

Electromechanical Battery for Rural Power Supplies

By

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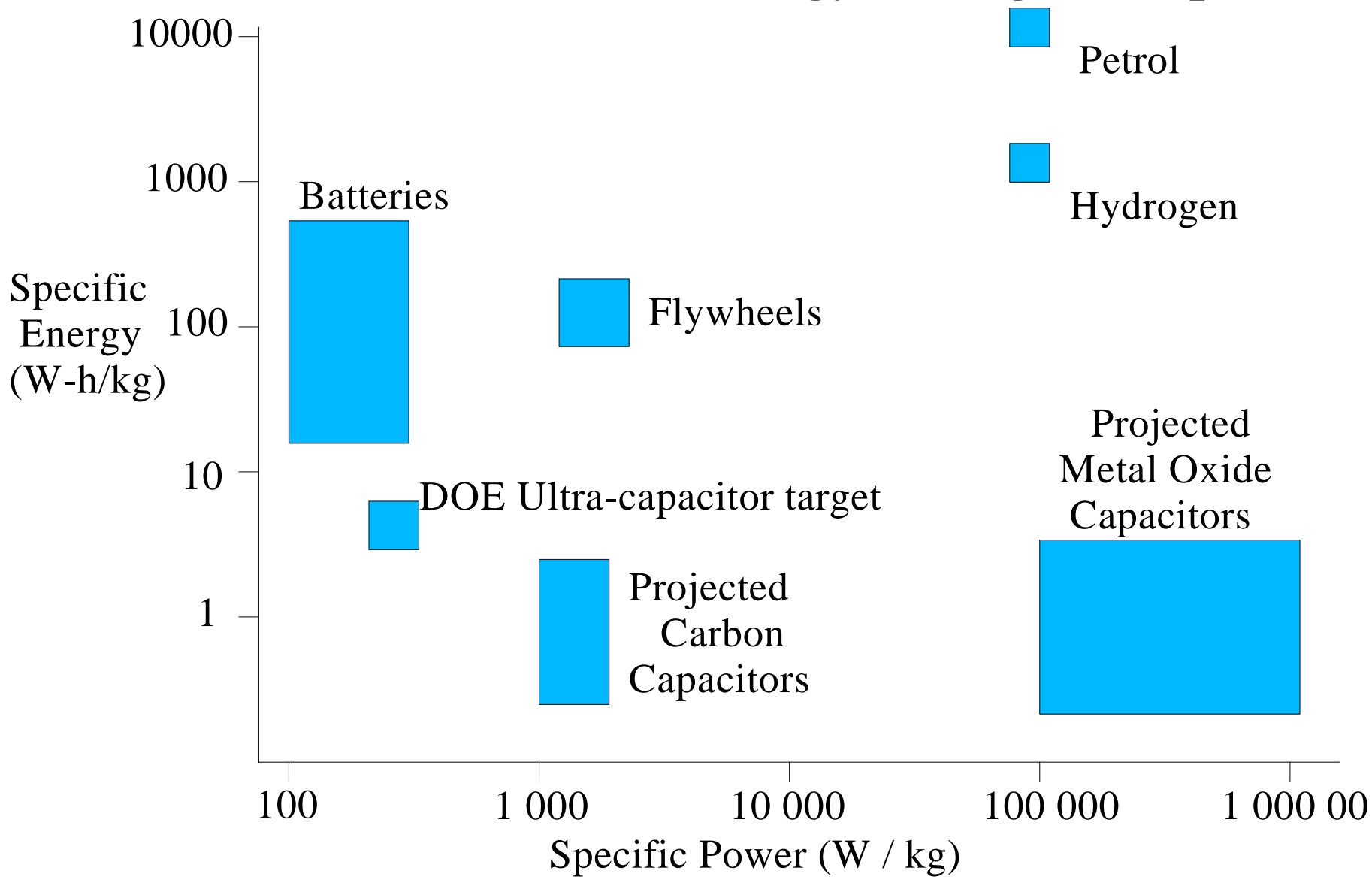
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Types of storage

- Chemical- batteries
- Potential- pumped storage, pneumatic, magnetic
- Kinetic- flywheels
- Electrical- supercapacitors

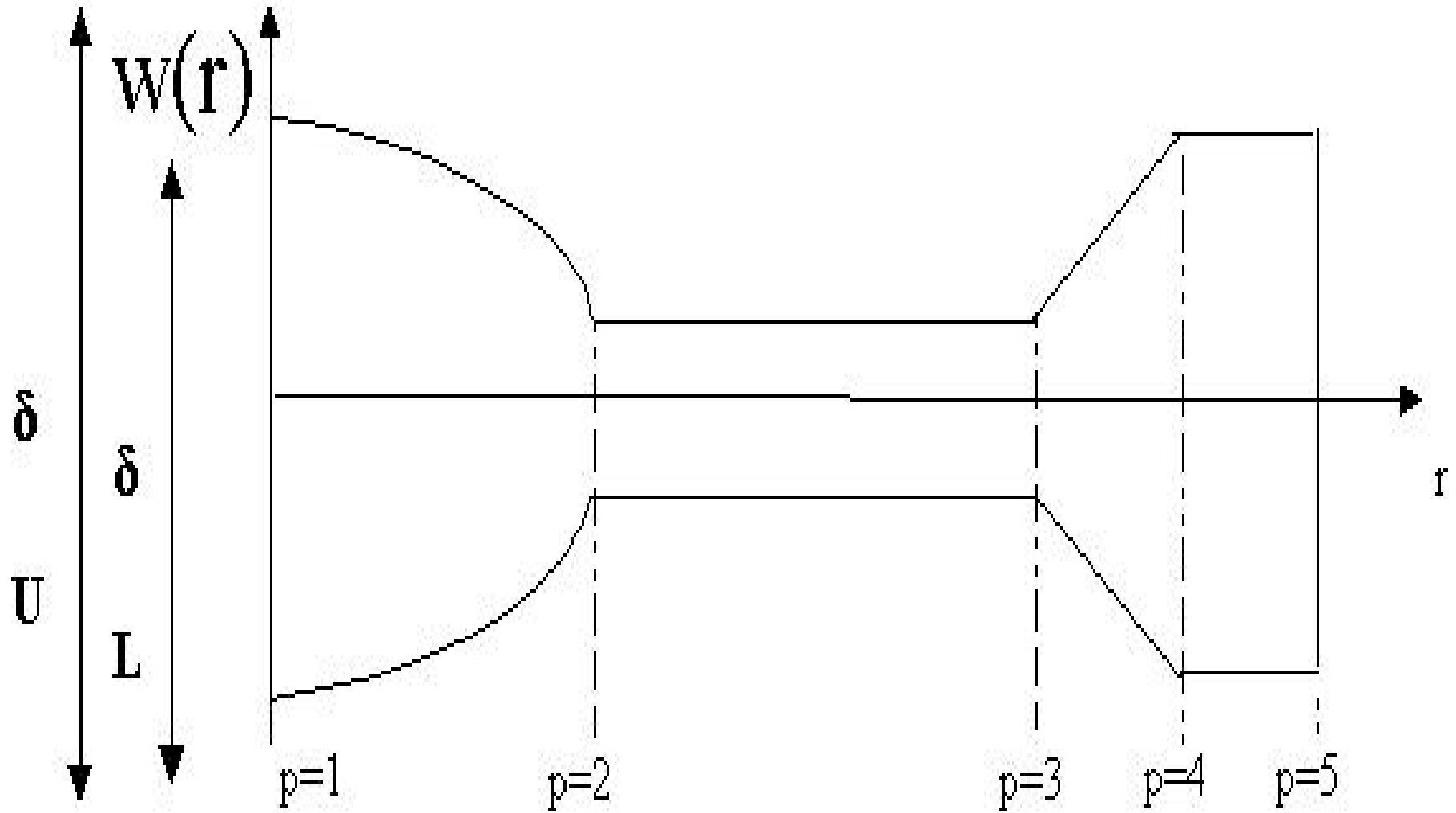
Electrical Power and Energy Storage Comparison



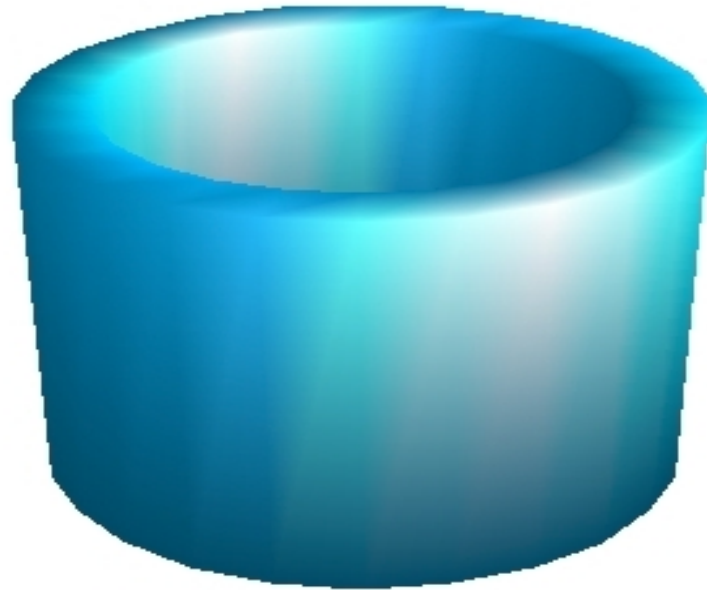
Storage by kinetic energy

- Flywheel
- Bearings
- Motor/generator
- Enclosure
- Converter
- Controller

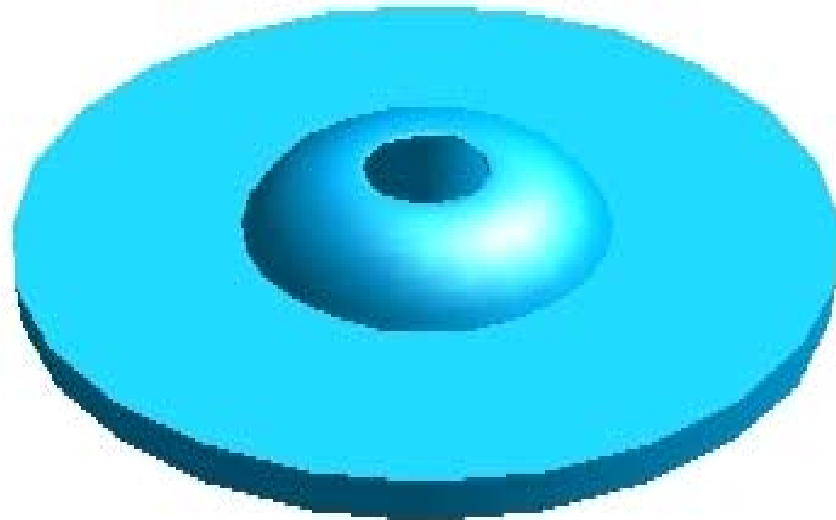
Berger and Porat [1] Piecewise definition of exact optimal shapes



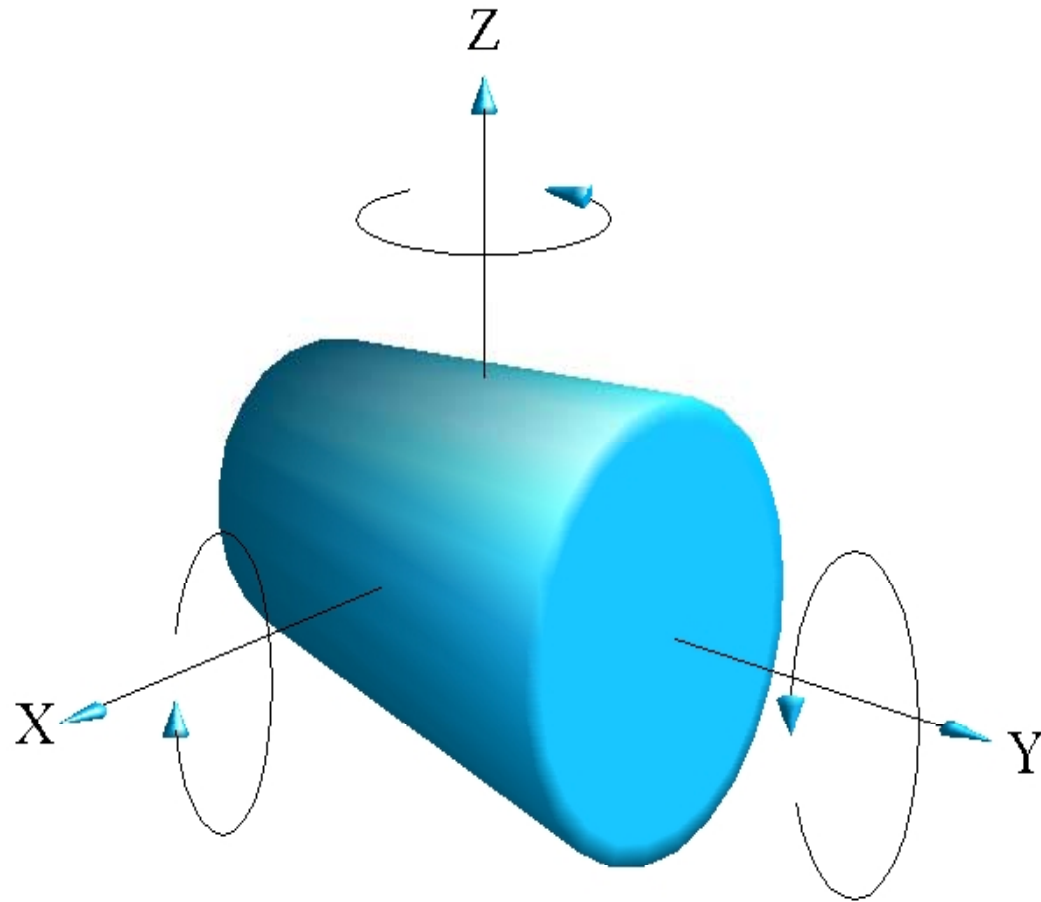
Thin walled cylinder



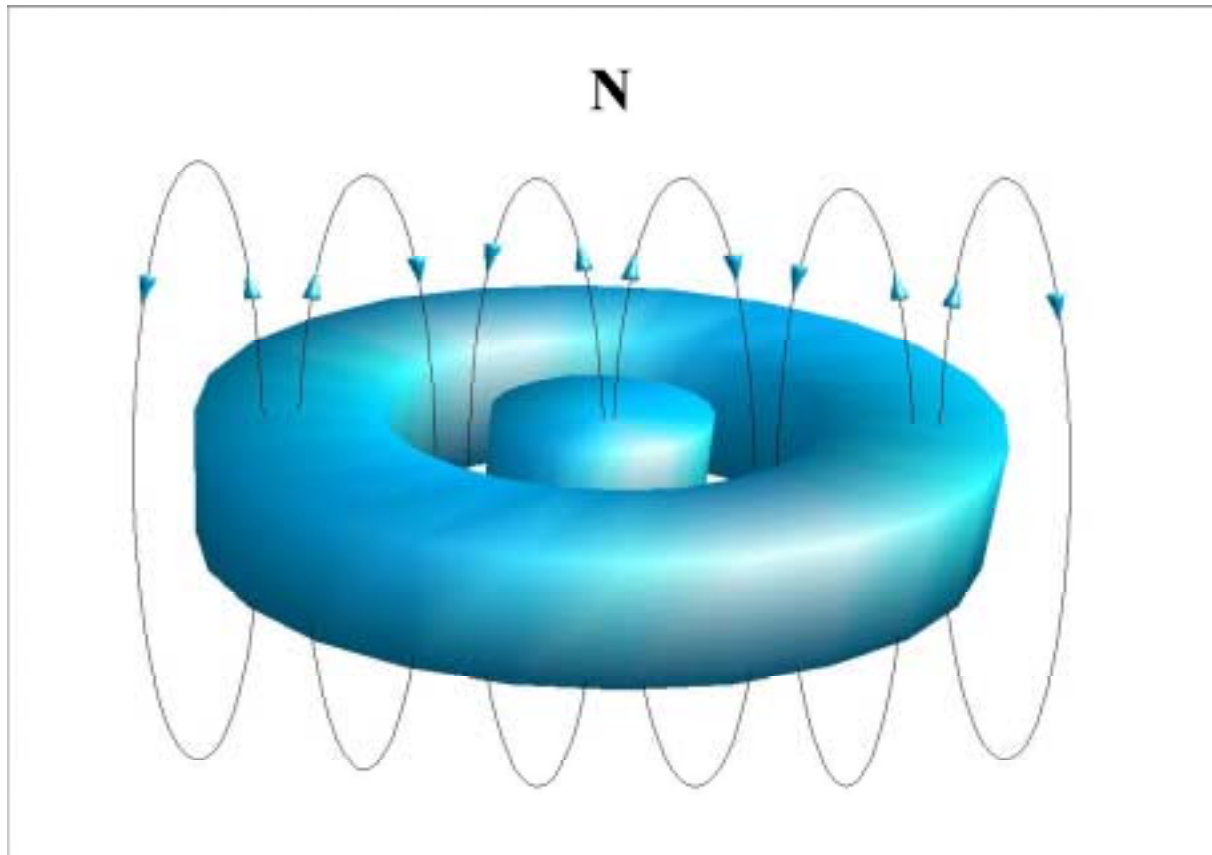
Ultimate speed Flywheel

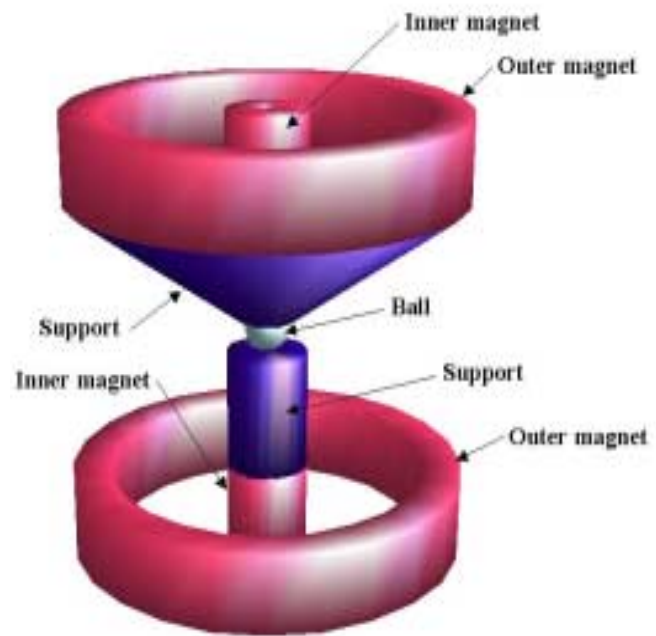


The six degrees of freedom of a body

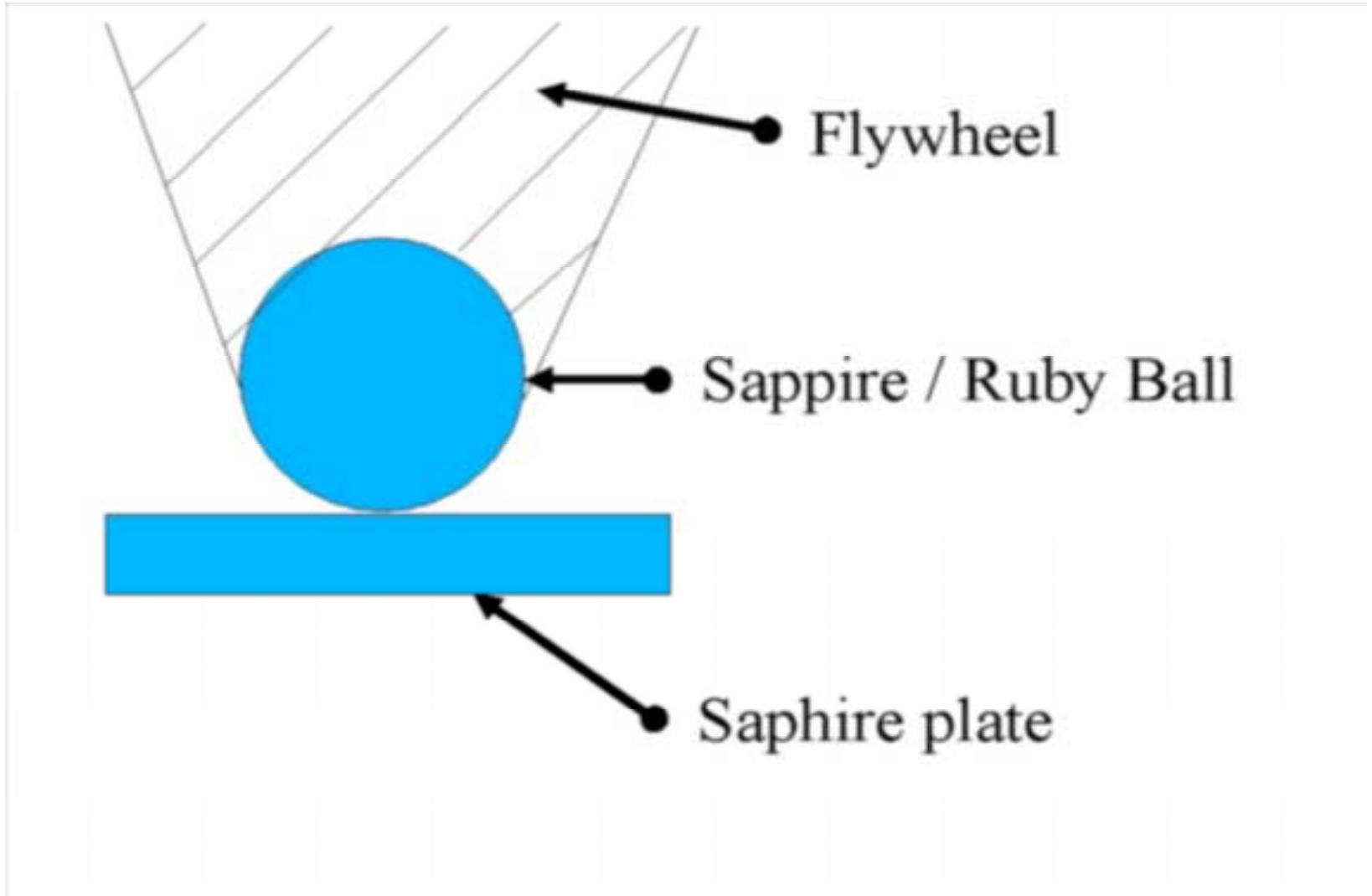


Radial magnetic bearing

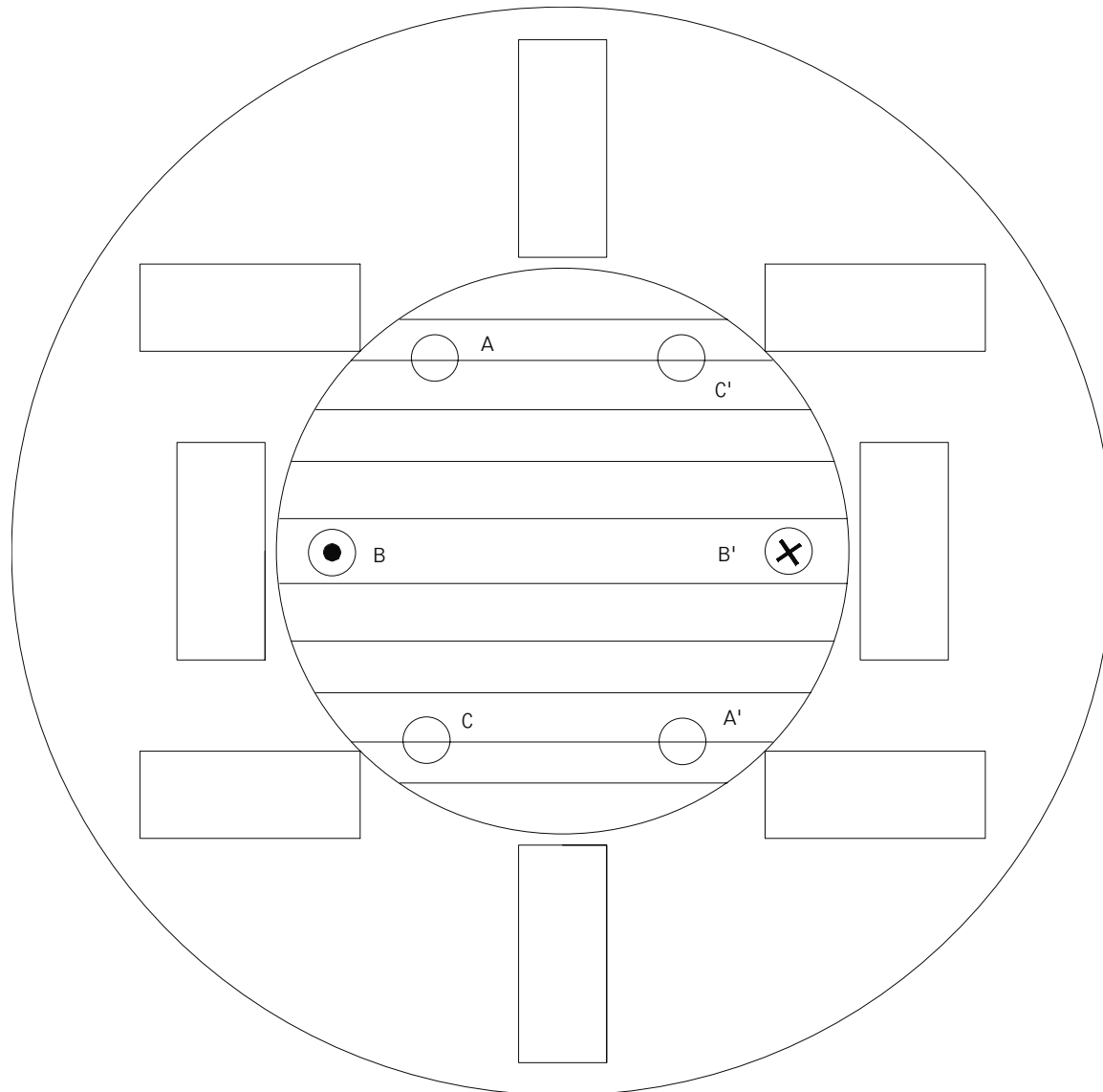


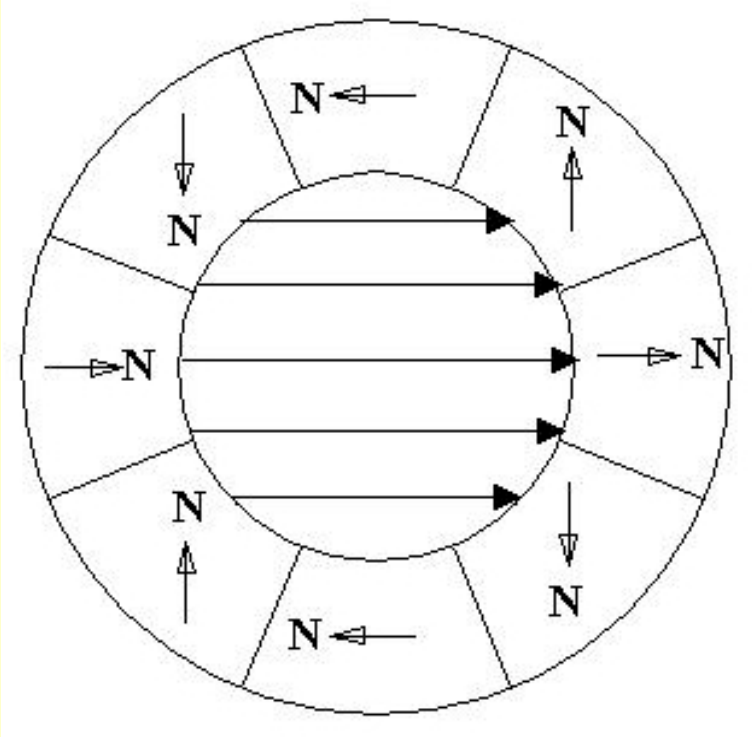


Axial Bearing



Model of motor

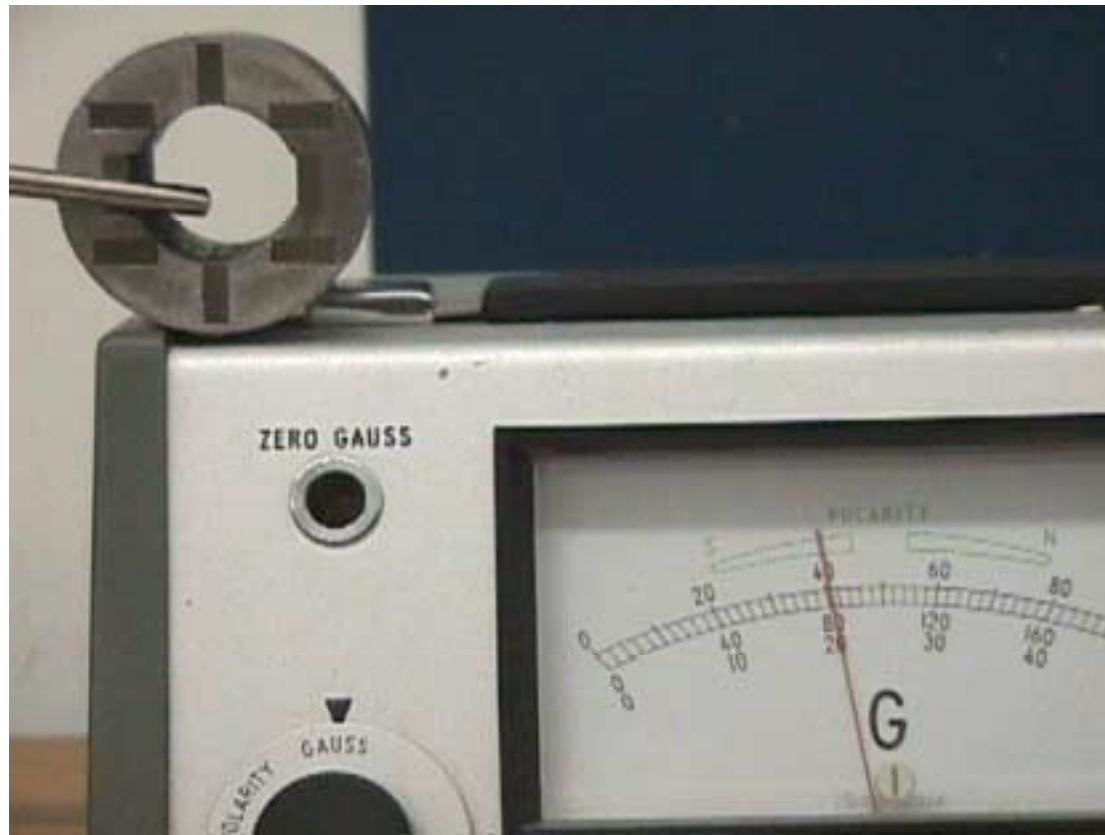




Motor with Halbach Array



Actual Flux reading with a Gauss meter



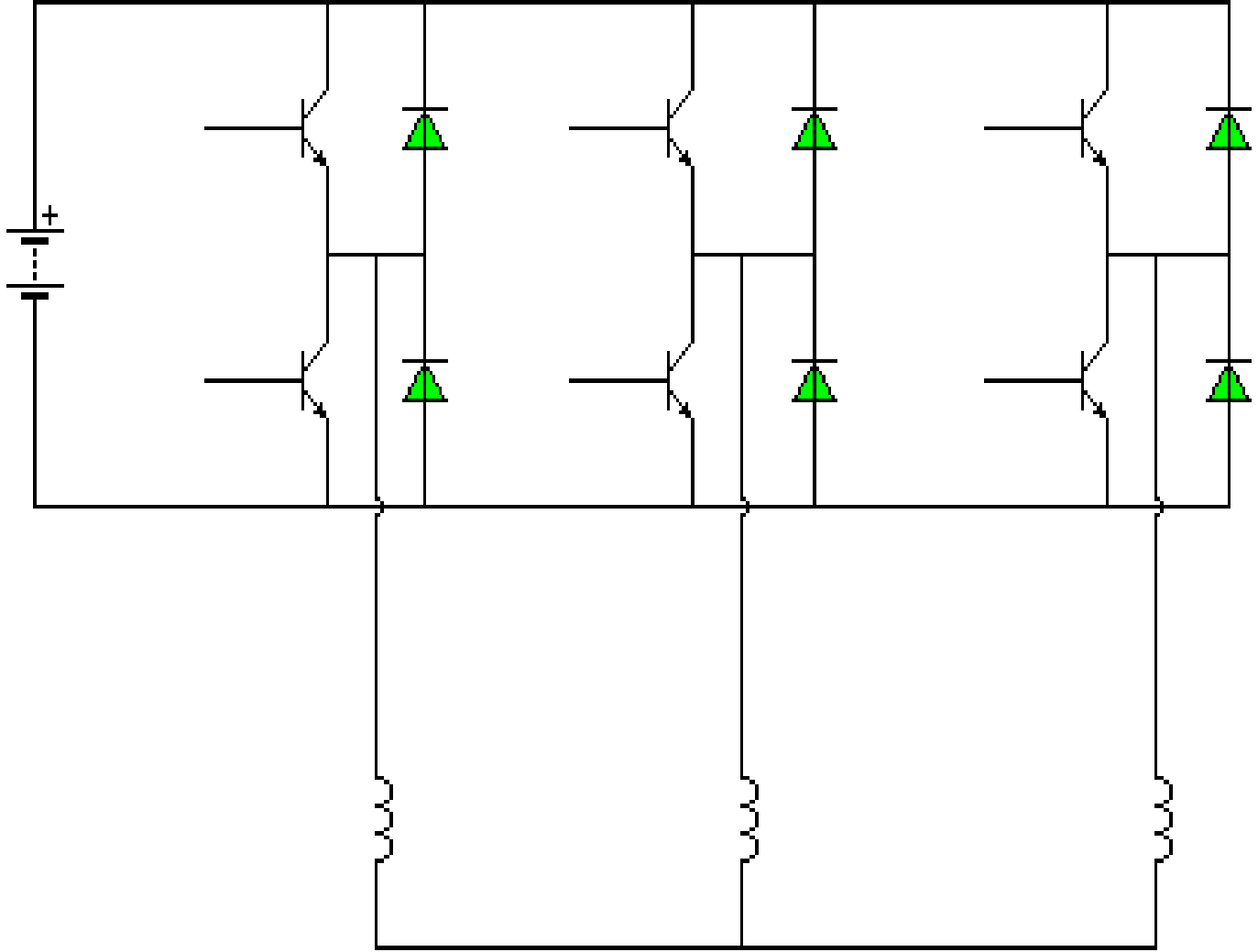
Material	σ_{\max} [MPa]	U [Wh/kg]	U_{optimal} [Wh/kg]
Mild Steel	240	42	81
Aluminium	85	45	86
Mir. steel	1000	47	89.3
E-glass	760	73	139
Epoxy			
Graphite	/4200	327	621
Epoxy			
E-glass fibre	1700	190	-
Graphite fibre	7000	545	-

Prototype dual rim composite flywheel

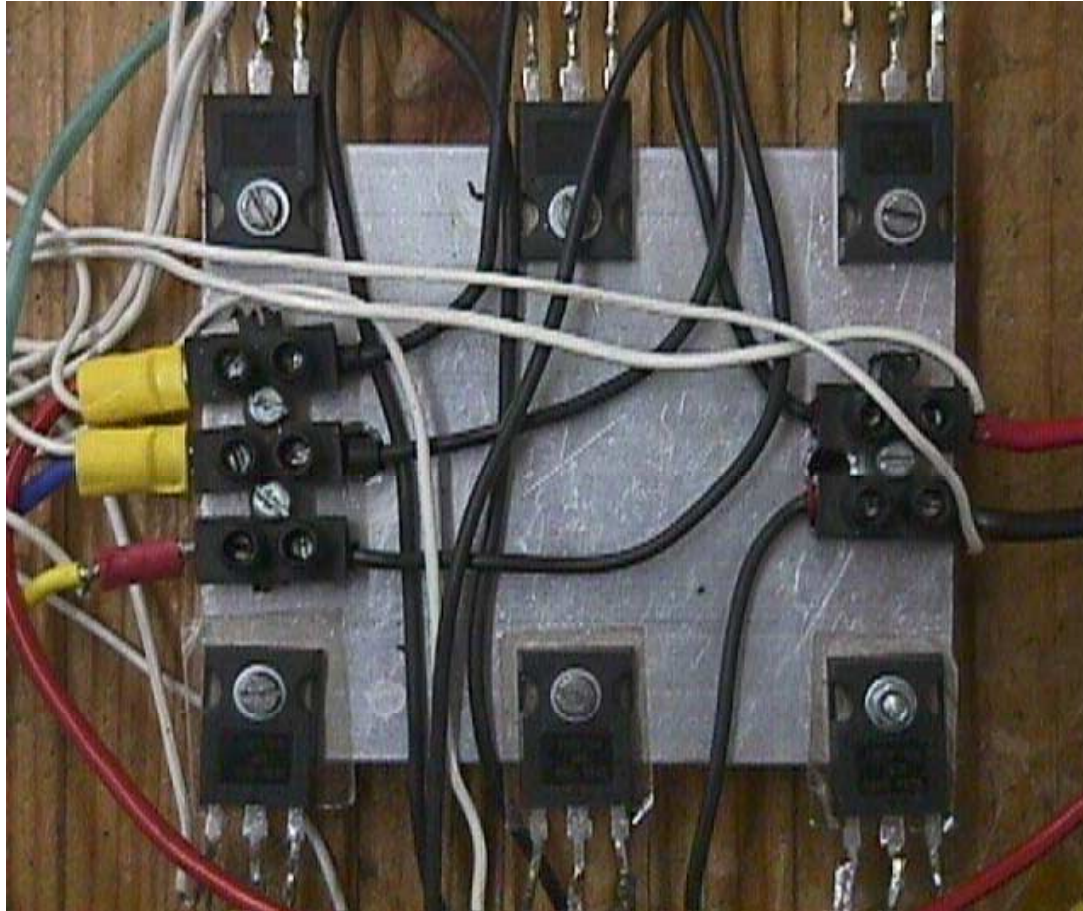


Encoder disk with optical pickups

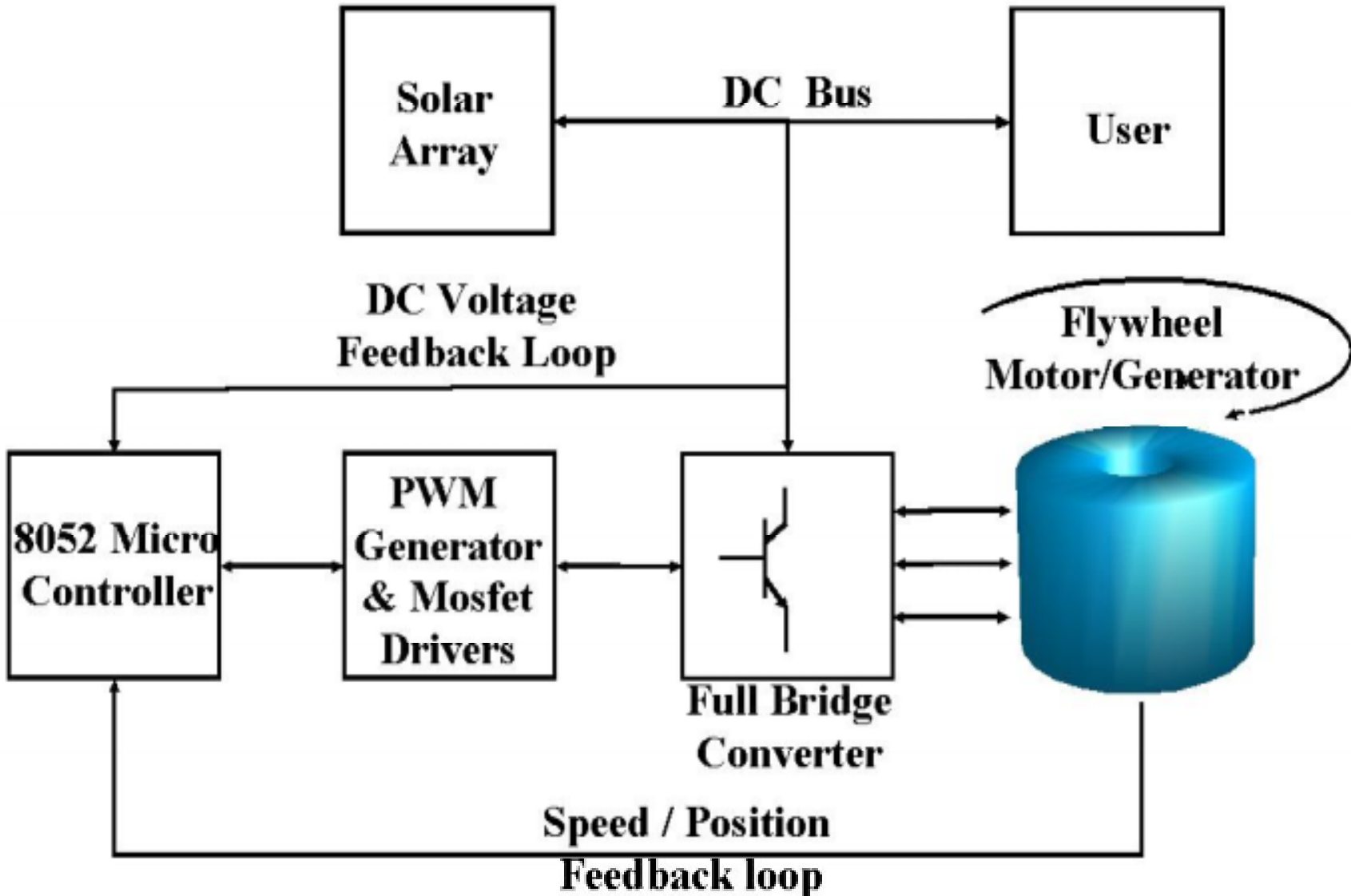




Three phase full bridge converter



Electromechanical Battery with Microprocessor control



Brushless EMB prototype suspended on modified roller bearings

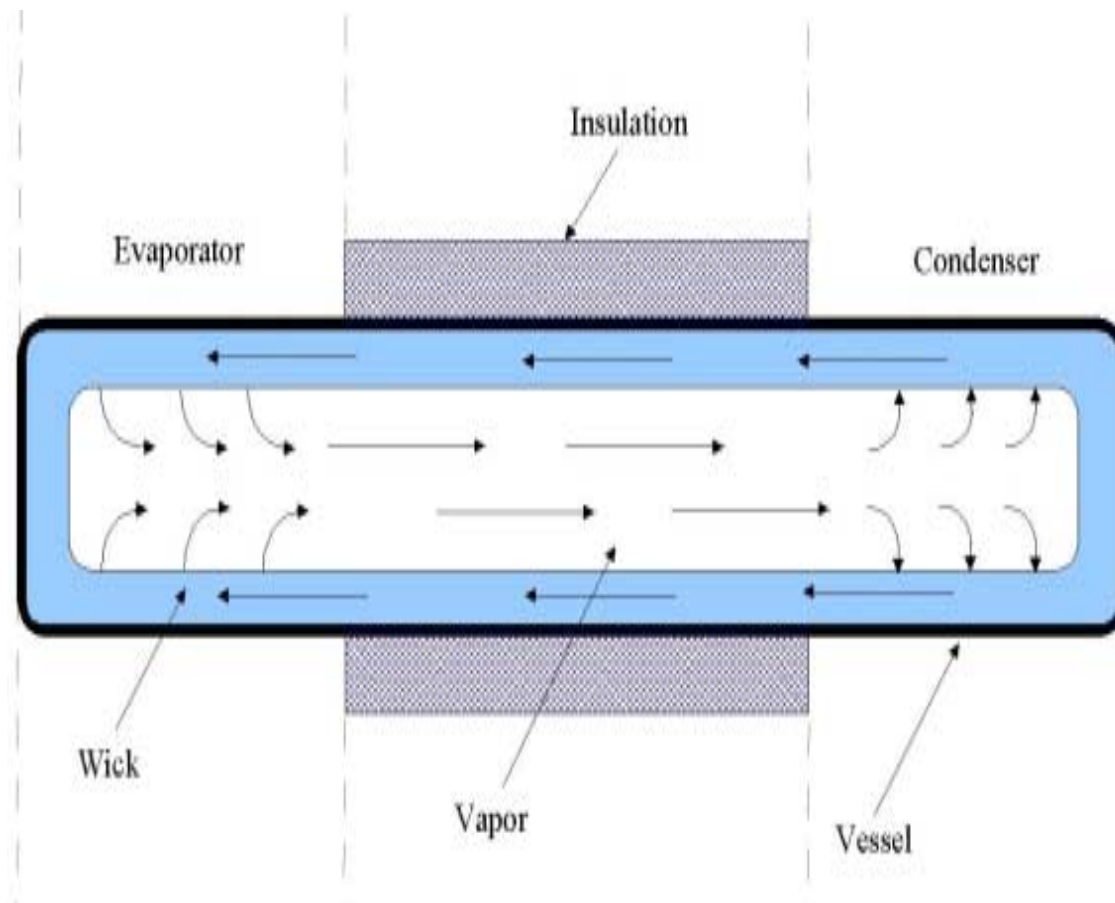


Brushless EMB prototype with vacuum containment suspended on magnetic bearings



Maximum estimated Voltages for different stator windings

<i>Windings</i>	<i>V_{L-L} (Delta Connected)</i>	<i>V_{L-L} (Star Connected)</i>
14	24	41.6
20	34.3	59.4
25	42.9	74.3



Conclusions

- Overview of storage technologies
- Magnetic bearings
- Brushless dc machine
- Drive schematic
- Test Results