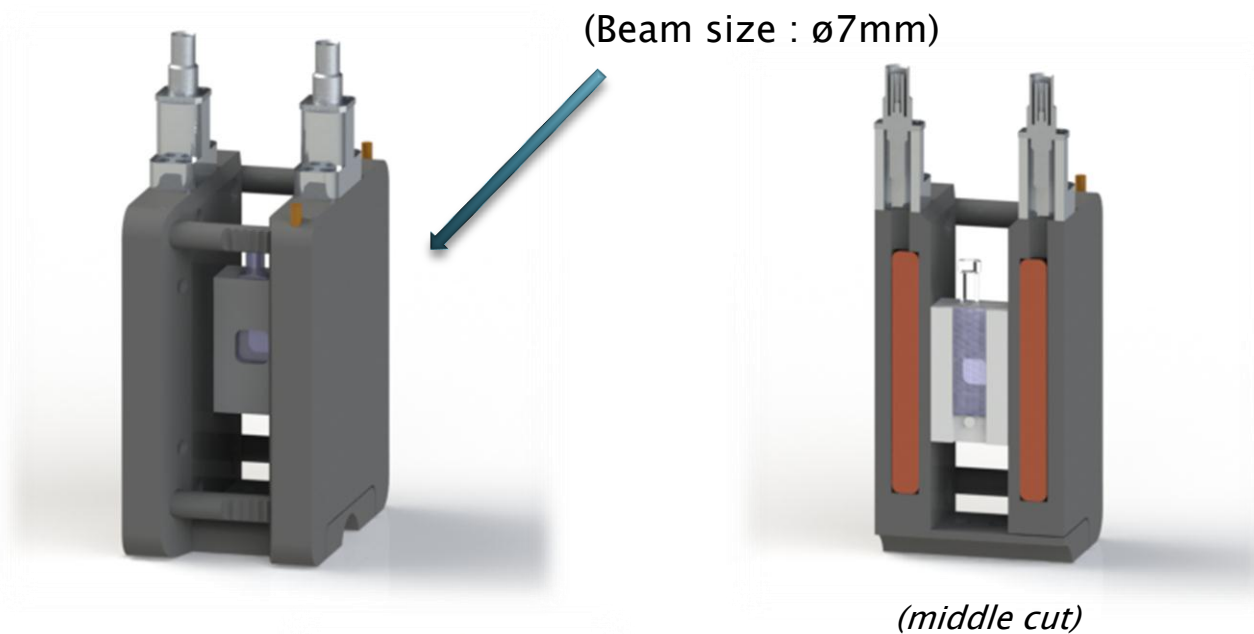
- ▶ 2 electrodes plates with electric charge and same axis
(R : radius & D : distance between her).
- ▶ $D \leq R \rightarrow$ homogeneous electric field at the center $\left(E = \frac{U}{D}\right)$

Example: Electric field with a tension $U=10\text{kV}$

Distance between copper (mm)	12	18.5	25	31.5	38
Electric field (kV/mm)	0.83	0.54	0.4	0.32	0.26

Prototype presentation

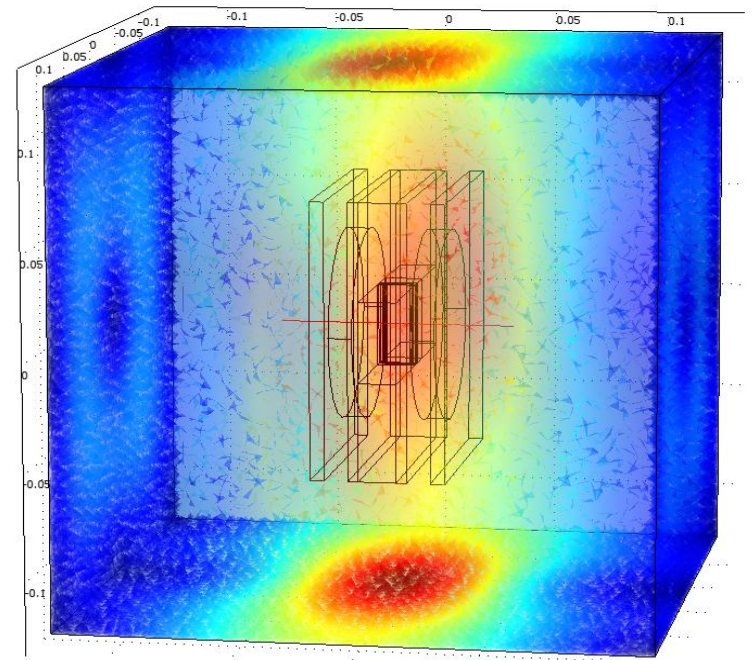
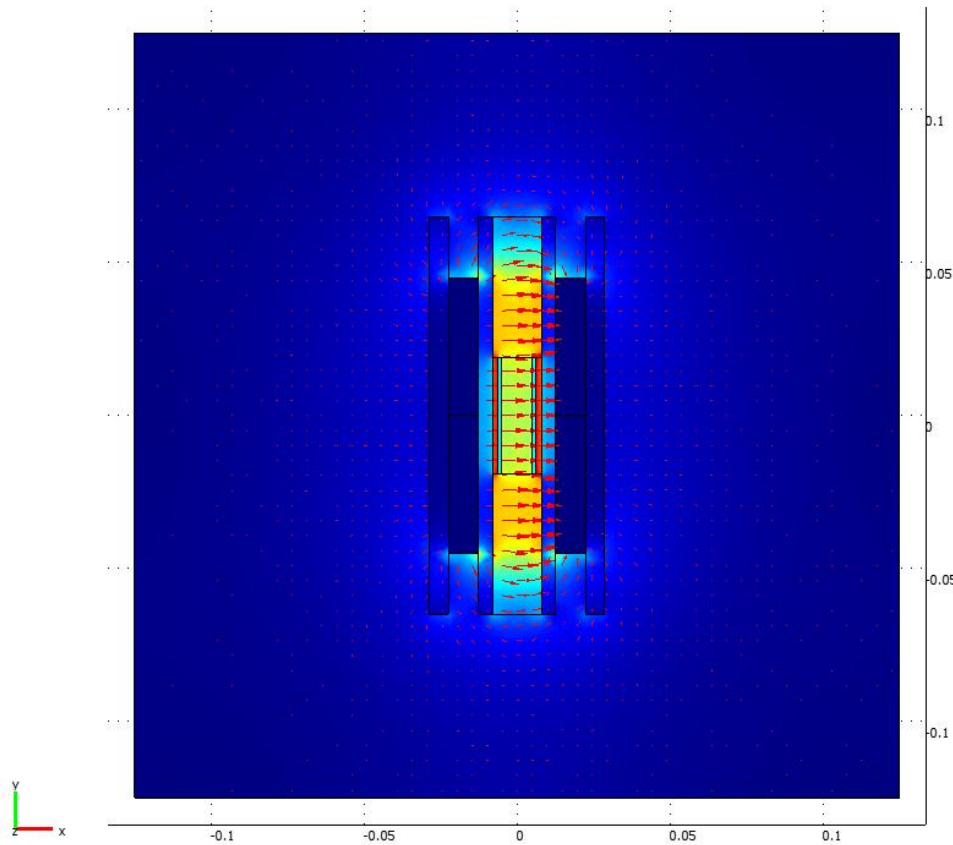
Neutrons beam
(Beam size : $\varnothing 7\text{mm}$)



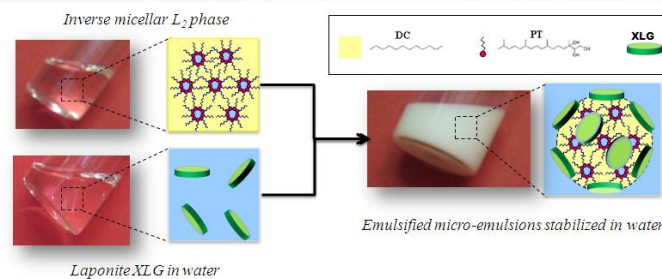
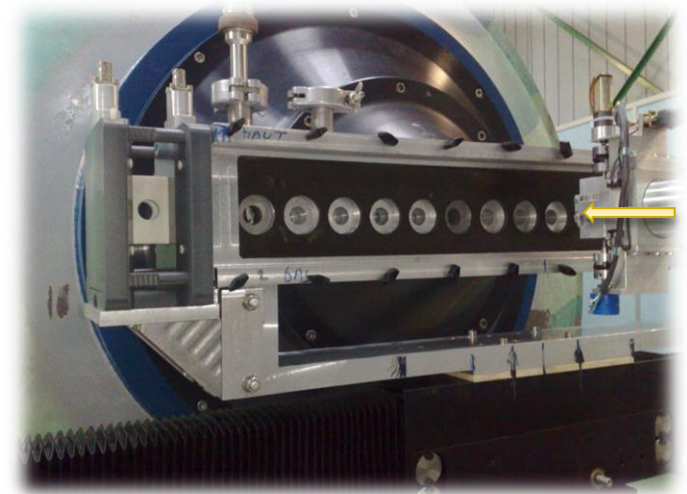
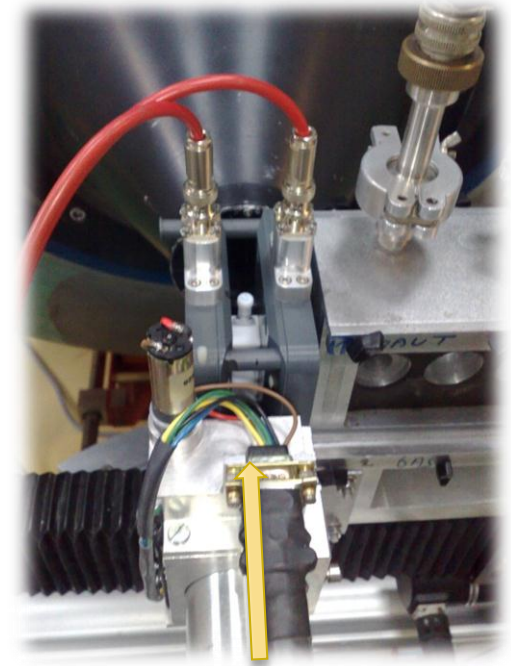
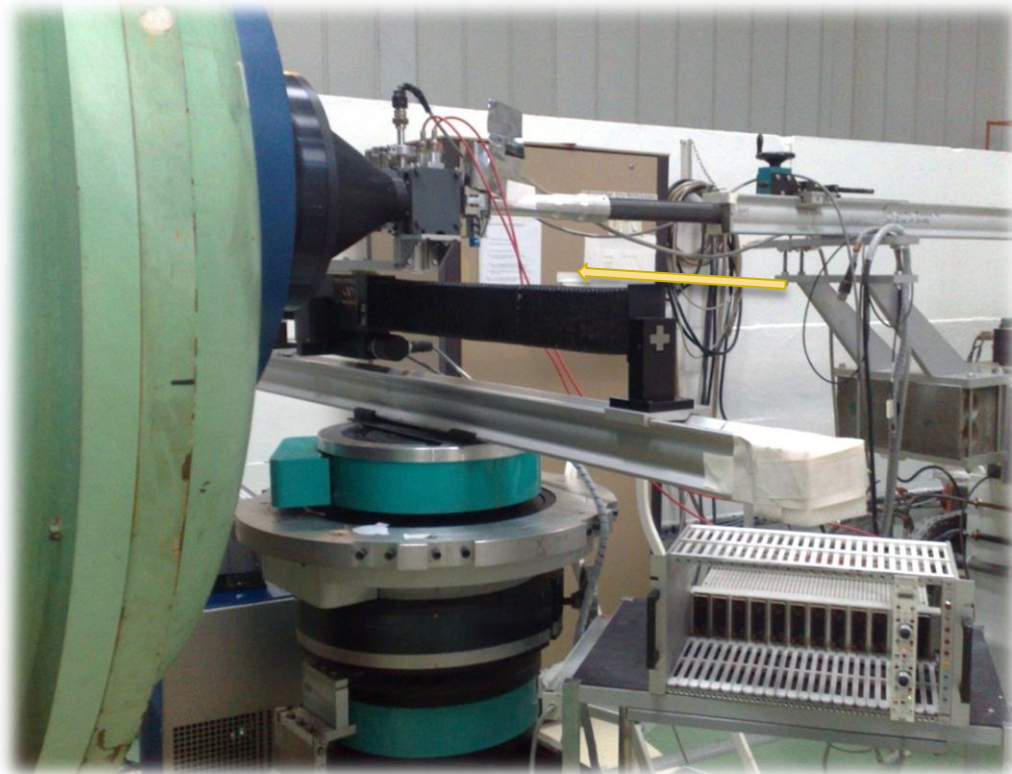
Sample cells

Prototype presentation

Simulation with Comsol software



Experiment



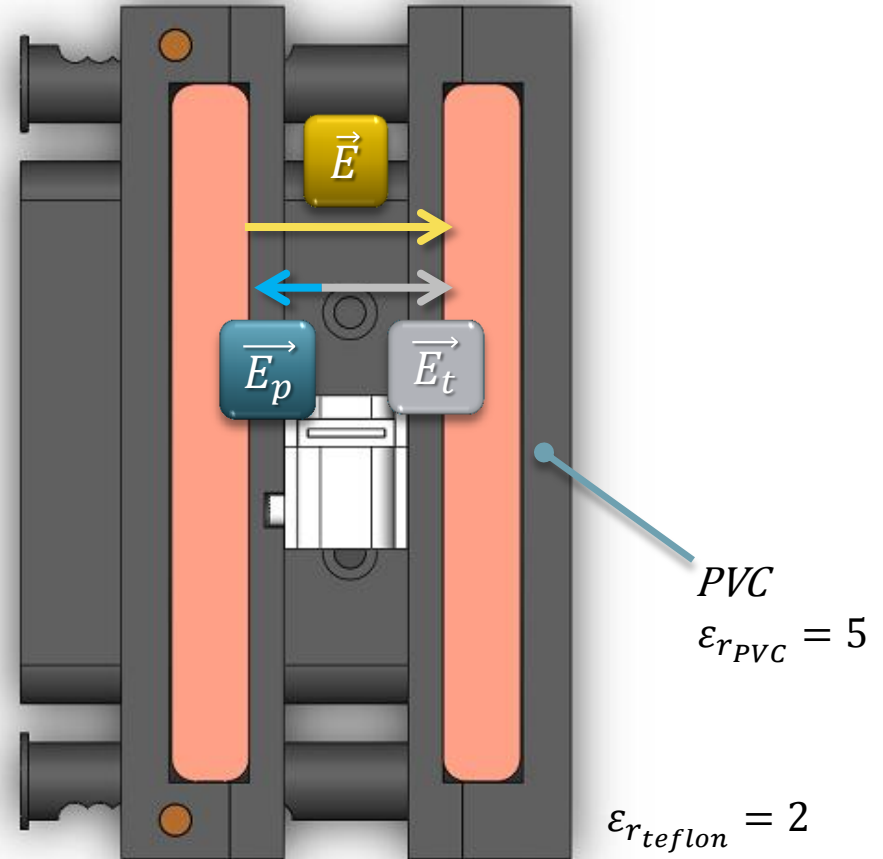
Problem: what is the exact value of the electric field ?

E : Theoretical electric field

E_p : Electric field polarization

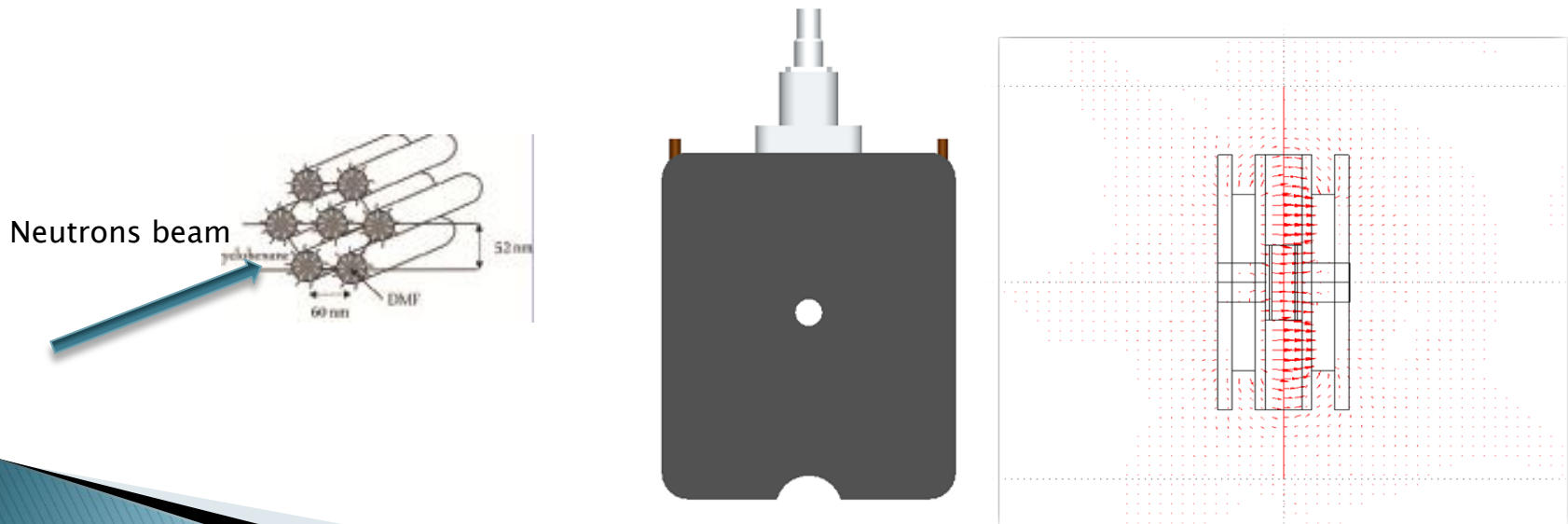
E_t : Total electric field

$$\begin{cases} \vec{E}_t = \vec{E} + \vec{E}_p \\ E_t = E - E_p \end{cases}$$



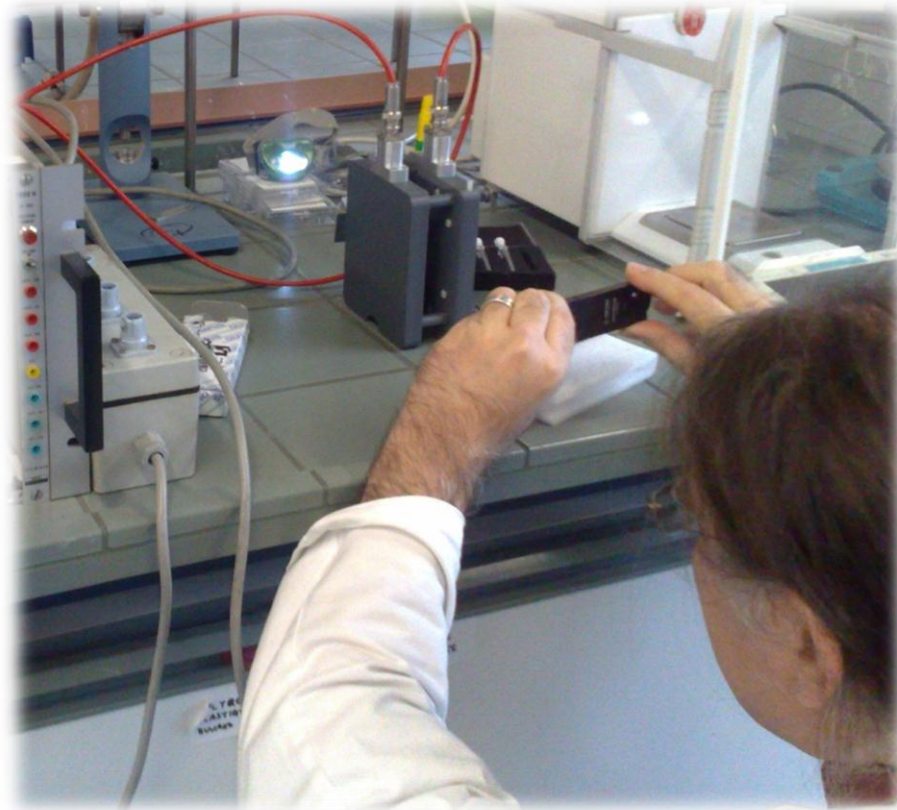
Next steps

- ▶ Comparison test between the two approaches to see the influence concerning the dielectric material
- ▶ Find a system to measure the electric field inside the sample
- ▶ Development of a new device with the neutrons beam parallel to the electric field to measure structures like below:



Thanks

F. Boué, A. Brûlet, F. Cousin, P. Judeinstein, F. Muller



Visual observation of a liquid crystal inside the prototype