Paper 028 / Application 005

CryoBus: A Spacecraft Superconducting Power and Magnetic Subsystem Design Toolchain

From speculative superconductivity prompts to conservative cryogenic engineering

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Working paper draft / June 13, 2026

Abstract

CryoBus is a proposed JMP0X1B toolchain for superconducting spacecraft subsystems. It does not assume unverified room-temperature superconductivity. Instead, it models known cryogenic conductors, quench safety, current distribution, thermal load, magnetic cleanliness, mass trades, and technology-readiness gates. The toolchain translates the superconducting subsystem paper into executable engineering analysis.

Status. Draft manuscript for review and revision. This paper is not an empirical claim of new physics or field-ready technology. It is a structured proposal, theory note, protocol, or application architecture intended to be auditable, falsifiable, and publishable with source.

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1 Problem

Superconductors can reduce resistive losses and enable compact magnetic systems, but cryocoolers, insulation, quench protection, joints, radiation exposure, and operations can erase the advantage. The problem is to evaluate net mission value rather than isolated conductor performance.

2 Model

CryoBus represents a subsystem as cables, joints, coils, cryocoolers, thermal straps, shields, sensors, and quench protection. The optimizer computes mass, heat, reliability, magnetic field, stored energy, and failure margins across mission phases.

$$\Delta M = M_{\text{copper}} - (M_{\text{HTS}} + M_{\text{cryo}} + M_{\text{shield}} + M_{\text{quench}}),$$
$$E_B = \frac{1}{2} L I^2, \qquad Q_{\text{lift}} = \frac{Q_{\text{cold}}}{\eta_{\text{cryo}}(T)}.$$

3 Claims

1. **Claim 1.** A superconducting spacecraft subsystem should be accepted only on net mission value, not zero DC resistance alone.
2. **Claim 2.** Quench protection and magnetic cleanliness are core architecture variables, not afterthoughts.
3. **Claim 3.** A toolchain can reuse materials-atlas data even when speculative superconductivity claims fail.
4. **Claim 4.** CryoBus provides practical technology output from the frontier materials track.

4 Evidence Plan

The first evidence artifact is a trade study comparing copper and HTS power trunks on a small satellite bus with realistic cryocooler mass. The second is a coil module study with stored-energy and magnetic-contamination limits. The third is a thermal-vacuum test plan that links coupon data to subsystem qualification.

5 JMP0X1B Implementation Surface

JMP0X1B is used for unit-safe trades, effectful solver actors, requirements traceability, and qualification gates. Results should connect to AS9100-style evidence records when used for flight programs.

Illustrative JMP0X1B-style contract

```
record CryoSubsystem { conductors: List<Conductor>, cryo: Cryocooler, quench: QuenchPlan, missi
fn trade(system: CryoSubsystem) -> MissionValue effects{Units, Reliability, Audit}
```

6 Release And Review Plan

Release reference component models, unit tests, mission profiles, and a reproducible trade-study PDF. Include negative trade cases where superconductivity is not worth the cryogenic burden.

7 Open Questions

- Which small-sat mission class first benefits from HTS power trunks?
- How should radiation degradation enter conductor margins?
- Can magnetic cleanliness be verified early enough in design?
- What minimum telemetry is required for on-orbit quench diagnosis?

8 Conclusion

CryoBus is a conservative engineering application with clear value independent of speculative materials claims. It turns research skepticism into subsystem design discipline.

References

References

[1] JMP0X1B Research Group. *Replication and Falsification of Piezoelectric Strain-Driven Superconductivity in Composite Coated Wires*. Working paper, 2026. https://research.jmp0x1b.com/papers/piezoelectric-superconductivity-replication.html

[2] JMP0X1B Research Group. *From Speculative Superconducting Claims to Practical Spacecraft Power and Magnetic Subsystems*. Working paper, 2026. https://research.jmp0x1b.com/papers/superconducting-spacecraft-subsystems.html

[3] JMP0X1B Research Group. *Cryogenic Dielectric and Superconducting Shield Controls for Projection-Electromagnetism Nulls*. Working paper draft, 2026. https://research.jmp0x1b.com/papers/cryogenic-dielectric-and-superconducting-shield-controls-for-projection-electrom.html

[4] JMP0X1B Research Group. *A Strain-Electrodynamics Materials Atlas for Piezoelectric Superconductivity Claims*. Working paper draft, 2026. https://research.jmp0x1b.com/papers/a-strain-electrodynamics-materials-atlas-for-piezoelectric-superconductivity-cla.html

[5] SAE International. *AS9100D: Quality Management Systems - Requirements for Aviation, Space, and Defense Organizations*. 2016.

[6] JMP0X1B. *jmp0x1b_lang_spec package*. https://libs.jmp0x1b.com/packages/jmp0x1b_lang_spec

[7] JMP0X1B. *jmp0x1b_provenance package*. https://libs.jmp0x1b.com/packages/jmp0x1b_provenance