Replication and Falsification of Piezoelectric Strain-Driven Superconductivity in Composite Coated Wires

A Materials Protocol for Testing the Experimentally Concrete Pais Claim Family

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Abstract. This paper converts the Pais piezoelectricity-induced room- and high-temperature superconductor patent claims into a replication-grade materials experiment. The patent family describes composite wires with an insulating core and metal or piezoelectric coating, driven by pulsed current while mechanically or piezoelectrically vibrated. The strongest scientific form of the question is not whether the broad room-temperature claim should be believed. It is whether controlled strain, interface geometry, and nonequilibrium drive can produce reproducible superconducting observables in a coated-wire system. The protocol separates low resistance, zero resistance, Meissner response, critical current, magnetic hysteresis, and contact artifacts. It includes ordinary-metal samples, PZT-coated samples, known-superconductor controls, blind contact swaps, thermal mapping, AC susceptibility, magnetometry, and pulse-synchronized impedance measurements. A null result is expected and publishable; a positive result requires transport and magnetic evidence together.

Working-paper status. This manuscript is speculative and methodological. It makes no claim of experimentally demonstrated exotic propulsion, room-temperature superconductivity, inertial-mass reduction, or gravitational-wave generation. Its purpose is to state assumptions, formalize hypotheses, and define tests whose null outcomes are scientifically useful.

Contents

1 Problem

The Pais superconductor applications claim that a wire with an insulating core and metal coating can exhibit room- or high-temperature superconductivity when a pulsed current passes through the wire while it is vibrated [1, 2]. The documents further suggest interface superconductivity, London-depth-scale coatings, and electrically driven vibration through PZT-like materials.

The claim is extraordinary because established superconductivity requires stringent evidence. The Department of Energy summarizes the basic criteria: superconducting materials conduct DC current without energy loss below a critical temperature and expel magnetic fields as they transition to the superconducting state [3]. NASA's superconducting-wire work illustrates the orthodox engineering path: superconducting wires are useful because they reduce loss and support high current when cooled below their critical temperature [4]. This paper treats the Pais documents as a testable materials hypothesis, not as a validated technology.

2 Hypotheses

We define four nested hypotheses.

H0: Artifact. Apparent resistance drops are caused by contacts, heating, electromigration, nonlinear conduction, instrumentation bandwidth, or mechanical micro-welding.

H1: Strain tuning. Vibration or piezoelectric strain changes resistivity or superconducting parameters in already-superconducting controls, but does not create superconductivity in ordinary coated wires.

H2: Transient nonequilibrium state. Pulsed current plus strain creates a short-lived low-resistance state without full Meissner response.

H3: Full superconductivity. The driven wire shows zero resistance within instrumental limits, Meissner response, a critical current, and reproducible magnetic-field dependence at the claimed operating temperature.

The experiment is designed to reject H0 first. H3 is not accepted from transport data alone.

3 Sample matrix

Sample class	Purpose	Required diagnostics
Insulator plus aluminum coating	direct patent-like ordinary-metal case	four-point transport, thermal imaging, contact swaps
Insulator plus PZT plus metal	piezoelectric drive case	strain calibration, impedance spectroscopy
Known low-temperature superconductor wire	positive control	transition temperature, critical current, Meissner check
Known high-temperature superconductor tape	strain-tuning benchmark	AC susceptibility and transport under strain

Open dummy and short dummy	instrument artifact controls	pulse pickup and lead inductance measurement

4 Measurements

4.1 Transport

Use true four-terminal measurement. The voltage taps must be mechanically independent from current leads. Each run includes contact reversal, current reversal, and dummy substitution.

$$R(t) = \frac{V_{23}(t)}{I_{14}(t)}. \tag{1}$$

A claimed zero-resistance state must remain below the calibrated voltage floor across multiple current levels and contact configurations.

4.2 Magnetic evidence

A full superconductivity claim requires field expulsion or magnetic screening. Measure AC susceptibility and magnetization before, during, and after the drive:

$$\chi_{\mathrm{ac}}(\omega) = \frac{M(\omega)}{H(\omega)}. \tag{2}$$

A transport anomaly with no magnetic signature is classified as H1 or H2, not H3.

4.3 Thermal and mechanical diagnostics

Pulsed current and vibration can create misleading signals. Therefore every active run requires temperature maps, strain amplitude, resonance frequency, acoustic pickup, and contact-resistance monitoring.

5 Drive space

The control variables are

$$\Theta = (I_0, \Delta I, f_I, f_v, A_v, B, T, \sigma_{\mathrm{pre}}, d_c), \tag{3}$$

where I_0 is bias current, ΔI pulse amplitude, f_I pulse frequency, f_v vibration frequency, A_v vibration amplitude, B magnetic field, T temperature, σ_{pre} pre-strain, and d_c coating thickness. The first pass should scan conservatively to avoid irreversible sample damage. A second pass can target resonant regions.

6 Falsification rules

A room-temperature superconductivity claim is rejected for the tested design if any of the following occurs:

1. the apparent transition disappears under contact reversal or four-terminal reconfiguration;

2. the voltage drop correlates with sample heating or lead inductance;
3. no magnetic screening appears at the same time as the transport anomaly;
4. the anomaly is absent in blind reruns or in duplicated samples;
5. the effect appears equally in dummy samples.

7 Expected result

The most probable result is H0 or H1. This still matters. A rigorous null would prevent further engineering investment in a false room-temperature claim. A confirmed H1 result would be useful materials science: controlled strain could tune current density, loss, or transition behavior in known superconductors. Only a replicated H3 result would justify a new superconductivity program.

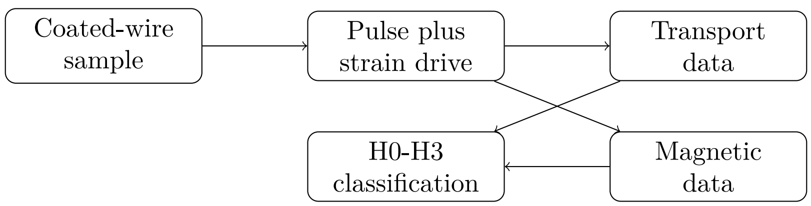

Figure 1: A positive superconductivity classification requires transport and magnetic evidence together.

8 Release notes

The release should include fabrication recipes, microscopy, coating thickness measurements, raw voltage and current waveforms, magnetometry data, thermal videos or maps, sample failure logs, and blind-run keys after publication.

References

[1] Salvatore Cezar Pais. *Piezoelectricity-induced Room Temperature Superconductor*. US Patent Application 20190058105, 2019. https://patents.justia.com/patent/20190058105.

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