MAGNETIC ENERGY DOMAIN

- **Superconductivity** is the set of physical properties observed in certain materials, wherein electrical resistance vanishes and from which magnetic flux fields are expelled.

- Any material exhibiting these properties is a **superconductor**.

- Unlike an ordinary metallic conductor, whose resistance decreases gradually as its temperature is lowered even down to near absolute zero, a superconductor has a characteristic critical temperature below which the resistance drops abruptly to zero.

- An electric current through a loop of superconducting wire can persist indefinitely with no power source

- It is characterized by the Meissner effect, the complete ejection of magnetic field lines from the interior of the superconductor during its transitions into the superconducting state.

- The occurrence of the Meissner effect indicates that superconductivity cannot be understood simply as the idealization of *perfect conductivity* in classical physics

- The **Hall effect** is the production of a voltage difference (the **Hall voltage**) across an electrical conductor, transverse to an electric current in the conductor and to an applied magnetic field perpendicular to the current. I

- t was discovered by Edwin Hall in 1879.

- For clarity, the original effect is sometimes called the **ordinary Hall effect** to distinguish it from other "Hall effects" which have different physical mechanisms.

- The Hall coefficient is defined as the ratio of the induced electric field to the product of the current density and the applied magnetic field. It is a characteristic of the material from which the conductor is made, since its value depends on the type, number, and properties of the charge carriers that constitute the current.

- **Theory**
- **The Hall effect is due to the nature of the current in a conductor. Current consists of the movement of many small charge carriers, typically electrons, holes, ions (see Electromigration) or all three.**

- **When a magnetic field is present, these charges experience a force, called the Lorentz force.**

- **When such a magnetic field is absent, the charges follow approximately straight, 'line of sight' paths between collisions with impurities, phonons, etc.**

- **However, when a magnetic field with a perpendicular component is applied, their paths between collisions are curved, thus moving charges accumulate on one face of the material. This leaves equal and opposite charges exposed on the other face, where there is a scarcity of mobile charges.**

- **The result is an asymmetric distribution of charge density across the Hall element, arising from a force that is perpendicular to both the 'line of sight' path and the applied magnetic field.**
- **The separation of charge establishes an electric field that opposes the migration of further charge, so a steady electric potential is established for as long as the charge is flowing.**

- **Magnetoresistance** is the tendency of a material (often ferromagnetic) to change the value of its electrical resistance in an externally-applied magnetic field.

- There are a variety of effects that can be called magnetoresistance.

- Some occur in bulk non-magnetic metals and semiconductors, such as geometrical magnetoresistance, Shubnikov de Haas oscillations, or the common positive magnetoresistance in metals.

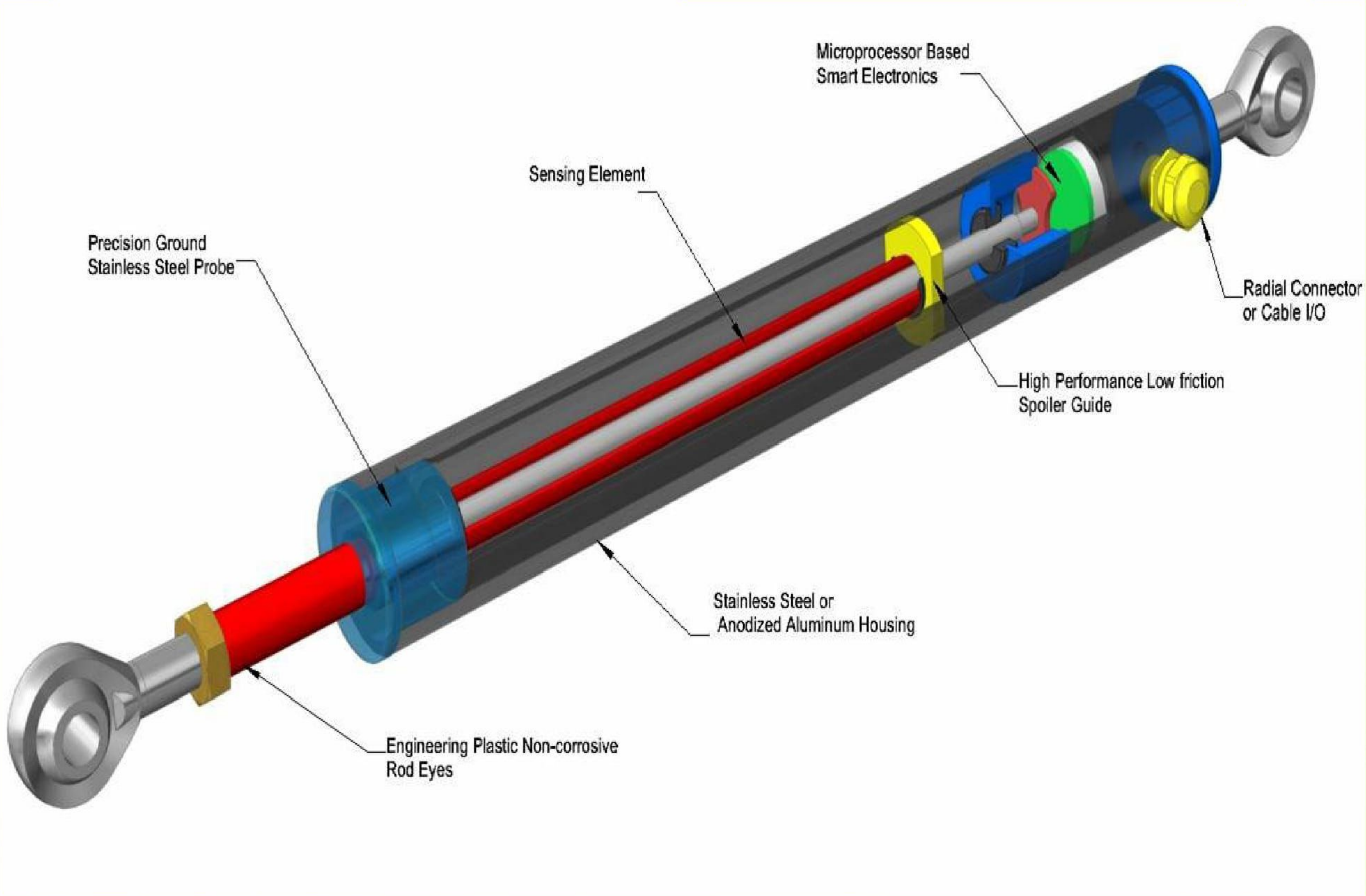
- Other effects occur in magnetic metals, such as negative magnetoresistance in ferromagnets[or anisotropic magnetoresistance (AMR).

- Finally, in multicomponent or multilayer systems (e.g. magnetic tunnel junctions), giant magnetoresistance (GMR), tunnel magnetoresistance (TMR), colossal magnetoresistance (CMR), and extraordinary magnetoresistance (EMR) can be observed.

- **An inductive sensor is a device that uses the principle of electromagnetic induction to detect or measure objects.**

- **An inductor develops a magnetic field when a current flows through it; alternatively, a current will flow through a circuit containing an inductor when the magnetic field through it changes.**

- **This effect can be used to detect metallic objects that interact with a magnetic field. Non-metallic substances such as liquids or some kinds of dirt do not interact with the magnetic field, so an inductive sensor can operate in wet or dirty conditions**


Microprocessor Based
Smart Electronics
Sensing Element
Precision Ground
Stainless Steel Probe
Radial Connector
or Cable I/O
High Performance Low friction
Spoiler Guide
Stainless Steel or
Anodized Aluminum Housing
Engineering Plastic Non-corrosive
Rod Eyes

- **A variable reluctance sensor (commonly called a VR sensor) is a transducer that measures changes in magnetic reluctance.**

- **When combined with basic electronic circuitry, the sensor detects the change in presence or proximity of ferrous objects.**

- **With more complex circuitry and the addition of software and specific mechanical hardware, a VR sensor can also provide measurements of linear velocity, angular velocity, position, and torque.**

- **Uses and applications**

- **A VR sensor used as a simple <u>proximity sensor</u> can determine the position of a mechanical link in a piece of industrial equipment.**

- **A <u>Crankshaft position sensor</u> (in an automobile engine) is used to provide the angular position of the crankshaft to the <u>Engine control unit</u>. The <u>Engine control unit</u> can then calculate engine speed (<u>angular velocity</u>).**

- **Speed sensors used in automobile transmissions, are used to measure the rotational speed (<u>angular velocity</u>) of shafts within the transmission.**

- **The <u>Engine control unit</u> or <u>Transmission control unit</u> (depending on the particular automobile) uses these sensors to determine when to shift from one gear to the next.**

- **A pickup used in an electric guitar (or other musical instrument) detect vibrations of the metallic "strings". See**

- A **Hall effect sensor** is a device that is used to measure the magnitude of a magnetic field. Its output voltage is directly proportional to the magnetic field strength through it.

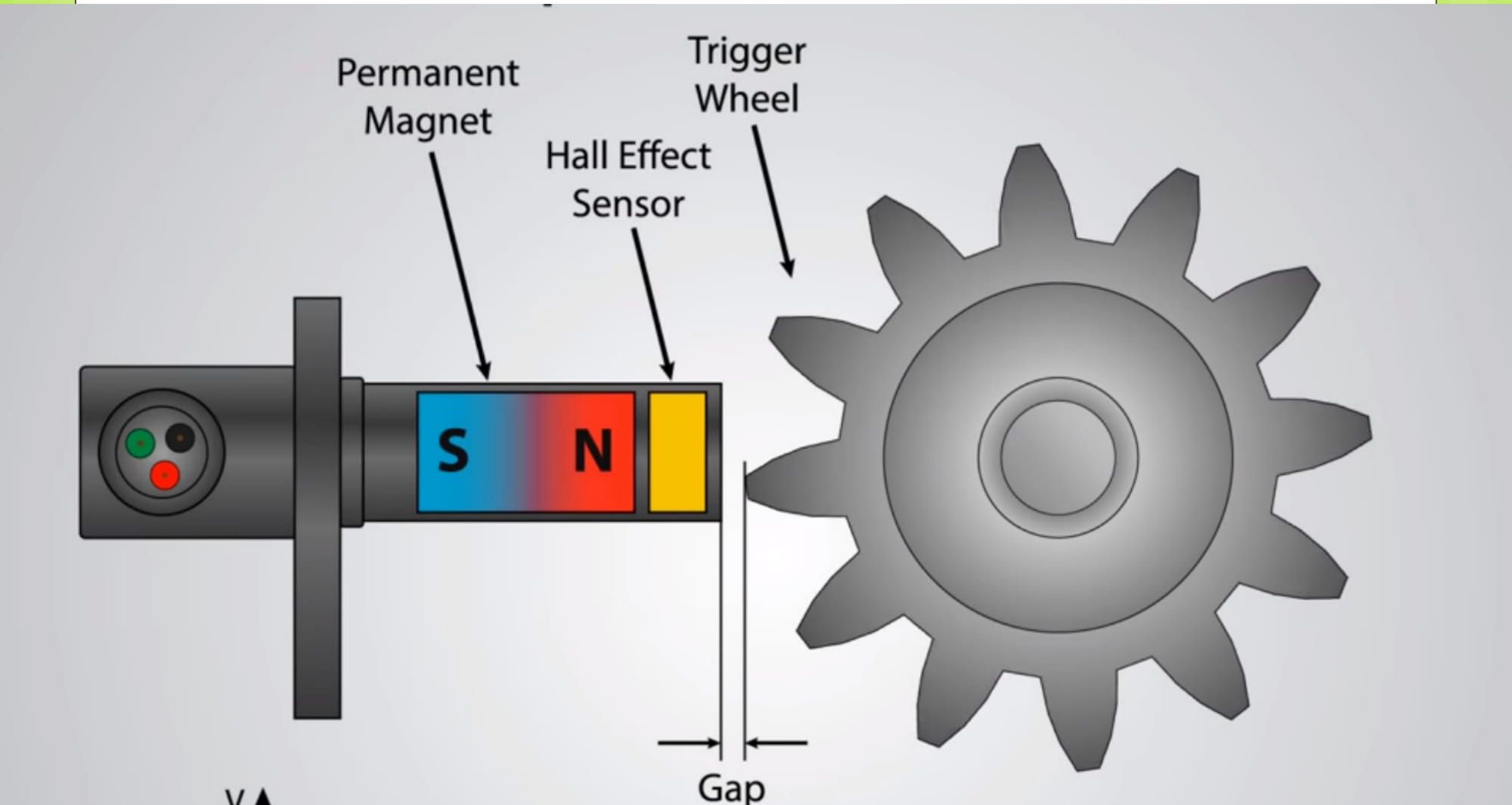
- Hall effect sensors are used for proximity sensing, positioning, speed detection, and current sensing applications.

- Frequently, a Hall sensor is combined with threshold detection so that it acts as and is called a switch.

- Commonly seen in industrial applications such as the pictured pneumatic cylinder, they are also used in consumer equipment; for example some computer printers use them to detect missing paper and open covers.

- They can also be used in computer keyboards, an application that requires ultra-high reliability.

- Another use of a Hall Sensor is in the creation of MIDI organ pedal-boards, where the movement of a 'key' on the pedal-board is translated as an on/off switch via Hall Sensors.



Permanent
Magnet
Hall Effect
Sensor
Trigger
Wheel
S
N
Gap
V