Houston, weve got a problem:

Coming soon, quantum vulnerabilities are no longer theoretical.

The coming era of quantum computing poses a serious threat to classical cryptographic infrastructure. I have a low-energy hardware security primitive made possible by aperiodic geometry — and it's built for space. My research explores a novel physics-based stopgap: using light diffracted through aperiodic quasicrystals etched into durable silicates to create unclonable, low-energy physical keys for space-grade authentication, in combination with light-path modulation (e.g. vibration, thermal variation). These keys could be used in parallel with standard encryption protocols.

Current cryptographic systems are vulnerable to Shor's algorithm. Post-quantum algorithms exist, but physics-based layers like this handshake method add robust, hardware-anchored resistance.

- Quasicrystals create complex, deterministic but non-periodic patterns.
- When struck with light (via laser), these surfaces produce unique, hard-to-replicate diffraction signatures.
- These signatures can act as physical unclonable functions (PUFs) and be used in challenge-response protocols.
- Especially relevant for laser-based space communications (e.g. Psyche's DSOC, LISA interferometry).

Use Cases and More!

Use Case Scales:

1. Satellite-level Authentication: Secure node-to-node quantum-resistant challenge-response.
2. Wafer-level ID tags: For supply chain & hardware attestation.
3. Deep-Space Probes: Robust, radiation-resistant identity protocols for long-range laser comms.

Why It Works:

- Combines unclonable structure + tunable challenge-response
- Adds geometric complexity as a physical-hardness layer beyond conventional memory-stored secrets
- Inspired by PUFs but compatible with optical & deep-space environments
- Quasicrystalline tiling acts as a mathematically unique dimensional vise — deterministic yet non-periodic, producing patterns that are, so far, human-impossible to invert without full knowledge of the tiling window.

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