



# Microwave theory, April 20, 2015

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Electrical and information technology

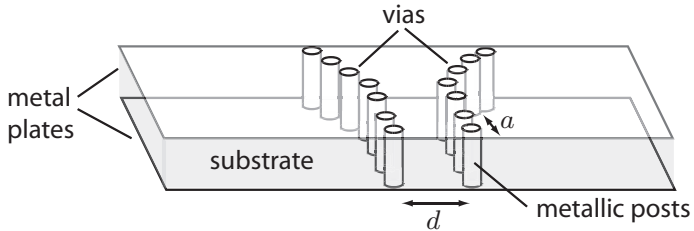
# Outline

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- ▶ Substrate integrated waveguides
- ▶ Comsol example
- ▶ Resonance cavities

# Substrate integrated waveguides

At high frequencies  $>10$  GHz the substrate integrated waveguides are an alternative to microstrips on integrated circuits.



# Resonance cavities

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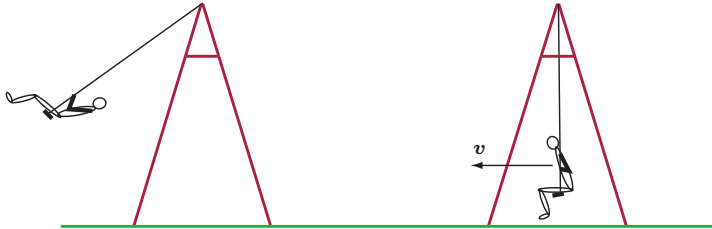
- ▶ High  $Q$  band-pass and band-stop filters
- ▶ Cavities in accelerators
- ▶ Klystrons
- ▶ Magnetrons
- ▶ NMR

Shumann resonances

# Resonance cavities

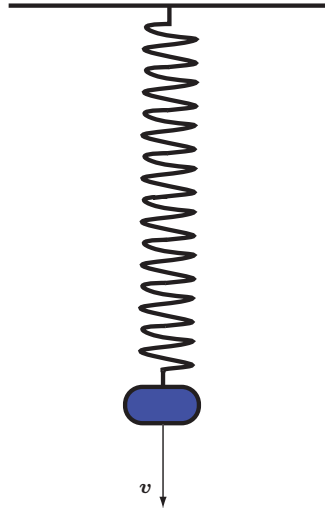
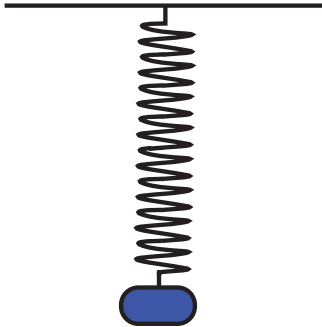
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To get a resonance you need two energy states!  
Potential energy  $\leftrightarrow$  kinetic energy



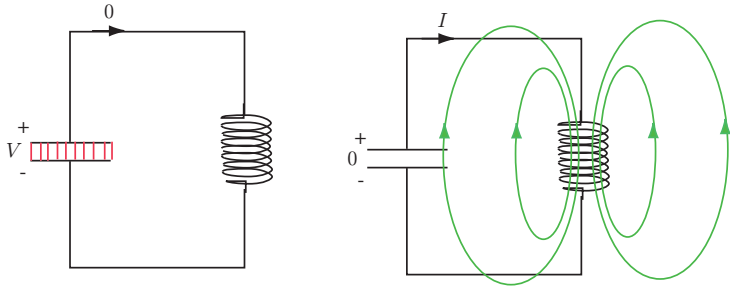
# Resonance cavities

Potential energy  $\leftrightarrow$  kinetic energy



# Resonance cavities

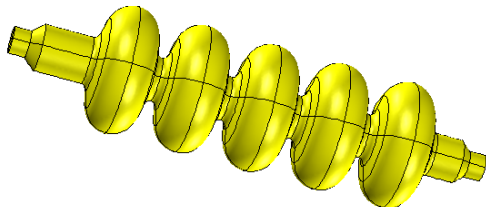
Electric energy  $\leftrightarrow$  magnetic energy



# Resonance cavities

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Electric energy  $\leftrightarrow$  magnetic energy





# Resonance cavities

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