Clarifying Redshifts

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Abstract

The word redshift is repeated often but the word redshift can refer to several completely different measurements. The respective measurements of redshift are explained so in the future each use can be correct.

Contents

1 Introduction 2

2 Terminology 2

3 Fundamental Assumptions 5

4 Fundamental Calculations 6

5 Samples of a Galaxy Spectrum 11

6 Sample of a Quasar Spectrum 11

7 Sample of a Photosphere Spectrum 11

8 Applying Doppler Effect 12

9 History of Redshift 13

10 Observations Show Error with Doppler Effect 15

11 Confirmations of Redshift Not From Velocity 19

12 Gravitational Redshift 20

13 Cosmological Redshift 21

14 Methods of Distance Measurement 25

15 New Redshift Rules 26

16 Conclusion 28

1 Introduction

The most common use of redshift is an indicator of velocity. There is more than one redshift measurement depending on the object, usually either a galaxy or quasar, but also a star. Sometimes the velocity is used to calculate a distance to the light source. This paper investigates whether the redshift velocity measurement is correct.
This paper describes two fundamental assumptions for how objects can exhibit the Doppler effect.

2 Terminology

Redshift is the focus of this paper but the explanation of redshift requires several other terms to be described first.

2.1 Intergalactic Medium

The Intergalactic Medium, IGM, is the space between galaxies. This space is not a perfect vacuum but has particles at a low density.
Some of these particles are critical to the analysis of light passing through the IGM.

2.2 Active Galactic Nucleus

The Active Galactic Nucleus, AGN, is the source of intense electromagnetic radiation from the core of a galaxy. This paper will use this common term but does not describe various theories of the mechanism in the AGN.

2.3 Redshift

Redshift is a term for the measurement of a spectrum change by the Doppler Effect. The following sections describe behaviors of light and several sources of light in the universe. As those terms are explained, the Doppler Effect is also explained.

2.4 Light and Wavelength

A spectrum is the entire range of wavelengths in electromagnetic radiation where light is the visible range. The ultraviolet and infrared ranges are not visible to the human eye but they are in the Sun's radiation. Because this paper is about the visible stars and galaxies, light is often used for the entire spectrum, including those ranges not visible.
Electromagnetic radiation is the propagation of synchronized, perpendicular electric and magnetic fields.The propagation has a defined rate of oscillation measured as either a frequency or a wavelength. The wavelength is usually measured in nanometers,10^{-9} m) or Angstroms (10^{-10} m or 0.1 nm). The velocity of this propagation has been measured in a vacuum using our standard definition for time and this measured value is called the constant c. This measurement also defined the standard unit of

1 meter. The velocity of propagation is reduced in a medium, defined by its diffraction index. Light transmits energy proportional to its frequency so the constant c appears in some physics equations involving energy.
Quantum physics defined a theoretical particle called a photon to refer to a single wavelength. A wavelength has no mass so a photon has no mass. In this paper, wavelength will be used because a spectrum analysis uses numerical values and no quantum particles. Using photon instead of wavelength only introduces possible confusion. Photon will not be used in this paper's original content. When photon is in a reference excerpt, wavelength can be substituted for photon.

2.5 Fraunhofer Lines

This description provides backgound for many terms and their use in a spectrum analysis.
excerpt from Wikipedia:
In 1814, Fraunhofer independently rediscovered the [dark] lines and began to systematically study and measure the wavelengths where these features are observed. He mapped over 570 lines.
About 45 years later Kirchhoff and Bunsen noticed that several Fraunhofer lines coincide with characteristic emission lines identified in the spectra of heated elements.It was correctly deduced that dark lines in the solar spectrum are caused by absorption by chemical elements in the solar atmosphere. Some of the observed features were identified as telluric lines originating from absorption by oxygen molecules in the Earth's atmosphere.
Because of their well–defined wavelengths, Fraunhofer lines are often used to characterize the refractive index and dispersion properties of optical materials.
(excerpt end)
reference:
link: Fraunhofer lines
Observation:
The same wavelength value is associated with a) an absorption line when the atom absorbs that energy, enabling the electrons change to a higher energy state and b) an emission line when the atom emits energyfrom as the electrons change to a lower energy state. Knowing the element's electron configuration the wavelength can be calculated for each change in energy states.

2.6 Absorption and Emission Lines

Both the absorption and emission lines come from atoms between the light source and the observer.These atoms could be anywhere in that distance but some observations can assume the atoms are very close to the source. That determination of relative position is very important when using either line.

2.7 Calcium atom's characteristic wavelengths

Though calcium makes up a very small portion of the Sun's mass, calcium atoms are present in the intergalactic medium so these atoms affect radiation passing through these atoms.
This wavelength is important because a galaxy can have this pair of calcium absorption lines at 3934 and 3969 Angstroms in its spectrum when a calcium atom is in the line of sight to the galaxy. A red or blue shift of this pair of lines indicates the relative velocity of the atom.

2.8 Hydrogen atom's characteristic wavelength

Hydrogen is the most common element in the universe; it is also the simplest having only one proton and one electron.
excerpt from Wikipedia:
In physics, the Lyman-alpha line is a spectral line of hydrogen, or more generally of one-electron ions, in the Lyman series, emitted when the electron falls from the n = 2 orbital to the n = 1 orbital, where n is the principal quantum number. In hydrogen, its wavelength of 1215.67 angstroms corresponding to frequency of of 10^{15} hertz, places the Lyman-alpha line in the vacuum ultraviolet part of the electromagnetic spectrum, which is absorbed by air. Lyman-alpha astronomy must therefore ordinarily be carried out by satellite-borne instruments, except for extremely distant sources whose redshifts allow the hydrogen line to penetrate the atmosphere.
(excerpt end)
reference:
link: Lyman-alpha line
This wavelength is important because a quasar has this emission line in its spectrum. A redshift of this emission line indicates the relative velocity of the atom.

2.9 Doppler Effect

(excerpt from britannica:
Doppler effect, the apparent difference between the frequency at which sound or light waves leave a source and that at which they reach an observer, caused by relative motion of the observer and the wave source. This phenomenon is used in astronomical measurements.
(excerpt end)
link: Doppler Effect
Observation:
The Doppler effect is observed by the entire spectrum of the light source being shifted in proportion to the source's velocity in that direction.
The Doppler effect occurs only at the moment of radiation emission or at the moment of radiation absorption when the motion of the object at that instant affects the spectrum.

3 Fundamental Assumptions

This paper has two fundamental assumptions.
First,
Absorption and emission lines come from atoms in the line of sight.

In many cases these atoms are not moving with the light source behind them. When independent, the atom's apparent motion cannot be applied to the light source.

Second,
This Doppler effect applies only to a single light source. The effect cannot apply to multiple sources even if many sources are moving together. The Doppler effect involves the kinetic energy of the light source so the effect can apply only to an individual source, having an individual mass and velocity. Even if multiple objects have the same mass and same velocity this wavelength shift is executed individually. This shift occurs at the moment of transmission from the surface of an individual object.

The possible cohesive light sources:
a) an atom or molecule,
b) a solid (where molecular bonds hold molecules together in a cohesive lattice strucuture),
c) condensed matter (where electromagnetic forces maintain a cohesive lattice structure; this lattice can result in a behavior of a solid or liquid).
newline The following celestial objects satisfy the above criteria:
a) an atom or molecule either:
on the light emitting surface, or
in the line of sight between the observer and the light emitting source,
b) a solid will generate thermal radiation as it cools,
c) the photosphere of a star is a layer of liquid metallic hydrogen which can expand and contract in its own motion; this behavior occurs in a pulsating variable giant star (like a Cepheid); this cycle results in the star's periodic luminosity curve; if the photosphere is not moving independent of the rest of the star then the photosphere is a cohesive light source for the star which can exhibit the Doppler effecct.
The distinction for the light source is critical because a galaxy does not have a surface. Only each star has a surface.
Therefore a galaxy which is considered to be moving will never exhibit a Doppler effect shift in the summation spectrum of all its individual stars in the observer's field of view.
Each item in the list radiates in all directions.
A star is a cohesive light source so its motion affects its radiated spectrum by the Doppler Effect.
A gas of atoms is not a cohesive light source so a capture of light from all its atoms will not exhibit a redshift by the Doppler effect. In a gas, each atom is an individual possible light source whose motion will affect its individual radiated spectrum; this atom's generated spectrum is only the atom's emission line when it changed to a lower energy state.
Note: an atom or molecule can cause an absorption line but not a star.

Unlike a star, a galaxy is not a cohesive light source but consists of many stars. The galaxy spectrum is just the summation of light from all its stars in the observer's field of view. Each individual star will exhibit the Doppler Effect in its light when the star is moving in some direction but the galaxy's spectrum seen by the observer cannot be affected that way.
The spectrum of a galaxy depends on the observer's line of sight. A galaxy has no spherical surface generating its radiation.
A spiral galaxy has arms with dust clouds. The measured spectrum of a galaxy will vary from:
a) directly above, sometimes called face on,
b)directly on edge to the galactic disk where many stars are obscured in the field of view,
c) directly in line with the apparent axis of an elliptical galaxy which are not always spherical but can appear as an ellipse lacking the symmetry of a sphere,
d) any other angle,
e) line of sight through variations in the IGM, causing different absorption lines from those intervening atoms.
Unlike the other items in the list of candidates, a galaxy (or quasar) spectrum depends on the observer's location relative to the galaxy where the collection of stars in the spectrum will vary.
As that radiation from all the stars in the galaxy propagates toward the observer the light will pass through space where intervening atoms can reside. An atom in this path can cause an absorption line (described above) in the galaxy's observed spectrum.

4 Fundamental Calculations

The kinetic energy of the source is involved in the energy transfer at the moment of the Doppler effect.
. This is a simple calculation of z.
First the velocity, called v here, of the source is compared to the velocity of light by dividing that value by the velocity of light, called the constant c.
The result is called z by convention (defined by astronomers long ago).
The simple equation is z=v/c, making sure the units are the same (usually km/s or m/s).
The spectrum being emitted by the radiation source in the direction of travel has its wavelengths reduced or toward the blue end of the spectrum; this is called a blue shift.
The spectrum being emitted by the radiation source in the direction opposite of travel has wavelengths increased or toward the red end of the spectrum; this is called a redshift.
The shift in a spectrum due to the motion of the light source is a simple equation, where EWL is the emission wavelength,
NWL is the new wavelength, so: NWL = EWL + (EWL x z)
where the z is the factor for the change in the new wavelength from that originally emitted; z is positive for a red shift or negative for a blue shift.
It is very important to note:

The Doppler Effect changes the spectrum only at the cohesive light source (defined above), based on the light source's velocity and direction.
Doppler effect does not change the total energy emitted by the light source. The chesive light source is generating a sphere of radiated energy in a continuum. In the direction of travel the energy is slightly increased by the wavelength reduction. In the direction opposite of travel the energy is slightly decreased by the wavelength increase. The energy change in one direction is exactly matched by the change in the other direction. The sphere of radiated energy is no longer uniform due to the motion of the light source but the total energy remains the same.

Doppler effect does not violate the conservation of energy, a basic principle of thermodynamics.

4.1 Sources of Radiation

There are several sources of radiation each having its signature in its spectrum.

4.2 Synchrotron Radiation

excerpt from Wikipedia:
Synchrotron radiation, electromagnetic energy emitted by charged particles (e.g., electrons and ions) that are moving at speeds close to that of light when their paths are altered, as by a magnetic field. It is so called because particles moving at such speeds in a variety of particle accelerator that is known as a synchrotron produce electromagnetic radiation of this sort.
Many kinds of astronomical objects have been found to emit synchrotron radiation as well. High-energy electrons spiraling through the lines of force of the magnetic field around the planet Jupiter, for example, give off synchrotron radiation at radio wavelengths. Synchrotron radiation at such wavelengths and at those of visible and ultraviolet light is generated by electrons moving in the magnetic field associated with the supernova remnant known as the Crab Nebula. Radio emissions of the synchrotron variety also have been detected from other supernova remnants in the Milky Way Galaxy and from extragalactic objects called quasars.
(excerpt end)
Observation:
The continuum of the wavelength distribution in the spectrum is rather uniform with synchrotron radiation, with the minimum wavelength directly indicating the energy (proportional to frequency) of the radiation. The ultraviolet frequency as the highest frequency is typical but increasing the electric current results in X-rays or even gamma rays. The lowest frequency will be infrared to radio.

This radiation comes from electrons in motion so there is no spherical surface for this radiation. A quasar is noted as a source of synchrotron radiation.

As there is no radiating surface which could move, there is no Doppler effect for this light source.

Note: quasars are known to generate synchrotron radiation.

reference:
link: Synchrotron radiation

4.3 Thermal Radiation

Excerpt from Wikipedia:
Thermal radiation is electromagnetic radiation generated by the thermal motion of particles in matter. All matter with a temperature greater than absolute zero emits thermal radiation. /newline If a radiation object meets the physical characteristics of a black body in thermodynamic equilibrium, the radiation is called blackbody radiation. Planck's law describes the spectrum of blackbody radiation, which depends solely on the object's temperature. Wien's displacement law determines the most likely frequency of the emitted radiation, and the Stefan–Boltzmann law gives the radiant intensity.

Thermal radiation is also one of the fundamental mechanisms of heat transfer.
reference:
link: Thermal radiation
Observation:
This radiation spectrum covers a broad continuum from infrared at the lowest frequency to ultraviolet at the highest, depending on the object's temperature.

4.4 Photosphere

Excerpt from Wikipedia:

The photosphere is a star's outer shell from which light is radiated. The term [refers to] a spherical surface that is perceived to emit light. The photosphere is typically used to describe the Sun's or another star's visual surface.
The spectrum of sunlight has approximately the spectrum of a black-body radiating at 5,777 K, interspersed with atomic absorption lines from the tenuous layers above the photosphere.
(excerpt end)
reference:
link: Photosphere
Observation:
A star's surface is generating thermal radiation. Absorption lines occur from atoms on or very near this surface.

4.5 Stellar radiation

excerpt from britannica:

Solar radiation is electromagnetic radiation, including X-rays, ultraviolet and infrared radiation, and radio emissions, as well as visible light, emanating from the Sun.
(excerpt end)
reference:
link: Stellar radiation
Observation:
There is no reason for this paper to explain the Sun and its mechanism for generating its radiation. This paper is about what happens to light after its generation from any source, especially a galaxy or quasar.
The sun radiates a broad spectrum, essentially a continuum through all the wavelengths being generated, with the noticeable exception of the dark absorption lines which are missing wavelengths among the rest unaffected by intervening atoms.
When atoms are on the surface of the photosphere they will cause absorption lines in the observed spectrum.

A star with a system of planets, like the Sun in our solar system, will orbit around the planetary system's center of gravity, called the barycenter. Our solar system has 8 planets so the Sun wobbles around the barycenter as the 8 planets also orbit about the barycenter. One of the methods to find exoplanets is called the wobble method. By monitoring the star's spectrum, a cycle of blue shift and red shift reveals the star is wobbling due to its planets. This cycle can be analyzed to calculate the planetary masses and orbits required for the observed wobble in the primary.

4.6 Galaxy

One of the most important objects beyond our Milky Way is a galaxy.
A galaxy is a collection of millions of stars or more. M31 or the Andromeda Galaxy is estimated to have a trillion stars and M31 is not the largest. The spectrum of a galaxy captures and combines the light from all the stars in the field of measurement. This spectrum is also affected by everything in the line of sight to that collection of stars.
In simple terms, a galaxy has no surface. A galaxy is not a single light source, but its spectrum is the summation of radiation from many objects in the field of view for the spectrum measurement. Any motion of the entire galaxy (i.e., with all its stars moving independently) cannot be found easily in its spectrum by the Doppler Effect.
A star is a single cohesive light source with a surface. A star's motion will affect its radiation by the Doppler Effect. The star's radiation in the direction opposite of travel has wavelengths increased or toward the red end of the spectrum; this is called a redshift. A blue shift occurs to the radiation in the direction of travel.
A galaxy cannot reveal the motion of its entire system of millions of stars within the spectrum which consists of the light from all the stars in the field of view; not all stars in a galaxy can be seen from a distant perspective.

A globular cluster is a sphere of stars like an elliptical galaxy. Each sphere of stars, with a different diameter or a different star count, is treated the same in this paper.

4.7 Quasar

A quasar is an important object beyond our Milky Way.

Quasars are usually observed in a large cluster with a number of galaxies.

A quasar is neither a star nor a galaxy.

excerpt from Wikipedia: A quasar (also known as a quasi-stellar object abbreviated QSO) is an extremely luminous active galactic nucleus (AGN). [Its] energy is released in the form of electromagnetic radiation, which can be observed across the electromagnetic spectrum.

In 1963, a definite identification of the radio source 3C 48 with an optical object was published by Allan Sandage and Thomas A. Matthews. Astronomers had detected what appeared to be a faint blue star at the location of the radio source and obtained its spectrum, which contained many unknown broad emission lines. The anomalous spectrum defied interpretation.

Schmidt was able to demonstrate that these were likely to be the ordinary spectral lines of hydrogen redshifted by 15.8 percent—at the time, a high redshift (with only a handful of much fainter galaxies known with higher redshift). If this was due to the physical motion of the "star", then 3C 273 was receding at an enormous velocity, around 47,000 km/s, far beyond the speed of any known star and defying any obvious explanation. Nor would an extreme velocity help to explain 3C 273's huge radio emissions.

(excerpt end)

Observation:

The quasar generates a broad spectrum of synchrotron radiation (mentioned above) but sometimes the quasar has a noticeable hydrogen emission line with an extreme redshift indicating the hydrogen atom in the line of sight is moving at 'an extreme velocity.'

This emission line is generated by a hydrogen atom in motion. If the wavelength is shifted the value is the result of the atom's motion. This atom is not the source of the quasar's synchrotron radiation but it must be in the line of sight to the light source, the AGN.

A quasar is not a cohesive light source. Its spectrum is the summation of many objects, including its AGN and all the surrounding stars, though possibly obscurred by dust which might be common among quasars. Some quasars are dimmer by dust, not just by distance.

Similar to a galaxy the radiated light from the quasar will pass through space and an intervening atom anywhere in the light path could result in an absorption line in the observed spectrum. Some quasars have a complex spectrum where several absorption lines are observed from a variety of elements which are circulating in the space around the AGN.

reference:

link: Quasar

5 Samples of a Galaxy Spectrum

5.1 Sample from M31

M31 galaxy spectrum has 2 absorption lines for the calcium atom in the intervening space between Earth and M31. The linked page is an exercise for a student to duplicate the calculated blue shift velocity of -301 km/s, using the graph and wavelength values provided.
link: M31 galaxy spectrum

5.2 Samples from SDSS

Here is a galaxy example from the Sloan Digital Sky Survey (SDSS):

link: Galaxy spectra

Observation: Each spectrum has multiple absorption and emission lines.
for this analysis, the data set is small. Hovever the collection is consistent showing the presence of atoms in the IGM in the line of sight to each galaxy.

6 Sample of a Quasar Spectrum

newline

In the quasar entry in the terminology section above has this excerpt:

Schmidt was able to demonstrate that these were likely to be the ordinary spectral lines of hydrogen redshifted by 15.8 percent—at the time, a high redshift (with only a handful of much fainter galaxies known with higher redshift). If this was due to the physical motion of the "star", then 3C 273 was receding at an enormous velocity, around 47,000 km/s, far beyond the speed of any known star and defying any obvious explanation. Nor would an extreme velocity help to explain 3C 273's huge radio emissions.
(excerpt end)

The single sample is limited but the sample is sufficient and consistent with other descriptions, plus this reference has a spectrum graph with many details of this particular quasar.
link: Basics of Quasar Spectra

7 Sample of a Photosphere Spectrum

The Sloan Digital Sky Survey provides a number of spectra.

Here is a star example from SDSS:

link: Star spectrum

Observation:
this spectrum matches the thermal radiation distribution.
The motion of the thermosphere is determined by the shift in the entire spectrum. For this calculation the unshifted spectrum must be certain.

8 Applying Doppler Effect

There are observed redshifts and blue shifts in a spectrum by the Doppler effect. Some are handled correctly, while others are not.

8.1 A Moving Stellar Surface

The exoplanet search will use the wobble method which monitors the cycle of the full spectrum shift. The primary star will move toward the Earth or away depending on the orbits of its collection of one or more exoplanets. This application of the Doppler effect needs no further description; this paper is about galaxies and quasars.

However it demonstrates a star's motion results in the Doppler effect.

8.2 An absorption Line

An emission line has been thoroughly explained above .

An emission line is an active process where an atom decreases its energy state and releases that energy in electromagnetic radiation where the initial wavelength is directly related to this decrease in energy state, conforming to the conservation of energy.

An absorption line is a similar process but an atom in the line of sight absorbs a particular wavelength. This enables an increase in its energy state with the electrons changing to different energy levels. This absorption has a threshold where the wavelength must have the energy for a complete state change. Each atom's electrons have defined levels and do not take intermediate states. An absorption line is an active process where an atom increases its energy state by absorbing that energy from the energy in electromagnetic radiation. The absorbed wavelength is directly related to this increase in energy state, conforming to the conservation of energy.

This absorption process results in a missing wavelength in the spectrum measured by the observer. The atom absorbing its wavelength can be anywhere between the light source and the observer.

When the missing wavelength is measured with a shift in its normal value, whether this shift has is at the light source, depends on the light source.

In the case of a star with a shift in the wavelength, there are 2 scenarios:

1) the atom is either on the photosphere surface or above in the corona and moving independently.

The motion of the loose atom indicates nothing about the star. Examples are solar flares or a coronal mass ejection.These motions are independent of the star's motion.

2) the atom is on the photosphere surface so they are moving together.

In this case the absorption line is being shifted with the entire photosphere spectrum.

The shift in the spectrum indicates the relative motion of that surface.

There are 2 ways the phosphere moves, either as a) the star moves or b) by the kappa mechanism where the entire photosphere expands or contracts as part of the pulsating star's periodic changes in brightness.

In the case of a galaxy, an absorption line provides only one detail, an atom of this element is in the line of sight to the light source. Any measured shift is by the atom's motion.

The atom is always moving independent of the galaxy. No information about the light source (the galaxy) can be extracted from the missing wavelength.

This observation is important because sometimes an absorption line is assumed to have information about the light source.
A galaxy has no surface so any absorption line in a galaxy spectrum is always from an intervening atom and has no information about the galaxy motion.
A quasar has no surface so an absorption line in a quasar spectrum is always from an intervening atom and has no information about the quasar motion.

8.3 An Emission Line

For a galaxy, any emission linein its spectrum is from an atom in the intervening space and has no information about the galaxy motion.
A quasar will have a hydrogen absorption line. It will have a red shift because the atom is moving in the direction away from Earth as part of the jets of material ejected by the quasar.
This red shift for an atom in motion has no information for the quasar motion.

9 History of Redshift

9.1 Initial observations

(excerpt start from Wikipedia) In 1912, Vesto Slipher measured the first Doppler shift of a "spiral nebula" (spiral nebula is the obsolete term for spiral galaxies), and soon discovered that almost all such nebulae were receding from Earth. He did not grasp the cosmological implications of this fact, and indeed at the time it was highly controversial whether or not these nebulae were "island universes" outside our Milky Way.
Edwin Hubble is often incorrectly credited with discovering the redshift of galaxies. These measurements and their significance were understood before 1917 by James Edward Keeler, Vesto Melvin Slipher, and William Wallace Campbell at other observatories.
Combining his own measurements of galaxy distances with Vesto Slipher's measurements of the redshifts associated with the galaxies, Hubble and Milton Humason discovered a rough proportionality of the objects' distances with their redshifts.

(excerpt end)

Observation:

The critical conclusion was 'a rough proportionality of the objects' distances with their redshifts' so this means the red shift is increasing by an increasing distance to the object.

reference:

link: Vesto Slipher

9.1.1 Later observations

A study of quasars concluded the hydrogen absorption line redshift is affected by the density of hydrogen atoms in the line of sight.

An excerpt from a paper from Caltech (linked below; select from the initial page: Basics of Quasar Spectra).

(excerpt start) Observation:

However, the vast majority of absorption lines in a typical quasar spectrum are "intervening", produced by gas unrelated to the quasar that is located along the line of sight between the quasar and the Earth.

A structure along the line of sight to the quasar can be described by its neutral Hydrogen column density, N(HI), the number of atoms per cm^{-2} . N(HI) is given by the product of the density of the material and the path length along the line of sight through the gas. Each structure will produce an absorption line in the quasar spectrum at a wavelength of lambda-obs = lambda-rest (1 + zabs), where zabs is the redshift of the absorbing gas and lambda-rest = 1215.67 Angstroms is the rest wavelength of the Lyalpha transition. Since zabs $<$zQSO, the redshift of the quasar, these Lyalpha absorption lines form a "forest" at wavelengths blueward of the Lyalpha emission. The region redward of the Lyalpha emission will be populated only by absorption through other chemical transitions with longer lambda-rest. Historically, absorption systems with N(HI) $<$1017.2 cm^{-2} have been called Lyalpha forest lines, those with 1017.2 $<$N(HI)$<$1020.3 cm^{-2} are Lyman limit systems, and those with N(HI) ¿ 1020.3 cm^{-2} are damped Lyalpha systems. The number of systems per unit redshift increases dramatically with decreasing column density. Lyman limit systems are defined by a sharp break in the spectrum due to absorption of photons capable of ionizing HI, i.e. those with energies greater than 13.6 eV.

(excerpt end)

Observation:

The ionizing radiation from the AGN affects the number of neutral hydrogen atoms in its vicinity. The paper is explicit about 'vast majority' of absorption lines are from 'intervening atoms in the line of sight.

This behavior of a red shift due to the density of hydrogen atoms in the line of sight is applicable to all distant objects not only quasars.

This red shift is related to the author's phrase of 'hydrogen column density' which is apparently the number of hydrogen atoms in a distance along the line of sight.

reference:

link: Quasistellar Objects: Intervening Absorption Lines

9.1.2 Agreement among these Redshift observations

The observations from the above sources found the same relationship: the hydrogen absorption line increases with the number of hydrogen atoms in the line of sight.

9.1.3 Wrong Conclusion with these Redshift observations

The accepted assumption became the hydrogen absorption line was directly related to the velocity of the larger object, a galaxy, in the line of sight of these hydrogen atoms causing this redshifted absorption line.

This assumption is a clear mistake because an absorption line can never provide information about the distant light source.

10 Observations Show Error with Doppler Effect

10.1 Local Group Anomalies

(excerpt start from Wikipedia)

Cepheid variable stars were known by 1921 through Leavitt's work using the Small Magellanic Cloud.

Henrietta Swan Leavitt was a Harvard "computer" — one of several women in the early 1900s who studied photographic plates for fundamental properties of stars. Leavitt is best known for discovering about 2,400 variable stars between 1907 and 1921 (when she died).
She discovered that some of these stars have a consistent brightness no matter where they are located, making these so-called Cepheid variables a good measuring stick for astronomical distances. Her work helped American astronomer Edwin Hubble measure galaxy distances in the 1920s, which led to his realization that the universe is expanding. (excerpt end)

Observation: Hubble was measuring galaxy distances because of the relationship between redshift and distance.

reference:

link: Henrietta Swan Leavitt

Observation:

Cepheid variables provided a means of checking Hubble's Law, with its proportion between red shift and distance.

However the Magellanic Clouds do not conform to Hubble's Law. Cepheids indicate a much closer distance.

A number of the galaxies in the direction of M31 galaxy including M32 and M33 have a blue shifted calcium absorption line, indicating calcium atoms are in the line of sight to some of the Local Group.

The calculated negative velocity from the blue shift is the result of the mistake of assuming an absorption line has data about the galaxy behind the intervening calcium atoms.

reference:

link: Observing the spectrum of M31

Observation:

Hubble's Law results in a negative distance for a blue shift or negative relative velocity. A negative distance is impossible.

Here are several Local Group galaxies and their relative velocity (from Wikipedia or the paper cited below which has a plot of velocities) and accepted distance (assumed to be via Cepheids) from Wikipedia shown as DC=

In the following list, RV = Relative Velocity

The calculated distance from Hubble's Law (abbreviated as CDH here) using H0=70 is shown as CDH=

M31 has RV = -301 km/s DC= 0.76 Mpc

M32 has RV = -200 km/s DC= 0.76 Mpc

M33 has RV = -181 km/s DC= 0.79 Mpc

LMC has RV = +275 km/s D= 0.05 Mpc CDH= 3.93 Mpc

SMC has RV = +148 km/s D= 0.06 Mpc CDH= 2.11 Mpc

Sagittarius dwarf has RV = +142 km/s DC= 0.03 Mpc CDH= 2.03 Mpc

Sculptor dwarf has RV = +110 km/s DC= 0.09 Mpc CDH= 1.57 Mpc

Clearly the redshifts have been increased greatly by the hydrogen gas clouds which are known to surround both Magellanic Clouds.

The redshifts are clearly unreliable because both Magellanic Clouds would be beyond both M31 and M33 based on Hubble's Law calculation for distance. They are certainly not that far.

The Cepheids in both Magellanic Clouds provided an alternate distance calculation. The Hubble's Law result is never published as the distance of LMC and SMC.

As long as the line of sight was not through a varying density of hydrogen atoms, Hubble's Law could provide a rough, though unreliable, distance estimate for early observations.

Observation:

M31 galaxy and several others in its direction were found to have blue shifts, not red shifts, while both Magellanic Clouds, though near, have large red shifts. These observations of both red and blue shifts just in our Local Group were not consistent.

Hubble recognized a problem with this data, noted in his 1936 book.

The 1999 paper linked below is titled: The Local Group Of Galaxies and has this excerpt:

(excerpt start) Hubble's (1936, p. 125) view that the Local Group (LG) is "a typical, small group of nebulae which is isolated in the general field" is confirmed by modern data. The zero-velocity surface, which separates the Local Group from the field that is expanding with the Hubble flow, has a radius Ro = 1.18 +/- 0.15 Mpc.

(excerpt end)

reference:

link: The Local Group of Galaxies

Observation:

In Hubble's 1936 book he proposed this solution for this problem: treat the Local Group as unique, essentially ignoring the inconsistency of redshifts and blueshifts. According to this paper astronomers have 'confirmed (through 1999) this 'zero-velocity surface' so rather than questioning Hubble's assumptions, the problem remains unrecognized.The problem with absorption lines should have been resolved around 1936.

The critical statement for this paper:

"Hubble discovered a rough proportionality between redshift of an object and its distance. "

Observation: Hubble recognized the hydrogen absorption line red shift is proportional to distance.

The redshift is caused by the distance in the IGM to the galaxy. The redshift is not from the galaxy but from its distance.

Researchers later concluded hydrogen atoms in the intergalactic medium cause this red shift which varies by the density in the path and direction so the red shift is roughly distance related but with a varying ratio.
This red shift has nothing to do with velocity. It is a mistake to relate them.
Hubble found red shifts and blue shifts in the Local Group so he placed them on a 'zero-velocity surface' for these inconsistent objects separate from the Hubble Flow. There are differences in the IGM affecting redshifts being measured here.

In 1936, the universe expansion had a known problem but astronomers never addressed it, so the anomaly persists even today.

10.2 Galaxy Redshifts by SDSS

The Sloan Digital Sky Survey has 11 galaxy spectra and those graphs reveal in each core a mix of metals, which are elements not hydrogen or helium.

The page for each ID includes both an image of the spectrum sample area for each galaxy and a spectrum graph.

Each ID has the z value in the graph. The set of spectra reveal how astronomers make a mistake with a redshift for many galaxies.

From this sample of 11, astronomers are clearly making a mistake with atoms unrelated to the galaxy's motion.

excerpt from the link:

When you look at the spectrum of a galaxy, you are really looking at the combination of spectra from the millions of stars in the galaxy.

So studying the features of a galaxy spectrum tells you about the types of stars the galaxy contains, and the relative abundances of each type of star.

(excerpt end)

Observation for the 2 sentences:

1) When the field of view encompasses all the stars, the spectrum is the summation of them.

The result is a spectrum covering a broad spectrum from UV to infrared with a similar intensity across. All the stars have this similar wavelength distribution. This summation is like seeing a white sphere where individual details are diminished among the millions.

2) If there are any intervening atoms they appear as absorption lines. M31 has calcium absorption lines as the distinguishing feature in its spectrum. These calcium atoms are in theintergalactic medium between us and M31.

The M31 spectrum gives no information about individual stars. To get that detail the spectrum must be narrowed to a field of view of the individual star.

In this SDSS survey there are no stars in the analysis but only atoms in motion in the galaxy's core.

This survey reveals a different mistake than using intervening atoms (like with M31). These are random motions inside not outside the galaxy.

In this Sloan survey, the images had a narrow field of view to capture motions of material in the galaxy's core rather than capturing all the stars as claimed in the SDSS page.

Each spectrum has absorption and emission lines from varying elements in the collection of 11.

A summary: Nearly all have hydrogen, magnesium and sodium, most have oxygen and sulfur. Many have calcium and nitrogen.

Their analysis identified these elements. Despite that basis in specific atoms, the motion of these atoms is used to determine the motion of the entire galaxy.

Here are the redshifts assigned by mistake to the respective galaxies based on their faulty spectrum analysis:

ID 587722984438038552 z=0.0252
ID 588848900982505544 z=0.0264
ID 587722983889698846 z=0.0840
ID 588848901521866964 z=0.1083
ID 588015508204290235 z=0.0472
ID 587725492671086642 z= 0.0273
ID 587731512606326869 z=0.0426
ID 588015510353805384 z=0.0431
ID 587722983363838126 z=0.1428
ID 587731513146998997 z=0.1878
ID 587727177932472422 z= 0.1463

Conclusion:

There are no patterns in these random motions of whatever atoms were captured in the field of view for the spectrum capture of the galaxy core.
Astronomers assign velocities to galaxies based on these mistakes.

All velocities shown above are wrong.
link: SDSS set of 11 Galaxy Spectra

10.3 Extreme Calculated Values

The Wikipedia list of largest redshifts has these two objects as of December 30, 2019:

List has this galaxy:
GN-z11 has z=11.09
Reference has notes for GN-z11.
excerpt:

With an estimated light-travel distance of about 13.4 billion light-years (and a proper distance of approximately 32 billion light-years (9.8 billion parsecs) from Earth due to the Universe's expansion since the light we now observe left it about 13.4 billion years ago), astronomers announced it as the most distant astronomical galaxy known. (excerpt end)

List has this quasar:

ULAS J1342+0928 has z=7.54

excerpt from Wikipedia:

ULAS J1342+0928 is the most distant known quasar detected at a reported redshift of z = 7.54, surpassing the redshift of 7 for the previously known most distant quasar ULAS J1120+0. (excerpt end)

reference:

link: List of the most distant astronomical objects

Observation:

Using Hubble's Law with H0=70 these are the distance results for these redshifts:

GN-z11 RV= z=11.09, distance=155Bly

ULAS J1342+0928 RV= z=7.54, distance = 105 Bly

For reference:

z=11.09 = 3,327,000 km/s

z=7.54 = 2,262,000 km/s

These calculated velocities and distances are incredible.

These velocities are a mistake with the redshift used wrong.

These calculated RV values are still online as of the date above and remain unquestioned. The force required to move a galaxy or quasar to such a superluminal velocity is incredible.

The calculated distance, with the result like above, is never shown.

The extreme calculated distances for extreme red shifts are not published so the mistake is hidden.

Such extreme velocities and distances are accepted and so the result of that mistake is the expanding universe. Dark energy is offered as the force generating these velocities, or the force expanding the fabric of space carrying these objects.

11 Confirmations of Redshift Not From Velocity

There have been studies of high redshift galaxies and they concluded the redshift is not from velocity.

11.1 GN-Z11, highest redshift Galaxy

excerpt from paper titled "Remarkably luminous galaxy at z = 11.1 " is about GN-Z11:

Spectroscopic confirmations of very high-redshift candidates remain limited, however. The primary spectral feature accessible from the ground for these sources, the Ly-alpha line, is likely attenuated by the surrounding neutral hydrogen for all z ¿ 6 galaxies. Therefore, despite the large number of candidates from HST imaging, only a handful of galaxies in the epoch of reionization have confirmed redshifts to date.

Given the low success rate of Ly-alpha searches, a viable alternative approach is to search for a spectroscopic confirmation of the UV continuum spectral break. This break is expected owing to the near-complete absorption of UV photons shortward of Ly-alpha by neutral hydrogen in the early universe.

(excerpt end)

Observation:

The Z=11.1 is explicitly from the Ly-alpha line because that is the emphasis here. The reference to this shift being affected by much neutral hydrogen in the early universe clearly recognizes the redshift is not caused by velocity.

reference

link: A Remarkably Luminous Galaxy At Z = 11.1 Measured With Hubble Space Telescope GRISM Spectroscopy

Observation:

The galaxy is remarkably luminous because of the redshift mistake suggesting an extreme distance. Because it is not at that distance, it is not that luminous.

11.2 Galaxies with z 9 to 10

excerpt from this paper about galaxies with z 9 to 10:

The identification of LBGs in the epoch of reionization makes use of the almost complete absorption of UV photons shortward of the redshifted Ly-alpha line due to a high neutral hydrogen fraction in the inter-galactic medium.

(excerpt end)

reference

link: The Most Lunminous z= 9-10 Galaxy candidates yet found: The Luminosity Function, Cosmic Star-Formation Rate, And The First Mass Density Estimate At 500 Myr

Observation:

These galaxies with z from 9 to 10 have their redshift from 'hydrogen in the inter-galactic medium' as explained in this paper. The redshift is known to be not from velocity.

12 Gravitational Redshift

Gravitational redshift is usually not mentioned with galaxy or quasar redshifts.
It deserves mention so it is used correctly.

Excerpt from Wikipedia:

The gravitational redshift of a light wave as it moves upwards against a gravitational field refers to the shift of wavelength of a photon to longer wavelength (the red side in an optical spectrum) when observed from a point at a higher gravitational potential. In the latter case the 'clock' is the frequency of the photon and a lower frequency is the same as a longer ("redder") wavelength.

The redshift of Sirius B was finally measured by Greenstein et al. in 1971, obtaining the value for the gravitational redshift of 89 km/s, with more accurate measurements by the Hubble Space Telescope, showing 80.4 km/s. (excerpt end)

reference:

link: Gravitational Redshift

Observation:

This shift must affect the entire spectrum of the light source. Proposing a gravitational redshift for only an absorption or emission line while the rest of the spectrum was unaffected is a mistake.
Claims of its observation have no spectrum for evidence.

Also there is no explanation how the motion of the star was accounted for in this measurement. Our Sun has an assumed velocity in the Milky Way of 217 km/s so the Sirius B measurement required distinguishing a gravitational redshift from the star's relative motion. This must be done for a valid claim.

13 Cosmological Redshift

Cosmological redshift is the result of failing to fix the mistakes with redshifts.

Instead of addressing the mistakes with absorption and emission lines, the explanation of their redshifts is: the fabric of space is expanding, pulling apart the most distant objects to make their extreme velocity in their redshift a result of light distortion while propagating through the expanding fabric of space.

Excerpt from SAO Enclopedia of Astronomy:

Laboratory experiments here on Earth have determined that each element in the periodic table emits photons only at certain wavelengths (determined by the excitation state of the atoms). These photons are manifest as either emission or absorption lines in the spectrum of an astronomical object, and by measuring the position of these spectral lines, we can determine which elements are present in the object itself or along the line of sight.

However, when astronomers perform this analysis, they note that for most astronomical objects, the observed spectral lines are all shifted to longer (redder) wavelengths. This is known as 'cosmological redshift' (or more commonly just 'redshift').

(excerpt end)

Observation:

In a cosmological redshift, the wavelength at which the radiation is originally emitted is lengthened as it travels through (expanding) space. Cosmological redshift results from the expansion of space itself and not from the motion of an individual body.

A quasar has a hydrogen atom emission line with redshift but that is from the atom's motion and should never be used as the quasar's velocity. The SAO description ignores this mistake. A galaxy spectrum has no emission lines, only absorption lines from the intergalactic medium. This absorption line should never be used for the galaxy's velovity.

The SAO description combines the two mistakes to justify the simplified description.

Cosmological redshift violates the conservation of energy.

The reason:

When the light source is in motion and emits light the velocity of light's propagation cannot change. instead some of the kinetic energy of the source is exchanged with the light energy by its frequency. The energy in light is proportional to its frequency. Light emitted in the direction of motion gets an increase in energy (from the positive kinetic energy) by an increase in frequency or a blue shift. Light emitted in the opposite direction of motion loses some energy by an decrease in frequency or a red shift.

A blue shift or red shift can occur only at the moment of emission when the light source kinetic energy is available for an energy transfer. A light emission from a source with no motion will not shift.

A blue shift or red shift at any other time is a change in light's energy, a violation of conservation of energy because the energy transfer is undefined so the energy is lost.

A blue or red shift in an absorption line is invalid for motion because it is a missing wavelength. By observation, the number of hydrogen atoms in the line of sight can affect its absorption line shift. This redshift behavior unrelated to velocity is one of the main reasons for the wrong cosmological redshift. If there is an energy change involved in an absorption line shift then the atoms in the intergalactic medium have their kinetic energy affected.

reference

link: Cosmological Redshift

Explanations of this velocity from expanding space are cryptic.

excerpt from Wikipedia:

The redshifts of galaxies include both a component related to recessional velocity from expansion of the universe, and a component related to peculiar motion (Doppler shift).The redshift due to expansion of the universe depends upon the recessional velocity in a fashion determined by the cosmological model chosen to describe the expansion of the universe, which is very different from how Doppler redshift depends upon local velocity. Describing the cosmological expansion origin of redshift, cosmologist Edward Robert Harrison said, "Light leaves a galaxy, which is stationary in its local region of space, and is eventually received by observers who are stationary in their own local region of space. Between the galaxy and the observer, light travels through vast regions of expanding space. As a result, all wavelengths of the light are stretched by the expansion of space. It is as simple as that..." Steven Weinberg clarified, "The increase of wavelength from emission to absorption of light does not depend on the rate of change of a(t) [here a(t) is the Robertson–Walker scale factor] at the times of emission or absorption, but on the increase of a(t) in the whole period from emission to absorption."

Popular literature often uses the expression "Doppler redshift" instead of "cosmological redshift" to describe the redshift of galaxies dominated by the expansion of spacetime, but the cosmological redshift is not found using the relativistic Doppler equationwhich is instead characterized by special relativity; thus v ¿ c is impossible while, in contrast, v <c is possible for cosmological redshifts because the space which separates the objects (for example, a quasar from the Earth) can expand faster than the speed of light. More mathematically, the viewpoint that "distant galaxies are receding" and the viewpoint that "the space between galaxies is expanding" are related by changing coordinate systems. Expressing this precisely requires working with the mathematics of the Friedmann–Robertson–Walker metric.

If the universe were contracting instead of expanding, we would see distant galaxies blueshifted by an amount proportional to their distance instead of redshifted. (excerpt end)

Observation: The cosmological redshift comes from assumption in the cosmological model and 'precisely working with the mathematics of the Friedmann–Robertson–Walker metric.'

It is ironic for someone to say It is as simple as that..." when this calculation is not simple when based on so many unfounded assumptions; the universe expansion arose from mistakes with redshifts.

reference link: Redshift

The lack of communication among cosmologists is being demonstrated by recent studies.

In the section above, studies of galaxies with high redshifts concluded the redshifts were from hydrogen in the intergalactic medium, not from velocity.

When those studies are unknown or ignored, then the cosmological redshift is proposed to explain the extreme redshifts wrongly assumed to remain unexplained.

13.1 Cosmological Redshift Mistake

A University of Oregon document demonstrates the mistake of a cosmological redshift.
reference
link: Galaxies with redshift mistake

Summary of the linked article:
these 5 unnamed nebula objects (only a constellation is provided) are in a page of quasars. There is no redshifted emission line shown in any of them indicating all are galaxies, not quasars.
cluster nebula in Virgo at 1200km/s from the shifted calcium H&K lines
cluster nebula in Ursa Major at 1500km/s from the shifted calcium H&K lines
cluster nebula in Corona Borealis at 2200km/s from the shifted calcium H&K lines
cluster nebula in Bootes at 39000km/s from shifted calcium H&K lines
cluster nebula in Hydra at 61000km/s from the shifted calcium H&K lines

Their relative positions in the sky using the galactic coordinate quadrants:

Bootes (NQ3), Como Berenices (NQ3), Ursa Major (NQ2), Virgo (SQ3) are close. One end of (long) Hydra is near Virgo. Without names and coordinates, checking proximity is impossible.

Apparently in each case of these 5, calcium atoms are moving rapidly toward the nebula. This is observed as a high redshift.
In the case of M31, the calcium atoms are moving toward the Milky Way, resulting in a blue shift.
Apparently there is a source of the alcium atoms observed moving toward each object in this sample of 5.

Analysis of this set of 5 spectra:
1) there are vertical bars to indicate the same frequency location enabling a simple comparison.
2) there is an horizontal arrow below the spectrum to indicate the H&K position.
3) from top to bottom the H&K lines are moving more to the right, or lower frequency, or a redshift.
4) from top to bottom the left and right ends of the spectrum remain about the same.
The image quality is poor but definitely the left end is about the same and the right end is about the same.
5) from top to bottom the strongest intensities are roughly right of center for the first while maybe roughly left of center for the last (definitely not to the right for the last).

Conclusions:
1) These absorption lines are from intervening atoms; all velocities are of the atoms not the object.
2) all the velocities and their distances are wrong, based on only an atom in motion. These are mistakes.
3) Each spectrum is not completely shifting, only the absorption lines 4) Most important:

This single page refutes the claim for cosmological redshift.

Observation:
The critical assumption is every wavelength is shifted to the right wnen the object is moving away.
Conclusion:

That behavior is not observed in these spectra.
With this cosmological redshift, the entire spectrum must shift. All of the left end should be gone while the right end should be intense, like the middle of the non-shifted spectrum. From top to bottom the strongest intensities are roughly right of center for the first while roughly left of center for the last. The center of intensity should have moved to the right; it did not.
The two ends did not change. The only change is in the absorption lines. This figure shows these high redshift galaxies do not exhibit the cosmo-

logical redshift caused by universe expansion.
The data actually refute the claim.
The entire spectrum did not shift, only the absorption lines shifted.
This is because velocities of the atoms changed for each object.

Observation:

Astronomy has made the mistake with the Doppler effect for roughly 100 years: an absorption line from an intervening atom cannot be the galaxy velocity.
The real Doppler Effect conserves energy. Cosmological redshift does not.
An object radiates in all directions. The energy transmitted in the direction of travel can be increased because of the object's kinetic energy in that direction.
The energy transmitted in the direction opposite of travel can be decreased because of the object's kinetic energy. The energy increase in one direction is exactly balanced by the decrease in the other. Energy is always conserved at the moment of emission, even though an observer in either direction sees a red or blue shift.
The cosmological redshift proposes light while travellling through the fabric of space will increase its wavelengths which is a loss of energy. This is a violation of thermodynamics, or impossible by physics.
Red and blue shifts occur only at the moment of emission but with no change in energy. They cannot occur at any other time.

14 Methods of Distance Measurement

There are several methods to determine the distance to an object.

1) the parallax method is simple and reliable. By observing an object against its backgound from opposite ends of Earth's orbit, any angular deviation can be used to calculate its distance knowing the distance between the two ends of observation (or a baseline). This method is limited by a) the size of Earth's orbit as the longest available baseline, b) the precision of the imaging technology, and c) the resolution.
Galaxies, have two methods based on certain giant stars which exhibit a repeatable light curve. If this light curve is observed in a distant galaxy then the dimming is assumed to be due to a distance further than the benchmark star.
This method should be reliable if a) the light curves for the benchmark star and thedistant stars are accurate, b) both stars are known to be identical and should behave the same, and c) the dimming is only by distance not by obscuring dust.
The two types of benchmark stars are Cepheid variable stars and Supernova events. These are called standard candles because a well defined candle has a known brightness at a specific distance. As one moves away from the candle its brightness can be precisely measured. Because light dims with an increased distance, one can calculate the current distance from the candle.
Because the peak brightness of a Cepheid is dimmer than the peak of

a supernova, the effective range of observing and precisely measuring a Cepheid is less than a supernova.
Both techniques are known to have a margin of error.
The problem with a supernva event is the explosive event is not well understood. A recent study of many supernovae had to classify the host galaxies as low or high redshift. The study's assumption was the host galaxy's redshift represents both distance and time to the event.
This paper concludes that study's assumption is invalid vecause redshifts are not reliable.

There is new research looking for other star types with a known precise luminosity which could also serve as an alternate standard candle.
The difficulties with such an approach are 1) the requirement for imaging resolution to individual stars and 2) the uncertainty of identifying the correct star type for this comparison. Item (1) is helped by technology advancements over time.
At this time, there are no distance measurement techniques known to be reliable beyond the range of the somewhat reliable Cepheids.

15 New Redshift Rules

The Doppler effect is observed by the entire spectrum of the light source shifted by direction and the light source velocity.

If the low end and high end of frequency or wavelengh are not shifting then the light source is not exhibiting the Doppler effect.

This distinction is crucial. Currently a galaxy spectrum is checked for only a shift in absorption or emission lines which come from the IGM. The summation of all stars in the field of view (affected by intervening dust and other stars) might not reveal the correct overall motion in this spectrum.

15.1 New Rule for Galaxies

A galaxy cannot exhibit the Doppler effect with an absorption line.
Any redshift of an absorption line or emission line has no detail, such as velocity or distance, about the galaxy. These lines are from atoms in the line of sight. Any conclusions drawn from the galaxy redshift are wrong.

This redshift must be ignored.

All galaxy red shifts and blue shifts must be ignored when seeking a velocity.
Only a galaxy distance determined by a reliable standard candle is valid.
A galaxy is not a cohesive light source, so its spectrum will never be affected by the Doppler effect; only a cohesive light source can be affected.
Everything in the galaxy is moving independently.
There are 2 alternatives to the mistake with an absorption line:

1) A star is a cohesive light source so many individual stars could be analyzed for relative motion. The analysis would determine whether all shared a common component as an offset contribution in velocity and direction. That offset from all stars could be attributed to the galaxy. This analysis would be challenging to distinguish individual motions from a common motion, but is possible. That is not done now because only the absorption lines are used.
2)

The correct spectrum of the summation of all the stars in the field of view could be determined by calculation with a spectrum when all are not in motion; then the continuum observed could be compared to determine an overall motion. An example is the spectrum of a face-on spiral where that galaxy spectrum from that angle would have less diversity in motion so the summation comparison is perhaps possible for a shift calculation. This techique requires an accurate spectrum baseline for comparison, which is a difficult spectrum to make sure is correct given the variables when viewing a galaxy, which has no intrinsic spectrum. This comparison method (with a no-motion spectrum) is not done when using an absorption line.

After completing either star-based analysis method, a relative velocity is obtained for a galaxy. That velocity value cannot be treated as proportional to distance. That assumption is invalid.

This rule applies to all galaxy types, including spiral, elliptical, lenticular, and irregular types, because all are a collection of independent stars and all will have the same intervening atom's absorption lines. Dwarf spheroidal galaxies and globular clusters also can have the same absorption lines (from atoms in the IGM) when beyond the Milky Way. Just as with galaxies, lines from these atoms in the IGM are not valid velocity indicators for objects behind those intervening atoms.

With Gaia probe data providing the distance and motion of individual stars, an analysis can avoid anything in the intergalactic medium by directly observing each star; several Milky Way globular clusters have been analyzed with this recent data. This detail is still unavailable for anything beyond the limit of our current imaging technology, such as very distant galaxies.

15.2 New Rule for Quasars

A quasar cannot exhibit the Doppler effect with an emission line.

The hydrogen emission line has no detail, such as velocity or distance, about the quasar. Any conclusions drawn from the quasar redshift are wrong.

A quasar redshift must be ignored for a velocity.

If the quasar light source (a plasmoid having no physical surface) could exhubit the Doppler effect then its entire spectrum must shift.

Like with a galaxy, this quasar redshift calculation requires a no-motion spectrum baseline of a quasar (often spanning X-rays to radio) to compare with the broad spectrum observed with each quasar. The emission line redshift does not indicate the quasar motion.

16 Conclusion

With the new rules for redshifts, cosmology can use actual observations of the universe using the array of technologies now available, without having the analysis affected by bad data caused by mistakes with redshifts.

There is no cosmological redshift.

There are no extreme velocities or distances for galaxies and quasars; first they must be measured correctly.
By never fixing that mistake, the universe has the illusion, from the bad data, of expanding; but it is not.

There is no expanding fabric of space for this mistaken expansion.

The Doppler effect must be applied correctly to attain a better understanding of the universe.

Galaxies and quasars have the Doppler effect applied incorrectly.

After that mistake is fixed then their correct relative motions can be found.
We must use standard candles to establish a basis for distances.