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Contradictions Associated with the Use of the Doppler Effect to Measure Cosmic Distances, and How These Contradictions Are Resolved.

Le Thanh Duc[1], Le Thi Thu Thuy[2]
[1]University of Transport Ho Chi Minh City,
Ho Chi Minh, Vietnam

[2]Campus in Ho Chi Minh City, University of Transport and Communications, Ho Chi Minh City, Vietnam

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Abstract
The scientist Christian Andreas Doppler discovered the phenomenon that bears his name: the Doppler effect. This effect is used to measure the speeds of nearby objects and the distances to remote stars and galaxies. Scientists encountered no inconsistencies when applying it; consequently, it has been accepted as valid.

Through this research, the author raises doubts regarding the scientific accuracy of the effect's underlying physical nature. Drawing upon classical physics, achievements in astronomy and modern technology, and logical reasoning, the author identifies aspects that warrant re-examination.

To clarify the issue, the article presents a model requiring experimental investigation. The analysis reveals contradictions involving fundamental astrophysical concepts and the technology behind Doppler-based speed guns. The nature of the phenomenon is described based on an entirely different principle. The author proposes a verification experiment that cannot yet be conducted due to current technological limitations; thus, there is insufficient evidence to refute the Doppler effect definitively. This study makes a significant contribution to current scientific understanding by addressing a range of related issues and opening entirely new avenues for research.

Keywords: astrophysics, experiment, photon, error, universe.

1. Introduction

Based on historical data and recent astronomical findings, the age of the universe is approximately 13.7 billion years. The oldest galaxies formed after the Big Bang.

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Electromagnetic waves (including ultraviolet, visible, and infrared light) from these galaxies reach most powerful modern telescopes in the infrared range. Contemporary scientists attribute this to redshift. Redshift is understood as follows: as the universe expands, the wavelengths of electromagnetic radiation stretch, causing the observed light to appear redder. Current scientific understanding views the matter in this way:

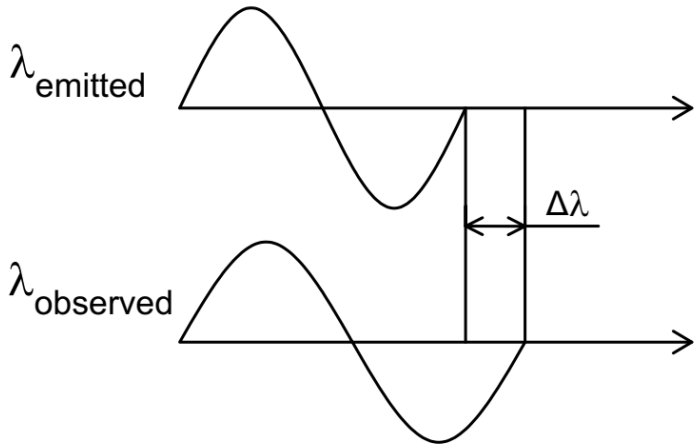


Figure 1. The change in wavelength as light travels through an expanding universe (a phenomenon where the distance between the point of emission and the point of observation continuously changes).

The following equation describes the properties of the photon:

$$E = h.f \quad \textbf{(1)}$$

Where:

- E: photon energy
- h: Planck's constant ($6.626.10^{-34}(J.s)$
- f: frequency of the electromagnetic wave associated with the photon

Frequency f is calculated using the formula:

$$f = \frac{c}{\lambda} \quad \textbf{(2)}$$

Where: c: speed of light in a vacuum $(3\times10^{8}\, m/s)$

It is evident here that changing the wavelength causes the frequency (f) to change, thereby altering the energy (E)—specifically, the photon's quantum energy decreases.

Modern telescopes have successfully observed cosmic black holes; however, most black holes with accretion disks do not emit significant electromagnetic radiation within the visible spectrum. Current findings indicate that only the matter swirling around the black hole forms a luminous disk. The innermost region is the hottest, emitting blue or white light, while the cooler outer region emits red or yellow light.

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The expansion rate of the universe is defined by the Hubble constant (H_0), which indicates how rapidly space is expanding.

Currently, the most precise measurements indicate:

- According to the SH0ES team (Adam Riess, 2024):

$$H_0 \approx 0,73 \pm 1,0 \, km/s/Mpc \quad \textbf{(3)}$$

- ***According to Planck data (ESA/NASA), based on the cosmic microwave background radiation:***

$$H_0 \approx 67,4 \pm 0,5 km/s/Mpc \quad \textbf{(4)}$$

Interpreting this figure

• 1 megaparsec (Mpc) ≈ 3.26 million light-years.
• This means that for every 3.26 million light-years of distance, space expands at a rate of ~70 km/s.
• If observing a galaxy 100 Mpc (~326 million light-years) away, it is receding at a speed of approximately 7,000 km/s.

Conversion to the unit of "global expansion rate"
The expansion rate as a percentage per year:
→ meaning the universe expands by approximately 0.000000000000000024% per second.

Physical Significance.

• The universe does not expand uniformly; the rate of expansion changes over time.
• In the past, expansion was slower due to gravity; currently, dark energy is causing expansion to accelerate.
• If this trend continues, distant galaxies will gradually move beyond" observable horizon."

Here is how to calculate the expansion rate for a distance of one light-year.
Step 1: Unit conversion:

• 1 light-year ≈ $9,46 \times 10^{12} \, km$
• $1 Mpc \approx 3,09 \times 10^{19} \, km$
• Therefore, 1 light-year ≈ $3,06 \times 10^{-7} \, Mpc$.

Step 2: Apply Hubble's Law:

$$v = H_0 \times d \quad \textbf{(5)}$$

$$v = 73 km/s/Mpc \times 3,06 \times 10^{-7} Mpc = 2,2 \times 10^{-5} \, km/s \quad \textbf{(6)}$$

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Step 3: Result:

- The universe expands by an additional 0.000022 km/s at a distance of 1 light-year.
- This equates to ~2.2 cm per second.

Doppler-based speed guns operate according to the following principles:

- *Transmission:* The radar device emits electromagnetic waves (typically microwaves) at a fixed frequency toward the vehicle.
- *Reflection:* The waves strike the moving vehicle and reflect to the receiver.
- *Frequency change (Doppler shift):*
  - If the vehicle approaches → the reflected frequency is higher than the transmitted frequency.
  - If the vehicle moves away → the reflected frequency is lower.
  - Velocity calculation: The processor measures the frequency shift (Δf) between the transmitted and reflected waves.
  - Basic formula:

$$v = \frac{c.\Delta f}{2 f_0} \qquad (7)$$

Where:

- v: vehicle velocity
- c: speed of light
- f_0 : transmitted wave frequency
- Δf : frequency shift due to the Doppler effect

Result: The device displays the vehicle's instantaneous speed.

Radar devices typically use microwave frequencies:

X-band: approx. 10.525 GHz → wavelength approx. 2.85 cm.
K-band: approx. 24.150 GHz → wavelength approx. 1.24 cm.
Ka-band: approx. 33.4–36 GHz → wavelength approx. 8.9–9 mm.

Illustrative Example.

A specific calculation for a vehicle traveling at 80 km/h using K-band radar (24.150 GHz) to demonstrate the shift in the reflected wavelength relative to the originally transmitted wavelength.

Initial data

- Transmission frequency: $f_0 = 24.150\ GHz = 24.150 \times 10^9\ Hz$
- Transmission wavelength:

$$\lambda_0 = \frac{c}{f_0} = \frac{3 \times 10^8}{24{,}150 \times 10^9} \approx 0{,}01243 m = 12{,}43 mm \qquad (8)$$

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• Vehicle speed: $v = 80\,km/h = \frac{80}{3,6} \approx 22,22\,m/s$

Doppler frequency shift
Formula: *(From equation (7))*

$$\Delta f = \frac{v.2f_0}{c} = \frac{2 \times 22,22}{3 \times 10^8} \times 24,150 \times 10^9 \approx 3,57\,kHz \quad \textbf{(9)}$$

Reflected wavelength
Reflected frequency:

$$f' = f_0 + \Delta f \approx 24150003570 \quad \textbf{(10)}$$

Reflected wavelength:

$$\lambda' = \frac{c}{f'} \approx \frac{3 \times 10^8}{24150003570} \approx 0,012429999998\,m \quad \textbf{(11)}$$

Wavelength difference

$$\Delta\lambda = \lambda_0 - \lambda' \approx 0,012430000000 - 0,012429999998 \approx 2 \times 10^{-12}\,m$$

$$\Delta\lambda \approx 0,002\,nm \quad \textbf{(12)}$$

In 1 second, the shift will be

$$s \approx \Delta\lambda \times f' \approx 0,002 \times 10^{-9} \times 24150003570 = 0,0483\,m \quad \textbf{(13)}$$

Results

• Transmitted wavelength: 12.43 mm
• Reflected wavelength: shifted by approximately 0.002 nanometers
• This represents an extremely small difference, yet the radar unit can detect it through precise frequency analysis.

The above outlines the principles behind how speed-measuring devices in everyday life calculate speed. This explanation focuses on the calculation system rather than on the device's internal construction. Let us now examine the typical structure of a device that utilizes the Doppler effect.

A Doppler radar speed gun consists of the following main components:
Basic Structure

Transmitter:
• Generates microwaves at a standard frequency, typically in the X-band (10.525 GHz), K-band

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(24.150 GHz), or Ka-band (33–36 GHz) ranges.
• The wave is emitted using an oscillator and a transmitting antenna.
Antenna (Transmit/Receive):
• Emits radar waves toward the vehicle.
• Receives waves reflected from the vehicle.
• Can utilize a parabolic antenna or a compact microstrip antenna.
Receiver:
• Captures the reflected signal from the vehicle.
• The reflected wave has a frequency shift caused by the Doppler effect.
Mixer:
• Compares the frequencies of the transmitted wave and the reflected wave.
• Generates a beat frequency signal (frequency difference).
Filter & Amplifier: Filters out noise and amplifies the signal for easier analysis.
Digital Signal Processor (DSP):
• Analyzes the frequency shift (Δf).
• Applies the Doppler formula to calculate the vehicle's speed.
• Integrates with a camera (if equipped) to capture images of the license plate.
Display / Data Recorder:
• Displays the measured speed.
• Stores data to serve as evidence for enforcement actions.

Table 1. Electromagnetic waves consist of the following wavelengths: (Microsoft, 2026)

Type of Wave	**Wavelength (λ)**	**Frequency (f)**	**Main Applications**
Radio waves	1 m – 100,000 km	3 Hz – 300 MHz	Broadcasting, radio, wireless communication
Microwaves	1 mm – 1 m	300 MHz – 300 GHz	Microwave ovens, radar, satellite communication
Infrared (IR)	0.76 μm – 2 mm	3×10^{11} Hz – 4×10^{14} Hz	Remote controls, thermal cameras, medical uses
Visible light	380 nm – 760 nm	4×10^{14} Hz – 8×10^{14} Hz	Vision, lighting, photosynthesis
Ultraviolet (UV)	10 nm – 380 nm	8×10^{14} Hz – 3×10^{17} Hz	Sterilization, material inspection, medical uses
X-rays	0.01 nm – 10 nm	3×10^{16} Hz – 3×10^{19} Hz	Medical imaging, security scanning,

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			cancer treatment
Gamma rays (γ)	< 0.01 nm	> 3×10^{19} Hz	Nuclear research, cancer therapy, food sterilization

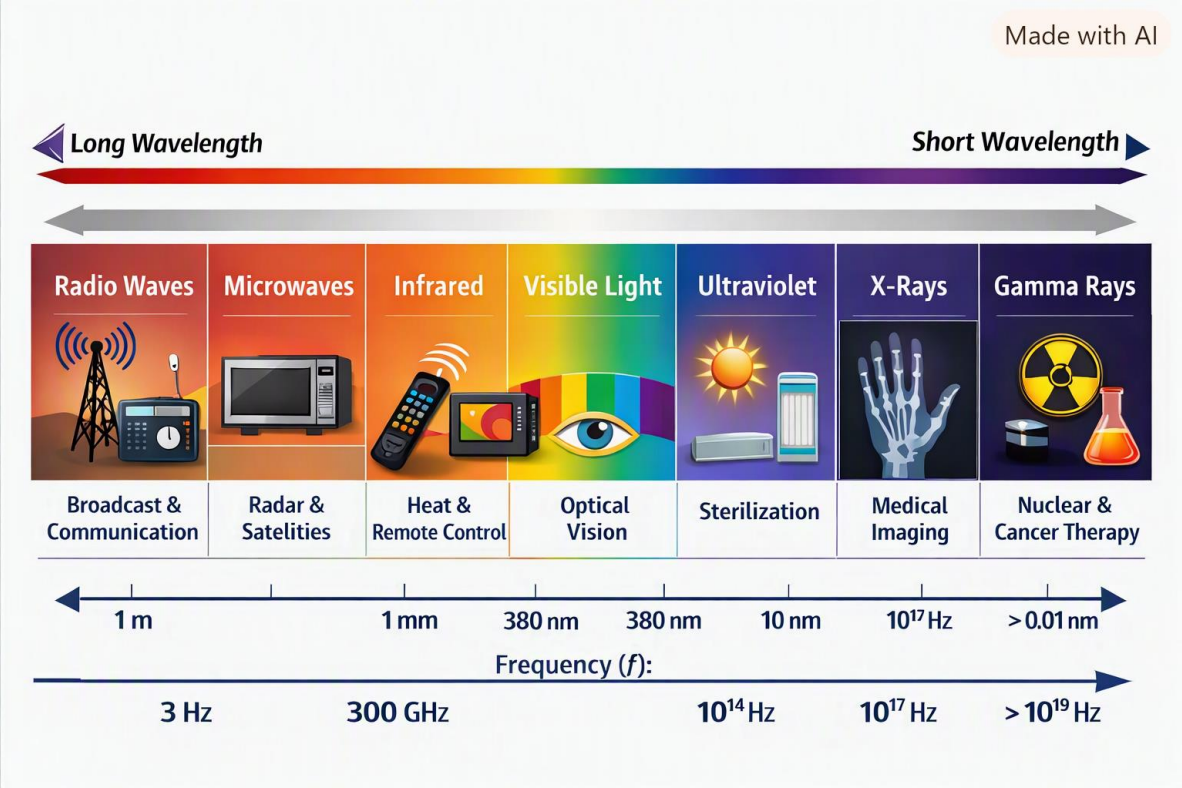


Figure 2. The Electromagnetic Spectrum (Microsoft, 2026)

Here's the spectrum chart — it shows the electromagnetic waves from radio all the way to gamma rays, with their wavelengths, frequencies, and typical applications.
The visual makes it much easier to see how the spectrum flows continuously from long wavelength / low frequency on the left to short wavelength / high frequency on the right.

2. Method

The aforementioned fundamental concepts present a contradiction.
Every photon in the universe exists in a quantum state and travels at the speed of light, c = 300,000 km/s; no photon remains stationary. In other words, if a photon has a sufficiently long wavelength, current instruments are unable to detect it. Consequently, there is no evidence to confirm the existence of photons with such wavelengths. This raises an issue regarding the wave-

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particle duality of electromagnetic waves: particles carry quantum energy and propagate as waves

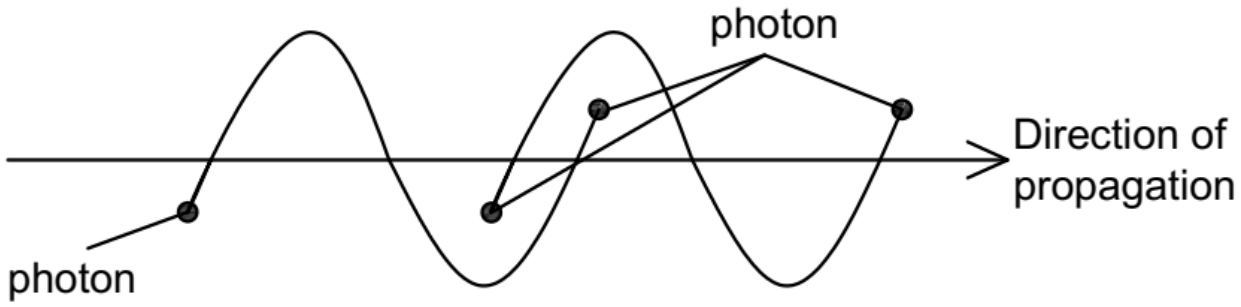


Figure 3. A diagram illustrating the nature of the movement of a single photon.

Research to date has established that a photon carries a specific quantum of energy. According to the law of conservation of energy—which states that energy is neither created nor destroyed but merely transforms from one form to another—what causes the photon's energy to drop from a higher to a lower level (as illustrated in Figure 1)? Where does that energy difference go? Furthermore, if quantum energy levels can decrease, why are photons that gain quantum energy never observed in the universe? Is this due to a lack of measurement equipment, or does the phenomenon of a quantum energy increase not exist?

Due to the Doppler effect (specifically redshift), photons from distant galaxies are detected in the infrared range. Blue light has a longer wavelength than ultraviolet light, meaning it carries less energy. Through a mechanism similar to redshift, ultraviolet rays undergo a wavelength shift due to the expansion of the universe; consequently, observations at a specific time and location should reveal various objects, each with a distinct color. In reality, however, even the most advanced telescopes detect only near-infrared wavelengths.

Black holes in the universe distort the surrounding space, thereby altering the wavelengths of light. However, no observations have revealed the standard seven-colored visible spectrum. Logically, given that the universe is expanding in all directions, if the ultraviolet wavelength emitted by a galaxy and the infrared wavelength subsequently detected from its light are known, it becomes possible to determine other relevant parameters precisely. This approach eliminates the reliance on measurement methods currently in use that depend on empirical constants**.**

The following example illustrates the measurement.

The most distant galaxy currently known

- Name: MoM-z14
- Redshift: z=14.44

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Here's the detailed explanation of how the redshift parameter (z) is constructed.

Mathematical Definition

The redshift parameter is defined as:

$$z = \frac{\lambda_{observed} - \lambda_{emitted}}{\lambda_{emitted}} \quad \textbf{(14)}$$

Where:

$\lambda_{emitted}$: the original wavelength when the light was emitted.

$\lambda_{observed}$: the wavelength measured on Earth.

If the light is stretched (shifted toward red), z>0. If compressed (shifted toward blue), z<0.

How It's Measured

Identify spectral lines of known elements (e.g., hydrogen, oxygen, calcium).

Measure the observed wavelength using a spectrograph.

Compare with the laboratory reference wavelength to calculate z.

Example:

Hydrogen's Hα line has a rest wavelength of 656.3 nm.

If observed at 721.9 nm:

$$z = \frac{721,9 - 656,3}{656,3} \approx 0,1 \quad (15)$$

→ The galaxy is receding at ~0.1c (≈ 30,000 km/s).

Relation to Velocity and Distance

For small z (z < 0.1):

$v \approx c \cdot z$

For large z (z > 1): cosmological models (ΛCDM) are required to convert z into distance and recession velocity.

Physical Meaning

Larger z → farther galaxy → older light.

z = 1 → light emitted ~7.8 billion years ago.

z = 14 → light emitted only ~280 million years after the Big Bang.

Types of Redshift

Type of Redshift	Cause	Example
Doppler redshift	Object moving away	Nearby stars, galaxies
Cosmological redshift	Expansion of space	Distant galaxies
Gravitational redshift	Light escaping strong gravity	Near black holes, neutron stars

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Light-travel distance: ~13.53 billion light-years
- Comoving distance (actual): ~33.8 billion light-years
- Formation time: ~280 million years after the Big Bang.
- Discovery: James Webb Space Telescope (JWST), May 2025

Recession velocity
- Concept: The recession velocity of a distant galaxy is not "motion through space" but the expansion of space itself.
- At z = 14.44, the recession velocity—calculated using the extended Hubble formula—can exceed the speed of light multiple times over.
- This does not violate the theory of relativity, as no matter is moving faster than light through space; rather, it is space itself that is expanding.
- The information discussed above is considered correct to date. There is a contradiction here.
-

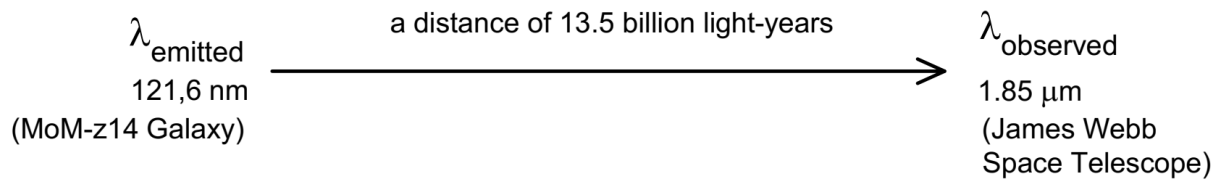


Figure 4. Describing the electromagnetic wavelengths emitted by the galaxy and the wavelengths received by the telescope.

Hypothesis:

An emitted electromagnetic wave lies in the ultraviolet range with wavelength $\lambda_{emitted} = 121,6nm = 121,6\times10^{-9}\,m$. After traveling for 13.5 billion years (equivalent to $1,277\times10^{26}$), it has a wavelength $\lambda_{observed} = 1,85\mu m = 1,85\times10^{-6}\,m$

Thus, for every meter of distance, the wavelength changes by an amount of:

$$\Delta_{\lambda} = \frac{1.85\times10^{-6} - 121.6\times10^{-9}}{1.277\times10^{26}} \approx 1,353\times10^{-32}\,m \quad (16)$$

In one second, light travels a distance

$$c = 300000\,km/s = 3\times10^{8}(m/s)$$

Thus, in one second, the wavelength increases by a length of:

$$l_{1s} = 1.353\times10^{-32}\times3\times10^{8} = 4.059\times10^{-24}\,(m/s) \quad (17)$$

At a distance of one light-year, the increase in wavelength would be:

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$$l_{1y} = 4.059 \times 10^{-24} \times 365 \times 24 \times 60 \times 60 = 1.28 \times 10^{-16}\, m \quad (18)$$

l_{1y} is also the rate at which the universe expands over a distance of one light-year.

However, the expansion rate over one year (based on the aforementioned calculation) is 2.2 cm/s. This represents a difference of a factor of $n = \frac{2.2 \times 10^{-2}}{1.28 \times 10^{-16}} = 1.7186 \times 10^{14}$ — a massive discrepancy.

In the case of a speed gun utilizing the Doppler effect in everyday life (as calculated above): at velocity $v = 80 km/h = \frac{80}{3,6} \approx 22,22 m/s$, the discrepancy over one second is $s \approx \Delta\lambda \times f' \approx 0,002 \times 10^{-9} \times 24150003570 = 0,0483 m$, resulting in a difference factor of $n = \frac{22,22}{0,0483} = 460,04$

The two examples above demonstrate that the principle of the Doppler effect application is not entirely robust. In the case of speed guns, because electrons and photons travel through conductors of finite length, they require time to reach the measuring device. Semiconductor microcircuit components—such as transistors and diodes—operate via switching mechanisms, a process that also entails a time delay. These factors introduce measurement errors; specifically, the resulting discrepancies manifest as time lags and wavelength elongation, leading to misconceptions regarding the Doppler effect.

Currently, spectral line shifts indicate whether a galaxy is distant or nearby, while spectral composition reveals whether it is young or old. However, a complication arises in these measurements: although outer space is extremely rarefied, it contains an average density of one atom per cubic meter. Consequently, over vast distances, this matter affects electromagnetic waves; the waves are absorbed by these atoms, leaving only near-infrared radiation to reach the observation equipment.

The aforementioned points are based on logical reasoning that can be empirically verified as follows:

- Verify the accuracy of radio-wave-based Doppler equipment. This procedure is carried out in specialized laboratories.
- Conduct the following measurement experiment:

In the vastness of intergalactic space, atoms are always present—predominantly hydrogen (accounting for 75%) and helium (approximately 25%). Since electromagnetic waves from ancient galaxies experience minimal absorption as they pass through helium, the analysis focuses on waves passing through hydrogen. Hydrogen in space exists in an ionized state, with a density of approximately 1 atom per cubic meter. $1\ atom/m^3$

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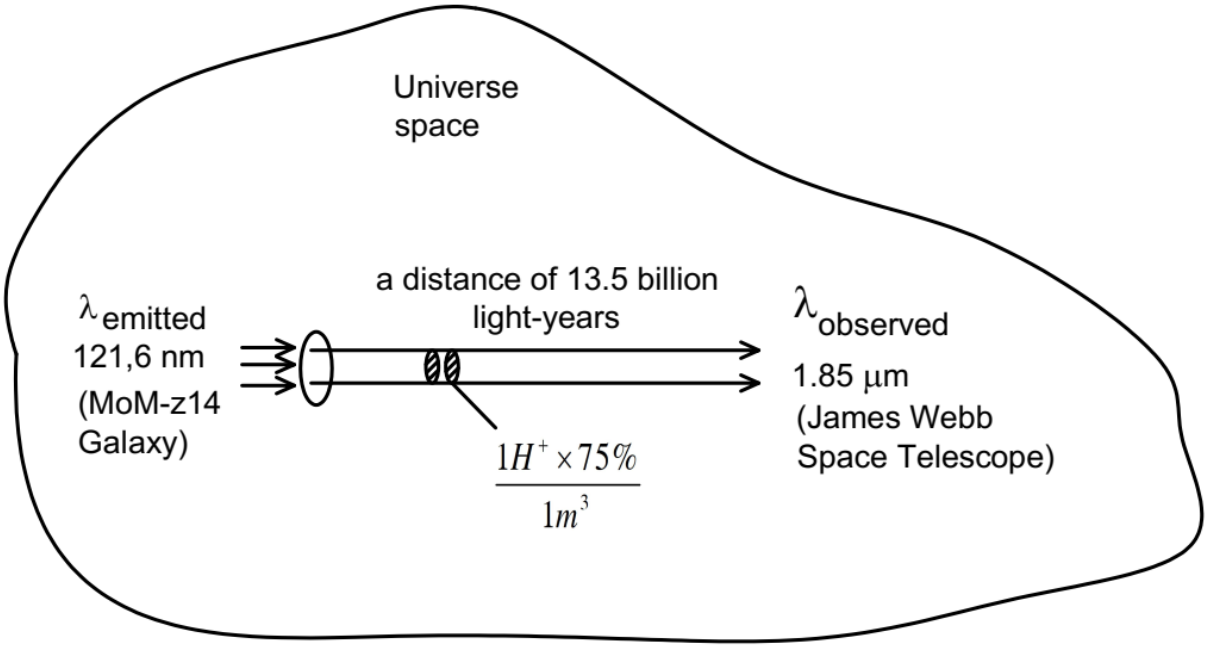


Figure 5. The diagram illustrates light being obstructed by ionized hydrogen as it travels from a galaxy 13.5 billion light-years away to the instrument of observation.
After 13.5 billion light-years, the number of atoms passing through is:

$$\frac{1H^+ \times 75\%}{1m^3} \times 1.277 \times 10^{26} m = 9.5775 \times 10^{25} \textbf{\textit{(atoms)}} \qquad \textbf{\textit{(19)}}$$

As they travel across a vast distance of 13.5 billion light-years, positive hydrogen ions absorb electromagnetic waves, leaving behind only near-infrared wavelengths. Let us hypothesize that light waves do not undergo lengthening due to cosmic expansion, but are instead absorbed, leaving only near-infrared waves. We can experiment as follows:

As they travel across a vast distance of 13.5 billion light-years, positive hydrogen ions absorb electromagnetic waves, leaving behind only near-infrared wavelengths. Let us hypothesize that light waves do not undergo lengthening due to cosmic expansion, but are instead absorbed, leaving only near-infrared waves. Experiment as follows:

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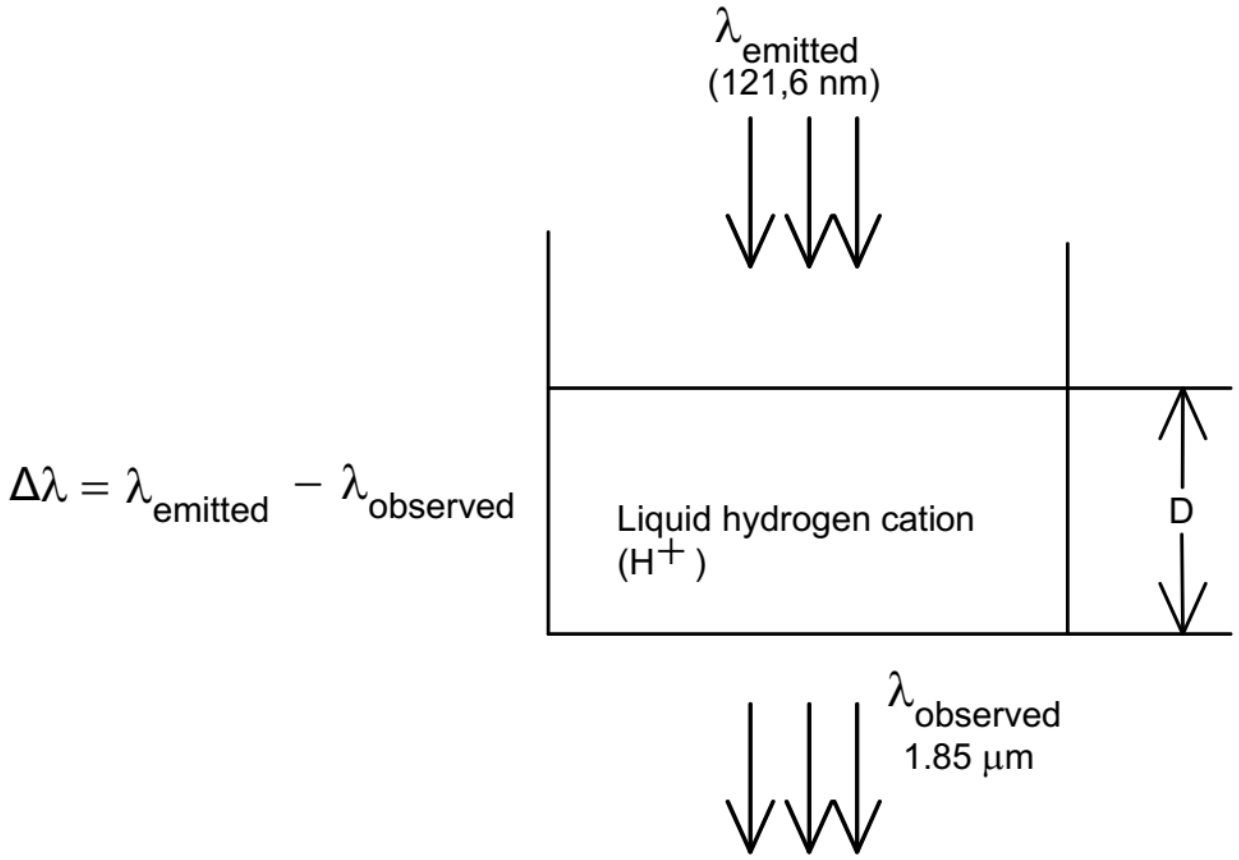


Figure 6 Description of an experiment to demonstrate the effects of the misapplication of the Doppler effect in astrophysics.

Consider an ultraviolet beam (with a wavelength of 121.6 nm) as shown in the diagram; after passing through a container of liquid H+, the beam emerges from the other side with a wavelength of 185 μm. Once the input and output wavelengths have been precisely adjusted, the distance D is measured. Based on D, the number of H+ atoms can be calculated; this result is then compared with the previously calculated number of atoms (see Equation (19)), yielding the conclusion.

3. Results

Based on the logical analysis above, there are grounds to suspect that the Doppler effect has been misapplied. Doppler originally described the effect for measuring the speed of moving objects—objects traveling at speeds far below that of light. However, the motion of microscopic particles at high velocities requires scrutiny. The parameters of speed-measuring instruments need to be re-verified in specialized laboratories to determine the true underlying causes. Regarding distance measurement, current methods rely on real constants (such as the Hubble constant) and the redshift phenomenon. The example presented in this paper—comparing the wavelength

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emitted by a galaxy with the observed wavelength—demonstrates a method for determining the galaxy's distance. Nevertheless, as this example relies on theoretical reasoning, the resulting calculations do not invalidate the high-precision technological equipment or the theoretical and experimental research established over many years.

Table 2. Comparison between the proposed paper and recent studies.

Criteria	This article raises doubts.	The studies are considered valid and are currently being used.
Doppler effect	The effect applies only to low-velocity mechanical waves.	Valid for both low and high speeds.
Redshift	The observed phenomenon is due to light being absorbed by H+ ions.	Due to the expansion of the universe.
Astrophysics knowledge.	Using recognized theoretical calculations	In addition to theoretical calculations, empirical constants and inconsistent measurement results are also used.
Research results.	The argument is logical but lacks empirical evidence.	The argument is based on empirical evidence but contains numerous contradictions and raises doubts.
	The two calculation methods yield vastly different results. Therefore, it can be predicted that only one of them is correct.	

The count of H+ atoms will provide the definitive answer, putting an end to doubts, contradictions, and debates.

If the arguments presented in this article are correct, astrophysics will gain new tools for a better understanding of the structure of the entire universe; if not, this endeavor will still contribute to the body of specialized knowledge in astrophysics.

4. Discussion and Conclusions

The Doppler effect is not a new concept; it has been known for centuries. Observations made by the James Webb Space Telescope (JWST) in the infrared spectrum have been used to estimate the distances to the most remote galaxies and calculate the age of the universe at 13.7 billion years. However, measurements remain inconsistent, and various hypotheses about the structure of the universe persist, underscoring the need for adjustment. To address these discrepancies, this study presents arguments highlighting the existing contradictions and uncertainties, while proposing an experimental solution.

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The experiment requires a container for liquid H+, which presents a significant challenge. Current technology has not focused on the liquid state of H+ ions; consequently, both generating and containing this liquid for experimental purposes pose complex technical challenges.

The proposed calculation and measurement method relies on electromagnetic wavelengths and does not utilize any empirical coefficients. Therefore, if validated, this approach would represent a novel methodology in modern astrophysics.

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