Easy Evaluation of Streamer Discharge Criteria

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Introduction: Modern power transmission systems operate at high voltages to reduce resistive losses. Also, components are made smaller. Avoiding discharges and flashovers due to high electric fields **E** thus requires careful design optimization. Simulations have become crucial but so far commercial codes have not contained features to evaluate the required field line integrals of effective ionization $\alpha_{eff}(E)$.

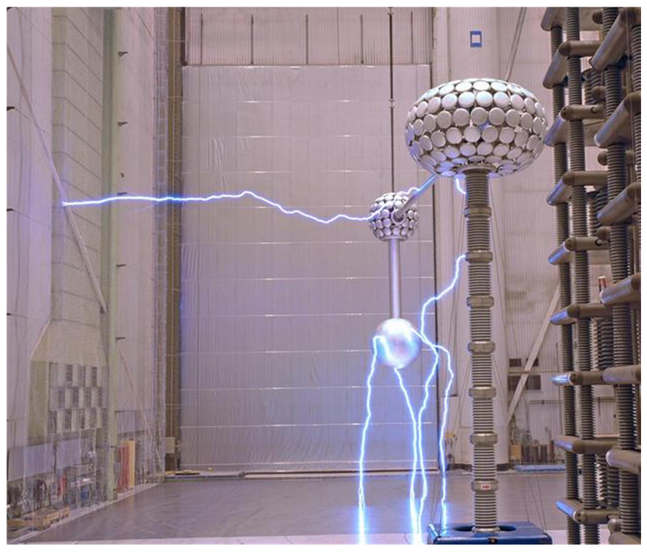

Figure 1. Very long discharges

Computational Methods: The new Particle Tracing module in COMSOL MP version 4.3 enables easy calculation of integrals along field lines. The computation is made in two steps: (i) Find **E** using the Electrostatics interface, then (ii) Use Charged Particle Tracing interface to integrate the critical integral *S* along field lines.

$$S = \int \alpha_{eff}(E)\, dl > C_{crit} \quad (1)$$

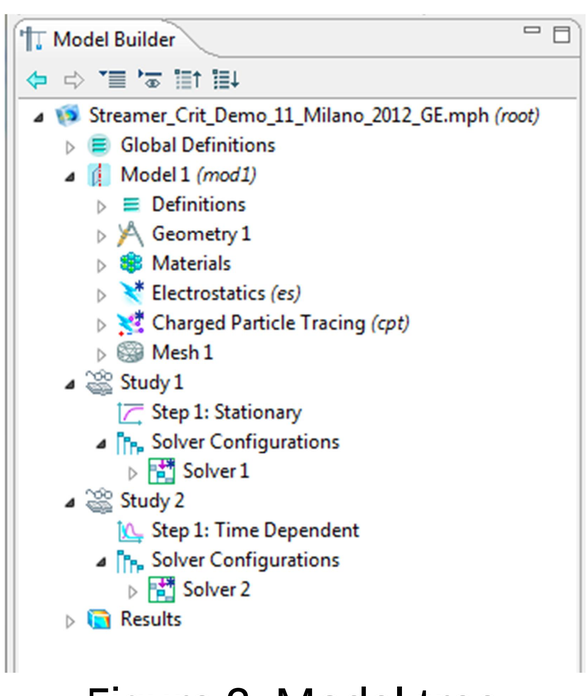

Figure 2. Model tree

Results: Fig. 3 shows the 2D axisymmetric geometry of a high voltage conductor penetrating an opening in a grounded wall. In Fig. 4 is shown the field lines satisfying the criteria for flashover.

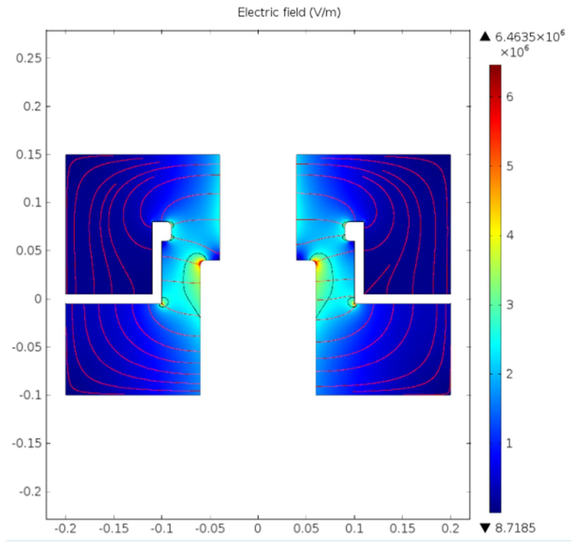

Figure 3. 2D E- field solution

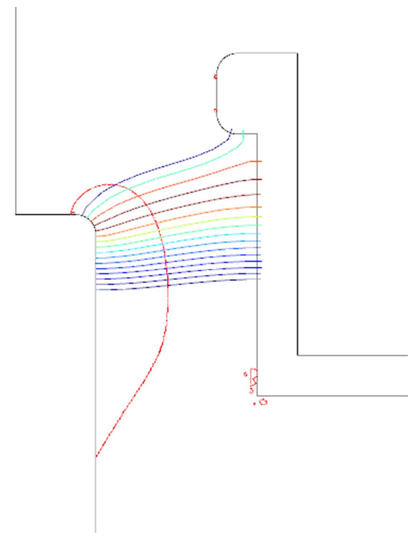

Figure 4. Critical field lines

The technique also works in 3D, as seen in Fig. 5.

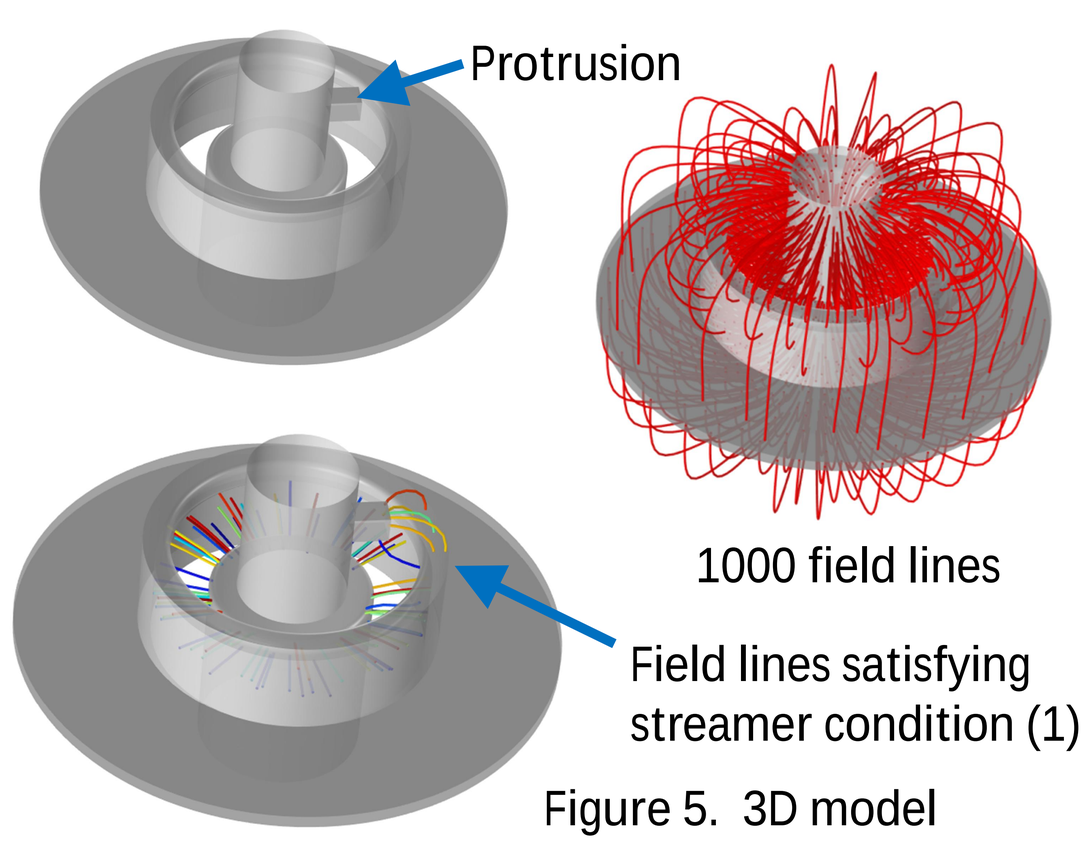

Figure 5. 3D model

Conclusions: The method is easy to implement and works well in 2D and 3D.

References:

1. Kuffel, E. and Zaengl, W.S., *High-Voltage Engineering Fundamentals*, Pergamon Press, Oxford (1984)
2. Christen, T., Proc. SCEE2012 Scientific Computing in Electrical Engineering, ETH Zurich (Sep. 2012)