Internship proposition level M1/M2

Duration: 3-6 months (starting February 2025) **Location:** Grenoble

Desired Profile: Electrical Engineering background, or Master's degree in Physics or in Materials Science

Contact:

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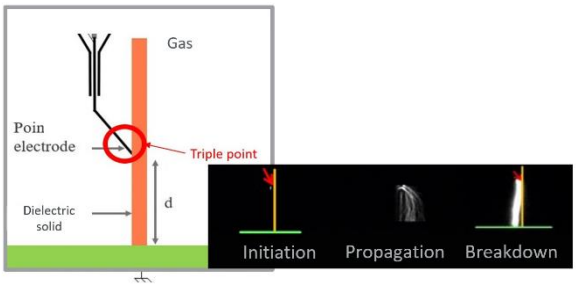
Key words: High Voltage, Triple Point, Gas/Solid Insulation, Charge Density, Potential Decay, Breakdown, Pre-Breakdown.

Charge Accumulation in Polymers: Application to High Voltage Hybrid Gas/Solid Insulation Systems

Climate change is a global, pressing issue that calls for innovative solutions across all sectors, including electrical engineering. A key challenge in this field is the replacement of sulfure hexafluoride (SF6), widely used in medium and high-voltage insulation systems due to its exceptional properties, including low electrical losses, high thermal conductivity, and a breakdown voltage approximately 3 times higher than that of air. However, SF6 is also known as the most potent greenhouse gas, with an environmental impact of 1 kg of SF6 equivalent to 24 tons of CO2. This high global warming potential has prompted researchers and industry developers to seek alternative gases for insulation.

Beyond identifying substitute gases, the transition to sustainable insulation systems requires a deeper understanding of the physical processes governing these systems. Hybrid gas/solid insulation systems, used in critical applications such as gas-insulated switchgear (GIS), pose unique challenges. One area with many unanswered questions is the discharge mechanism, often initiated at the "triple point" where two insulators with different dielectric properties intersect with a conductor. This intersection is the weakest region in the insulation system, where discharges may start, potentially leading to equipment failure.



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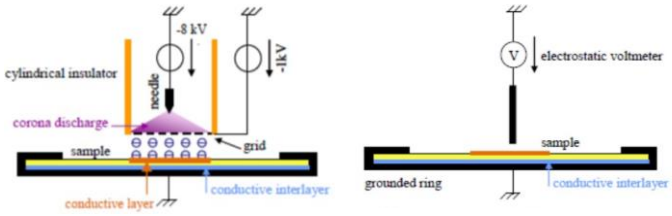
The discharge mechanism in these hybrid insulation systems is influenced by several factors, including the properties of the gas, electric field distribution, applied voltage, and characteristics of the solid insulators, such as permittivity, conductivity, and charge accumulation.

Internship Objective at G2ELab: This internship focuses on experimentally investigating charge accumulation in polymeric solid insulators. Through surface potential decay experiment, this study will examine PTFE (Polytetrafluoroethylene), PVDF (Polyvinylidene fluoride), and HDPE (High-Density Polyethylene). Based on the behavior of these materials following the deposition of charges, further studies can be conducted on other types of polymers. Following surface potential decay assessment, pre-breakdown and breakdown experiments will be conducted to provide a comprehensive understanding of the dielectric properties of these materials under electrical stress.



Tasks to be Completed:

1. Literature review
2. Study how charges accumulate on specific solid materials, as well as potential decay
3. Pre-breakdown and breakdown measurements using configuration similar to that of the hybrid insulation of GIS
4. Writing of an internship report

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