**Advanced 3D time resolved imaging of streamers and comparison with numerical model results**

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Streamer discharges are self-organizing discharges which occur when a fast high voltage pulse is applied, leading to a local, but not global electric field above the breakdown field. These ionization waves can then penetrate areas below the breakdown field. Streamers occur as a precursor to sparks and lightning, but also as separate discharges. In recent years, both simulations and diagnostics of streamer have made great steps, so great that they allow us to compare simulation results now directly to experiments and see that their results agree very well.

Here, we will show some examples of recent diagnostics which help us to bridge the gap between experiment and simulation even further. We will show details of inception of discharges, both from electrodes as from suspended dielectric particles representing hail stones. Results are obtained from measuring statistics of inception delay times with respect to a high voltage pulse. This leads to surprising distributions of delays that can give great insights in the mechanisms involved, but also brings up many new questions.

Next to this, we will show how we can use a combination of stereoscopic and stroboscopic imaging to determine the path of a propagating and branching streamer discharge. We have developed a semi-automatic routine to reconstruct this path from the images, giving us a complete picture in 3D of streamer velocity, diameter and branching properties. This data will be compared to numerical streamer simulation results obtained using the 3D Afivo streamer model.