

探測閃電的光、電場與磁場

Light, Electricity and Magnetic Field Detection of Lightning

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閃電探測工作坊

Lightning Detection Workshop

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閃電探測的物理原理

Physical Principles of Lightning Detection

- 光（閃光） Light (flash)
- 聲（雷聲） Sound (thunder)
- 電場 Electric field
- 磁場 Magnetic field
- 電磁波 Electromagnetic wave

探測

低難度

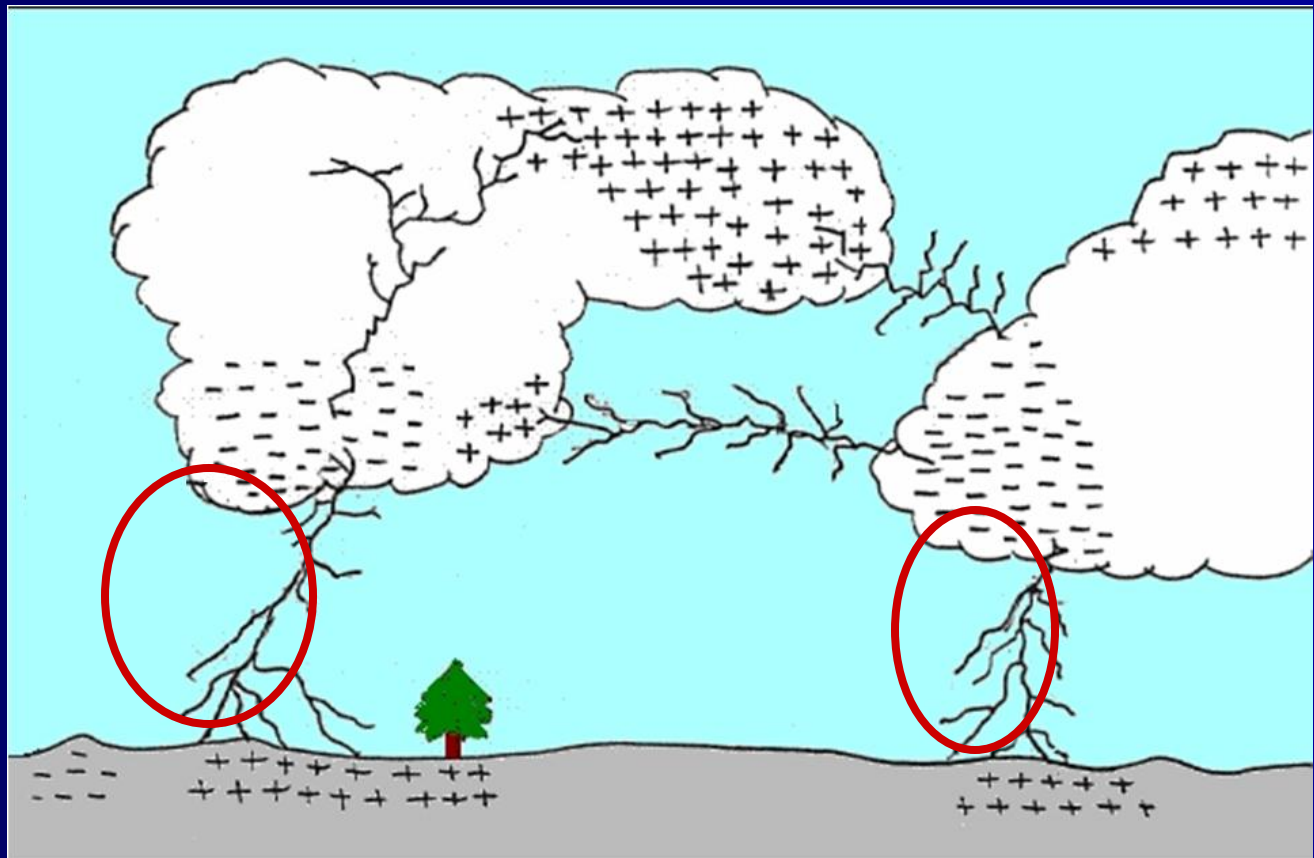


高難度

- 有閃電在附近發生了
Occurrence ← 初級組
- 閃電發生的方向
Occurrence + Direction ← 高級組
- 閃電發生的方向和距離
Direction and Distance
- 閃電發生的方向、距離、高度
Direction, distance, height
- + 閃電的電流（正電流、負電流及強度）
lightning type (positive or negative current and intensity)
- + 雲間閃/雲空閃/雲地閃
Cloud-to-Cloud flash, Cloud-to-Air flash, Cloud-to-Ground flash

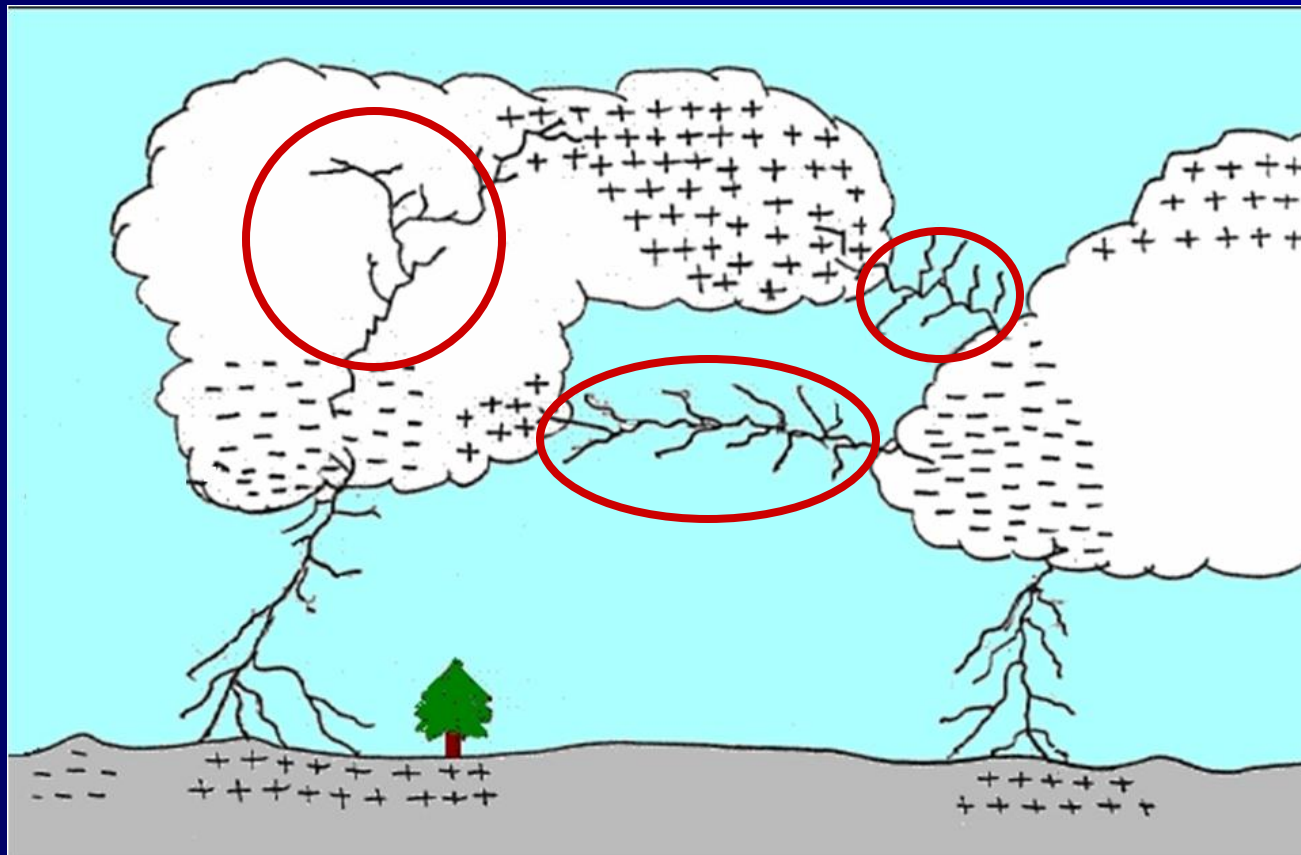
雲地閃電

Cloud-to-Ground lightning



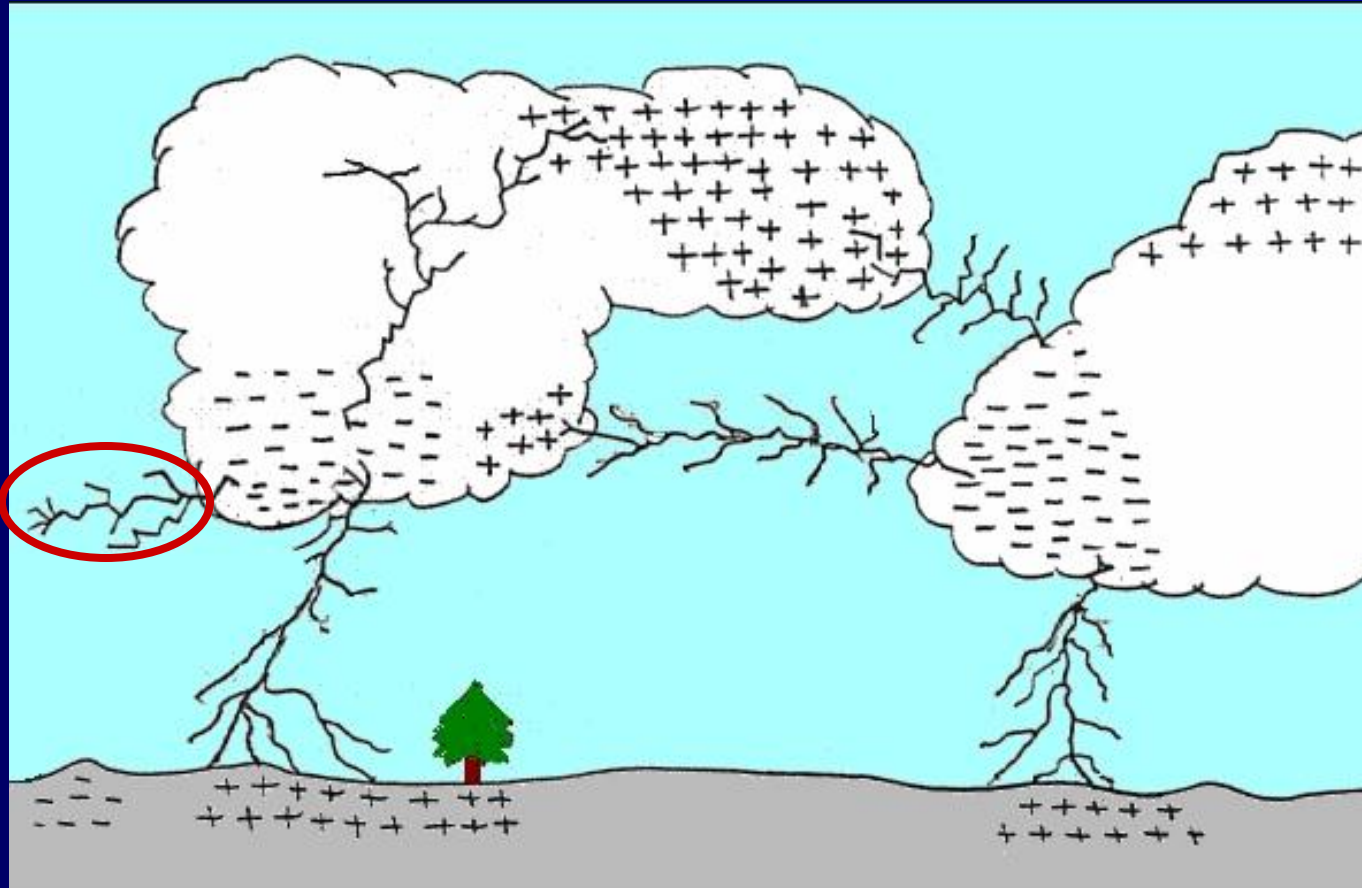
雲間閃電

Cloud-to-Cloud lightning

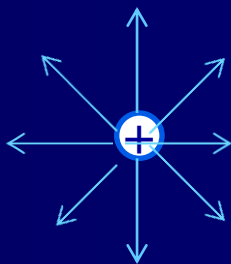


雲對空閃電

Cloud-to-Air lightning



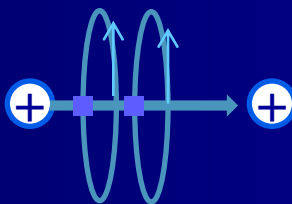
電荷



電場

electric field

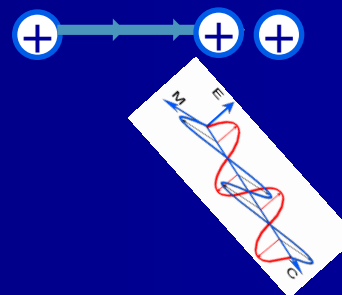
流動的電荷
= 電流 current



磁場

magnetic field

變動的電流
varying current

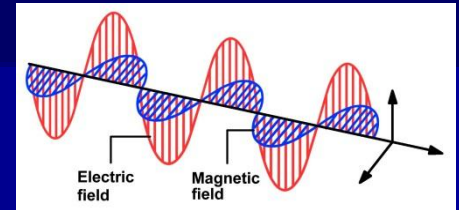
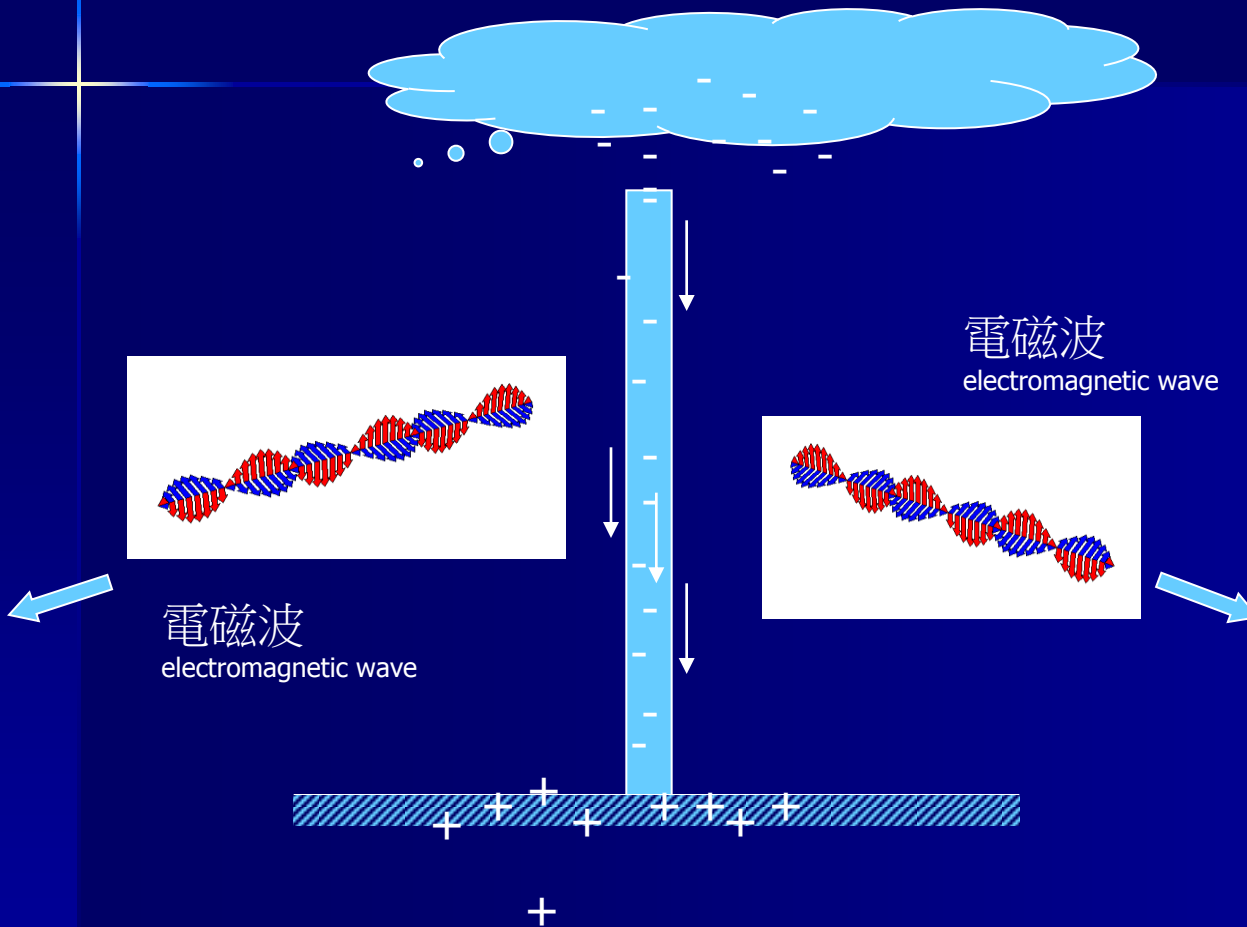


電磁波

electromagnetic waves

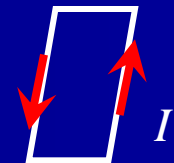
閃電 – 瞬間電流 -> 發射電磁波

lightning flash – instantaneous current -> radiating electromagnetic waves



電場 磁場
electric field magnetic field

環形電線圈
electric wire loop

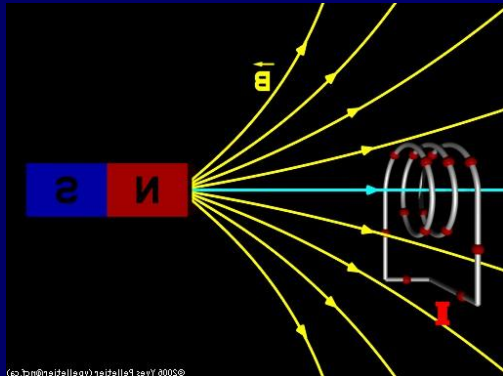


電磁波穿過電線
圈產生電流

electric current is generated when
electromagnetic waves pass through the
electric wire loop

法拉第電磁感應定律

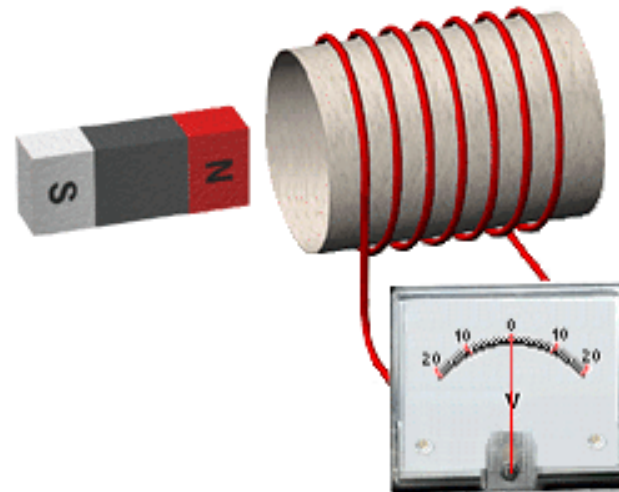
磁場



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Magnetic field

Faradays Law of Induction

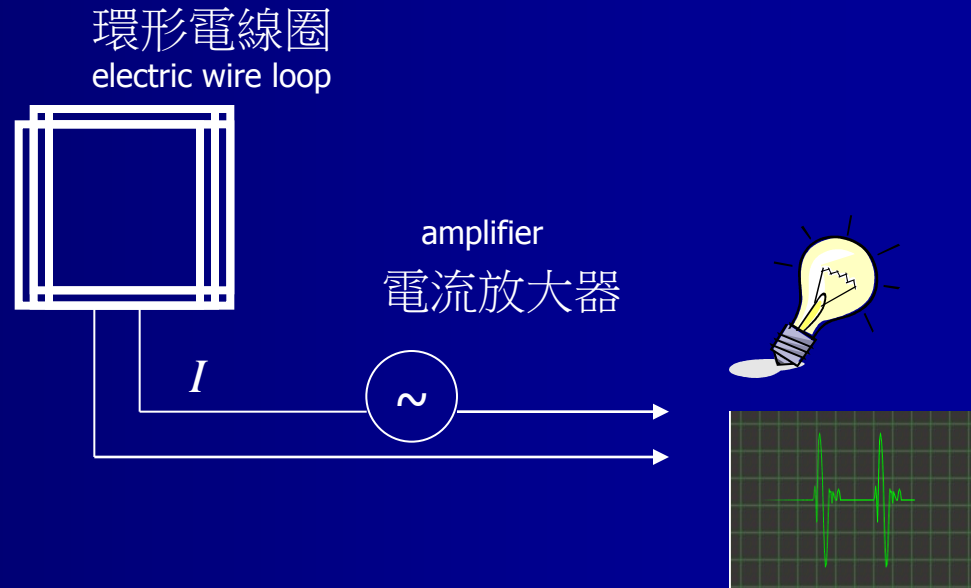


Kieran Mckenzie

電磁波穿過電線圈產生電流

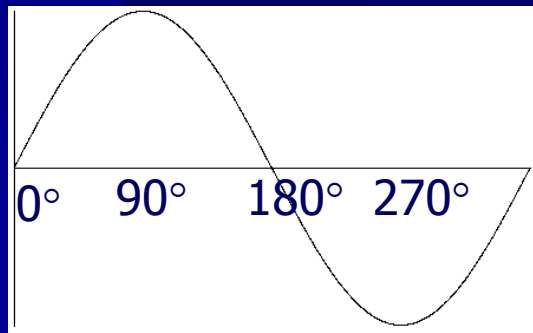
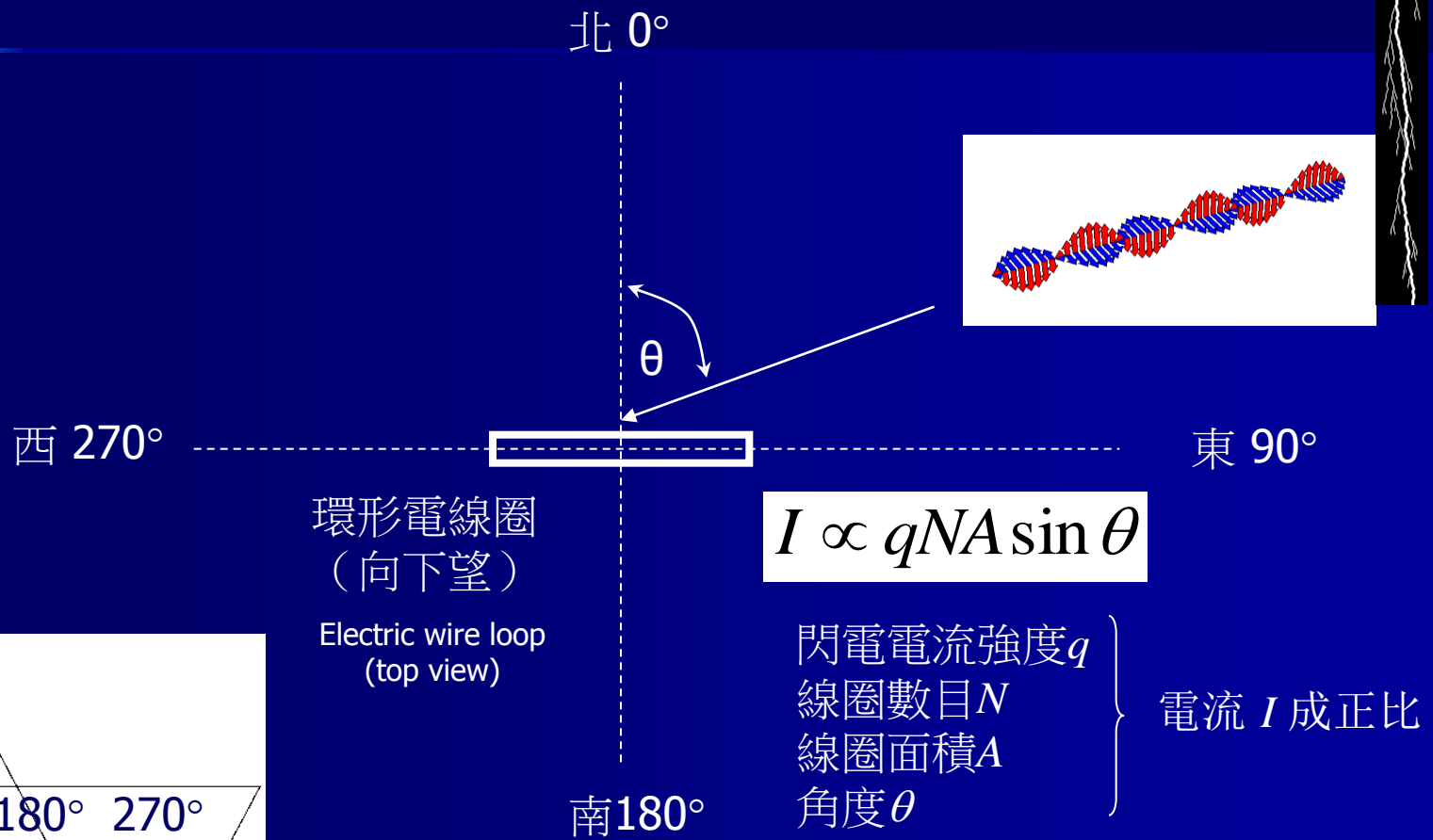
electric current is generated when electromagnetic waves pass through the electric wire loop

電線圈越多，電流越強
The more the loop, the larger the electric current



定方位

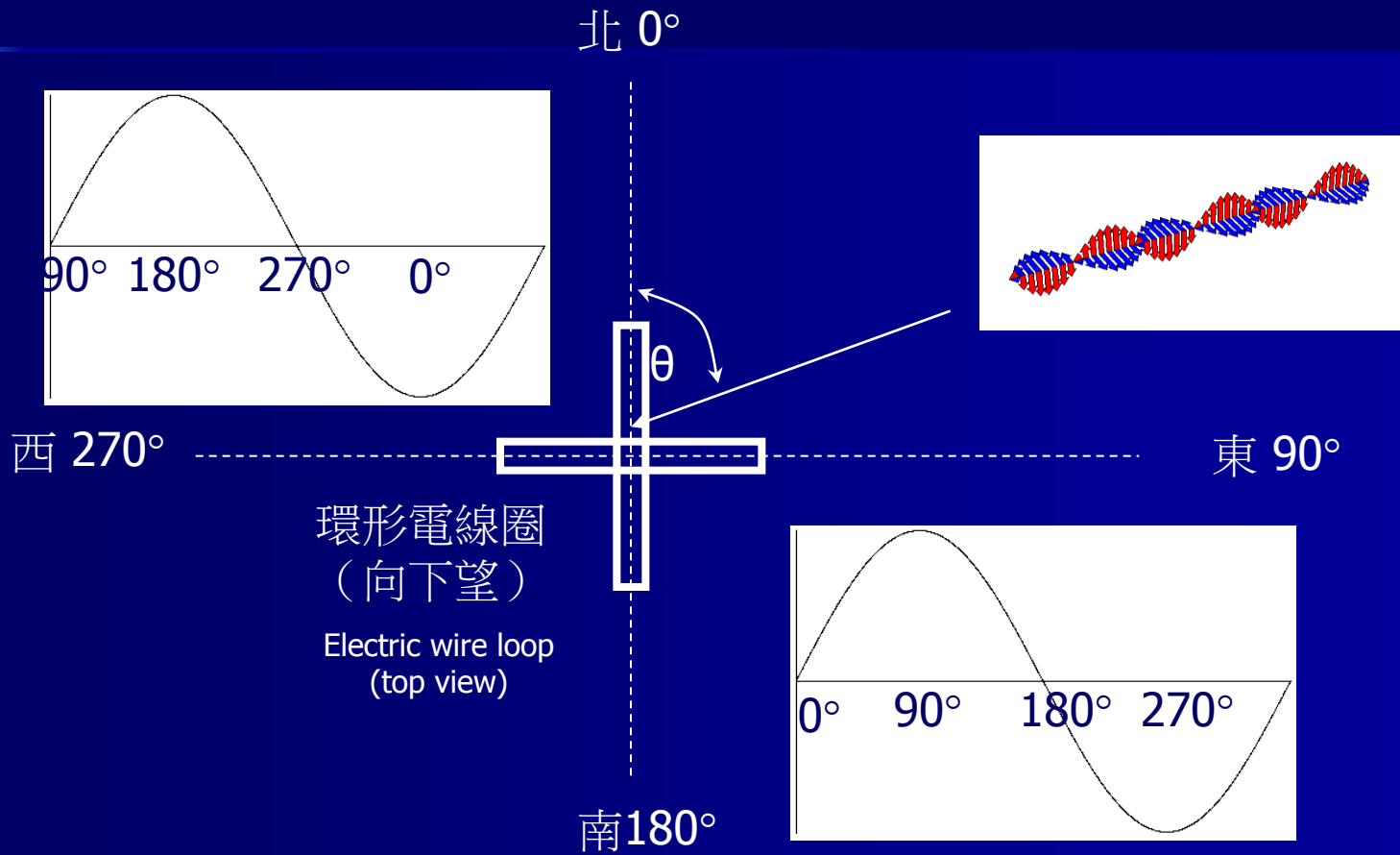
To determine the direction



The electric current is proportional to:
Lightning flash current intensity
Number of loop
Area of the loop
Angle

定方位 — 雙線圈

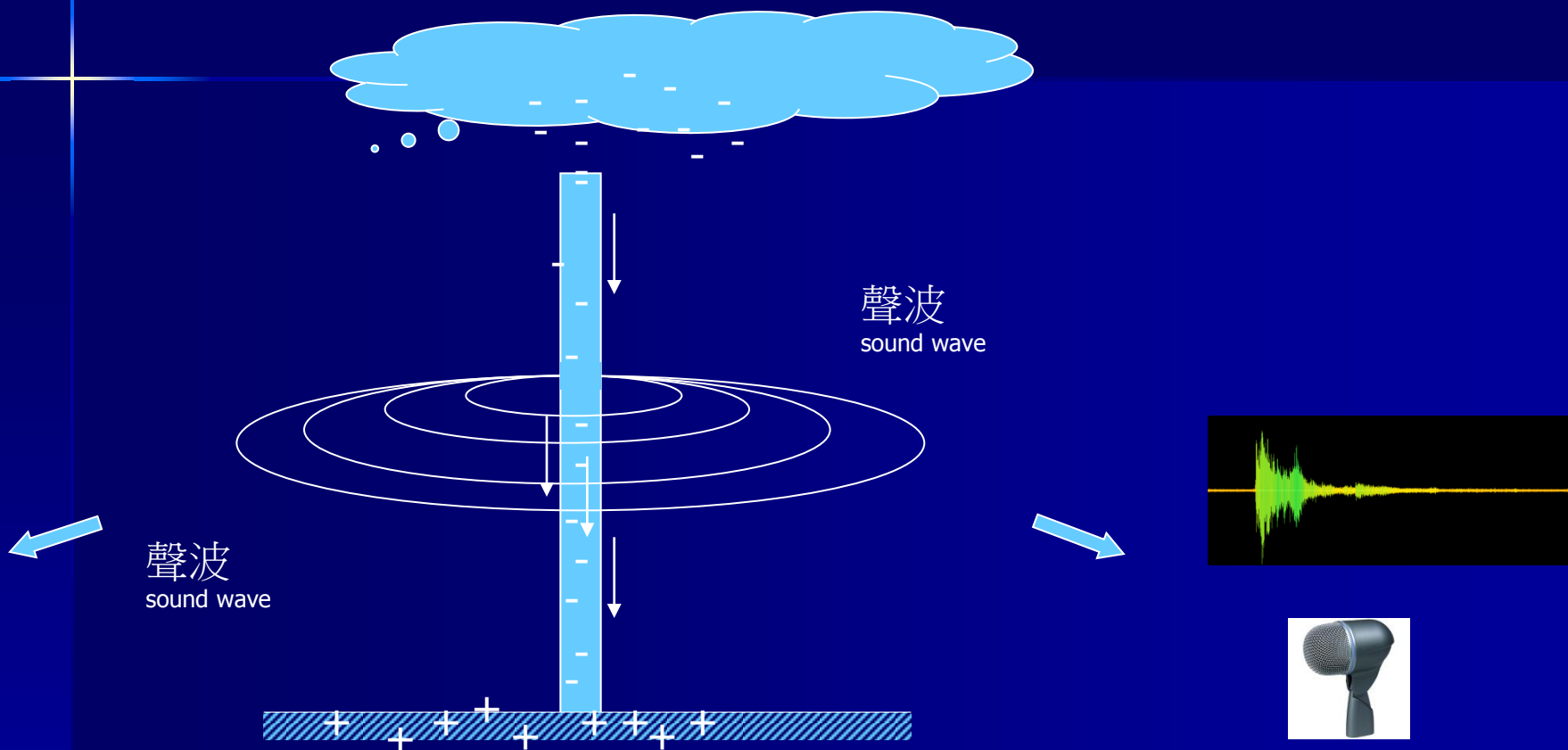
To determine the direction — two loops



雷聲 Thunder

閃電發熱 - 空氣瞬間膨脹 -> 發射聲波

lightning flash heat - instantaneous air expansion -> radiating sound waves



限制：不能確定方向
Limitation: direction undetermined

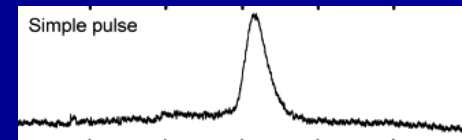
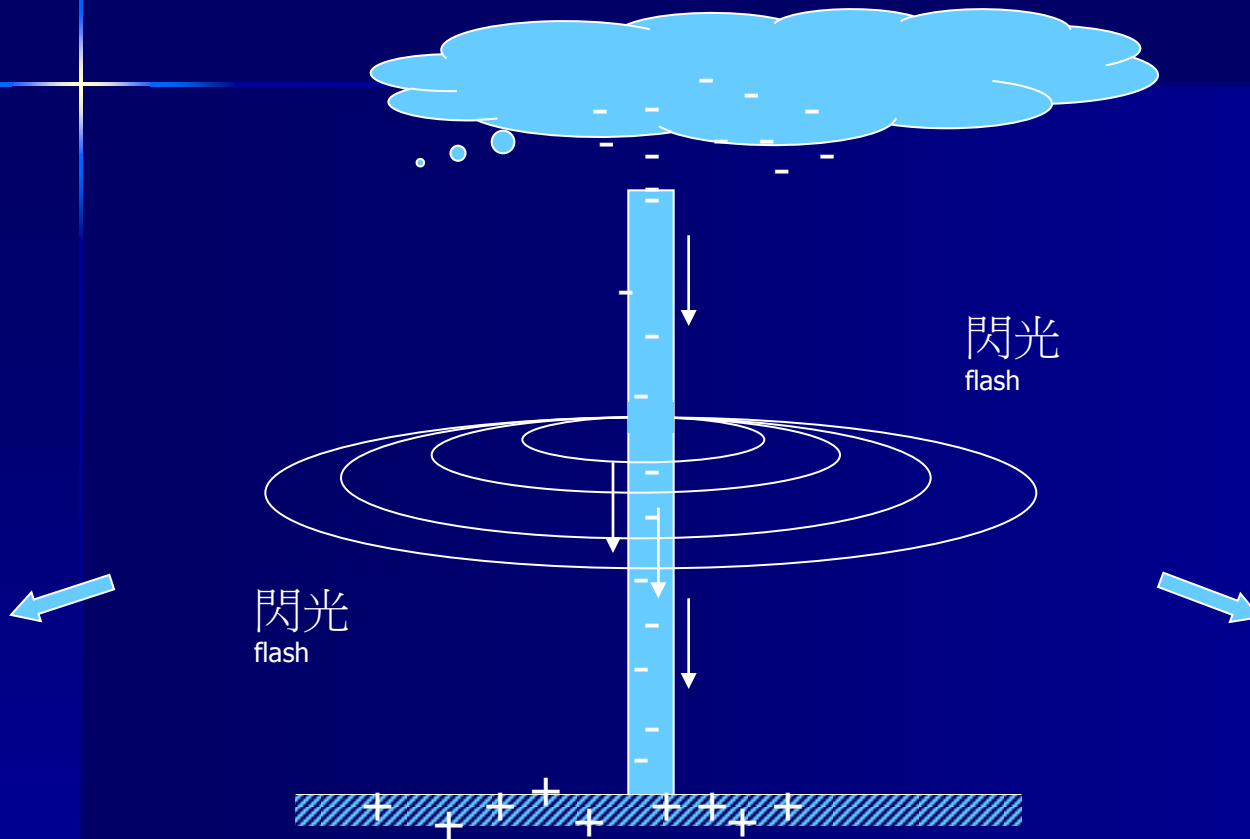
聲波由咪接收

Sound waves picked up by microphone

閃光 **flash**

閃電發光 - > 閃光

lightning - flash



閃光由光二極管探測

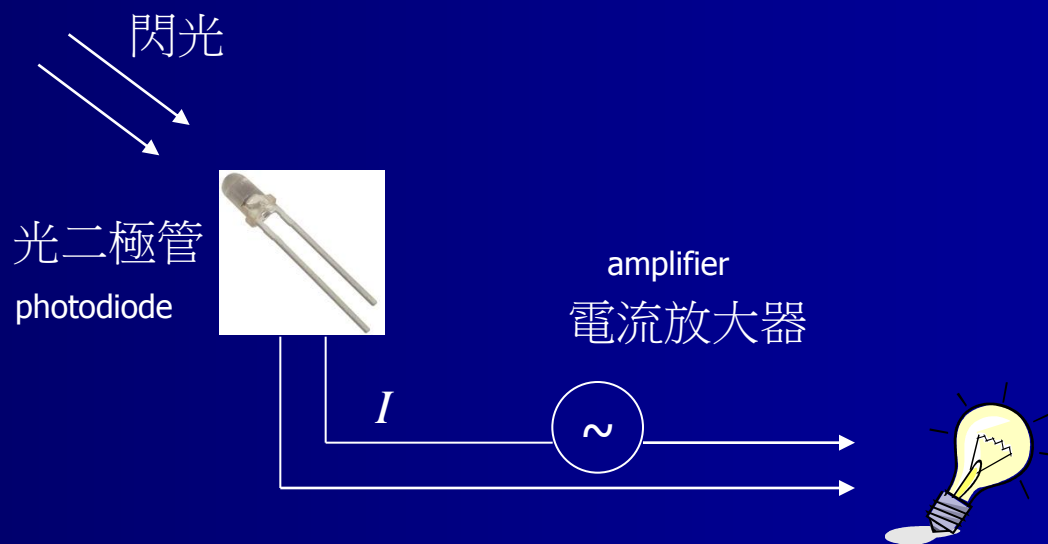
Flash detected by photodiode

光電效應

Photoelectric effect

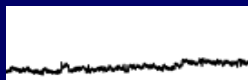
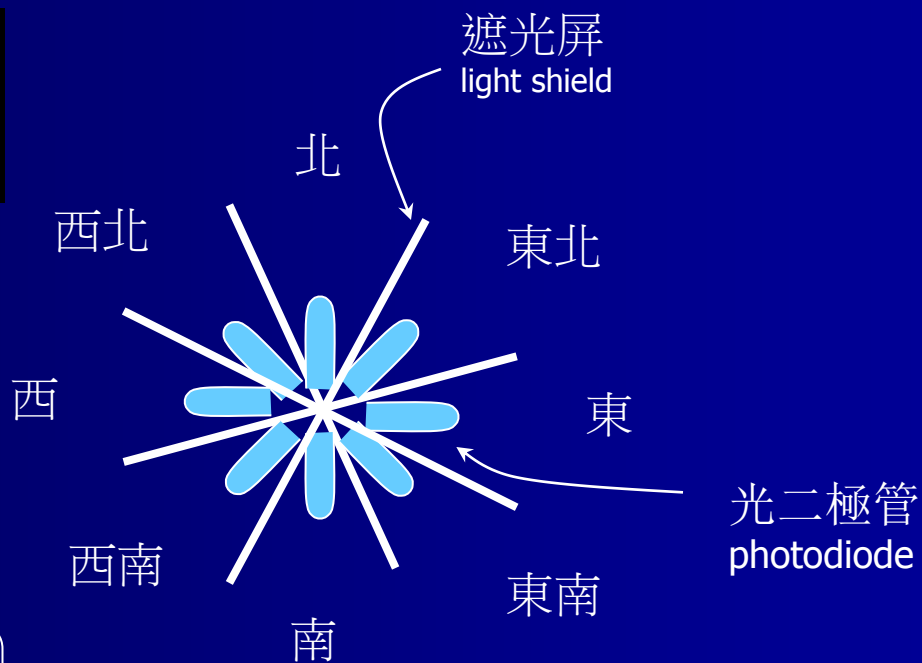
光電效應

Photoelectric effect

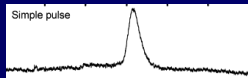


定方位

To determine the direction



北



西北



西

閃電發生在西北方向

Flash occurred in the northwest direction

Happy Workshop

愉快的工作坊