III-Nitride as a prospective TFET

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Drawback</th>
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</thead>
<tbody>
<tr>
<td>Possibility of subthreshold swing&lt;60 mV/decade</td>
<td>TFET</td>
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<tr>
<td>Lower power consumption</td>
<td>Tunneling based drive current → lower ION</td>
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**Tunneling rate increase in III-Nitride TFETs**
- Large polarization field → small tunneling length
- Small effective mass (e.g., bulk InN~0.20m₃)
- Tunneling through low bandgap material → efficient tunneling

**Ballistic current: Sidegate vs In-line**
- SS: 25mV/dec
- IL: 247µA/µm
- SS: 12mV/dec
- IL: 191µA/µm

**Ballistic vs Non-ballistic simulation**
- Geometry for best gate control:
  - Sidewall gate structure vs In-line geometry
- Proposal & Experiments:
  - Jena, Fay, Seabaugh (Notre Dame)

**Open design issues**
- Impact of scattering:
  - Ballistic vs Non-ballistic simulation

**Simulation methodology: Ballistic**
- Band Structure
- DFT
- Tight-binding
- Polarization: Spontaneous & Piezoelectric field
- Charge density, Transmisson & current-voltage

**Simulation methodology (Non-ballistic)**
- Scattering region 1 (Left contact)
- Scattering region 2 (Right contact)

**Next steps**
- Non-ballistic simulation: Explore graded junction device to overcome the degrading effects of quasi-bound states.
- Investigate the impact of atomistic strain on the transport characteristics of Nitride TFETs