On the Norway Spirals and their Physically Impossible “Ripple” Propagation

Arash Amini
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amini.arash1@gmail.com

Abstract:

On the morning of December 9th, reports of strange, spinning spirals flooded the internet and media outlets. They have come to be known as the “Norway Spirals”. Though popularly attributed to a failed test-launch of a Russian “RSM-56 Bulava” Submarine Launched Ballistic Missile (SLBM), it can be shown with some basic trigonometry that this explanation is physically impossible. From a single, time-lapsed photo and anyone of the many videos of the spirals, the speed at which the “ripples” caused by the phenomena propagate can be calculated at two limits:

1) In the lower limit, the spiral is taken to be directly over the mountain in the photograph (9.63km away) and the velocity of the “ripple” propagation is approximately 316.8m/s.
2) In the upper limit, the spiral is taken to be directly over the White Sea (971km) and the velocity of the “ripple” propagation is found to be approximately 32,873m/s

It is assumed that the missile, the alleged cause of the spirals, would be somewhere between these two points at the moment of the malfunction, yet these velocities suggest that the observed “ripples” cannot be smoke and therefore the spiral could not be caused by a missile.

1. Introduction:

Let us first examine a photograph (similar to many others available) of the spirals in question.

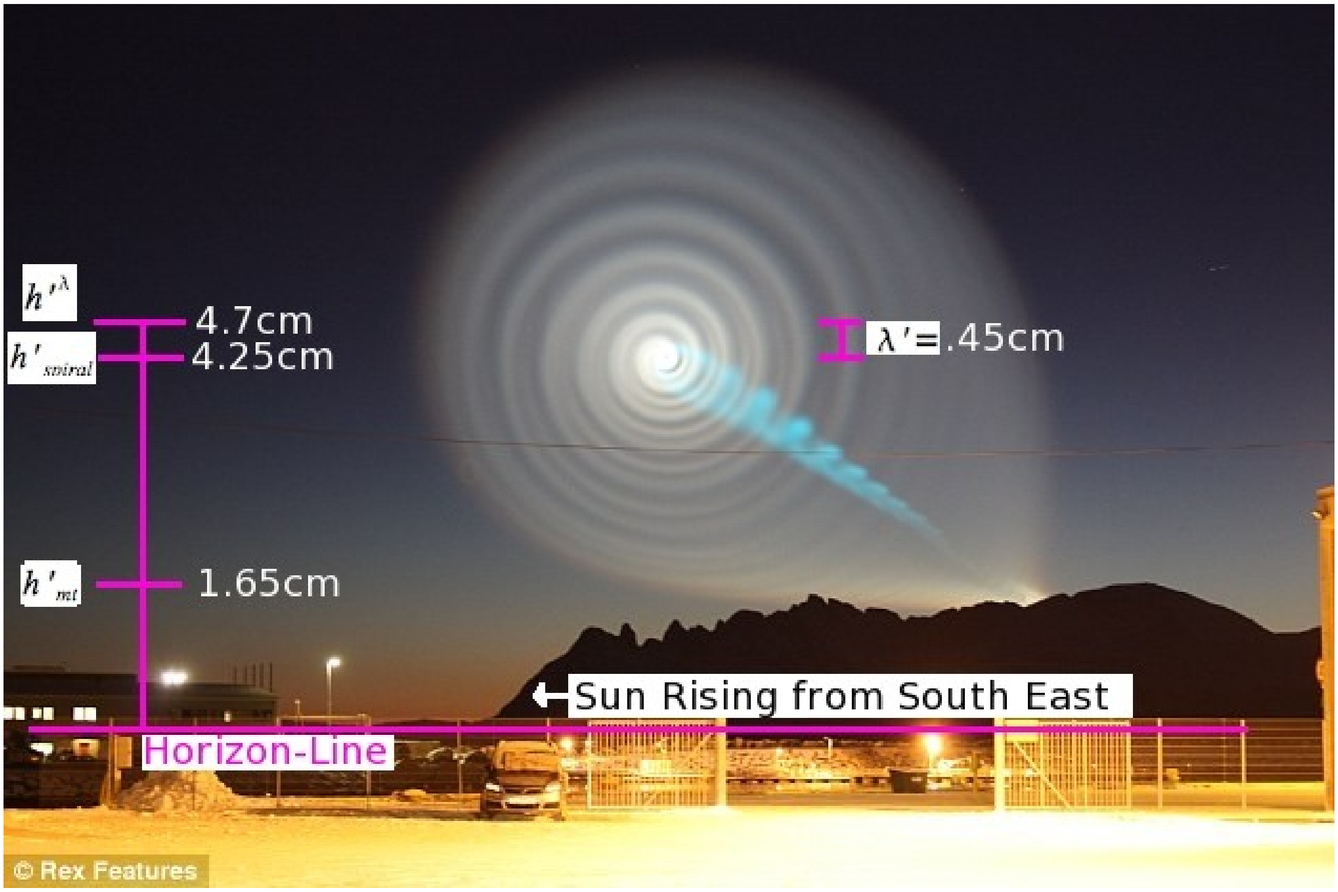

PHOTO 1

[http://www.dailymail.co.uk/news/worldnews/article-1234430/Mystery-spiral-blue-light-display-hovers-Norway.html}

This photograph was taken from Tromsø, Norway near dawn on December 9th, 2009. We can clearly see two spirals. The white spiral appears to be in the plane of the picture and the blue spiral extends out of the picture-plane, but is not quite perpendicular to the plane. From here on, let us use simply the term "spiral" when referring to the *white spiral*.

Since it was very dark at the time, PHOTO 1 was captured using a long exposure time. The fact that the "ripples" in the spirals are so clear tells us that they were created from a sources with a near regular frequency of rotation. From watching the several videos available on the internet, we can see the "ripples" moving away from the spiral's center and we can find that the frequency (how many times the spiral rotates per second), f , is about 1Hz.

$$f = 1\,\text{Hz}$$

Note, from here on:

-Prime variables $\{h', d', \lambda'\}$ will denote values measured from PHOTO 1.

-Non-prime variables $\{h, d, \lambda\}$ will denote values in the physical world.

From the Horizon-Line in PHOTO 1, we measure the distance to the center of the spiral (h'_{spiral}) , and top of the mountain (h'_{mt}) , the height of the 1st full wavelength, (h'^{λ}) , and the wavelength $(h'^{\lambda} - h'_{spiral} = \lambda')$

$$h'_{spiral} = 4.25\,\text{cm} \qquad h'^{\lambda} = 4.7\text{cm}\ [1]$$

$$h'_{mt} = 1.65\,\text{cm} \qquad \lambda' = .45\text{cm}$$

Building on an insight that Kevin Martin shared at [http://www.youtube.com/watch?v=1GSa2wRtZRI], we look to Google Maps for information regarding this mountain. Investigating the terrain to the South-East of Tromsø we find the mountain in PHOTO 1.

FIG. 1

FIG. 2

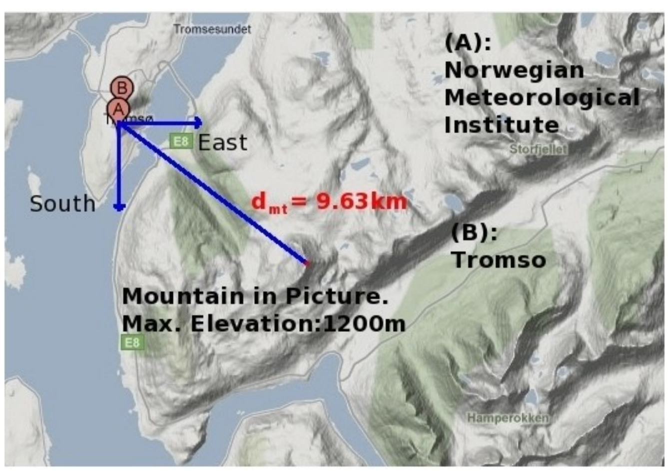

FIG. 3

1 Note that it is not important for my measurements from the picture to be invariant under scaling, rather, it is the *ratios* of these measurements that are of concern and which *are* constant.

Using Google Earth, we find the distance, from the center of Tromsø to the center of the White Sea (d_{ws}) and to the peak of the relevant mountain (d_{mt}) - along with the mountain's peak height (h_{mt}) ,

$$d_{ws} = 971.26\text{km}$$
$$d_{mt} = 9.63\text{km}$$
$$h_{mt} = 1.2\text{km}$$

Notice how this peak lies almost perfectly in between the rising Sun and the town of Tromsø- this agrees very well with PHOTO 1.

2. Analysis:

Ultimately, we want an expression for the wavelength of the spiral, which must depend on how far away the spiral is in reality.

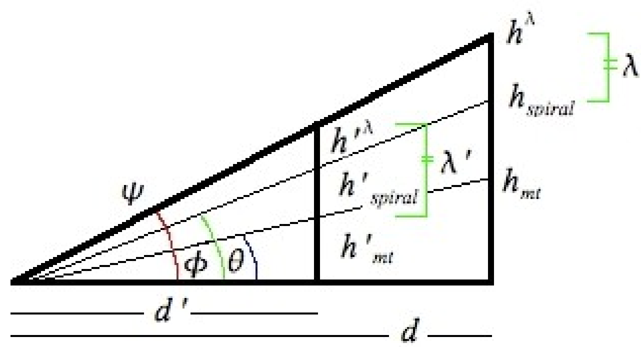

FIG. 4

Because the two triangles share the same angles, we can use the *Law of Similar Triangles* to equate ratios of similar length [2]. We now can use some basic trigonometry to calculate the angle between the Horizon-Line and the peak of the mountain:

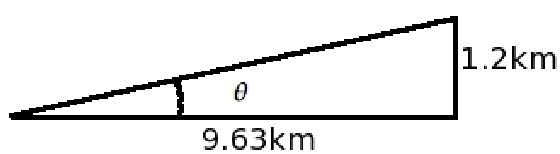

FIG. 5

$$\theta = \tan^{-1}\left\{\frac{1.2\text{km}}{9.63\text{km}}\right\} = 7.103^{\circ} \quad \ldots[1]$$

2.<u>Note</u>:
For two similar triangles, as in *fig. a*,
$\frac{C}{A} = \frac{D}{B}$ *(they must share the same angle).*

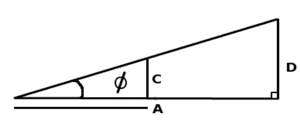

fig. a

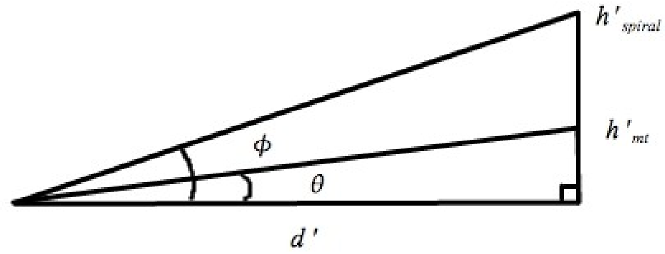

FIG. 6

Now we can solve for the distance to the mountain in the scale of PHOTO 1,

$$d' = \frac{h'_{mt}}{\{\tan(\theta)\}} = 13.24\text{cm} \quad \ldots[2]$$

What this means physically is that if we were to make a mockup of a tiny, toy photographer taking a picture of the mountain and spiral (like a diorama), and we wanted the distances involved to be to scale, we would make the mountain peak be 1.65cm tall, and put the mountain 13.24cm away from our little photographer. Further more, we would place the center of the white spiral 4.25cm above the ground.

With d' , we can find the value for ϕ , the angle between the Horizon-Line and the center of the spiral.

$$\phi = 17.727^\circ \quad \ldots[3]\ .$$

3. Determining λ :

The wavelength (λ) is the difference between the top of the 1st wavelength and the height of the spiral's center. To find λ , we once again invoke the *Law of Similar Triangles* to relate h^{λ} and h'^{λ} .

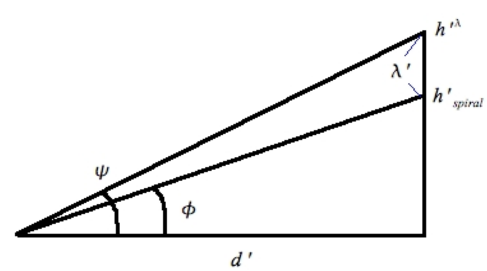

FIG. 7

Recall:

$$h'_{spiral} = 4.25\,\text{cm},\quad h'^{\lambda} = 4.7\,\text{cm}$$

$$\lambda' = .45\,\text{cm},\quad d' = 11.64\text{cm}$$

& Note: $\lambda = h^{\lambda} - h_{spiral} \quad \ldots[4]$

Comparing the lengths of the similar triangles sharing the angle ψ , we find the relation, from *FIG. 7*,

$$\frac{h^{\lambda}}{h_{spiral}} = \frac{4.7\text{cm}}{4.25\text{cm}} \quad \ldots[5]$$

Because we do not know how high up the white spiral actually is, this relation cannot give us any meaningful results by itself- this is why we will explore the limits of our situation.

4. LIMITS:

It is impossible from the data available to surmise exactly how far away the white spiral is in reality. But we can take limits and find some interesting results nonetheless. We will assume that the center of the white spiral is no closer than the mountain (9.63km away), since it's supposedly a malfunctioning ICBM, it would have been extremely loud and there does not seem to be any reports describing any noise. Also, since there was no eyewitness accounts of any missile part(s) being explicitly visible, this low limit assumption seems more than fair.

In the upper limit, we will assume the missile malfunctioned no further away than directly above the White Sea (971.26km away). Once again, this seems like a vast over estimation given that the great amount of reports came from northern Norway. Then, mathematically,

$$d_{spiral} \in (9.63\text{km}_{(\text{low limit})},\ 971.26\text{km}_{(\text{high limit})}) \quad \ldots[6] \ .$$

It is now our task to calculate the height of the center of the spiral in both limits. This will give us a means of measuring the wavelength, λ . Let us define a few terms,

h_{spiral} $\rightarrow$ The physical height of the center of the white spiral (measured from the Horizon-Line).
d_{spiral} $\rightarrow$ The physicl distance to the white spiral's center (measured along the ground).

……[8]

A) Lower Limit:

In the lower limit, d_{spiral} is defined as 9.36km,

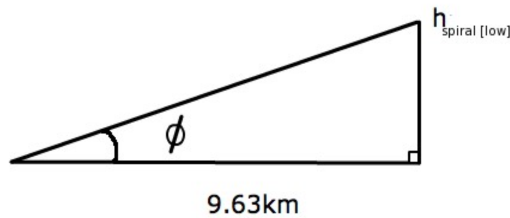

FIG. 8

Then,

$$h_{\text{spiral [low]}} = 9.63\text{km} * \tan[\phi] = 2.99\text{km} \quad \ldots[8]$$

Pugging [8] into [5], then using [4] we find

$$\underline{\lambda_{[low]} = 316.58\text{m}} \quad \ldots[9]$$

B) Upper Limit:

In the upper limit, d_{spiral} is defined as 971.26km,

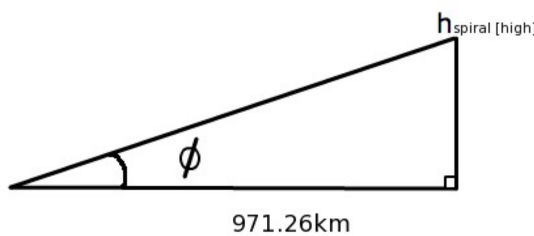

FIG. 9

Then,

$$h_{\text{spiral [high]}} = 971.26\text{km} \times \tan[\phi] = 310.47\text{km} \quad \ldots[10]$$

Pugging [10] into [5], then using [4], we find

$$\underline{\lambda_{[high]} = 32{,}873\text{m}} \quad \ldots[11]$$

5. CONCLUSIONS:

From the well known expression for the velocity of a wave,

$$f * \lambda = v \quad \ldots[12]$$

we can derive the magnitudes of the velocity in each limit.

We have found the wavelength for two limiting cases. One in which the white spiral is directly above the mountain, at a distance of about 9.36km and the other in which the spiral is directly above the White Sea, at a distance of 971.26km.

Recall from before:

$$f = 1\,\mathrm{Hz},$$

$$\underline{\therefore\ \left|\boldsymbol{v}_{[low]}\right| = \mathbf{316.58m/s}} \quad \ldots[13]$$

$$\underline{\therefore\ \left|\boldsymbol{v}_{[high]}\right| = \mathbf{32{,}873m/s}} \quad \ldots[14]$$

The lower limit velocity of 316.58m/s is equivalent to about 710mph. This is over twice the 318mph world record for the fastest wind speed recorded (which was caused by a tornado). The speed of the “ripple” propagation in the lower limit is far greater than any particulate could travel in the atmosphere and furthermore, the “ripples” move away from the center of the spiral with a near constant speed. Particulates moving at such speeds should dissipate quite rapidly. This impossible speed is calculated as if the spiral's center were above the mountain and yet the further we assume the spiral is, the larger the speed of the “ripples.” So, based on the speed of the “ripples,” the missile could not be any further than the mountain, This only allows the missile to be somewhere between Tromsø and the mountain peak.

Yet, if one assumes that the “ripples” are moving at the speed of sound, which is still physically impossible (mind you, sonic booms would have been heard if this were the case), the wavelength of the ripples would be about 340m, then the height of the spiral's center would be about 432m above the ground. This pushes our lower limit to under 432m! At this height, the missile would be both extraordinarily loud and visible. Since no one has described neither a sound or visible object when recounting their observation of the Norway Spirals, we can safely conclude that there is no physically possible distance at which a missile could be the cause of the spirals in question.

Thank you.