QGD Interpretations of Redshift Effects

We have shown in previous chapter that light is singularly corpuscular, and the wave-like behaviour is entirely explained by discrete interactions between photons and structures. The reader undoubtably may think that QGD's description of light is contradicted by the Doppler redshift of light, which is attributed to a change in the frequency of light due to the relative motion of a source, hence requires light to be wave-like. But, as with all other optical phenomena we discussed earlier, the observed Doppler redshift can be explained using a strictly corpuscular model of light.

We will also discuss intrinsic redshift effects which, in addition to the Doppler redshift, may contribute significantly to observed redshifts.

The Doppler Effect

Definitions

Let us first introduce the annotations we will need to describe the Doppler effect in QGD.

$\underset{n}{S}$: the set of n permitted states of an atomic electron where given that $\underset{i}{S}, \underset{i'}{S} \in \underset{n}{S}$ then $i' > i \rightarrow \left\| \vec{P}_{e^-_{i'}} \right\| > \left\| \vec{P}_{e^-_i} \right\|$.

$\underset{i}{S} \uparrow \underset{i+x}{S}$: upshift from a state i to a state $i + x \leq n$, shift to a higher energy state.

$\underset{i}{S} \downarrow \underset{i+x}{S}$: downshift from a state i to a state $i - x \geq 1$, shift to a higher energy state.

$\ddot{d}_{\varepsilon_i}$: the spatial interval between of an upshift of upshift or downshift from state $\underset{i}{S}$ of the source.

$\ddot{d}_{\varsigma_i}$: the spatial interval two photons that will successively be received photons from the source.

$\ddot{d}_{ref_i}$: the spatial interval between of an upshift of upshift or downshift from state $\underset{i}{S}$ of the reference.

$\ddot{r}_{\varepsilon_i}$: The rate at which a source electron shift from state i. We define this rate as the inverse of the spatial interval separating two successively emitted photons or $\ddot{r}_{\varepsilon} = \dfrac{1}{\ddot{d}_{\varepsilon_i}}$

$\ddot{r}_{\varsigma_i}$: The rate at which photons are received from the source and is defined as the of inverse of the spatial interval separating two photons that will successively be received (observed) or $\ddot{r}_{\varsigma_i} = \frac{1}{\ddot{d}_{\varsigma_i}}$

$\ddot{r}_{ref_i}$: The rate at which a reference electron of the same element shifts states from the same given state $\underset{i}{S}$.

$\underset{\ddot{d}\ \gamma_i}{E}$: the total momentum of photons in the spatial interval $\ddot{d}_{\varsigma_i}$ where $\left\|\underset{\ddot{d}\ \gamma_i}{\vec{P}}\right\| = \frac{\ddot{r}_{\varsigma}}{\ddot{r}_{ref}} \vec{P}_{\gamma_i}$

z : The Doppler redshift where $z = \frac{\ddot{r}_{ref} - \ddot{r}_{\varsigma}}{\ddot{r}_{\varsigma}}$

$\tilde{z}$: The intrinsic redshift where $\tilde{z} =$

z_{obs} : observed redshift

Assuming that there are no intrinsic redshifts, that is $\ddot{r}_{ref_i} = \ddot{r}_{\varepsilon_i}$, then we have the following cases:

Doppler effect when relative distance between the source and the reference increases.

Based on the laws of momentum as they apply to the states of atomic electrons, an electron can shift momentum from a state $\underset{i}{S}$ only if the momentum of photons received within the spatial interval $\ddot{d}_{ref_i}$ corresponds to a permitted change in momentum (change of state), that is $\left\|\vec{P}_{\gamma_i}\right\| \frac{\ddot{d}_{ref_i}}{\ddot{d}_{\varsigma_i}} = m_{e_i^-} \rho$ where $\left\|\vec{P}_{\gamma_i}\right\| \frac{\ddot{d}_{ref_i}}{\ddot{d}_{\varsigma_i}}$ is the total momentum of photons within a spatial interval $\ddot{d}_{\varsigma}$ and ρ is minimum momentum necessary to overcome n-gravity between two $preons^{(-)}$.

When the source moves away from the observer, the distance between the source and the receiving electrons increases and $\left\|\vec{P}_{\gamma_i}\right\| \frac{\ddot{d}_{ref_i}}{\ddot{d}_{\varsigma_i}} < m_{e_i^-} \rho$. As a consequence, photons emitted by a source electron in state $\underset{i}{S}$ and received at the rate $\ddot{r}_{\varsigma_i} < \ddot{r}_{ref_i}$ cannot be absorbed by an electron in state $\underset{i}{S}$ but only by an electron at state $\underset{i-x}{S}$ such that $\left\|\vec{P}_{\gamma_i}\right\|\frac{\ddot{d}_{ref_{i-x}}}{\ddot{d}_{\varsigma_i}}=m_{e^-_{i-x}}\rho$ which observationally appears as a redshift of the absorption line of the photons from the source relative to the reference and $z_{obs}=z=\frac{\ddot{r}_{ref}-\ddot{r}_{\varsigma}}{\ddot{r}_{\varsigma}}>0$.

The relative distance between the source and the reference decreases.

When the source moves towards the observer, the distance between the source and the receiving electrons decreases and $\left\|\vec{P}_{\gamma_i}\right\|\frac{\ddot{d}_{ref_i}}{\ddot{d}_{\varsigma_i}}>m_{e^-_i}\rho$. As a consequence, photons emitted by a source electron in state $\underset{i}{S}$ and received at the rate $\ddot{r}_{\varsigma_i}<\ddot{r}_{ref_i}$ cannot be absorbed by an electron in state $\underset{i}{S}$ but only by an electron at state $\underset{i+x}{S}$ such that $\left\|\vec{P}_{\gamma_i}\right\|\frac{\ddot{d}_{ref_{i-x}}}{\ddot{d}_{\varsigma_i}}=m_{e^-_{i+x}}\rho$ which observationally appears as a blueshift of the absorption line of the photons from the source relative to the reference and $z_{obs}=z=\frac{\ddot{r}_{ref}-\ddot{r}_{\varsigma}}{\ddot{r}_{\varsigma}}<0$

The relative distance between the source and the reference is constant.

If the relative distance of the source remains constant, then $\left\|\vec{P}_{\gamma_i}\right\|\frac{\ddot{d}_{ref_i}}{\ddot{d}_{\varsigma_i}}=m_{e^-_i}\rho$, then the photons emitted by an electron in $\underset{i}{S}$ will be absorbed by an electron in the same state. In this case $z_{obs}=z=\frac{\ddot{r}_{ref}-\ddot{r}_{\varsigma}}{\ddot{r}_{\varsigma}}=0$

Intrinsic Redshifts

The momentums of photons emitted by atomic electrons of an element from a distant source may differ from the momentums of photons emitted by a reference's atomic electrons of the same element. That is $\left\|\overset{\rightarrow\varepsilon}{P}_{\gamma_i}\right\|\neq\left\|\overset{\rightarrow ref}{P}_{\gamma_i}\right\|$.

In such case we can have $z_{obs}=\tilde{z}$ at $z=0$.

For example, if $z=0$ and $\left\|\vec{P}^{\varepsilon}_{\gamma_i}\right\|<\left\|\vec{P}^{ref}_{\gamma_i}\right\|$ then $\tilde{z}>0$ and $z_{obs}=\tilde{z}$ which would be observational similar to a Doppler redshift.

Since observed redshifts compound both Doppler and intrinsic redshifts, the actual velocities and distances of distant sources may differ, sometimes significantly, from estimates based on the assumption that observed redshifts are solely caused by the Doppler effect. Consequently, it is necessary to observationally distinguish between Doppler and intrinsic redshifts.

We may be able to do so based on the mechanisms responsible for intrinsic redshifts.

Intrinsic Redshift Mechanisms

We have seen that changes in momentum of electrons obey the law:

[1] $$\Delta\vec{P}_{e^-}=m_{e^-}\vec{\rho}$$

which imposes that only photons such that,

[2] $\vec{P}_{\gamma_i}=m_{e^-}\vec{\rho}$ can be absorbed or emitted.

Equation [1] governs not only changes in momentum that are induced by the absorption of emission of a photon, but also momentum changes resulting from variations in gravity and/or the electromagnetic field effect, the latter resulting from a variation in the preonic density. Hence taking gravity and the electromagnetic effect into account we get:

[3] $\Delta\vec{P}_{e^-}=\vec{P}^{\varepsilon}_{\gamma_i}+\Delta\vec{G}+\Delta\vec{\Theta}=m_{e^-}\vec{\rho}$ where $\Delta\vec{G}$ is the variation in gravity and $\Delta\vec{\Theta}$ is the variation in the magnitude of electromagnetic interaction of the atomic electron is subjected to wand and which varies depending on the preonic density of the space occupied by the source. For simplicity and the purpose of the present discussion, we will assume that $\Delta\vec{\Theta}=\vec{0}$ and will use $\Delta\vec{P}_{e^-}=\vec{P}^{\varepsilon}_{\gamma_i}+\Delta\vec{G}=m_{e^-}\vec{\rho}$

Since the law of momentum [1] must be obeyed then from equation [3] we see that an increase in gravity or the preonic density or both proportionally decreases the permitted momentum of photons an electron can absorb or emit, hence intrinsically redshifts it. Conversely, if gravity and/or the preonic density decrease(s) then the permitted momentum for photons to be absorbed or emitted increases proportionally, hence intrinsically blueshifts it, since

[4] $\vec{P}_{\gamma_i}^{\varepsilon} = m_{e^-}\vec{\rho} - \Delta\vec{G}$.[22]

Gravitational Redshift

Though general relativity and QGD gravitational redshifts may be observationally similar, they result from very distinct mechanisms and give differing pictures of the sources.

Unlike general relativity which predicts that photons become redshifted because they lose energy when coming out of gravitational wells (and blue shifted when they enter them), QGD predicts that photons are intrinsically redshifted at the source itself.

From [3] we find that $\vec{P}_{\gamma_i}^{\varepsilon} = m_{e^-}\vec{\rho} - \Delta\vec{G}$, where $\Delta\vec{G}$ is the variation of gravity on the emitting electron. The influence of gravity can be hugely significant either when the source is near of massive object or at cosmological distances. As we have seen, the n-gravity component of gravity is proportional to the square of the distance and that beyond the threshold distance d_Λ it overcomes the p-gravity component, so that $\Delta\vec{G} < \vec{0}$, and gravity becomes repulsive.

N-gravity being proportional to the square of the distance, QGD predicts that at cosmological distances $\left\|\vec{P}_{\gamma_i}^{\varepsilon}\right\| \ll \left\|\vec{P}_{\gamma_i}^{ref}\right\|$, that the source may emit photons with momentums orders of magnitude smaller than photons from our reference atomic electrons which observationally will appears greatly redshifted.

This implies that an important component of the observed cosmological redshift is the direct result of gravitation acceleration predicted by QGD's equation for gravity, a gravitational redshift, which along with the Doppler effect completely explains observations. It does so without invoking the so-called cosmological Doppler effect.

Using the equations [4] and the equation we can calculate the observed redshift in the following way.

First we must find what the equivalent Doppler redshift would be. From measurements of $\left\|\vec{P}_{\gamma_i}^{\varsigma}\right\| \frac{\ddot{d}_{ref_i}}{\ddot{d}_{\varsigma_i}}$, and $\left\|\vec{P}_{\gamma_i}^{ref}\right\|$,

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22 $\vec{P}_{\gamma_i}^{\varepsilon} = m_{e^-}\rho - \left\|\Delta\vec{G} + \Delta\vec{\Theta}\right\|$ being the complete equation

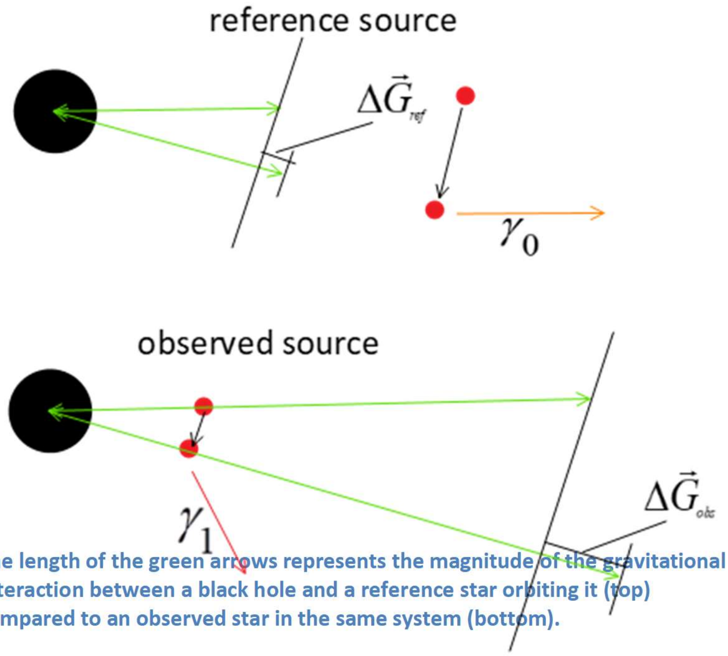
To find the equivalent Doppler redshift we will assume that $\left\|\vec{P}^{\varepsilon}_{\gamma_i}\right\| = \left\|\vec{P}^{ref}_{\gamma_i}\right\|$ and $\tilde{z}=0$ that so that $\left\|\vec{P}^{\varepsilon}_{\gamma_i}\right\|\frac{\ddot{d}_{ref_i}}{\ddot{d}_{\varsigma_i}} = \left\|\vec{P}^{ref}_{\gamma_i}\right\|\frac{\ddot{d}_{ref_i}}{\ddot{d}_{\varsigma_i}} = \left\|\vec{P}^{ref}_{\gamma-x}\right\|$. Which is the magnitude of the momentum of a photon emitted by a reference electron in state S_{i-x}. Since all values except $\ddot{d}_{\varsigma_i}$ can be measured, thus known, we can resolve $\left\|\vec{P}^{ref}_{\gamma_i}\right\|\frac{\ddot{d}_{ref_i}}{\ddot{d}_{\varsigma_i}} = \left\|\vec{P}^{ref}_{\gamma-x}\right\|$ for $\ddot{d}_{\varsigma_i}$. And from $\ddot{d}_{\varsigma_i}$ and $\ddot{d}_{ref_i}$ we get $\ddot{r}_{\varsigma}$ and $\ddot{r}_{ref}$ from which we get $z_{obs} = \frac{\ddot{r}_{ref} - \ddot{r}_{\varsigma}}{\ddot{r}_{\varsigma}}$.

Cosmological expansion, which we will be discussed in detail in the section on QGD Cosmology, is driven by gravity which at the cosmological scale is repulsive (scale at which structure are separated by distances $d > d_{\Lambda}$).

Important note: *Even though QGD predicts the effect gravity on the rates of clocks (see section The Relation between Gravity and the Rates of Clocks), it does not, as Einstein's Equivalence Principle does, imply that light is redshifted when coming out of a gravitational well. The gravitation effect on the rates of clocks supports but does not necessarily imply GR's gravitational redshift. GR's gravitational redshift is a distinct prediction require a different type of tests such as those suggested above. EEP and QGD make different predictions therefore experiment 1 and 2 can be considered tests of Einstein's equivalence principle.*

Gravitational redshift caused by proximity massive object.

From the previous section we understand that the greater $z_{obs} \propto \Delta\vec{G}$, thus the effect will be most noticeable when a star moves close to a high-density object such as a black hole. The redshift of a the spectrum of a star near a black hole has been



The length of the green arrows represents the magnitude of the gravitational interaction between a black hole and a reference star orbiting it (top) compared to an observed star in the same system (bottom).

recently observed[23] and though it is taken as confirmation of the gravitational redshift predicted by general relativity, the observation is also consistent with the predictions of QGD as shown in the figure on the left where the light from a star orbiting a black hole will redshifted relative to a reference source orbiting at a larger distance.

Other Important Factors to Consider for Real World Observations

If QGD is right, then all objects in the universe are interacting gravitationally and those interactions are instantaneous. Also, though for $d < d_\Lambda$ gravity is attractive with the magnitude of the gravitational interaction between two objects approximately inversely proportional to the square of the distance, for $d > d_\Lambda$ gravity becomes repulsive and sees its magnitude increasing exponentially and vastly exceeding the maximum possible magnitude of attractive gravity. That is $\vec{G}(a;b) \gg -\max \vec{G}^{+}(a;b)$ where $\max \vec{G}(a;b) = m_a m_b k$ which the equation for gravity reduces to for $d = 1$, the shortest possible distance in quantum-geometrical space.

It follows that all objects in the universe are subject of gravitational interactions from objects in all directions located at very large distances making them even more powerful than local interactions. The questions is, what is the resultant of the sum of all significant gravitational interactions?

In a homogeneous universe, much of these powerful interactions converging on an object or system would cancel each other, but the net gravitational effect may still be very significant to induce gravitational acceleration which in turn causes intrinsic redshifts.

So, observations of the relative redshift of a distant object should account for the instantaneous gravitational effect the object has on the local reference light source. The photons from the observed source may have been emitted from the position the object was at billions of years ago, but the gravitational effect is from the object in current position.

It is true that this model makes interpretations of observed redshifts much more complicated, but if the theory the model is derived from is correct, then isolation and analysis of local effects of non-local events is possible and may allow us to map out the universe and its evolution in real time. Local effects of non-local events will be discussed in a separate section.

[23] https://arxiv.org/abs/1807.09409v1

Mapping the Universe

Different cosmologies provide different interpretations of observational data and draw different maps of the Universe. As we will see in the section on QGD cosmology, QGD predicts that the universe is finite therefore it must have a center and an edge. Interpreted by QGD, the measurements of redshifts along with other methods of estimating distances will draw a map that is different from that obtained by applying standard redshift interpretations.

QGD's description of the Universe is consistent with the law of gravity and the laws of momentum and does not require spatial dimensions beyond the three that we observe, nor does it need any ad hoc particles or mechanisms to explain such things as the dark matter or dark energy effects. QGD describes reality using the smallest possible number of initial assumptions; a minimal axiom set necessary to describe dynamic systems.

We will continue this discussion in the QGD Cosmology section.