Recognition Physics Institute

Prospectus · November 2026

Independent research · Austin, Texas

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What we are building

Abundant energy, a world free of disease and a new kind of intelligence. The Recognition Physics Institute develops the mathematics, experiments and engineering behind that ambition. Our long-term goal is to make matter designable, down to the atom.

We start from Recognition Science and follow its consequences into gravity, molecules, plasmas, light and computation. This prospectus sets out what we have established, the programs it supports, the people doing the work and how support moves it forward. Every count and status below matches the research library at recognitionphysics.org/publications.

The science

Recognition Science is the discovered architecture of reality. It begins with distinction and the requirements of consistent recognition. Occurrences can be told apart. Comparing two of them requires information about both. A later comparison needs a record of the earlier one. From these requirements Recognition Science derives a fixed mathematical foundation for physics.

Its central results are forcing results. Each one shows why a structure must take the form it does: within the stated requirements, no alternative survives. Here is one, published in *Mathematics* in 2026. Take a measure of difference that is never negative, is zero at a perfect match, obeys a law for combining comparisons and has a fixed scale. Those rules select exactly one formula,

$$J(x) = \tfrac{1}{2}\Big(x + \frac{1}{x}\Big) - 1.$$

Twice as much and half as much then carry the same cost, $J(2) = J(\tfrac{1}{2}) = 0.25$, and a perfect match costs nothing.

We formalize the mathematics in Lean, a proof assistant that checks every logical step by machine. The same definitions drive a live simulation of reality from its first recognition event, computed in exact arithmetic. The simulation page shows how far it reaches today, what is proved at each stage and the open problem at its frontier.

The record so far

- **23 journal papers**: 20 published and 3 accepted, in 11 journals, including *The Journal of Chemical Physics*, *Journal of Statistical Mechanics: Theory and Experiment*, *Entropy*, *Mathematics*, *Axioms*, *Symmetry*, *Molecules* and *AIP Advances*.
- **12 preprints**: 11 on arXiv and 1 on Preprints.org.
- **2 technical books**: *The Structure of Reality* (155 pages) and *The δ Foundation* (third edition, 393 pages).
- **24 preliminary manuscripts**, not peer reviewed, including a 13-paper series on gravity from the recognition lattice.

Table 1. Selected results and their status.

Result	Where	Status
Uniqueness of the canonical reciprocal cost	*Mathematics* 14(6):935	Published
The δ-calculus: from distinction to arithmetic	*Advances in Pure Mathematics* 16(9):705–739	Published
A discrete informational framework for classical gravity	*Entropy* 28(4):477	Published
Charged lepton masses from the recognition composition law	*Symmetry* 18(6):962	Published
Curvature-induced smectic-C order of hard spherocylinders on a sphere	*The Journal of Chemical Physics* 165(7):074903	Published
A golden-ratio ladder for the hydrogen-bond network of liquid water	*Molecules* 31(15):2701	Published
CHSH reference acquisition on a cloud photonic processor	arXiv 2608.18153	Preprint

Research programs

Foundations and mathematics

Most of the journal record sits here: the unique measure of difference, the geometry of comparing several quantities at once, recognition geometry and the δ-calculus, which builds arithmetic from records of repeated distinction. *The δ Foundation* sets out that construction at book length.

Gravity

Our paper in *Entropy* derives Newton's law of gravity, with a small correction, from a model built from discrete information, and compares the result with galaxy rotation without fitting a separate parameter to each galaxy. A 13-paper series of preliminary preprints, not yet peer reviewed, builds gravity on the recognition lattice: the sum over geometries, Einstein's field equations, Newton's constant, the graviton, black holes and the cosmological constant.

Matter and medicine

With Hartmut Löwen and Elshad Allahyarov we have two papers in *The Journal of Chemical Physics*, one published and one accepted, on how rod-shaped particles pack on a curved surface. Further papers organize the hydrogen-bond network of liquid water (*Molecules*), within-period atomic trends (*Symmetry*) and measurement design for molecular conformer spectroscopy (*AIP Advances*, accepted). The program's aim is the physics of protein folding and binding: to understand disease at the molecular level and guide the design of treatments.

Fusion energy

Fusion power depends on controlling a hot, moving plasma. Three of our scientists work on plasma behavior and on the physics and engineering needed to make fusion a practical source of abundant energy. The fusion results to date are the institute's own work. None has yet been replicated outside the institute, and none is yet published.

Quantum computing with light

We ran two experiments on Quandela's commercial cloud photonic processor, both reported as arXiv preprints. In the first, eight sequential passes each recorded a CHSH score above 2 in selected photon detections. The analysis examines readout imbalance. The scores establish a measurement reference; they do not certify entanglement. The second tests nested parity-check filters on the same processor.

Cambrian

Cambrian is our AI system for mathematical discovery. Its agents develop results and proofs, and Lean checks every logical step. Among its results is a machine-checked bound on a cube that holds however finely space is divided into a grid.

Ethics and economics

Ethics and economics concern the same physical relations, actions and consequences as the rest of the science. This program is at the stage of preliminary manuscripts, including *The Moral Code of Reality*.

People

Name	Role	Focus
Jonathan Washburn	Founder and Lead Scientist	Leads Recognition Science and its applications across the institute.
Dr. Elshad Allahyarov	Research Scientist	How interacting particles give rise to complex materials.
Dr. Sebastian Pardo Guerra	Research Scientist	The mathematical structures underlying Recognition Science.
Dr. Megan Simons	Research Scientist	Molecular behavior through theory and computation.
Dr. Anil Thapa	Research Scientist	Fundamental particles and the laws of physical change.
Dr. Philip Beltracchi	Research Scientist	Gravity and matter under extreme conditions.
Dr. Roman Shugayev	Research Scientist, Fusion	Plasma technologies for fusion and quantum devices.
Dr. Dylan Funk	Research Scientist, Fusion	The behavior of plasmas and charged dust.
Dr. Sajid Ahmed	Research Scientist, Fusion	Experiments and computation on magnetized plasmas.
Emma Tully	Chief Operating Officer	People, partnerships and research operations.

How we report results

Every result carries its exact status: published, accepted, preprint, or preliminary and not peer reviewed. Our mathematical results are formalized in Lean, and the Lean proofs behind them are available to reviewers on request. Our photonic experiments report their counts, analysis and code, so other researchers can inspect and reproduce the calculation.

Supporting the work

Support funds the research team, the computing behind formal proofs and simulation, and experiments. We also welcome researchers and partners with a problem our science can help solve, or an experiment that puts it to the test.

To discuss a gift, a grant or a partnership, write to hello@recognitionphysics.org.