

WHITE PAPER: ETA (Energy-Time Architecture)

Solving the AI Compute Thermal Wall

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1. Executive Summary

The AI revolution is hitting a physical brick wall: heat. State-of-the-art GPUs consuming 700+ Watts require massive liquid cooling infrastructure, limiting data center density and inflating operational costs by over 40%.

Teleden has developed the Energy-Time Architecture (ETA) —a fundamentally new transistor paradigm that eliminates Joule heating at the source. By leveraging the intrinsic wave-nature of the electron, ETA performs logic operations via phase modulation rather than brute-force current flow.

The Result: A 1,000× reduction in power consumption, zero active cooling, and the ability to stack 100 layers of compute in a single chip.

2. The Problem: The Thermal Wall in AI Hardware

Scaling AI models (LLMs, Diffusion, Transformers) requires exponential increases in compute. However, traditional CMOS scaling has ended.

- Power Density: GPUs now exceed 700W per chip.
- Cooling Costs: Data centers spend more on cooling infrastructure than on the chips themselves.
- Physical Limits: You cannot stack 3D logic because the bottom layers would melt the top layers.

The industry is out of solutions. Voltage scaling has hit a floor, and leakage current is catastrophic at sub-3nm nodes. A new computing paradigm is required—one that doesn't rely on pushing electrons through a resistive channel.

3. The ETA Solution: Logic Without Current

ETA redefines the transistor. Instead of modulating channel resistance with current, ETA modulates the phase of the electron's wavefunction.

How it works (High-Level):

1. Ultra-Scaled Channels: We engineer transistor channels with extreme spatial confinement.
2. Resonant Interferometry: This confinement induces a resonant coupling between the electron's internal clock and the semiconductor lattice.
3. Phase Logic: Logic states (0, 1, 2) are determined by the discrete energy packets (phonons) exchanged during this resonance, rather than by the number of electrons flowing.

The Critical Difference: There is no net current flow during switching. The electron is "tickled," not "pushed." This eliminates I^2R (Joule) heating entirely.

4. Key Performance Advantages (The Numbers)

Metric	Conventional GPU (H100)	ETA Architecture	Improvement
Total Chip Power	~700 W	< 1 W	1,000× reduction
Heat Generation	~700 W (waste)	~0.1 W (recyclable phonons)	7,000× reduction

Operating Temp	85°C (needs liquid cooling)	25°C (Room temp)	Eliminates active cooling
Compute Density	1 Layer	100 Layers (3D Stacked)	100× increase
Switching Energy	~1 fJ	< 0.1 aJ	Near-Landauer Limit

Implication: A server rack with ETA chips runs at ambient temperature. No chillers, no immersion tanks, no thermal throttling.

5. Memory & Compute-in-Memory

ETA is not just a logic transistor; it is a unified architecture.

- **ETA-RAM (Non-Volatile):** Data is stored as localized lattice strain (phonon traps). Retention exceeds 1 hour without power, enabling instant-on computing and dramatic standby power savings.
- **Compute-in-Memory (CIM):** The phase-shift principle allows analog matrix multiplication directly inside the memory array. AI inference performs with zero data movement, eliminating the "Memory Wall" bottleneck that consumes 90% of energy in traditional AI chips.

6. Commercial & Manufacturing Readiness

We are not asking the industry to build new fabs.

- **Compatibility:** The ETA transistor is fabricated using standard CMOS tools: EUV lithography, Atomic Layer Deposition (ALD), and Gate-All-Around (GAA) processes.
- **Roadmap:** The architecture is scalable and ready for integration into 2nm and 1nm foundry nodes.

Patent Pending: U.S. Provisional Application No. 64/102,031 (Filed June 30, 2026).

7. Strategic Opportunity

We are actively seeking strategic partnerships and licensing agreements with semiconductor foundries, AI hardware vendors, and data center operators.

We invite qualified parties to contact us for:

- NDA Review: Full technical disclosure and test data.
 - Joint Development: Co-optimization for specific AI/HPC workloads.
 - Patent Licensing: Royalty-based access to the ETA IP portfolio.
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8. Contact

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Let's end the thermal wall and unlock the next era of AI compute together.