Star light bending near the Sun – an insight into Huygens-Fresnel principle

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Abstract

In this paper, a simple intuitive explanation of the phenomenon of star light bending near the Sun is proposed based on some insight into Huygens-Fresnel principle. Light (and other waves) does not necessarily go in a straight line. If there is *intensity gradient* of a (light) wave at a point in space, the wave will bend towards the lower intensity regions, and away from higher intensity regions of space. Only waves from ideal isotropic sources propagate in a straight line, in a space where there are no obstructions between light source and point of light detection. Intensity gradient may arise due to non-isotropic emitter/radiator or due to an obstruction shadowing a region of space. If diffraction pattern arises from a wave passing through a slit, then diffraction should also arise from intensity gradient of a wave.

Introduction

The phenomenon of bending of star light near the Sun is known since Newton's times and there is no logical, intuitive and satisfactory explanation to date. Some authors have attempted to explain it in terms of refractive index of the Sun's atmosphere. However, more probably, the same theory that explains this phenomenon should also have the potential to explain ' black holes '. The mainstream assumption is that star light passing near the Sun is bent due to the mass and gravity of the Sun.

Huygens' principle; Intensity gradient

The finding in this paper is that light (and other waves) does not necessarily go in a straight line. If there is *intensity gradient* of a light wave at a point in space, the wave will bend towards a lower intensity region, away from a higher intensity region. This is a new insight into Huygens' principle[1]. Only electromagnetic waves from ideally isotropic radiators move in a straight line, if there are no obstructions between the light source and the point of observation of light. In the case of light wave, a photon emitted from an atom will propagate in a straight line only if the probability of the photon being emitted in every direction is equal, which is not possible in reality. In the case of radio waves, EM waves from an antenna propagate in a straight line only if the radiating antenna is isotropic, which is not practical. However, such bending of light rays may be noticeable only at astronomical distance scales.

In reality, there will always be an intensity gradient (in the case of light, we are referring to a single photon. For this discussion assume a photon as a wave and not as a localized particle. This author has proposed that there is a precursor wave preceding a photon [2]). The intensity gradient may arise due to non-isotropic emitter/radiator or due to an obstruction shadowing a region of space.

Diffraction of light passing through a slit (single slit diffraction) is understood by considering all the points on the wave front passing through the slit as secondary sources. The waves from the secondary sources propagate *forward* in every direction, creating future wave fronts. The same treatment should be applied to propagation of any wave, whether it is a wave passing through a slit or a wave propagating in free space. Therefore, applying the above insight to the Huygens – Fresnel principle, light should bend away from regions of higher intensity towards regions with lower intensity.

Let us see how Huygens- Fresnel principle will give rise to bending of light rays. Consider a wave front of an electromagnetic wave. According to Huygens' principle, the secondary sources at 'a' and 'b' create the wave at point 'c' (fig.1). Actually the complete wave at point ‘c’ is caused not only by secondary sources ‘a’ and ‘b’; the wave at point ‘c’ is the superposition of the waves from all secondary sources on the current and previous wave fronts. We consider only two secondary sources for ease of discussion .

At point 'c', the electric field due to secondary source 'a' is E_a , the electric field due to secondary source ' b' is E_b . If the intensity of the EM wave at point 'a' is equal to the intensity of the wave at point 'b', the resultant electric field at 'c', which is $\mathbf{E_c}$, will be perpendicular to the radial line SR and hence the light will propagate along the radial line SR . However, if there is an intensity gradient of the wave at the infinitesimal region containing points 'a' , 'b' and 'c', then the electric field at 'c' will not be perpendicular to radial line SR, the wave will not propagate along the radial line SR, hence bending of the light ray.

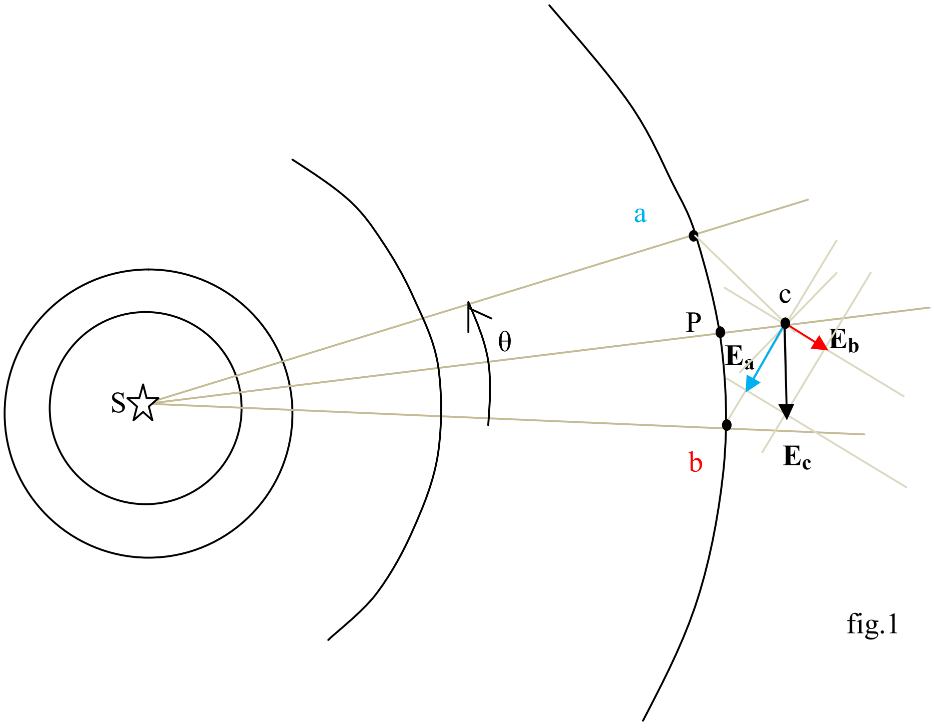

fig.1

$$\text{Intensity gradient at point P} = \frac{dI}{d\theta}$$

where I is light intensity.

Consider a radio antenna with non- isotropic radiation pattern shown below (fig. 2) .

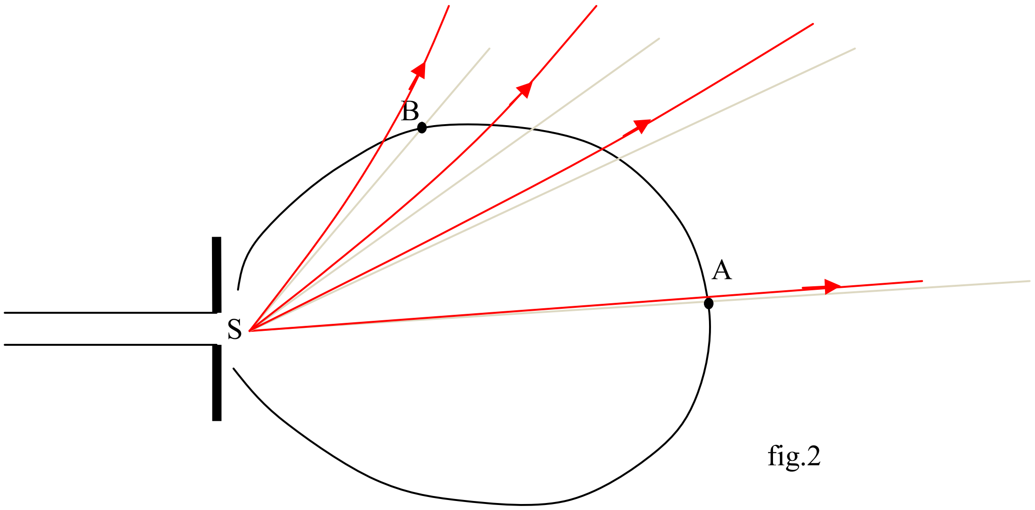

fig.2

Since the intensity gradient is minimum (nearly zero) in the direction SA, there will be no bending of light emitted in this direction. The intensity gradient in the direction of line SB is high and there will be significant bending of light emitted in this direction. As shown in the figure (fig.2) , the higher the intensity gradient in a given direction, the more the bending of light rays going in that direction .

The intensity gradient in the above case is due to *non-isotropic* radiator /emitter .

But intensity gradient at a point in space may also be caused by an obstruction shadowing a region of space (fig.3).

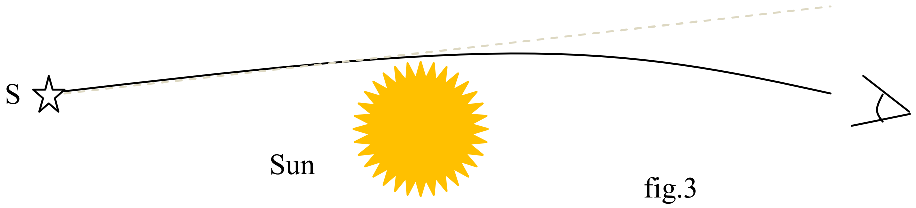

fig.3

Since the object will shadow a region of space just behind it, creating intensity gradient in that region, light will bend towards the shadowed region, as shown in the figure above.

Therefore, the mass of the Sun has nothing to do with bending of star light. So the mainstream assertion that bending of star light near the Sun is due to the mass of the Sun is wrong. Then, what is the factor determining the amount of light bending ? The bending of star light near the Sun is not due to the mass of the Sun, but due to the *size* of the Sun.

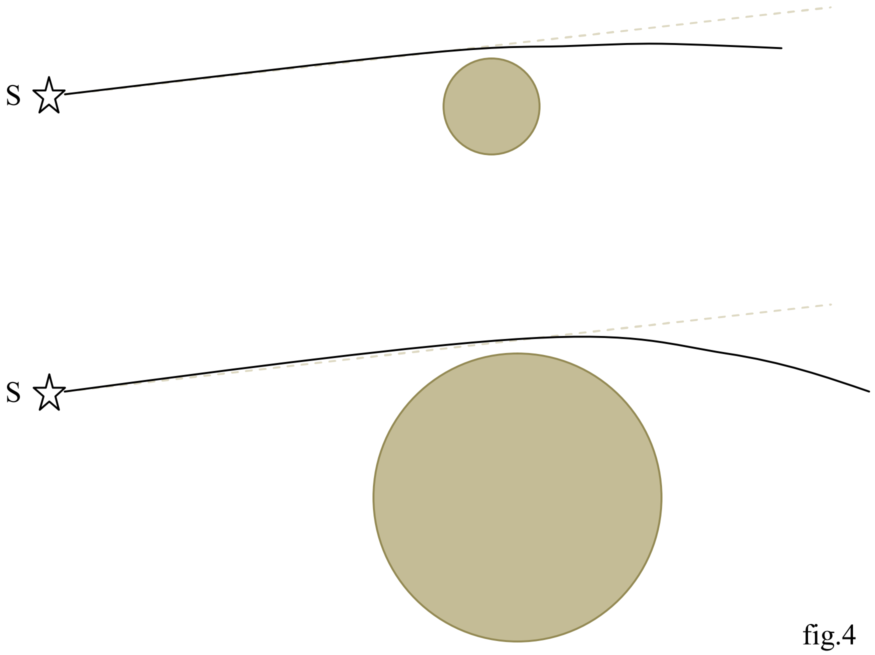

fig.4

The bigger the obstructing object, the more the bending of light. As the size of the obstructing object increases, it creates a shadow extending to great distances accompanying the light path, and eventually which light cannot escape. This might explain 'black holes'[3].

Conclusion

In this paper, not only is star light bending explained, but it has been shown that light fundamentally propagates in a non-straight line. Propagation of light in a straight line is only a special case of light emitted from an ideal isotropic light source, in the absence of obstructions creating shadows. The new theory may also have the potential to explain 'black holes'.

Thanks to God and Our Lady Saint Virgin Mary.

References

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