S03E19 - The Red Dots At The Beginning of Time

The Multiverse Employee Handbook - Season 3

The Multiverse Employee Handbook has this to say about *The Beginning of Time*:

It began, as many ill-advised projects do, without a meeting, a timeline, or a clear understanding of downstream consequences.

From a physical standpoint, the Beginning of Time is defined as the moment when space, energy, and matter all appeared at once and immediately started expanding, apparently in an effort to create distance from whatever had just happened. Temperature was infinite, density was infinite, and documentation was unavailable due to time not yet existing in a usable format.

Administratively, this created challenges. With no “before” to reference, causality had to be introduced retroactively, along with basic concepts such as duration, sequence, and regret. Early versions of time were unstable, prone to rapid inflation, and lacked standardized units, which made scheduling extremely difficult for the first several hundred million years.

The Handbook notes that despite popular misconception, the Beginning of Time was not an explosion *in* space, but an expansion *of* space itself—a distinction that remains technically important and socially unhelpful. There was no centre, no edge, and no observable purpose, though several would be proposed later.

Employees assigned to early-universe operations are advised that initial conditions were set permanently at launch. Several polite suggestions were made to fiddle with gravity, redefine physics, or nudge a few constants, but these were dismissed on the grounds that it would involve turning everything off and on again.

In summary, the Beginning of Time was not a moment of intention or design, but a starting condition.

Everything that followed—stars, planets, life, Monday morning meetings—emerged as a consequence. That it all works at all is considered a success, even if the rollout remains under ongoing review.

You're tuned into The Multiverse Employee Handbook.

Today, we're exploring the Little Red Dots—compact, mysteriously energetic objects that the James Webb Space Telescope discovered lurking at cosmic dawn, when the universe was barely out of its infancy.

These aren't your standard celestial objects exhibiting reasonable workplace behaviour. These are impossibly bright, impossibly compact things consuming resources at rates that violate our comfortable assumptions about how the early universe should operate. They appear frequently in JWST's deepest images, glowing with a distinctive red hue, and then—rather suspiciously—seem to vanish from the cosmic record around two billion years into universal history.

For a while, astronomers genuinely couldn't work out what they were looking at. Too bright to be normal galaxies. Too compact to fit standard models. Too red and too quiet in all the wrong wavelengths. The spectra were baffling. The energetics made no sense. And one particular object—nicknamed "The Cliff" for its extraordinarily steep spectral features—defied every conventional explanation anyone could propose.

The James Webb Space Telescope spotted them in 2022. By 2024, "The Cliff" had forced scientists into increasingly exotic territory, proposing structures that sounded more like science fiction than astrophysics. And by January 2026, a scientific paper finally revealed what was actually hiding inside those mysterious red dots—and why they'd been fooling us about nearly everything.

Which is to say: the early universe was considerably more theatrical than anyone expected.

But first, gather 'round the temporal zoning committee, my photometrically perplexed colleagues, for a cautionary tale of ambitious cosmic real estate development and the critical difference between "prime location" and "survivable location at the beginning of time."

In the fluorescent-lit realm of Quantum Improbability Solutions, specifically in the Cosmic Real Estate Development Division (which existed in a superposition of "visionary expansion strategy" and "catastrophically premature infrastructure investment"), the Square-Haired Boss was having what could charitably be called a temporal zoning crisis.

It had started, as these things often do, with a competitor analysis memo from the QIS′ new agentic AI system:

SUBJECT: URGENT - Competitor Establishes Prime Facilities at Cosmic Dawn

"Recent JWST observations indicate rival organizations have constructed compact, highly efficient operations during the epoch of first light. These facilities demonstrate extraordinary energy throughput whilst maintaining minimal footprint. Recommend immediate strategic response."

The Square-Haired Boss had recently discovered Douglas Adams' The Restaurant at the End of the Universe, and had become convinced that if one could build dining establishments at temporal extremes, corporate fitness centres were the logical next step.

"If they can have a restaurant at the end," he announced, hair achieving geometries that suggested divine inspiration, "we'll build a gymnasium at the beginning. First Light Fitness—be there when it all starts!"

Patricia from Facilities Management was assigned to the project. The pitch was admittedly compelling: cosmic dawn, around redshift six or seven, when the first stars were forming and the universe was young, energetic, and full of possibility.

"Prime real estate," the Boss insisted. "Get in early. Establish presence. Corner the market on beginning-of-time wellness solutions."

Patricia pulled the environmental surveys. Her enthusiasm dimmed considerably.

The proposed site existed during an epoch when the universe was extraordinarily hot, dense, and actively hostile to the existence of gymnasium equipment. Stellar radiation levels exceeded anything found in later cosmic periods. The interstellar medium was thick with ionised gas. Young stars were prone to spectacular outbursts.

"Sir," Patricia ventured, "the radiation environment alone would—"

"Details, Patricia. Details."

Construction proceeded. The QIS Wellness Centre at Cosmic Dawn opened with great fanfare—at least according to the press release, which was written well in advance and took certain liberties with definitions of "operational."

For approximately fourteen microseconds, it was magnificent. The equipment gleamed. The signage was pristine. Everything looked exactly as the architectural renderings had promised.

Then the local stellar neighbourhood had one of its characteristic early-universe outbursts, and the treadmills achieved plasma state.

The elliptical machines lasted slightly longer—nearly forty microseconds—before undergoing what the incident report would delicately term "spontaneous thermal disassembly."

The weights didn't so much melt as sublime directly into constituent atoms, skipping several intermediate phases of matter that Patricia had rather hoped they'd respect.

The Boss remained undeterred. "Reorder everything. Mark it urgent."

"Sir, this is the fundamental nature of the early universe—"

"I'm aware of that, Patricia. That's why we call it an extreme environment training facility. It's a feature, not a problem. The equipment is simply experiencing accelerated depreciation."

Margaret from Accounting eventually noticed that equipment replacement costs for the Cosmic Dawn facility were exceeding the operational budgets of their entire galactic division network—combined—for the next several epochs.

"We're spending more on gymnasium equipment at the beginning of time than we spend on life support for actual functioning facilities," Margaret observed, with the measured calm of someone who had transcended shock and arrived at a kind of fiscal enlightenment.

The Boss remained philosophically committed. "But it's at the beginning. You can't put a price on that kind of positioning."

"Actually," Margaret said, "I can. It's approximately the heat death budget of several medium-sized galaxies."

The facility was rebranded as the "Cosmic Dawn Extreme Conditioning Centre" and remained officially operational, though "operational" had been redefined to mean "continuously replacing equipment that exists in a state of aggressive thermodynamic protest."

The equipment shipments continued. The stellar flares continued. And somewhere in the dense, ionised chaos of the early universe, a small pile of gymnasium equipment achieved temperatures approaching those of the Big Bang itself, which the marketing department would later describe as "returning to our roots."

Patricia updated her CV and began searching for positions that didn't require familiarity with cosmic dawn environmental tolerances.

The universe, indifferent as always, carried on expanding.

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And that brings us to the fascinating science behind cosmic objects that appear to have violated several fundamental principles of astrophysics whilst maintaining an air of complete innocence about the whole affair.

When JWST began sending back its first deep-field images in 2022, astronomers immediately noticed something peculiar: scattered throughout the early universe were these compact red sources that shouldn't exist. Not in the philosophical sense—though philosophers were certainly available to discuss that aspect at length—but in the straightforward astrophysical sense of "the equations say this is impossible, yet here it is, glowing smugly back at us from 12 billion years ago."

The objects were tiny—barely larger than point sources in JWST's exquisite images. They were exceptionally bright. And they were red. Not the gentle, evolved red of mature galaxies that have settled into comfortable middle age, but a distinctive, almost aggressive red that suggested something unusual was happening to their light.

Astronomers did what astronomers do when confronted with unexpected observations: they formed committees, wrote papers with cautious titles, and began the careful process of determining whether the universe was genuinely misbehaving or whether they'd simply forgotten to calibrate something important. This is the scientific method in its purest form—systematic doubt applied with institutional thoroughness until the universe admits what it's been doing.

The initial hypothesis was straightforward enough: these must be very young supermassive black holes—the kind that anchor the centres of massive galaxies, but caught early in their formation. The brightness made sense if they were actively feeding. The compactness fit. Early universe, early black holes, aggressive growth phase. Perfectly reasonable.

Then they measured the spectra. Broad hydrogen lines. Extremely broad. The kind of velocities that, if you worked backwards through the standard equations, implied black hole masses of hundreds of millions of solar masses. Some estimates pushed into the billions.

Which created a rather significant problem: these objects existed when the universe was only 500 to 700 million years old. Current theory suggests black holes need billions of years to grow that massive. These appeared to have achieved in half a billion years what should require ten times longer.

Astronomers call this a "tension" with theory, which is the academic equivalent of saying "our models are screaming and we're not entirely sure why."

When we return from this brief quantum intermission, we'll explore exactly what JWST was actually seeing, why "The Cliff" became the most confounding object in the early universe, and discover that sometimes the simplest explanation is that you're being fooled by an extremely dense cloud of ionised gas that's been lying to your spectrograph.

Welcome back, my temporally-displaced colleagues!

While you were away, several hundred billion photons completed their multi-billion-year journey from the early universe, arriving at JWST's mirrors with all the punctuality of cosmic background radiation and none of the explanatory notes we'd have preferred.

Let's establish something fundamental about observing the early universe: you're not just looking far away, you're looking far back. Light travels at a fixed speed—299,792,458 metres per second, which sounds impressively fast until you realise space is so preposterously large that even at that speed, light from distant galaxies takes billions of years to reach us.

This creates what Douglas Adams might have called "an SEP field"—Somebody Else's Problem—except in this case, the problem is everybody's, because when you point JWST at a galaxy 12 billion light-years away, you're seeing it as it was 12 billion years ago. Which means you're essentially conducting archaeology on objects that may no longer exist, using photons that have been travelling since before Earth formed, all whilst sitting in an orbit around a planet that wouldn't exist for another 8 billion years after those photons departed.

It's rather like trying to file a performance review for an employee who quit 8 billion years ago based on a memo that's only just arrived.

But here's where it gets properly complicated: in 2022, when JWST first spotted these little red dots, astronomers were looking at objects from when the universe was only 500 to 700 million years old. For context, that's roughly 4% of the universe's current age. If cosmic history were compressed into a single year, these objects existed around January 15th, when the universe was still working out basic operational procedures and presumably hadn't yet established proper HR protocols.

The dots appeared frequently in JWST's deepest images—scattered across multiple survey fields like cosmic breadcrumbs. Compact. Bright. Distinctively red.

And then, mysteriously, they seemed to vanish from the cosmic record by the time the universe reached about 2 billion years old.

When astronomers actually measured their spectra—the detailed breakdown of their light—they found something deeply unsettling: broad emission lines. Specifically, hydrogen lines with widths indicating velocities of 1,000 to 3,000 kilometres per second.

In astrophysics, broad emission lines generally mean one thing: you're looking at gas moving very fast around something very massive. The standard interpretation is straightforward—if gas is orbiting that quickly, you can work backwards through Newtonian mechanics to calculate how massive the central object must be to hold that gas in orbit.

For these little red dots, that calculation produced black hole masses of 100 million to 1 billion solar masses. Some estimates pushed even higher.

This is where the universe appears to have filed paperwork incorrectly, because these measurements created what scientists diplomatically call "a significant challenge to current models of black hole formation."

Black holes don't just materialise at a billion solar masses. They grow. Slowly. Through accretion—pulling in gas and dust and converting gravitational potential energy into radiation. The process has well-understood limits. Feed a black hole too quickly, and radiation pressure pushes the incoming material away. There's a maximum growth rate called the Eddington limit, and even at that maximum rate, growing from a stellar-mass black hole seed to a billion solar masses requires roughly a billion years.

These objects existed when the universe was only half that old.

Astrophysicists responded with increasingly creative solutions: maybe black holes formed much more massive than expected. Maybe they grew faster than theory allowed. Maybe primordial black holes—hypothetical objects from the Big Bang itself—seeded early galaxy formation.

Or maybe, as one particularly confounding object suggested, the measurements themselves were lying.

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On January 14th, 2026, a team led by Vasily Rusakov and Darach Watson published a paper in *Nature* with the admirably restrained title "Little red dots as young supermassive black holes in dense ionised cocoons"—which is the scientific equivalent of naming your thriller novel "The Mystery Was Actually Explained By A Very Specific Physical Process We Can Now Describe Mathematically."

What Rusakov, Watson, and their colleagues discovered was elegantly simple and profoundly unsettling: the broad emission lines weren't being broadened by velocity at all. They were being broadened by electron scattering.

Here's what that means: imagine you're trying to measure the width of a voice coming from inside a building, but between you and the speaker is an extraordinarily dense fog of charged particles. Every photon leaving the speaker bounces off electrons thousands of times before reaching you. Each bounce changes the photon's direction slightly, stretching out the signal. By the time the light reaches your detector, it's been broadened—not because the source was moving fast, but because the light itself took a chaotic, pinball-like path through an ionised gas cocoon.

The team analysed the highest-quality JWST spectra and found something tell-tale: the line profiles weren't Gaussian, as you'd expect from Doppler broadening. They were exponential—the characteristic signature of electron scattering. When you plot them on semi-logarithmic scales, they form straight lines over several orders of magnitude. Textbook electron scattering, hiding in plain sight.

This changes everything. If electron scattering is doing most of the broadening, then the intrinsic velocities are much lower—only a few hundred kilometres per second instead of thousands. Which means the black hole masses are roughly *one hundred times smaller* than previous estimates. Not billions of solar masses. More like 100,000 to 10 million solar masses.

Suddenly, the impossible timeline becomes possible. These aren't overmassive black holes that violated formation theory. They're young black holes, accreting near the Eddington limit, wrapped in extraordinarily dense cocoons of ionised gas with electron column densities around 10^{24} particles per square centimetre—compressed into regions only light-days across.

The cocoon explains nearly everything: the red colour (reprocessed nebular emission), the weak X-rays (absorbed by the dense gas), the missing radio emission (suppressed by the high-density environment), even those strange Balmer absorption features that had puzzled observers. It was all theatre. An extremely effective disguise.

But as with all good scientific revelations, answering one question immediately spawns others. Why do these cocoons exist at cosmic dawn but apparently vanish by 2 billion years? Are we witnessing a specific phase of black hole growth that every supermassive black hole passes through early in its life? Why is this population so compact and so heavily obscured? And what happens when the cocoon finally clears—does it blow away in winds, does it get consumed, or does it simply evolve into the more familiar structures we see in later epochs?

The universe, as always, has provided an answer that raises more questions than it resolves. Which is either profound evidence of nature's infinite complexity, or a sign that reality enjoys keeping astrophysicists gainfully employed.

Meanwhile, somewhere on Earth, someone is ordering coffee, complaining about traffic, and scrolling past a headline about "mysterious objects in the early universe" without realising that we've just discovered an entirely new phase of cosmic evolution—one that's been hiding behind an ionised veil for 12 billion years, waiting for someone to finally look closely enough at the shape of a spectral line and think, "Hang on, that's not quite right."

And that, perhaps, is the most human thing about science: the universe keeps all its secrets in plain view, and we just have to notice when something's slightly off.

Well, my electron-scattered colleagues, we've reached the end of another quantum investigation into cosmic deception.

Today we've learned that the Little Red Dots—those impossibly bright, impossibly compact objects that appeared to violate every comfortable assumption about early black hole formation—weren't actually violating the rules at all. They were simply wearing extremely effective disguises made of dense ionised gas, broadening their spectral lines through electron scattering and fooling an entire field of astrophysics into thinking they were looking at billion-solar-mass black holes when they were actually observing far more modest hundred-thousand-solar-mass objects wrapped in Compton-thick cocoons.

We've discovered that sometimes the universe's most confounding mysteries can be solved not by inventing new physics, but by carefully examining the shape of a spectral line and realising it's exponential when everyone assumed it was Gaussian. Which is either a testament to the power of precise measurement, or evidence that reality enjoys hiding revolutionary discoveries behind minor differences in mathematical functions that require semi-logarithmic plots to properly appreciate.

From Rusakov and Watson's January 2026 paper revealing the electron-scattering mechanism to the realisation that these objects represent an entirely new phase of supermassive black hole evolution, we've watched a cosmic mystery unravel through the kind of meticulous spectroscopic analysis that makes headlines read

"Scientists Discover Young Black Holes Were Actually Young All Along, Just Very Well Hidden."

But perhaps most importantly, we've learned that Patricia from Facilities Management was entirely correct to question whether the Cosmic Dawn Wellness Centre represented sound environmental planning. The early universe was not, in fact, a hospitable location for gymnasium equipment—or indeed for anything that preferred not to be continuously ionised by radiation from young black holes accreting near the Eddington limit whilst wrapped in gas dense enough to scatter every photon that tried to escape.

Though I suspect somewhere in the quantum foam of reality, there's a universe where the Square-Haired Boss successfully opened his fitness centre at cosmic dawn, and it's been operating profitably for 12 billion years despite equipment replacement costs that exceed the GDP of several galaxy clusters. That universe probably also features a restaurant at the end of time with reasonable waiting lists and a wine selection that hasn't been red-shifted into the microwave spectrum.

We don't live in that universe. We live in this one, where the early universe kept its most dramatic phase of black hole growth hidden behind ionised cocoons for years of observations, and where the solution to "impossibly massive black holes" turned out to be "actually quite reasonably-sized black holes wearing very convincing disguises."

Want to explore more cosmic mysteries hiding in spectral line shapes? Visit us at multiverseemployeehandbook.com where you'll find fascinating science news, deep dives into electron scattering physics, and our latest blog series: "Exponential vs Gaussian: A Guide to Not Being Fooled By Dense Gas."

And if you've enjoyed today's journey into the spectroscopic detection of cosmic deception, why not share it with a fellow astronomer? Perhaps you know someone who's been measuring broad emission lines and assuming they're entirely due to Doppler broadening. Spread our signal like photons through a Compton-thick medium—scattered, delayed, and arriving with a significantly different velocity distribution than you might have expected!

This is your quantum-coherent correspondent, reminding you that in the multiverse of observational astronomy, we're all just trying to figure out whether we're measuring actual velocities or just watching light bounce around inside very dense gas clouds for several dozen scattering events before finally reaching our detectors.

And somewhere in the archives of Quantum Improbability Solutions, Patricia's final environmental impact assessment for the Cosmic Dawn Wellness Centre remains filed under "Catastrophically Accurate Predictions That Management Ignored." The equipment replacement costs eventually exceeded the facility's projected lifetime revenue by a factor of approximately 10^{24}—which, coincidentally, is also the electron column density of the ionised cocoons that were trying to tell us all along that cosmic dawn was not, in fact, an appropriate location for corporate expansion.

The universe remains indifferent to our business plans. But at least now we know why those little red dots were glowing so mysteriously: they were young black holes, growing up fast, wrapped in dense gas, and accidentally fooling an entire generation of astronomers about their actual mass.

Rather like interns, really. Promising, energetic, occasionally confusing, and almost certainly going to evolve into something much larger given sufficient time and resources.