

Title: Physics in Nature Presentation: Dielectric (Corona) Breakdown Model for Lightening

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Abstract:



# Dielectric (Corona) breakdown Model for lightning

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## Content

- 1 Historical overview
- 2 Lightning in nutshell
- 3 Two important types of lightning
- 4 Notable lightning strikes
- 5 Creation mechanism of lightning



## Historical Overview

The first attempt to investigate lightning was made in 1753 independently in; France by Thomas-Francois, and De Lors, and United States by Benjamin Franklin



Figure: Lightning of Eiffel Tower in France.<sup>2</sup>

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This figure is taken from wikipedia.org



## Lightning in nutshell

- It is an atmospheric electrostatic discharge (spark) accompanied by thunder.
- The leader of a bolt of lightning can travel at speed of 220000 km/h, and reaches temperature of 30000°.
- The distance traveled by the bolt is proportional power of lightning.



## Two important types of lightning

- **Negative lightning** Is created on clouds, the negative charges get transformed from the clouds to the ground.  
A bolt carries current about 30 - 120 KA and about 15-350 Coulombs.
- **Positive lightning** Is created in the upper parts near the top of the thunderstorm, where high positive charges resides, travels longer distances and so is stronger.  
A bolt carries current about 300 - 1200 KA which is 10 times the negative lightning current.

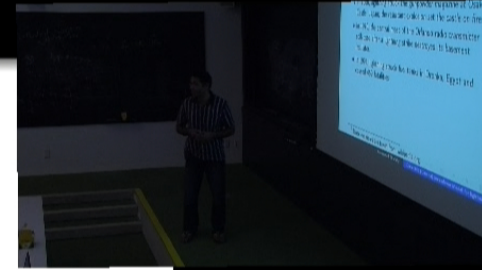
## Notable lightning strikes<sup>3</sup>

- In 1660, lightning struck the gunpowder magazine at Osaka Castle, Japan; the resultant explosion set the castle on fire.
- In 1970, the central mast of the Orlando radio transmitter collapsed after a lightning strike destroyed its basement insulator.
- In 1994, lightning struck fuel tanks in Dronka, Egypt and caused 469 fatalities.

<sup>2</sup>These examples are taken from wikipedia.org

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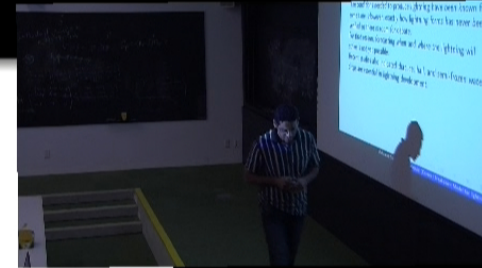


## Creation mechanism of lightning

The conditions needed to produce lightning have been known for some time. However, exactly how lightning forms has never been verified so there is room for debate.

For that reason, forecasting when and where the lightning will strike is not yet possible.

Recent studies also indicated that ice, hail, and semi-frozen water drops are essential in lightning development.



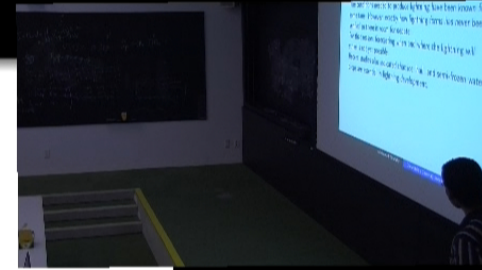


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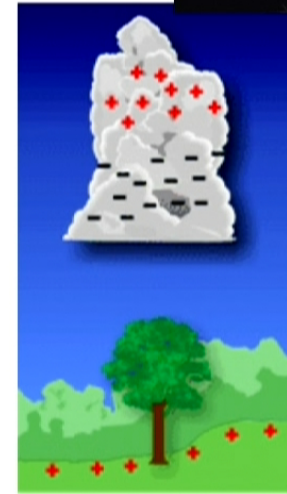
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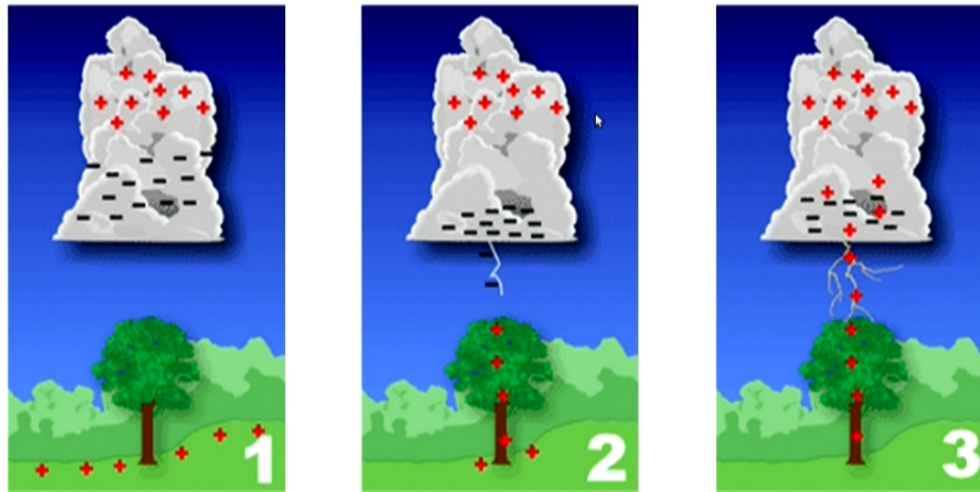
## Creation mechanism of lightning

- **Field Generation** As positive and negative charges begin to separate within the cloud, a strong electric field is generated between its top and base. However, the atmosphere is a very good insulator that inhibits electric flow, so a TREMENDOUS amount of charge has to build up before lightning can occur. When that charge threshold is reached, the strength of the electric field overpowers the atmosphere's insulating properties, and lightning results.



# Creation mechanism of lightning

- Cloud-Ground lightning development



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Thanks for attention



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