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Here's an overview of the landscape presented in the **2023 IRDS "Beyond CMOS"** roadmap (2023IRDS_BC.pdf, IEEE) :

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1. Emerging Memory Devices (Ch. 2)

Highlighted categories include:

- **Novel magnetic memories**: STT-MRAM, SOT-MRAM, VCMA-based MRAM
- **Resistive memories**: OxRAM, CBRAM (filamentary/non-filamentary)
- **Ferroelectric memories**: FeFET, FTJ (leveraging HfO_2's ferroelectric property)
- **Macromolecular memory** (e.g., flexible polymer-based)
- **Mott memories** (based on insulator–metal transitions)
- **Massive storage** concepts (e.g., DNA-based)
  Each has strengths—e.g., MRAM for speed endurance, ReRAM and FeFETs for analog compute, DNA for density.

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2. Emerging Logic & Information-Processing Devices (Ch. 3)

Three major groups:

- **CMOS extensions**: nanowire/nanosheet FETs, CNT-FETs, 2D material FETs, TFETs
- **Charge-based Beyond-CMOS**: NC-FETs, NEMS switches, MottFETs, topological insulator devices
- **Non-charge-based Beyond-CMOS**: spin-wave devices, excitonic devices, transistor-lasers, magnetoelectric logic, domain-wall logic, Spin-Torque Majority Gates
  These offer alternate state variables—spin, phase, photons—and new switching mechanisms.

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3. Device-Architecture Interaction (Ch. 4)

Focuses on how these devices could enable novel computing paradigms:

- **Neuro-inspired systems**: ReRAM/PCM/ECRAM, ferroelectrics, MTJ-based neural nodes, photonic weight multiply
- **Probabilistic computing**: stochastic MTJs, Josephson junctions, ReRAM
- **Dynamical systems**: oscillators (ring, spin-torque, metal-insulator transition, optical, electromechanical)

These architectures break from Boolean/von-Neumann models and leverage device physics directly.

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4. Emerging Materials Integration (Ch. 5)

Investigates the materials needed to realize these devices and integrate them with CMOS:

- 2D semiconductors (e.g., TMDs) for high-mobility channels
- Ferroelectric HfO_2 integration
- Novel interconnect materials chosen via ML-driven screening
- Transient/fading electronics for security and eco-friendly disposal.

🔍 **My Take**

- **Diversity**: The roadmap spans a rich tapestry of device types—magnetic, ferroelectric, resistive, spintronic, photonic, mechanical, and molecular.
- **Depth**: It doesn't only catalog devices—it connects them to system-level paradigms (neuromorphic, probabilistic, oscillatory computing).
- **Integration challenge**: Real-world adoption will hinge on integrating exotic materials into standardized CMOS flows—a recurring theme.