



Benefits of Size Reduction: MEMS

- Benefits of size reduction clear for IC's in elect. domain
 - ↳ size reduction ⇒ speed, low power, complexity, economy
- MEMS: enables a similar concept, but ...
 - MEMS extends the benefits of size reduction beyond the electrical domain**

↓

Performance enhancements for application domains beyond those satisfied by electronics in the same general categories

- Speed → Frequency ↑ , Thermal Time Const. ↓
- Power Consumption → Actuation Energy ↓ , Heating Power ↓
- Complexity → Integration Density ↑ , Functionality ↑
- Economy → Batch Fab. Pot. ↑ (esp. for packaging)
- Robustness → g-Force Resilience ↑

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Vibrating RF MEMS

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Basic Concept: Scaling Guitar Strings

Guitar String

Stiffness

Mass

Freq.

Freq. Equation:

$$f_o = \frac{1}{2\pi} \sqrt{\frac{k_r}{m_r}}$$

μMechanical Resonator

[Bannon 1996]

Performance:

- $L_r = 40.8 \mu\text{m}$
- $m_r \sim 10^{-13} \text{ kg}$
- $W_r = 8 \mu\text{m}, h_r = 2 \mu\text{m}$
- $d = 1000 \text{ \AA}, V_p = 5 \text{ V}$
- $\text{Press.} = 70 \text{ mTorr}$

Transmission (dB)

Frequency [MHz]

$f_o = 8.5 \text{ MHz}$

$Q_{vac} = 8,000$

$Q_{air} \sim 50$

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