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Study on the morphology and evolution law of positive polarity corona discharge plasma under the action of high velocity gas flow

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Wind energy has developed rapidly in recent years. As the stand-alone capacity and height of wind turbines increase, the risk of lightning attaching to wind turbine blades gradually increases. The natural observation and simulation test of lightning attachment on wind turbine blades show that the rotating state will make the blade more vulnerable to lightning. The displacement of the blade during a lightning strike of tens to hundreds of milliseconds is not negligible. This displacement will change the spatial charge distribution of the corona discharge at the blade tip, resulting in different characteristics of lightning attachment from traditional transmission lines.

However, this view is based on macroscopic discharge data and lacks microscopic observation. Therefore, we built a wind tunnel to simulate the airflow at the tip of the blade, and carried out positive polarity corona discharge experiments in it. By changing the airflow and voltage, we obtained the corona discharge current, optical morphology and other parameters under different conditions.

This talk will focus on our recent research on the morphology and evolutionary laws of positively polarized corona discharge plasma under the action of high velocity airflow. It is shown that airflow blowing away shielding ions and changing the pressure distribution at the electrode tip of the rods are two important ways to influence corona discharge. The results of the study can lay the foundation for the study of the corona – streamer – leader discharge conversion process and characterization under high-speed airflow, and furthermore can guide the design of lightning protection system for rotating wind turbines to reduce the risk of wind turbine damage.

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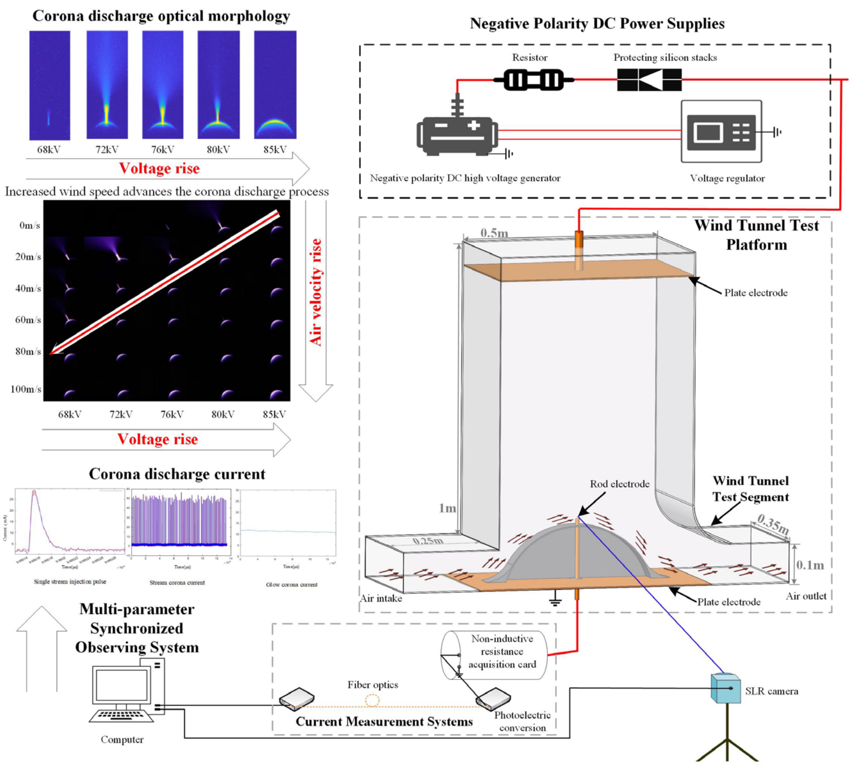

Fig-1. Experimental design of corona discharge under high velocity airflow and partial experimental results