



Magnetometers

Kelan Solomon

- A **magnetometer** is an instrument used to measure magnetic fields. It can be used to detect the **strength**, **direction**, and **changes** in magnetic fields.

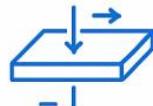


Different Types of Magnetometers



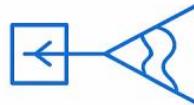
Fluxgate

- High sensitivity, wide range can measure static fields
- Bulky, high power consumption



Hall Effect

- Compact, low cost, low power consumption
- Limited sensitivity, accuracy impacted by temperature



Optically Pumped

- Very high sensitivity, very high accuracy
- Complex design, expensive, requires controlled environment



SQUID

- Extremely high sensitivity, very low noise
- Requires cryogenic cooling, delicate handling



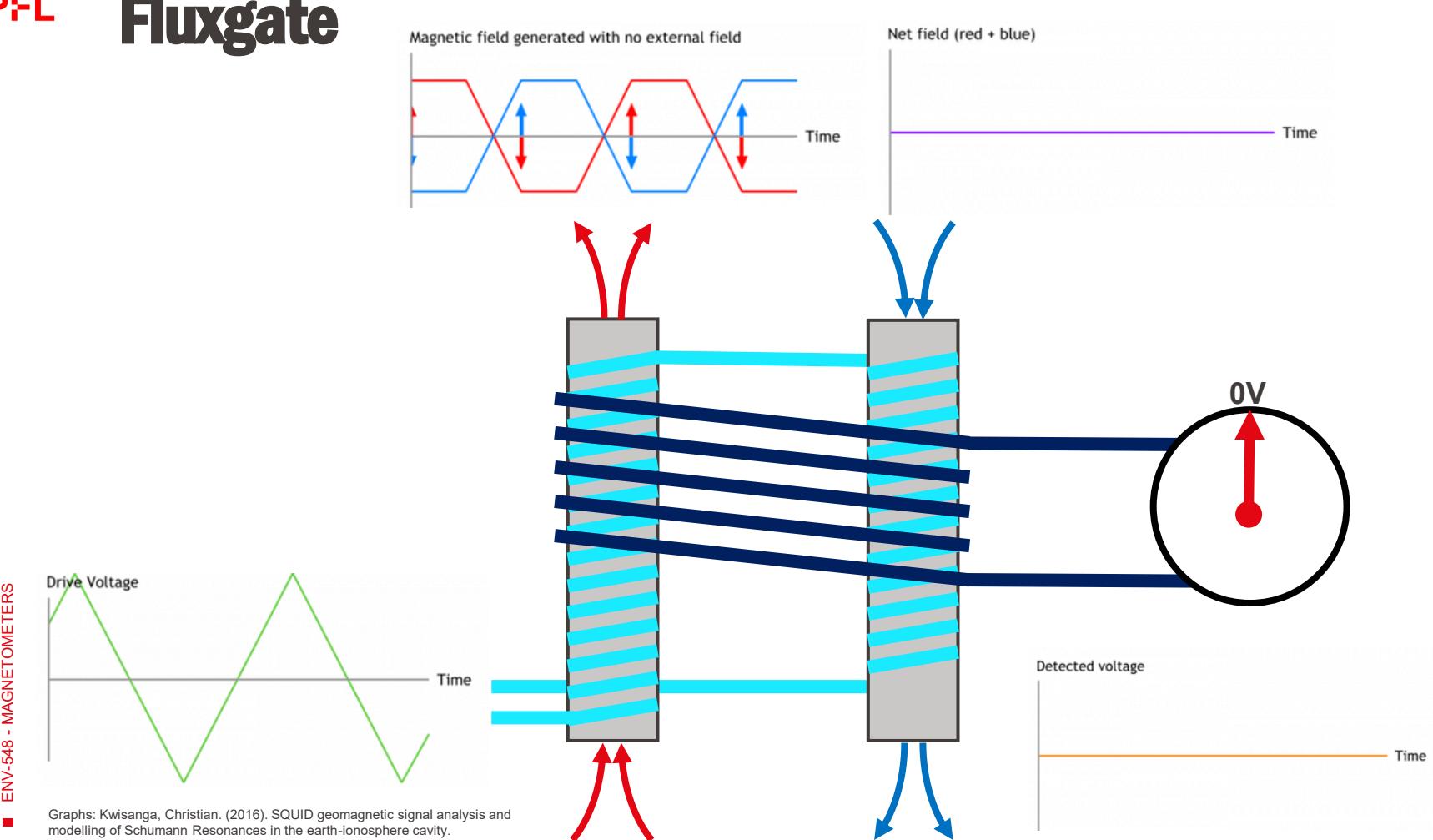
Magneto-Resistive

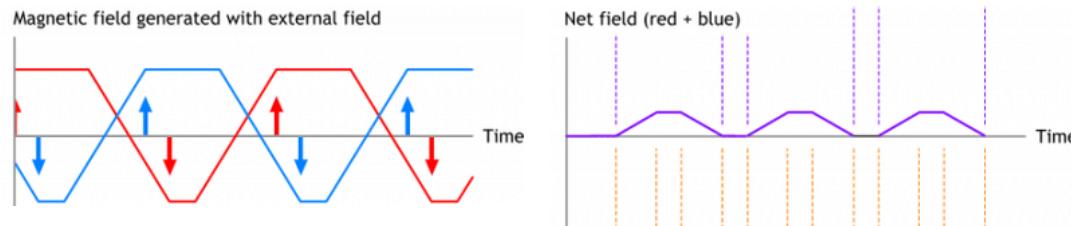
- Compact, low cost, low power consumption, good sensitivity
- Sensitive to temperature variations, require calibration



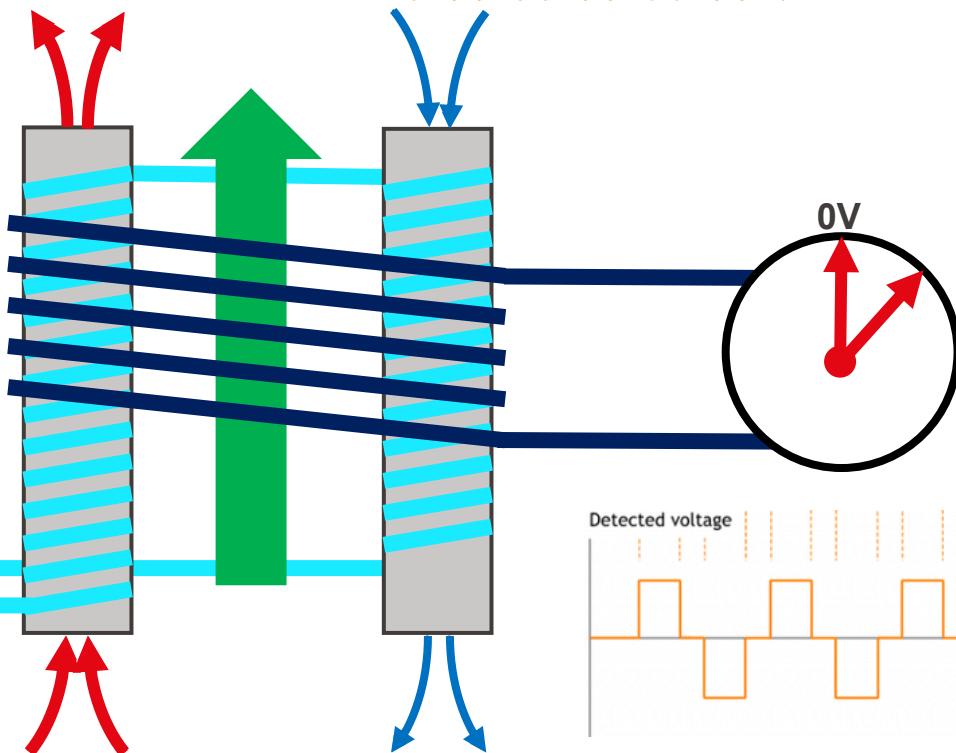
Lorentz Force

- Compact, low cost, good sensitivity
- Some sensitivity to temperature, may require calibration

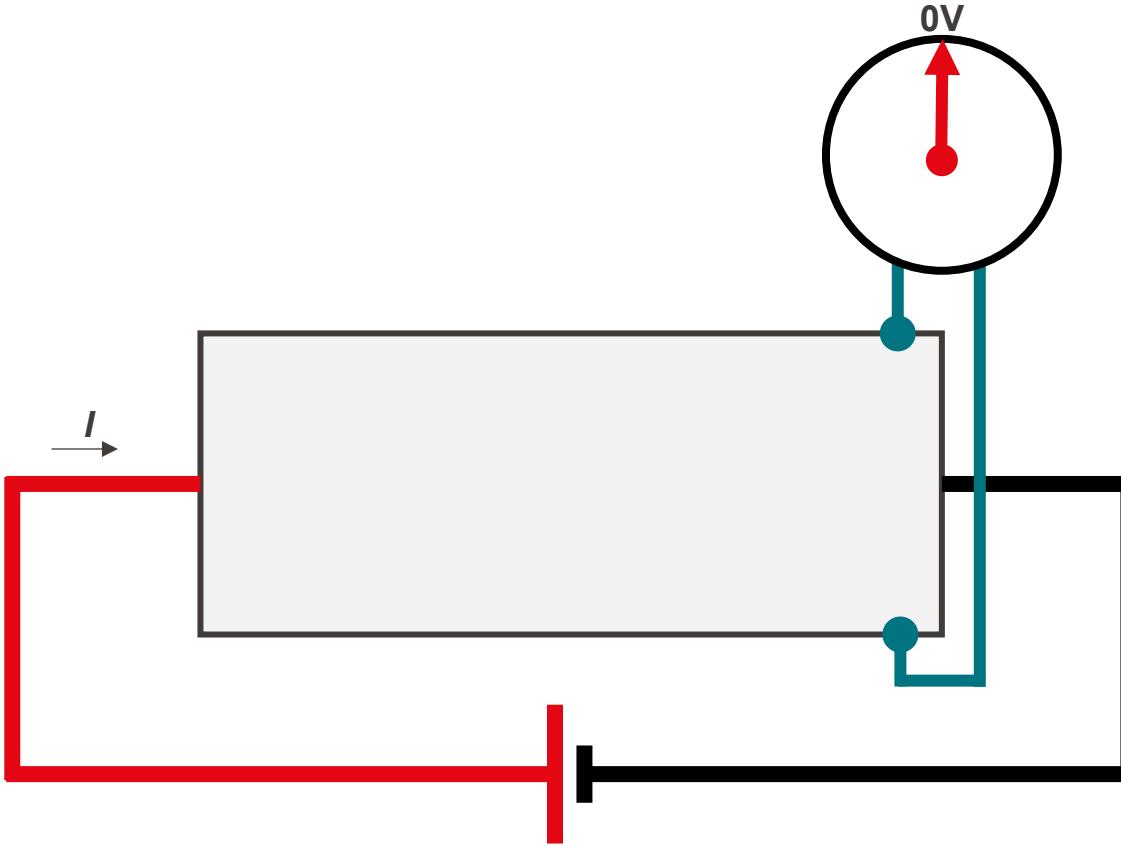




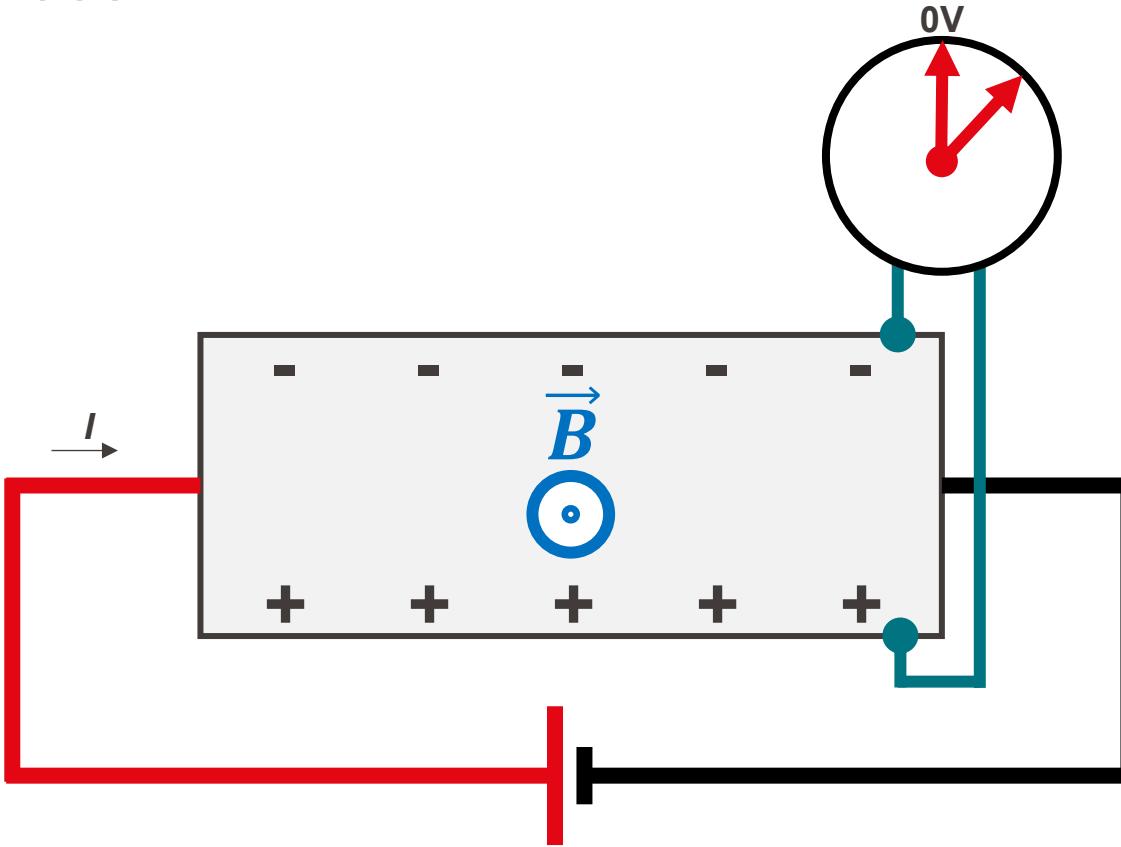
- One coil saturates before the other



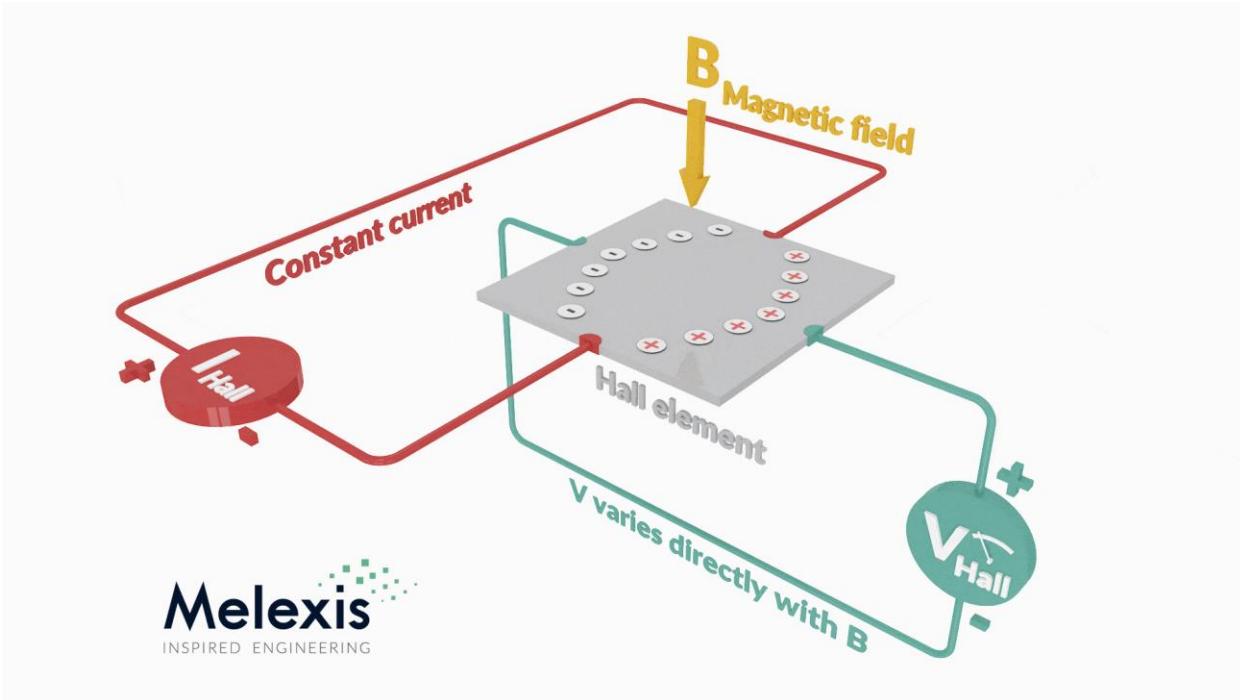
Hall Effect



Hall Effect

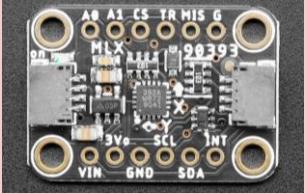
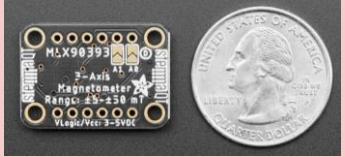


Hall Effect



Parameter	Hall Effect	Fluxgate
Sensitivity	$\sim 0.1 \mu\text{T}$	$\sim 0.1 \text{nT}$
Cost	\$1-500	\$200-10,000+
Size	Chip-scale	cm-scale+
Power	$\mu\text{A}\text{-mA}$	10-100+ mA
Bandwidth	MHz	Hz-kHz
Temp Stability	Moderate	Good
Best Use	Consumer/Industrial	Scientific/Precision

Comparison

Parameter	MLX90393	Mag-01H
Type	Hall	Fluxgate
Axis	3	1
Resolution	0.161 μ T	0.1nT
Price	10 chf	4'000 chf
Form factor	 	

- 9 Axis IMU
 - 3 accelerometers
 - 3 gyros
 - 3 magnetometers
- Strengths cover other sensor weaknesses
 - Gyroscopes drift over time → magnetometers help correct this by providing an absolute heading
 - When a magnetometer is tilted, it gives inaccurate heading unless corrected using accelerometer data.



**Thank you for
listening**

Kelan Solomon