

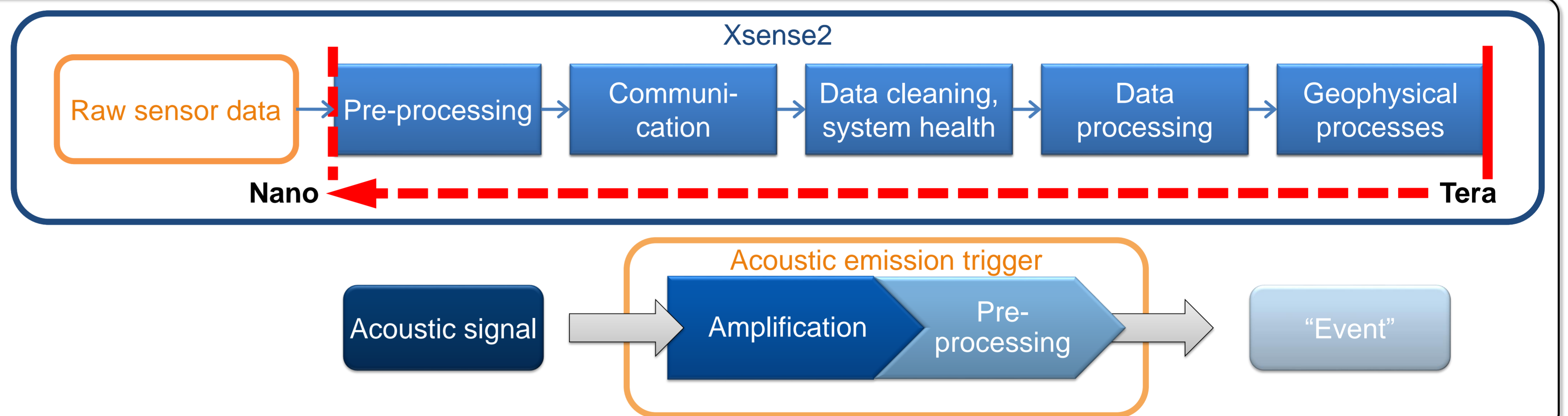
Ultra-low power electro-mechanical trigger for environmental acoustic emission monitoring

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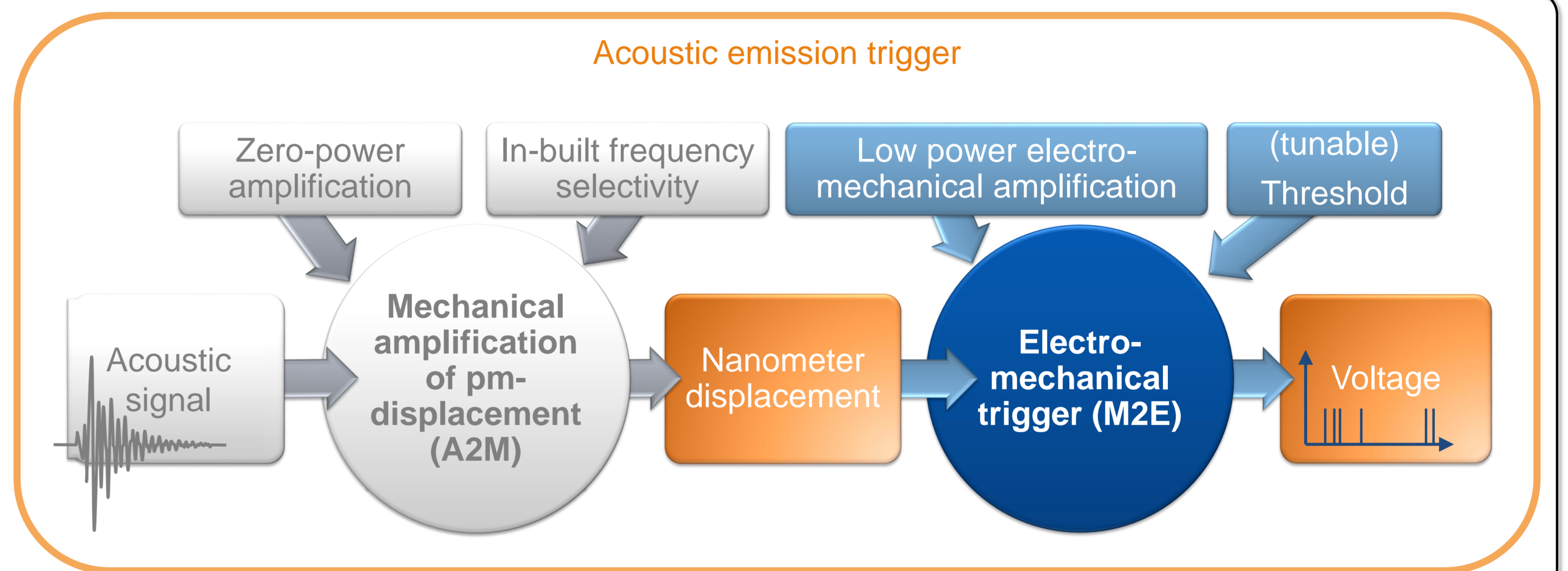
Motivation

- **Goal:** Wireless sensor networks for rock failure detection
- **Problem:** high power consumption due to over-sampling
- **Novelty:** Reduce power consumption and costs by using acoustic emission triggers



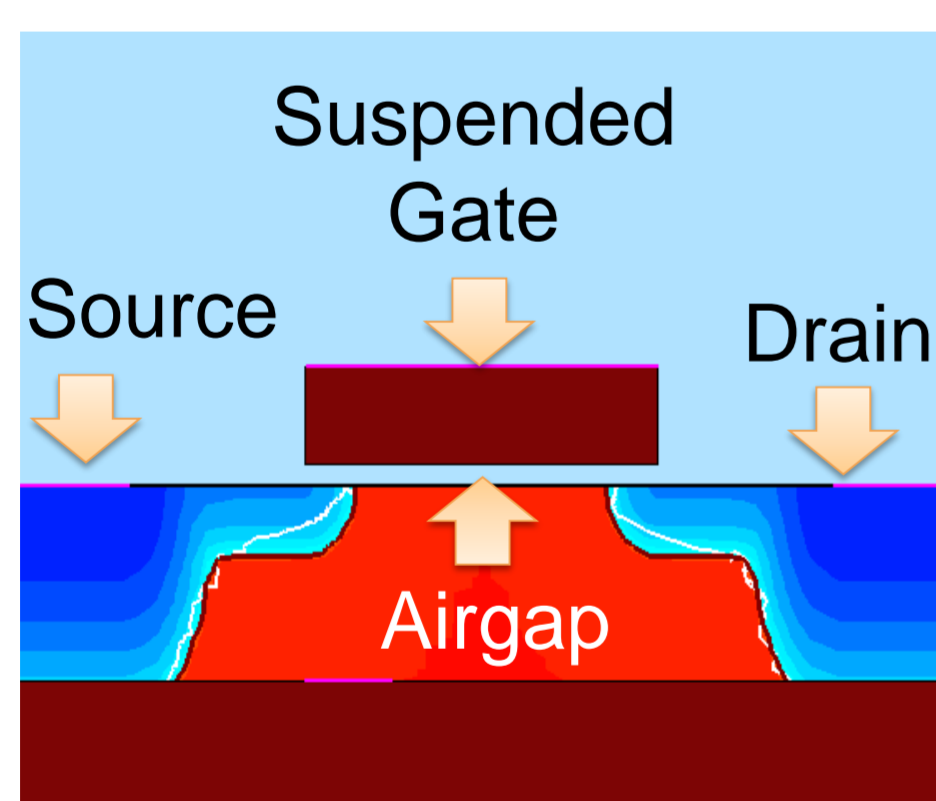
Requirements

- **Mean power consumption:** << 100 μ W (leakage current of a battery)
- **Bandwidth:** 5-20 kHz
- **Resolution:** 1 mg acceleration (~1 pm displacement at 10 kHz)
- **Resilience** towards shock and temperature changes
- Flexible threshold
- Cost
- Size

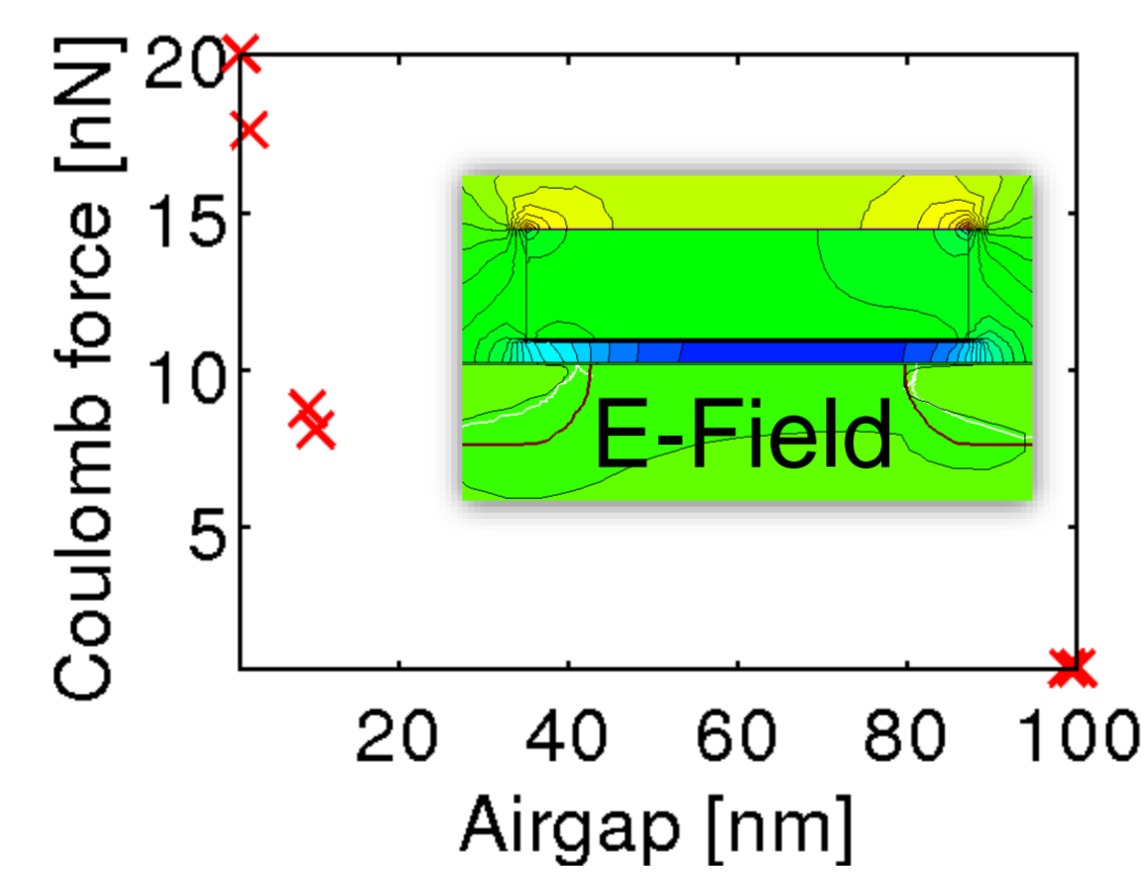


Electro-mechanical trigger (M2E)

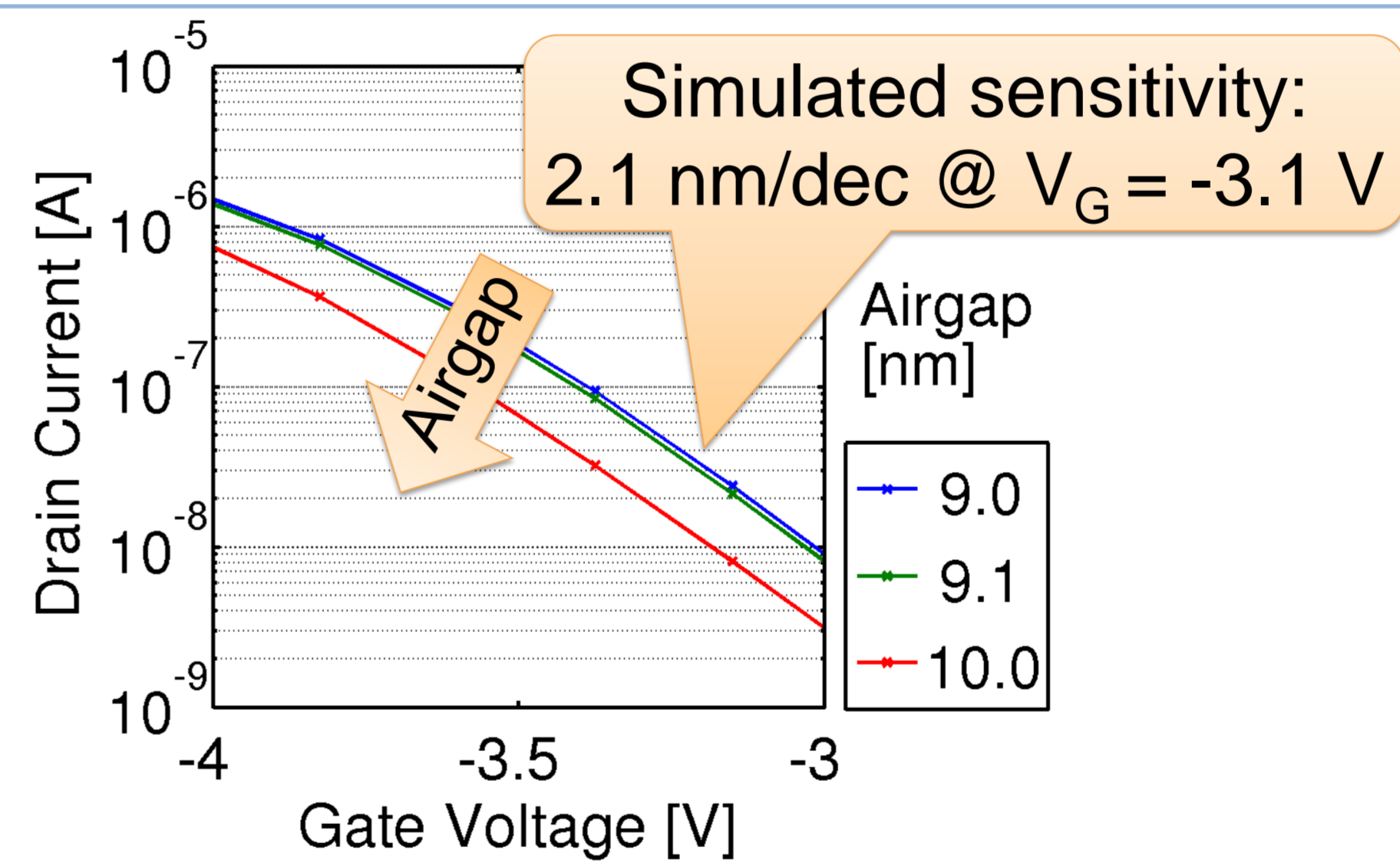
Suspended Gate FET (Sentaurus TCAD Simulation)



Modulation of airgap translates into modulation of drain current

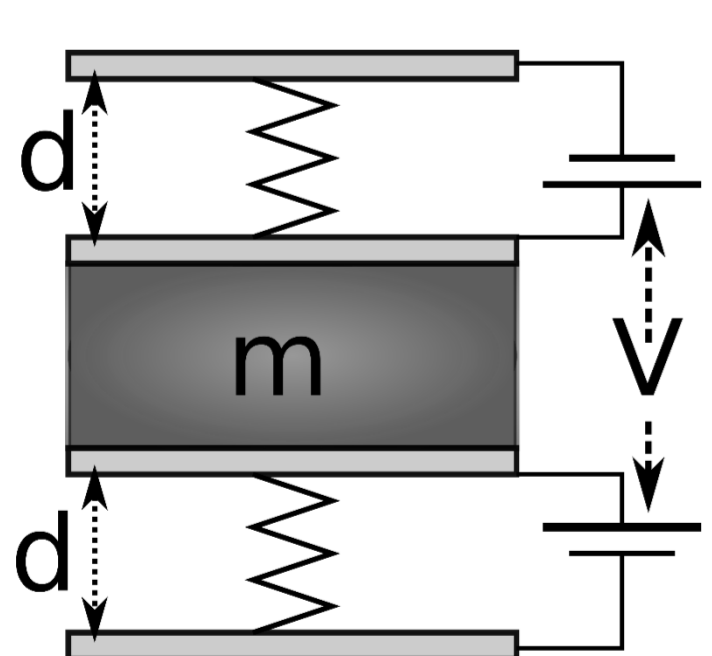


Attractive Coulomb force between gate and channel

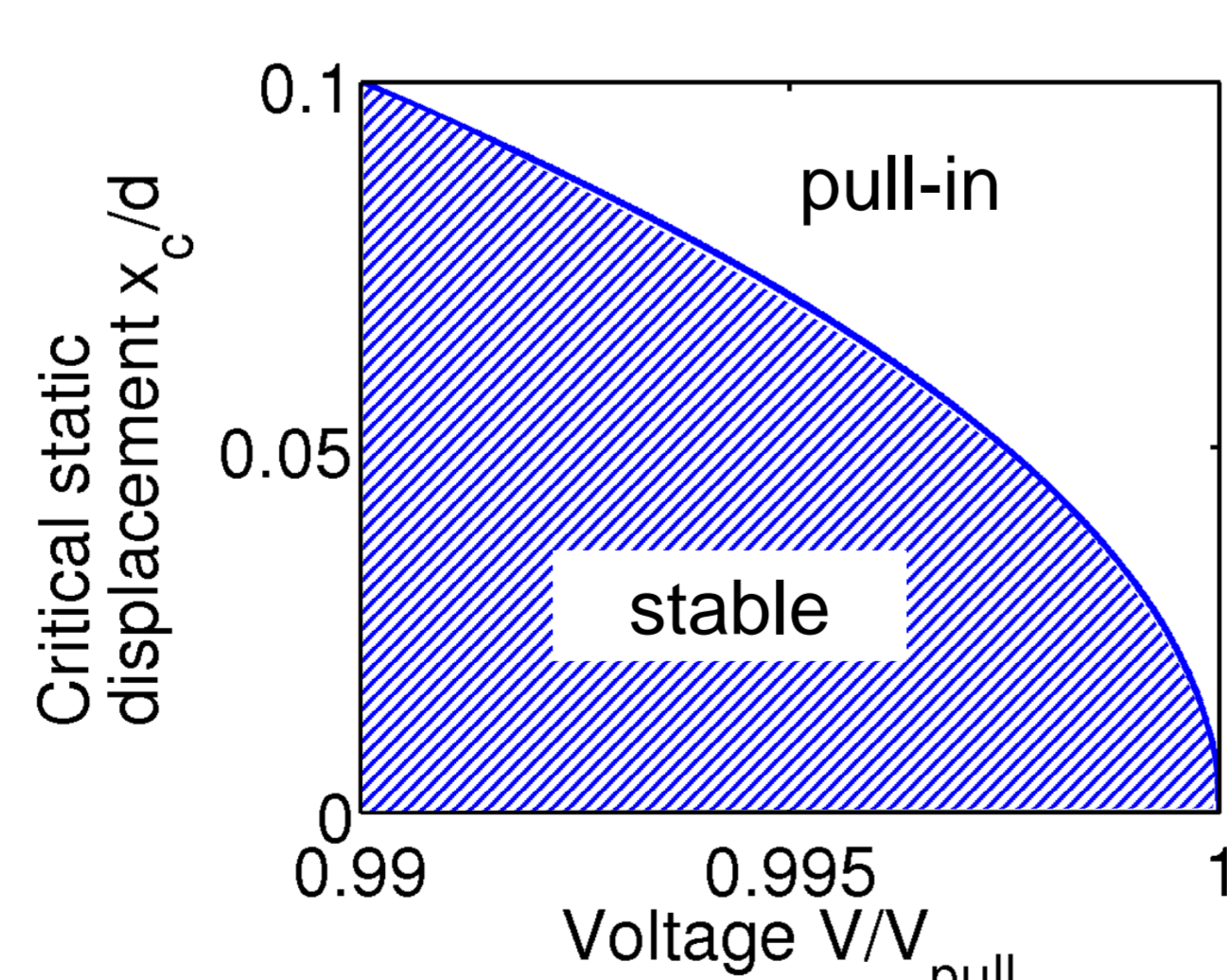


Exponential dependence of source-drain current on airgap

Pull-in contact switch



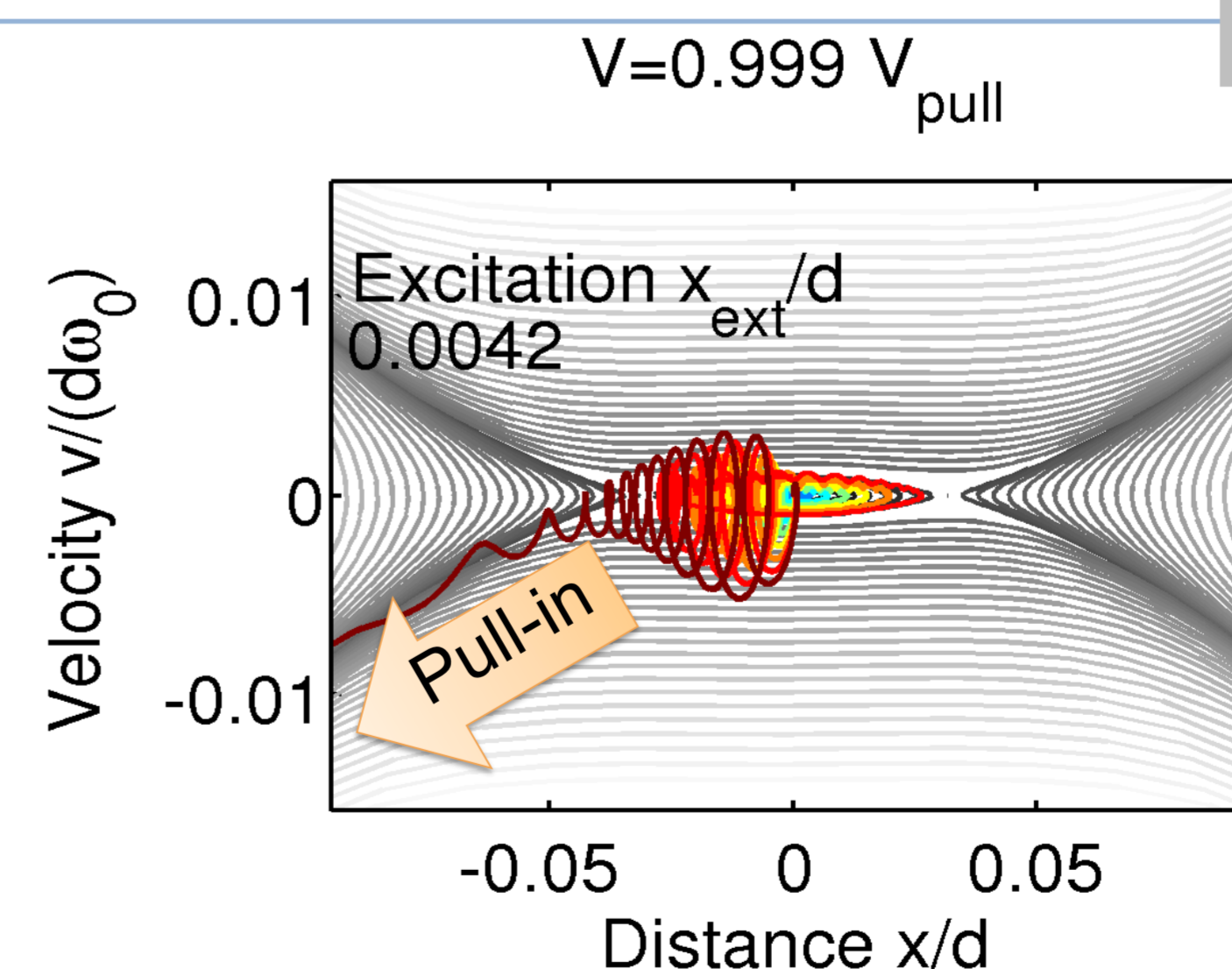
Coulomb forces cause pull-in upon threshold crossing in displacement and velocity



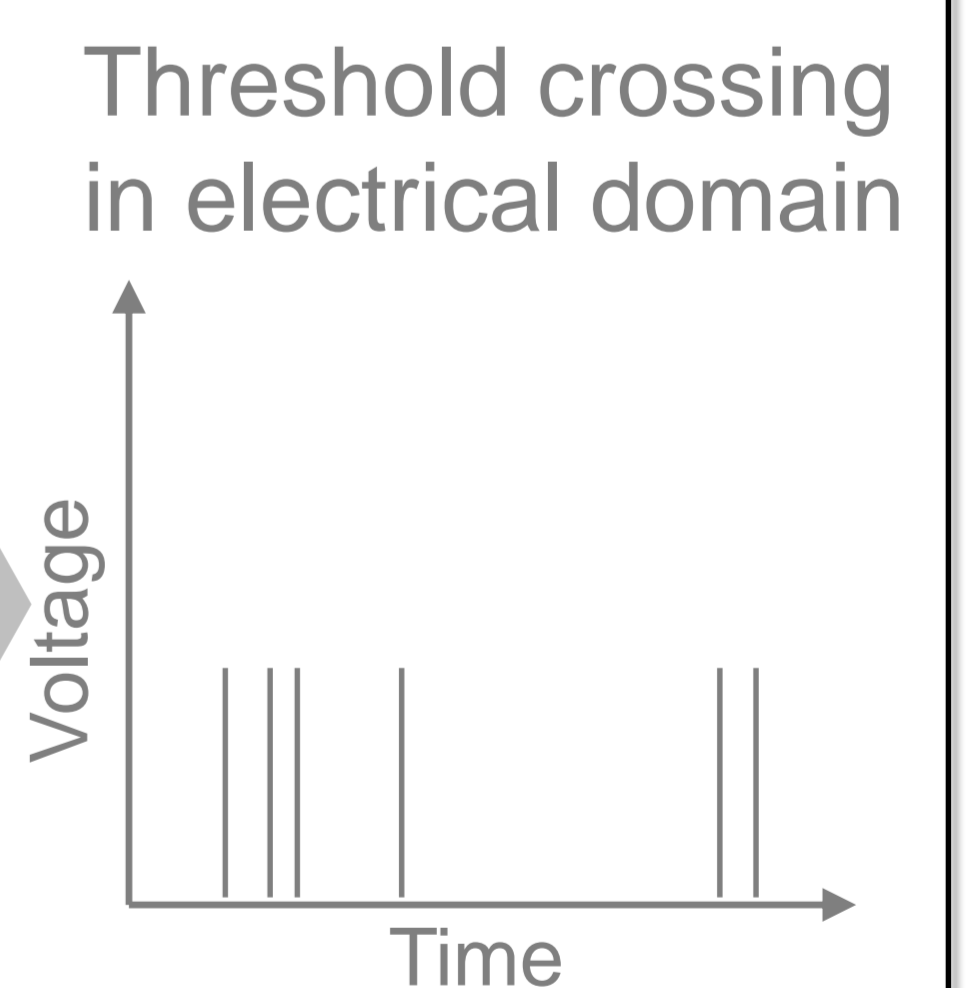
Threshold depends on V/V_{pull} and airgap d

$$\frac{x_c}{d} = \sqrt{1 - \frac{V}{V_{pull}}}$$

$$V_{pull} = \sqrt{\frac{kd^3}{2\epsilon A}}$$



At 240 nm gap: Pull-in when exposed to AE signal with >1 nm peak amplitude



Outlook

- Electro-mechanical feed-back
- Fabrication technology
- Re-set mechanisms
- Measurement setup
- Noise analysis

Acknowledgement

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