PAPER CHECK · ASTROPHYSICS

Gravity alone may ripple a galaxy's disk, says a new theory with nothing magnetic in it

Evgeny Griv and Asher Yahalom, of Ben-Gurion and Ariel universities in Israel, worked out how a rotating disk of stars can bend up and down by itself: in their theory, built from Newton's gravity and the equation for how stars move, bending waves grow slowly where they keep pace with stars drifting in their orbits, drawing energy from the disk's rotation [1 Abstract][1 p. 12]. They offer it as one possible cause of the ripples seen in the Milky Way and other galaxies, in "rough estimates, in order of magnitude" that need simulations to test [1 p. 13]. S0 News placed the paper among studies of "the magnetic rippling, wavy corrugation of the galactic sheet" [2 00:02:13–00:02:15]; there is nothing magnetic in its equations, and the disk's bending has been reported since the 1950s and its ripples since the 1970s [11 p. 1][7 Abstract].

By Fact-Checked Science · Published October 27, 2026

OUR ANALYSIS marks our own reasoning and calculations, including our reading and re-derivation of the paper's Fig. 4, and the verdicts are our assessment. Everything else comes from the numbered sources. For the paper [1], p. gives a page of the article as published (its own numbering, 1 to 15), § a section, eq. an equation and Fig. a figure; for the episode [2], times are positions in the video.

Ripples made by gravity and stars, in a theory that still needs testing

OUR ASSESSMENT

0

magnetic fields, currents or sheets in the paper's equations, which are Newton's gravity and the equation for how stars move [1 p. 3]

1974

when a corrugation of the Galaxy's gas layer was measured, a wave about 2 kpc long and 70 pc high [7 Abstract]; the warp was reported in 1957 [11 p. 1] and vertical waves near the Sun in 2012 [8 Abstract]

~1 Gyr

the paper's round figure for its waves' growth time, taking the rotation rate as 10^{-8} per year; at the rate in its Fig. 4, one e-fold takes 0.35 billion years, and the "10–20 rotation periods" to observable size 2.2–4.3 billion [1 p. 12]

THE CLAIMS

MISREAD

Magnetic rippling of the sheet

The presenter: “we’ve got more and more papers from scientists diagnosing and measuring and theorizing about the galactic plane, the magnetic rippling, wavy corrugation of the galactic sheet.” [2 00:02:07–00:02:15]

More papers are measuring the ripples, but this one is about gravity. Its waves are bends in a disk of stars, “a collective effect, meaning it arises from the interaction of many stars with the perturbation’s gravitational field” [1 Abstract], and its equations are Newton’s gravity and the equation for how stars move [1 p. 3]. No magnetic field, current or sheet enters them: “magnetic” appears only in analogies with plasma physics and citations of it, and “sheet” never, by our count. See section 2.

TRUE

About how the waves form

The presenter: “This one is about the mechanics of how the waves form and are maintained.” [2 00:02:17–00:02:19]

That is the paper’s subject. It works out how bending waves behave in a rotating disk of stars, finds them stable as a fluid, and shows that they can grow slowly where they keep pace with stars drifting in their orbits [1 p. 11], drawing on “the free energy associated with the circular differential rotation” until “some nonlinear effects limit the growth” [1 p. 12]. It is a mechanism proposed in a linear theory, not one seen at work; see the last claim and section 1.

PARTLY TRUE

They knew the math long ago

The presenter: “for an observer still trying to wrap their head around it, just know they knew the math long ago.” [2 00:02:23–00:02:29]

The tools are old: Oort’s 1932 slab model of the Galaxy’s disk [1 p. 5], the density-wave theory of the 1960s [1 p. 2], Hunter and Toomre’s 1969 work on the bending of the Galaxy [1 p. 3] and a plasma instability of the same kind found in 1963 [1 p. 13]. But the paper presents the mechanism as new: the role of a resonant bending instability inside the disk, it says, “has not been analyzed analytically in detail” [1 p. 3], and “At present, no widely recognized theory of galaxy corrugation exists” [1 p. 14]. See section 4.

TRUE

Seen more than a decade ago

The presenter: “We’re more than a decade past observational confirmation.” [2 00:02:29–00:02:31]

Several decades, in fact. The Milky Way’s warp was reported in 1957 [4][5], a corrugation of its gas layer was measured in 1974 [7 Abstract], and vertical waves among the stars near the Sun were found in 2012 [8 Abstract]. What was seen is ripples in stars,

PARTLY TRUE

Just figuring out how it exists

The presenter: “They’re just figuring out how it exists.” [2 00:02:31–00:02:33]

The cause is still open: the paper says no widely recognized theory exists, and that its own idea “may seem like a promising solution to the corrugation puzzle” [1 p. 14]. But “just” is wrong. Explanations have been proposed and tested for

UNCONFIRMED

Disks can ripple on their own

The paper: “The self-excitation of oscillatory-growing, spiral bending waves via the wave-star resonant interaction is proposed to be responsible for the vertically short (~200–300 pc), still radially long (~2–3 kpc) wavelength corrugation.” [1 Abstract]

A proposal from a linear theory, in “rough estimates, in order of magnitude” that its authors want tested with simulations gas and dust, which most of the studies that explain them attribute to gravity, from a passing satellite galaxy to the pull of the Galaxy itself [8 Abstract][13 Abstract], though one 2002 model makes gas ripple through a magnetic instability [28 Abstract]. No current sheet has been observed. See section 3.

decades, from the bending of the whole Galaxy, studied in 1969 [20], to a passing dwarf galaxy, modelled since 2013 [21 Abstract], which simulations now find could not have done it alone [25 Abstract]. See section 4.

[1 p. 13][1 p. 14]. Its two scales are put in, not predicted: the disk's half-thickness, and a radial scale 1/k taken as about ten times that [1 p. 12]. The ripples near the Sun repeat every 2–2.5 kpc [12 Abstract][11 p. 1], a full wavelength, 2π times 1/k, which lies outside the range the theory covers [1 p. 10]. And at the scale it does name, how fast its waves grow turns on a drift rate it sets only roughly: slowly with the value its text gives, which reproduces its Fig. 4, but up to its typical rate with the value its own flat rotation curve implies, by our re-derivation. See section 5.

1 · THE PAPER

Bending waves in a disk of stars, worked out with gravity and the stars' own motions

Evgeny Griv, of Ben-Gurion University of the Negev and Ariel University, and Asher Yahalom, of Ariel University, both in Israel, asked whether a rotating disk of stars can ripple by itself, without a passing satellite, through a resonance between its waves and its stars; that role, they write, "has not been analyzed analytically in detail" [1 p. 3]. The paper is a peer-reviewed research article in *Astrophysics and Space Science*, received on November 18, 2025 and accepted on October 5, 2026 [1 p. 1], and published on October 8, by its web page [1], under CC BY 4.0 [1 pp. 14–15]. The authors thank "both anonymous reviewers" and declare no competing interests; the first author held an Ariel University fellowship, and the Israel Science Foundation partly sponsored the study [1 p. 14]. Earlier in 2026 the first author found bending waves "always stable macroscopically" in a fluid treatment and proposed that resonances between waves and stars make the ripples, calling for "A Boltzmann kinetic theory" to examine them [3 Abstract]; this paper is that theory.

STEP 1

A disk of stars

"A self-gravitating rotation-flattened galactic disk of finite thickness composed of identical stars" [1 Abstract], idealized as a uniform slab a few hundred parsecs thick, the "Oort limit" [1 p. 4], with a dark-matter halo, if any, entering only through the rotation curve [1 p. 5].

STEP 2

Two equations

Poisson's equation for the disk's gravity and "the collisionless Boltzmann kinetic equation" for its stars, solved with "The plasma physics technique" [1 p. 3], linearized for small ripples and applied to waves that bend the midplane [1 p. 5][1 p. 6].

STEP 3

Stars that drift

In a disk whose rotation slows outward, each star's small loop around its average orbit drifts slowly along it; the drift vanishes in a disk that rotates like a solid body [1 p. 8].

STEP 4

A resonance

Where a bending wave keeps pace with the drifting stars, the two exchange energy. At one resonance, which the paper calls the outer cyclotron resonance, the wave can grow, slowly [1 p. 10][1 p. 11].

What the paper finds

As a fluid, the disk's bending waves are stable: "there are no exponentially growing nonresonant bending instabilities in rotating disks" [1 p. 11], as Hunter and Toomre found for cold disks in 1969 [1 p. 3]. With the stars' drift included, the waves are stable at one resonance and "may be oscillatory-unstable" at the other [1 p. 11]. The fastest-growing have one arm, m = 1, and those with up to four arms dominate; the growth rate is "relatively low", about a tenth of the disk's rotation rate Ω. At the Ω of its Fig. 4, that is one e-fold of growth in 0.35 billion years, which the paper rounds to "t_{grow} ~ 1 Gyr" by taking Ω as 10^{-8} per year, and the waves reach observable size "over a time of 10–20 rotation periods", 2.2–4.3 billion years [1 p. 12]. The energy comes from the disk's differential rotation [1 p. 12], and the authors conclude that this resonance "can by itself generate corrugations within the system … even in an isolated system" [1 p. 13].

What it does not do

It analyses no observations, "No datasets were generated or analysed" [1 p. 14], and runs no simulation. Its numbers come from a local, linear model whose simplifications are "employed here without further proof" [1 p. 6]; it sets no height for the ripples, and it "says nothing about the stability of global large-scale" waves that are not tightly wound [1 p. 14]. Its one worked example, Fig. 4, uses values for the Sun's neighbourhood: a radius of 8.2 kpc, a flat rotation curve and random stellar speeds of 35 and 20 km s^{-1} [1 Fig. 4]. It mentions no magnetic field in a galaxy, no current sheet, no Earth or Sun beyond a 1963 plasma citation, and no date to come.

In the authors' words

How they qualify their result.

"This is a very mathematical paper that contains several important approximations to solve the problem at hand, and its spirit is to motivate advanced particle-based N-body and Poisson-Vlasov numerical investigations."

Griv and Yahalom (2026) [1 p. 4]

"One understands, however, that these analytical results should be regarded merely as rough estimates, in order of magnitude …"

Griv and Yahalom (2026) [1 p. 13]

"As usual, linearity requires numerical testing."

Griv and Yahalom (2026) [1 p. 14]

2 · GRAVITY, NOT MAGNETISM

No magnetic field, no current and no sheet: the paper borrows plasma physics only as mathematics

The episode placed the paper among the studies of "the magnetic rippling, wavy corrugation of the galactic sheet" [2 00:02:13–00:02:15] and, in its opening, of "the galactic current sheet” [2 00:00:26–00:00:28]. The paper’s ripples are made of stars, and the only force in it is their gravity [1 Abstract][1 p. 3].

THE MODEL’S PHYSICS

2 equations

Newton’s gravity, in Poisson’s equation, and the collisionless Boltzmann equation for the stars, “the gravitational analog of the electrostatic Vlasov equation” [1 p. 3]

“SHEET” OUR ANALYSIS

0 times

in the paper’s 15 pages; “current” appears only in “the current paper”, “work” and “study”, by our count [1]

“MAGNETIC” OUR ANALYSIS

9 of 9

uses that borrow from plasma physics or cite it, all in the table below; none puts a magnetic field in a galaxy, by our count [1]

Every “magnetic” in the paper, and what it is doing there

WHERE	THE WORDS	WHAT IT DOES
§1, p. 3	“A formal analogy between the oscillations in a self-gravitating rotating disk and the oscillations of a hot, non-neutral plasma in a magnetic field has been established” [1 p. 3]	An analogy, qualified at once: “in many respects gravitating systems differ strongly from laboratory plasmas” [1 p. 4]
Note 2, p. 3	“The hose (or the fire-hose) instability occurs in magnetized plasmas where the pressure parallel to the magnetic field significantly exceeds the perpendicular pressure, overpowering the magnetic tension that normally keeps the plasma straight.” [1 p. 3]	Defines a plasma term the paper uses for a bending instability of star systems
§4, p. 7	The epicyclic frequency, “(cf. the cyclotron frequency at which a charged particle orbits in a magnetic field)” [1 p. 7]	An analogy: a star’s small loop around its orbit is likened to a charged particle’s circling
§5, p. 8	The drift term “may be found directly in analogy with the relation for the grad-B drift of charged particles across magnetic field lines, caused by a nonuniform magnetic field” [1 p. 8]	An analogy for the stars’ slow drift
§5, p. 10	The functions it uses “appear commonly in a theoretical treatment of Maxwellian plasmas in a magnetic field” [1 p. 10]	A note on shared mathematics
§6, p. 13	“In a plasma in equilibrium with a slightly nonuniform magnetic field, a similar instability of low-frequency oscillations propagating perpendicular to a magnetic field was discovered by Krall and Rosenbluth (1963), employing the collisionless Boltzmann equation and Maxwell’s equations.” [1 p. 13]	A citation of the plasma version of the instability
§6, p. 13	“Chamberlain (1963) proposed the drift instability as a mechanism for auroral bombardment, involving the injection of solar plasma (or at least energy) into the Earth’s magnetosphere.” [1 p. 13]	A citation of a plasma application; the paper’s only mention of Earth

Our count, on the paper’s PDF and its web page: “magnetic” 9 times (once, twice, once, twice, once and twice in the first six rows), with “magnetized” and “magnetosphere” once each. The names of the paper’s two resonances, the inner and outer “cyclotron” resonances, are borrowed from plasma physics too [1 p. 10].

Why a paper about stars talks about plasmas

The authors note “A formal analogy” between oscillations in a rotating disk of stars and in a plasma [1 p. 3], use “The plasma physics technique” to calculate how waves and stars interact, and send readers to the plasma literature for the method [1 p. 3]. A star’s small loop around its average orbit plays the part of a charged particle circling a magnetic field line, which is why the paper speaks of “cyclotron” resonances and of a drift like a plasma’s [1 p. 7][1 p. 8]. The kinship is in the mathematics only: there is no magnetic field in the model, and the authors stress that “gravitating systems differ strongly from laboratory plasmas” [1 p. 4].

Where magnetism does come into the story

The Galaxy has a magnetic field that runs, on average, parallel to its disk [31 Abstract] and, in its halo, reverses direction above and below the plane [30 Abstract]. A 2002 model made the gas along a spiral arm ripple through a magnetic instability, the Parker instability [28 Abstract], the process behind our video check’s note “‘Nova energy’ and the galaxy’s magnetic wave”; in the isolated galaxy IC 2233, though, the observers ruled that cause out and favoured gravity [17 Abstract]. Near the Sun the field appears to line up with the Radcliffe Wave [31 Abstract], as our video check notes in “The Radcliffe Wave”. None of this is in this paper, and none of it is a current sheet: the only galactic version our video check found in the scientific literature is a speculation by Hannes Alfvén and Per Carlqvist about a current flowing in the galaxy’s plane [29], at stop 14.

The paper’s ripples are made by gravity in a disk of stars; magnetism appears in it only as borrowed mathematics.

3 · SEEN FOR DECADES

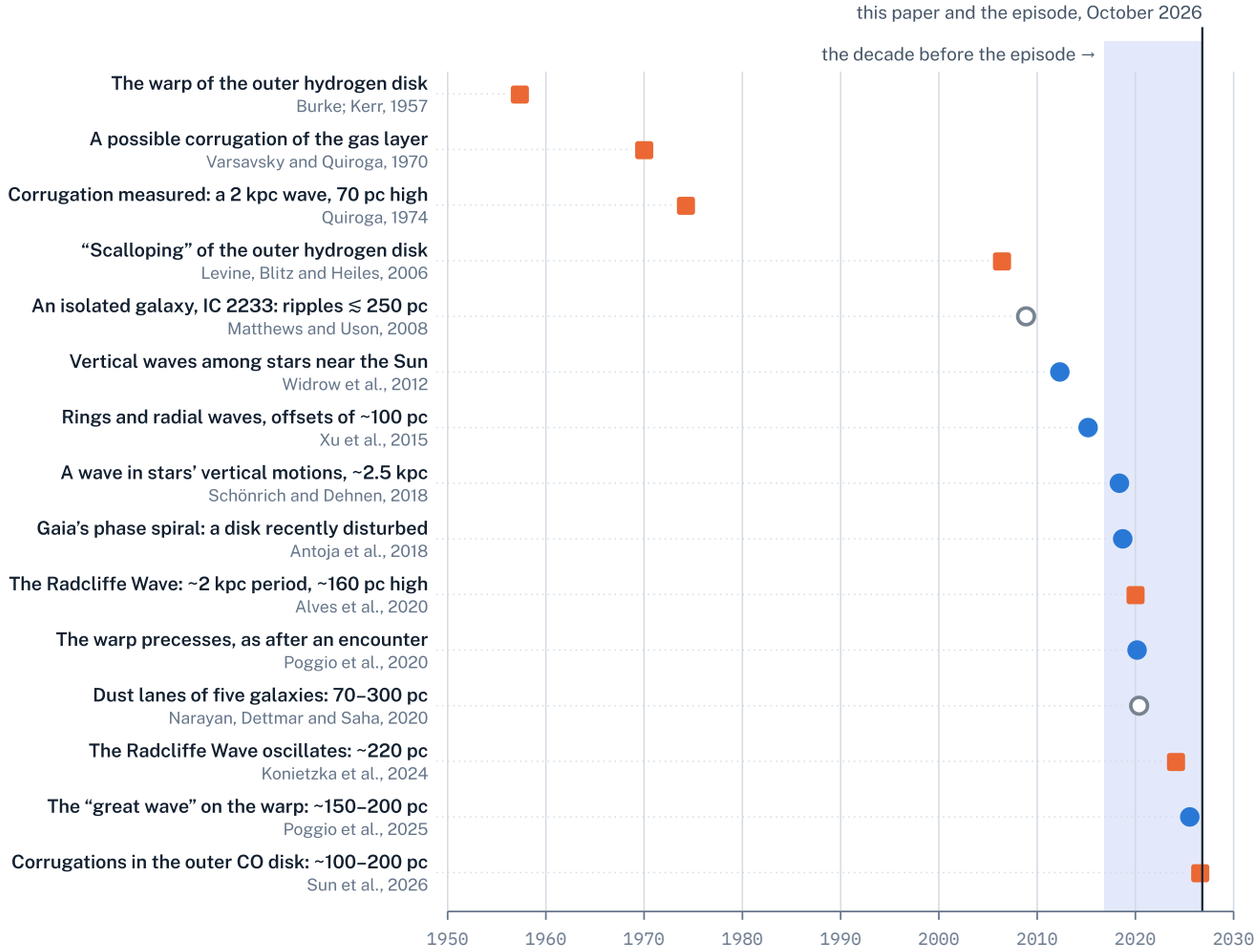
The ripples were seen long before this paper: the warp in 1957, a corrugation by 1974, waves near the Sun in 2012

“We’re more than a decade past observational confirmation,” the presenter said [2 00:02:29–00:02:31]. For the ripples in galaxy disks that understates it. The paper itself cites observations from 2006 to 2025 [1 p. 2], and the record goes back to the first radio maps of the Galaxy’s hydrogen.

When ripples in galaxy disks were reported

In the Milky Way’s stars · In the Milky Way’s gas · In other galaxies · The decade before the episode

Scroll sideways to see the whole chart →



A selection: our compilation of the publication dates and of the sizes the sources report, height or amplitude and wavelength or period; “~” marks their approximate values. The sources are in the table below.

What was seen, and what moves it

Every report above is of stars, gas or dust lying above or below the midplane, or moving up and down, in a regular pattern. Most of the studies that explain them point to gravity. Widrow and colleagues suggested the passage “of a satellite galaxy or dark matter subhalo through the Galactic disk” [8 Abstract]; Antoja and colleagues dated their disturbance to 300–900 million years ago, “consistent with estimates of the previous pericentric passage of the Sagittarius dwarf galaxy” [10 Abstract]; and the Radcliffe Wave’s star-forming regions move “as though they are part of an oscillating wave driven by the gravitational acceleration of the Galactic potential” [13 Abstract]. As our video check put it in “The Radcliffe Wave”, the 2024 study attributes its up-and-down motion to the Milky Way’s gravity, while no one yet knows what formed it. What gravity explains is the motion; the origins proposed for some ripples include other causes, such as the magnetic instability in section 2.

What has not been seen

A current sheet. The episode’s opening tied this paper to “the galactic current sheet” [2 00:00:26–00:00:28], which our video check rated Unsupported at stop 14: nothing like a wave that periodically sweeps through solar systems has been observed. What has been confirmed for decades is a rippling of the disk’s stars and gas, attributed mostly to gravity, which is the subject of this paper.

The mathematics is decades old, the mechanism is new, and the cause of the ripples is still debated

The presenter said “they knew the math long ago” [2 00:02:27–00:02:29] and “They’re just figuring out how it exists” [2 00:02:31–00:02:33]. Read against the paper, each is half right.

The tools are old

The paper builds on work going back almost a century: Oort’s 1932 model of the Galaxy’s disk as a slab [1 p. 5]; Lindblad’s 1959 account of how stars’ orbits drift [1 p. 8]; the density-wave theory of Lin, Shu and colleagues, from the 1960s [1 p. 2], and Toomre’s 1964 stability criterion [1 p. 7]; Hunter and Toomre’s 1969 study of the bending of the Galaxy, which found no bending instability in a cold disk [1 p. 3]; and Kalnajs’s 1973 work on oscillating slabs of stars [1 p. 2]. The instability it describes has a plasma twin, found by Krall and Rosenbluth in 1963 [1 p. 13], and computer models of star disks have shown bending waves since at least 1991 [1 p. 2]. In 2012 the discoverers of the vertical waves near the Sun already explored them with “the linearized Boltzmann and Poisson equations”, the same two equations [8 Abstract].

The mechanism is new

What the authors claim as new is the resonance: “the role of internal resonant bending instability in the self-excitation of corrugation in 3D rotating galactic disks has not been analyzed analytically in detail” [1 p. 3], and the slow growth it brings to a disk that is stable as a fluid is, they write, “a new effect discussed in the paper” [1 p. 11]. The first author put the idea forward earlier in 2026 as a hypothesis needing “A Boltzmann kinetic theory and particle-based computer modelling” [3 Abstract]; this paper supplies the theory, and the modelling is still to come [1 p. 14].

Explanations on offer for the Milky Way’s ripples, and where they stand

IDEA	SINCE	WHERE IT STANDS
A passing satellite galaxy or dark-matter clump shakes the disk	2012–2013, for the waves near the Sun [8 Abstract][21 Abstract]	The most studied. A Sagittarius-like dwarf reproduces “many features” in Gaia’s data [23 Abstract] and a long-lived phase spiral [24 Abstract], but high-resolution simulations conclude “that Sgr alone could not have caused the observed perturbation to the solar neighborhood” [25 Abstract]
Many small kicks, mostly from dark-matter substructure	2023 [26 Abstract]	Reproduces most of the properties of Gaia’s phase spiral, as an alternative to one big disturbance [26 Abstract]
Spiral arms inside the disk	2014 [22 Abstract]	Can make vertical motions like those observed, so “an external perturbation of the disc might not be a requirement” [22 Abstract]
A magnetic (Parker) instability in the gas	2002 [28 Abstract]	Models corrugations of the gas along one spiral arm [28 Abstract]; ruled out, with a companion’s tides, for the isolated galaxy IC 2233 [17 Abstract]
A gravitational instability of the disk itself	1991 in computer models of disks of stars and 2002 for wave–star resonances, as the	“Global gravitational instabilities appear to be the most likely explanation” for IC 2233

paper cites them [1 p. 2]; 2008 for IC 2233 [17 Abstract]; 2026 for this kinetic theory [3 Abstract][1 Abstract]

[17 Abstract]; this paper's resonance is not yet tested by simulation [1 p. 14]

Ideas and dates from the sources' abstracts; the list is not complete. A 2025 review of the Gaia era says the disk's disturbances are partly attributed to satellite galaxies and that more theoretical work is needed [27 Abstract].

How open the question is, in the sources' words

> *"At present, no widely recognized theory of galaxy corrugation exists."*
>
> Griv and Yahalom (2026) [1 p. 14]

> *"Internal to the disk, a hydrodynamic instability may be able to generate waves on the right scale, but additional work is needed ..."*
>
> Konietzka et al. (2024), on the Radcliffe Wave, in the authors' version [13 p. 3]

> *"We find that none of the simulations match the observations of the vertical perturbation using Gaia Data Release 2."*
>
> Bennett, Bovy and Hunt (2022) [25 Abstract]

OUR ANALYSIS

Old tools, a new mechanism, an open question

Read against the paper, the presenter's two sentences are each half right. His "they knew the math long ago" holds for the equations and methods, which date from 1932 to 1973 and were applied to the Galaxy's vertical waves by 2012 [1 p. 5][8 Abstract]; it does not hold for the mechanism, which the paper offers as new [1 p. 11]. "They're just figuring out how it exists" holds in that the cause is still debated, as the paper says [1 p. 14]; it does not hold in its "just", since the waves near the Sun have been modelled since 2013 and several explanations have since been tested against Gaia's data [21 Abstract][25 Abstract]. None of these explanations involves a current sheet.

5 · HOW FAR IT GETS

A promising idea in rough numbers, whose match with the observed ripples is looser than the abstract suggests

The abstract says the mechanism "is proposed to be responsible for the vertically short (~200–300 pc), still radially long (~2–3 kpc) wavelength corrugation" [1 Abstract]. The paper's one worked example, its Fig. 4, shows how fast waves of different radial wavelength grow in a disk like the Sun's neighbourhood [1 Fig. 4].

How fast the paper's bending waves grow, by radial wavelength

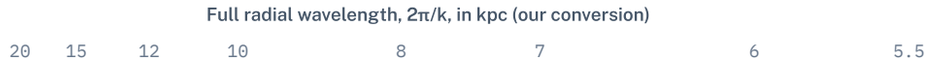
OUR ANALYSIS

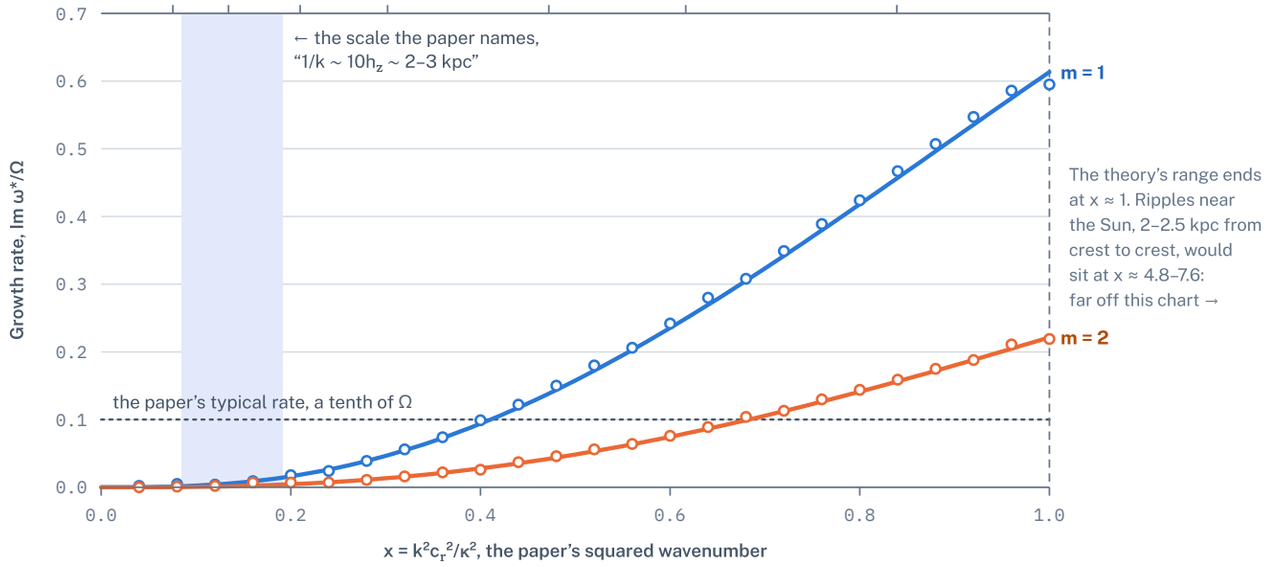
One-armed waves, m = 1 — Two-armed waves, m = 2

Dots: read off the paper's Fig. 4; lines: its eq. (49), re-derived — The radial scale the paper names

The paper's typical growth rate

Scroll sideways to see the whole chart →





0.002–0.014 Ω

the m = 1 growth rate at the scale the paper names, 1/k = 3 to 2 kpc, with the drift rate its text gives, which reproduces Fig. 4: one e-fold in 23 to 2.4 billion years at the figure's Ω, where the paper's typical rate, a tenth of Ω, takes 0.35 billion [1 p. 8][1 Fig. 4]

0.015–0.11 Ω

the same, with the drift eq. (24) gives for the caption's flat rotation curve, about four times smaller: up to the paper's typical rate at 1/k = 2 kpc, by our re-derivation [1 p. 8]

≥ 5.5 kpc

the full radial wavelengths inside the theory's range, $x \lesssim 1$ [1 p. 10]; the ripples near the Sun repeat every 2–2.5 kpc [12 Abstract][11 p. 1]

1.37–1.41 Ω

the waves' frequency in Fig. 4, as eq. (48) gives it at the caption's values: about κ, where the text has it about Ω [1 p. 12]

Adapted from Fig. 4 of Griv and Yahalom (2026) [1], CC BY 4.0. The lines are its eq. (49), which we re-derived with the drift rate its text gives ($r_{epic} \lesssim 1$ kpc, taken as 1, and $|L_\Omega| \approx 3$ kpc) and with χ′ taken as x times its square root, not as printed [1 p. 8][1 p. 10]. The open dots are the figure's dashed curves, read off the published image (traced from its pixels and checked by eye, good to about ±0.01–0.02 Ω); the lines match them to about 0.004 Ω. The paper's solid curves, the waves' frequency, run from 1.41 Ω to 1.37 Ω in every panel and are not drawn. Added by us: the top axis in full radial wavelength, 2π/k, from the caption's c_r = 35 km s^{-1} and κ = 40.01 km s^{-1} kpc^{-1}, at which x = 1 is 5.5 kpc [1 Fig. 4]; the band at 1/k = 2–3 kpc, the scale the paper names, and the dotted line at its typical growth rate [1 p. 12]; and the note on the ripples near the Sun [12 Abstract][11 p. 1]. Ω is the rotation rate in the caption, one turn in about 217 million years, by our arithmetic.

OUR ANALYSIS

The scales are put in, and the wavelengths don't line up

The vertical scale, "~200–300 pc" [1 Abstract], is the half-thickness the model assumes for the disk, $h_z \lesssim 300$ pc. The radial one is a choice: "the radial wavelength $\lambda \sim 1/k$, is much greater than h_z, say, on the order of $\lambda \sim 10h_z \sim$ 2–3 kpc" [1 p. 12]. Neither comes out of the dispersion relation, and a linear theory sets no height for the ripples at all. So the match with the observed ripples is a match of chosen scales.

The chosen one is also of a different kind. In the paper, "$\lambda = 2\pi/|k|$ is the radial spacing between arm centers" [1 p. 5], but its "2–3 kpc" is 1/k, which is 2π times smaller [1 p. 12][1 p. 13]. The observed ripples it compares with are measured crest to crest: the Radcliffe Wave has "an average period of about 2 kiloparsecs" [12 Abstract], the wave in stars' vertical motions about 2.5 kpc [11 p. 1]. With the caption's values, a full wavelength of 2–2.5 kpc lies at x ≈ 4.8–7.6 on Fig. 4's axis, far outside the range the theory covers, $x \lesssim 1$ [1 p. 10], within which the full wavelength is at least 5.5 kpc. The condition the paper sets for its short waves, $k^2h^2 \ll 1$ [1 p. 11], fails there too, so its formula says nothing about those wavelengths either way.

How fast the waves grow at the scale the paper does name turns on the stars' drift rate. The figure's caption does not give it, but the text does: $r_{epic} \lesssim 1$ kpc and $|L_\Omega| \approx 3$ kpc [1 p. 8], which make $2Dc_r^2$ about −0.08 Ω, rounded in the text to about −0.1 Ω [1 p. 11]. With that value eq. (49) reproduces Fig. 4 to within about 0.004 Ω, by our re-derivation, provided χ′, printed as √x times a square root [1 p. 10], is taken as x times it; as printed, no drift reproduces the figure. The one-armed waves then grow at about 0.002–0.014 Ω at 1/k = 3 to 2 kpc, as Fig. 4 shows, and reach the paper's typical rate only at a full wavelength of about 8.6 kpc. But eq. (24), with the flat rotation curve of the figure's caption, gives a drift about four times smaller [1 p. 8], and with it the same formula gives about 0.015 Ω at 1/k = 3 kpc and 0.11 Ω at 1/k = 2 kpc: the paper's typical rate, at its own scale. So whether the waves grow quickly there depends on a number the paper sets only roughly.

None of this shows the idea is wrong. The authors present every number as a rough, order-of-magnitude estimate and ask for simulations [1 p. 13][1 p. 14]. What these checks show is how much is still to be done before the mechanism can be said to explain the Milky Way's ripples, which is the authors' own view.

Ripple sizes in the sources the paper cites for its "250–350 pc" and "2–3 kpc"

SOURCE	HEIGHT	WAVELENGTH OR PERIOD
The paper's summary of the five sources below [1 p. 2]	**"a maximum out-of-plane amplitude of 250–350 pc"**	**"an average in-plane period of 2–3 kpc"**
Schönrich and Dehnen (2018), the Milky Way's stars [11 p. 1]	A wave of about 1 km s^{-1} in vertical speed, not a height	About 2.5 kpc
Alves et al. (2020), the Radcliffe Wave [12 Abstract]	About 160 pc at most	About 2 kpc
Narayan et al. (2020), the dust lanes of five other galaxies [16 Abstract]	70–300 pc	1–5 kpc
Konietzka et al. (2024), the Radcliffe Wave [13 p. 2]	About 220 pc at most	About 2 kpc
Poggio et al. (2025), young stars on the warp [14 Abstract]	About 150–200 pc	A wave at least 10 kpc long

Our comparison. The observed periods fit the paper's summary, 2–3 kpc crest to crest. The heights these sources measure for the Milky Way's 2–3 kpc ripples stop at about 220 pc, below its 250–350 pc, which only the largest ripples in other galaxies reach [16 Abstract]; larger waves, above 1 kpc, are reported further out, on longer scales [11 p. 1].

The test the authors ask for

"Sophisticated particle-based modelling is needed to evaluate the effect further, considering the behaviour of computer-generated N-body models over time at the microscopic level", they write, and the numerical Vlasov methods that could also test it are "an almost completely unexplored regime" in galactic dynamics [1 p. 14]. Such simulations would show whether an isolated disk of stars grows bending waves at the rates and wavelengths the paper estimates.

6 · THE EPISODE

What the episode said, beside the paper

S0 News of October 27, 2026 ended its round of papers with this one, linked in its description as "Galactic Corrugation", from 00:02:04 to 00:02:38 [2].

The episode's statements beside the paper

THE EPISODE SAID	THE PAPER, AND THE RECORD	OUR VERDICT

“We’ve also got continuing detail coming out on the galactic current sheet” [2 00:00:24–00:00:28]	The paper never mentions a current sheet, a sheet or any current [1]. Rated on our review of the episode.	**See that page**
“we’ve got more and more papers from scientists diagnosing and measuring and theorizing about the galactic plane, the magnetic rippling, wavy corrugation of the galactic sheet.” [2 00:02:07–00:02:15]	Bending waves in a disk of stars, made by gravity; magnetism only as borrowed mathematics [1 Abstract][1 p. 3]	**Misread**
“This one is about the mechanics of how the waves form and are maintained.” [2 00:02:17–00:02:19]	It is: a proposed mechanism for their growth, and its source of energy [1 p. 11][1 p. 12]	**True**
“for an observer still trying to wrap their head around it, just know they knew the math long ago.” [2 00:02:23–00:02:29]	The tools date from 1932 to 1973; the mechanism is offered as new [1 p. 3][1 p. 11]	**Partly true**
“We’re more than a decade past observational confirmation.” [2 00:02:29–00:02:31]	Ripples reported in 1957, 1974 and 2012, in gas and stars, attributed mostly to gravity; no current sheet observed [7 Abstract][8 Abstract]	**True**
“They’re just figuring out how it exists.” [2 00:02:31–00:02:33]	The cause is still debated [1 p. 14], but explanations have been tested for decades [21 Abstract][25 Abstract]	**Partly true**
“may want to listen to us when we tell you what it’s doing.” [2 00:02:33–00:02:38]	Nothing in the paper concerns Earth, the Sun or the solar system; its waves take about a billion years to grow, in its round figure [1 p. 12]. What S0 News says the sheet does was rated Unsupported at stop 14 and on our review of October 26.	**Not rated**

Quotations from the episode are from its automatically generated transcript, with the times of the first and last transcript lines of each [2]. The same sentences carry the same labels on our review of the episode.

7 · LIMITS

Where this check could be wrong

Arithmetic, not simulation

We checked the paper’s numbers against its own equations and figure. We did not run the N-body or Vlasov simulations that would test the mechanism itself, the test its authors call for [1 p. 14].

A figure re-derived, on one assumption

Our re-derivation of Fig. 4 uses the drift rate the paper’s text gives and needs χ' read as x times its square root, not as printed; only the authors can say which form they computed. Our tracing of the published image, good to about ±0.01–0.02 Ω, agrees with it to about 0.004 Ω [1 p. 8][1 p. 10].

What a linear theory can say

It tells which waves grow and how fast, not how high they get: the paper’s 200–300 pc is the disk’s thickness, not a predicted height [1 p. 12].

Sources read in part

Most related studies were read in their abstracts; Schönrich and Dehnen, Alves et al. and Konietzka et al. in the authors’ versions on arXiv [11][12] and [13]. Hunter and Toomre’s 1969 paper was not read (NASA’s abstract service showed our tools a bot check, which we did not bypass), nor were the two 1957 reports of the warp or Alfvén and Carlqvist’s 1978 paper; all four are cited for their dates [20], [4], [5] and [29].

The Milky Way is not isolated

Its ripples may have several causes at once, among them the Sagittarius dwarf galaxy, which this paper does not model; a mechanism that works in an isolated disk would add to the others rather than replace them [1 p. 14][25 Abstract].

What would change these verdicts

01
For the paper's claim: simulations of an isolated disk of stars that grow bending waves at the rates and wavelengths the paper estimates, the test its authors call for [1 p. 14].

02
A version of the theory that predicts the full wavelength and the height of the observed ripples, such as the Radcliffe Wave's 2 kpc and 160–220 pc [12 Abstract][13 p. 2].

03
For the episode's framing: an observation of a current sheet in the galaxy's plane, or a study that ties the disk's ripples to one. We found none, and neither did our video check at stop 14.

Our numbers

PY **fig4_rederive.py**
Re-derives the paper's Fig. 4 from its eqs. (48) and (49), with χ′ as printed and as x times its square root, with the drift its text gives and the drift eq. (24) gives for a flat rotation curve; compares each with our readings and prints the growth rates and e-folding times on this page · 8 KB

PY **scale_checks.py**
The conversions between the paper's wavenumber and wavelengths, the frequencies of its eq. (48), the drift of its eq. (24), its time scales in years and the years since ten of the timeline's reports, all from numbers printed in the paper and the sources · 6 KB

PY **fig4_curves.py**
Traces the curves of the paper's Fig. 4 from Springer's image of it and writes them on a grid of x · 4 KB

CSV **fig4_readings.csv**
Our readings of Fig. 4 of [1], CC BY 4.0: the growth rate for m = 1–4 and the frequency for m = 1, at x = 0 to 1 in steps of 0.02 · 2 KB

Run them

`python3 -I fig4_rederive.py` and `python3 -I scale_checks.py` need only Python 3; the first reads fig4_readings.csv from its own folder. `fig4_curves.py` needs Pillow and the figure's image from Springer, whose address is in the script: `python3 -I fig4_curves.py Fig4.jpg fig4_readings.csv`.

Related checks

UNSUPPORTED The galactic current sheet The Disaster Cycle, Fact-Checked

FALSE The Radcliffe Wave The Disaster Cycle, Fact-Checked

MISREAD "Nova energy" and the galaxy's magnetic wave The Disaster Cycle, Fact-Checked

Sources

Bracketed numbers refer to this list. For the paper [1], p. gives a page of the article as published (its own numbering, 1 to 15), § a section, eq. an equation, Fig. a figure or its caption and Abstract its abstract; values we read off its Fig. 4 are marked as our reading. For the episode [2], times are positions in the video (hours:minutes:seconds), from the first to the last line of its automatically generated transcript that holds the words quoted. For [11] and [13], which we read in the authors' versions on arXiv, p. gives a page of that version. For the other sources, Abstract names the part we read; where only an abstract or a record was read, or nothing at all, the entry says so. Links checked October 27, 2026.

1 Griv, E., and Yahalom, A. (2026). Generation of spiral bending waves in a rotating galactic stellar disk of finite thickness. *Astrophysics and Space Science* 371(10), 118. Received November 18, 2025, accepted October 5, 2026, published October 8, 2026. Open access, CC BY 4.0, which covers its figures. We read the publisher's version of record in full, as its PDF (15 pages, with Figs. 1–4) and as its web page, which agree; we found no preprint. The episode's link "Galactic Corrugation".

2 SpaceWeatherNews (S0) (October 27, 2026). The LONG Sun Cycle: 2037 Superflare | S0 News Oct.27.2026. YouTube video, https://www.youtube.com/watch?v=AAjL4LxiktY. Quoted from the automatically generated transcript; times are positions in the video. The video's description links the paper under the label "Galactic Corrugation".

3 Griv, E. (2026). Stability of bending gravity perturbations in rotating galactic discs of finite thickness: fluid dynamics description. *Monthly Notices of the Royal Astronomical Society* 546(4), staf2273. CC BY 4.0. The first author's companion paper. Abstract only.

4 Burke, B. F. (1957). Systematic distortion of the outer regions of the galaxy. *The Astronomical Journal* 62, 90. Not read; cited for its date, as Schönrich and Dehnen [11] cite it, with [5], for the warp of the Milky Way's outer hydrogen.

5 Kerr, F. J. (1957). A Magellanic effect on the galaxy. *The Astronomical Journal* 62, 93. Not read; cited for its date, as [4].

6 Varsavsky, C. M., and Quiroga, R. J. (1970). On a possible corrugation of the galactic plane. In *The Spiral Structure of Our Galaxy*, IAU Symposium 38, 147–150. Abstract only.

7 Quiroga, R. J. (1974). The corrugation of the galactic layer. *Astrophysics and Space Science* 27(2), 323–342. Abstract only.

8 Widrow, L. M., Gardner, S., Yanny, B., Dodelson, S., and Chen, H.-Y. (2012). Galactoseismology: discovery of vertical waves in the Galactic disk. *The Astrophysical Journal Letters* 750(2), L41. Abstract only.

9 Xu, Y., Newberg, H. J., Carlin, J. L., et al. (2015). Rings and radial waves in the disk of the Milky Way. *The Astrophysical Journal* 801(2), 105. Abstract only.

10 Antoja, T., Helmi, A., Romero-Gómez, M., et al. (2018). A dynamically young and perturbed Milky Way disk. *Nature* 561, 360–362. Abstract only.

11 Schönrich, R., and Dehnen, W. (2018). Warp, waves, and wrinkles in the Milky Way. *Monthly Notices of the Royal Astronomical Society* 478(3), 3809–3824. We read the authors' version in full, arXiv:1712.06616 (version 2), not the publisher's; p. gives its page.

12 Alves, J., Zucker, C., Goodman, A. A., et al. (2020). A Galactic-scale gas wave in the solar neighbourhood. *Nature* 578, 237–239. We read the publisher's abstract and the authors' full text, arXiv:2001.08748.

13 Konietzka, R., Goodman, A. A., Zucker, C., et al. (2024). The Radcliffe Wave is oscillating. *Nature* 628, 62–65. We read the publisher's abstract and the authors' full text, arXiv:2402.12596 (version 1), which gives the amplitude and wavelength quoted here; p. gives a page of that version.

14 Poggio, E., Khanna, S., Drimmel, R., et al. (2025). The great wave. *Astronomy & Astrophysics* 699, A199. CC BY 4.0. Abstract only.

15 Sun, Y., Zhang, S., Yang, J., et al. (2026). Widespread corrugations superimposed on the Galactic warp in the outer CO disk. *Nature Astronomy* 10, 1560–1569, published online August 7, 2026. Abstract only.

16 Narayan, C. A., Dettmar, R.-J., and Saha, K. (2020). Wobbly discs – corrugations seen in the dust lanes of edge-on galaxies. *Monthly Notices of the Royal Astronomical Society* 495(4), 3705–3714. Abstract only.

17 Matthews, L. D., and Uson, J. M. (2008). Corrugations in the disk of the edge-on spiral galaxy IC 2233. *The Astrophysical Journal* 688(1), 237–244. Abstract only.

18 Levine, E. S., Blitz, L., and Heiles, C. (2006). The vertical structure of the outer Milky Way H I disk. *The Astrophysical Journal* 643(2), 881–896. Abstract only, in the authors' version, arXiv:astro-ph/0601697.

19 Poggio, E., Drimmel, R., Andrae, R., et al. (2020). Evidence of a dynamically evolving Galactic warp. *Nature Astronomy* 4, 590–596. Abstract only.

20 Hunter, C., and Toomre, A. (1969). Dynamics of the bending of the Galaxy. *The Astrophysical Journal* 155, 747. Not read: NASA's abstract service showed our tools a bot check, which we did not bypass. Cited for its date and as the paper [1] describes it.

21 Gómez, F. A., Minchev, I., O'Shea, B. W., et al. (2013). Vertical density waves in the Milky Way disc induced by the Sagittarius dwarf galaxy. *Monthly Notices of the Royal Astronomical Society* 429(1), 159–164. Abstract only, in the authors' version, arXiv:1207.3083.

22 Faure, C., Siebert, A., and Famaey, B. (2014). Radial and vertical flows induced by galactic spiral arms: likely contributors to our 'wobbly Galaxy'. *Monthly Notices of the Royal Astronomical Society* 440(3), 2564–2575. Abstract only, in the authors' version, arXiv:1403.0587.

23 Laporte, C. F. P., Minchev, I., Johnston, K. V., and Gómez, F. A. (2019). Footprints of the Sagittarius dwarf galaxy in the Gaia data set. *Monthly Notices of the Royal Astronomical Society* 485(3), 3134–3152. Abstract only.

24 Bland-Hawthorn, J., and Tepper-García, T. (2021). Galactic seismology: the evolving 'phase spiral' after the Sagittarius dwarf impact. *Monthly Notices of the Royal Astronomical Society* 504(3), 3168–3186. Abstract only.

25 Bennett, M., Bovy, J., and Hunt, J. A. S. (2022). Exploring the Sgr–Milky Way–disk interaction using high-resolution N-body simulations. *The Astrophysical Journal* 927(1), 131. CC BY 4.0. Abstract only.

26 Tremaine, S., Frankel, N., and Bovy, J. (2023). The origin and fate of the Gaia phase-space snail. *Monthly Notices of the Royal Astronomical Society* 521(1), 114–123. Abstract only.

27 Hunt, J. A. S., and Vasiliev, E. (2025). Milky Way dynamics in light of Gaia. *New Astronomy Reviews* 100, 101721. CC BY 4.0. A review; abstract only, in the authors' version, arXiv:2501.04075.

28 Franco, J., Kim, J., Alfaro, E. J., and Hong, S. S. (2002). The Parker instability in three dimensions: corrugations and superclouds along the Carina-Sagittarius arm. *The Astrophysical Journal* 570(2), 647–655. Abstract only, in the authors' version, arXiv:astro-ph/0111406.

29 Alfvén, H., and Carlqvist, P. (1978). Interstellar clouds and the formation of stars. *Astrophysics and Space Science* 55(2), 487–509. Cited for the date of the idea of a galactic current sheet, as in stop 14 of our video check; not read here.

30 Han, J. L. (2009). The magnetic structure of our Galaxy: a review of observations. *Proceedings of the International Astronomical Union* 4(S259), 455–466, the proceedings of IAU Symposium 259. Abstract only, as on our review of S0 News of October 26, 2026.

31 Panopoulou, G. V., Zucker, C., Clemens, D., et al. (2025). The magnetic field of the Radcliffe wave: starlight polarization at the nearest approach to the Sun. *Astronomy & Astrophysics* 694, A97. CC BY 4.0. Abstract only; the 2025 study cited in "The Radcliffe Wave", an extra in our video check.

METHOD

How this was checked

On October 27, 2026, we checked every statement, number, quotation and citation on this page against its source. We read the paper in full, in the publisher's version of record, as its PDF and as its web page, which agree; the publisher served both to our tools without a bot check, and we found no

The verdicts on this page

MISREAD — Cites a real source but gets wrong what it says.

UNCONFIRMED — Rests on a preliminary result that hasn't been confirmed.

preprint. We checked the episode's words against its automatically generated transcript [2]. Of the 29 related works, we read three in full in their authors' versions [11][12] and [13], the abstracts of 22 others, mostly from their publishers, and nothing of four, which are cited for their dates [4][5] and [20][29]. NASA's abstract service showed our tools a bot check, which we did not bypass. In all, about 120 quoted passages and fragments, and every number on the page.

The verdicts and the items tagged "Our analysis" are our own assessment, built on the cited sources. They include our count of the words magnetic, sheet and current in the paper; the conversions between the paper's wavenumber x and wavelengths in kiloparsecs, from the values in the caption of its Fig. 4; our reading of that figure and our re-derivation of it from its eqs. (48) and (49), with the drift rate its text gives and the one its eq. (24) gives for the caption's flat rotation curve; the frequencies from its eq. (48); its time scales in years, at the caption's Ω; the comparison of ripple sizes in the sources it cites with its own summary of them; and the timeline, our compilation of the sources' dates and sizes.

Re-run here: every conversion and time scale on the page, with the hosted scale_checks.py, at one value of the rotation rate Ω, the one in the caption of Fig. 4; the curves of Fig. 4, traced by machine from the published image with the hosted fig4_curves.py and checked by eye, whose output is the hosted fig4_readings.csv, good to about ±0.01–0.02 Ω; and the same curves re-derived from the paper's eqs. (48) and (49) with the hosted fig4_rederive.py, using the drift rate its text gives. The two agree to about 0.004 Ω once χ′ is read as x times its square root; as printed, no drift reproduces the figure, and only the authors can say which form they computed. The growth-rate chart draws the re-derived curves, with the readings as dots, and the same script gives the growth rates with the drift eq. (24) implies for a flat rotation curve. No simulation was run: the test the authors call for is beyond this check.

After the page was built, a fresh reviewer who hadn't seen the drafting re-ran the hosted scripts, which reproduced every number, and checked every quotation, locator, date and source. The changes that followed: Fig. 4 is now re-derived from the paper's equations with the drift rate its text gives, where we had said the drift was not stated, and the

PARTLY TRUE	Part of the claim holds up and part doesn't.
TRUE	The evidence supports the claim.

All ten verdicts, and how we check point about how fast the waves grow at the paper's named scale now says that it turns on that drift; one value of Ω is used throughout, with the paper's growth time of about 1 Gyr given as its round figure; internal explanations are dated from 1991, as the paper cites them; the ripples' explanations are said to point mostly, not all, to gravity; and about twenty smaller fixes of wording, locators and credits. No verdict changed.

This page was researched and written with Claude, an AI assistant made by Anthropic, and then re-checked against its sources in a separate verification pass.

CORRECTIONS

Corrections and changes

If we get something wrong, we fix it and record the change below with the date. If a correction changes a verdict, the log says what the old verdict was.

Change log

Oct 27, 2026 Published on factchecked.science after a full check against the sources. Built from the paper's full text (CC BY 4.0), the S0 News episode of October 27, 2026, the observations and models the paper builds on, and our reading of its Fig. 4: six claims rated on the site's scale, five of them the episode's and one the paper's own. The growth-rate chart is adapted from the paper's Fig. 4, and the timeline is our compilation of the sources' dates. A fresh review the same day changed no verdict: it led us to re-derive Fig. 4 from the paper's equations with the drift rate its text gives, to say that growth at the paper's named scale depends on that drift, to use one value of Ω throughout and to date internal explanations from 1991, with some twenty smaller fixes.