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Earth rotates on itself, the revelation of the Qur'an more than 1400 years ago.

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Abstract:
The verse Q. 27:88 of the Holy Qur'an says that the mountains are seen as motionless, while they pass as the passing of the clouds. This verse reveals an important scientific discovery that person has not noticed before. The Quran 27:88 verse tells to the people that mountains are not motionless as they see them, but they are moving as the clouds; it's certainly to encourage them to discover early that the Earth rotates, thus to understand and explore the Universe. Given the current state of knowledge and depending on the chosen reference frame, obviously mountains will appear as if they are stationary or not. In the Terrestrial Reference Frame, the mountains are motionless; but in the Geocentric Reference Frame however, they are not, they are moving. Therefore, departing from this verse, our goal is to elucidate that the Earth's rotation and the Sun lies motionless phenomena, let us say, the idea of Copernicus, was revealed in the Qur'an more than 1400 years ago; just understand it at the time. To render the Quran 27:88 verse very clear, we will use some laws of the Mechanics and reference frames of coordinates that are more suitable. Calculation shows that the mountains, like the clouds, move at velocities in the order of 1, 10 to 100 m/s. The intervals of their speeds thus overlap. Moreover, the velocity of mountains depends strongly on the latitude angle unlike that of clouds, and what the verse Q. 27:88 says is not to compare velocities of mountains to those of clouds seen above them, but it mainly reveals the fact that the mountains are not in absolute immobility with respect to the Universe frame of reference, this is to push early people to start doing Sciences of astrophysics more than 1400 years ago.

Keywords:
Quran 27:88, Clouds, Earth's rotation, Mountains firmly fixed, Mountains pass as the passing of the cloud

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I. Introduction

Quran 27:88 verse says: «*And you see the mountains, thinking them motionless, while they pass as the passing of the clouds. [It is] the handiwork of Allah, who perfected all things. Indeed, He is Acquainted with that which you do.*» To say more than 1400 years ago that the mountains are moving like the clouds while we thinking that they are immobile is a great scientific discovery revealed by the Holy Qur'an at that time. More specifically, the verse Q. 27:88 of the Qur'an reveals a physical reality that says mountains are not stationary, but move at speeds as to those of clouds; and for this revelation to have a physical meaning, it is necessary to consider that the Earth is rotating around itself with respect to a certain fixed reference frame located somewhere in the Universe.

We have consulted a numerous references resources and different websites and it seems that there is a basic misunderstanding as to what the relation between mountains and clouds are, since there are several interpretations and translations versions of the verse Q. 27:88 all out of reality. Nonetheless, based on today's modern Sciences and available knowledge, most translations of this verse appear to us to be partially incorrect or even false due, for example, to the use of incorrect words such as "*firmly fixed*" or "*solidly fixed*" [1] which refers to the fact that mountains have roots or are like pegs instead of "*motionless*" or "*stationary*" which refers to the movement obeying the laws of Mechanics and which is the correct word to use. Some of them definitely are completely wrong. The disaster is that all translations of Q. 27:88 do not satisfy the rules of *dimensional analysis* [2] that all physical equations must fulfill in physics to be acceptable, because the verse Q. 27:88 involves the movement of mountains and clouds (the derivative of space in time) and not just the space. In addition, even attempts at explanation and interpretations that exist in Arabic, the mother tongue itself of the Qur'an, concerning this verse are unsuccessful and therefore incomprehensible and constitute controversies between the Muslims speakers and interpreters themselves. Although physical intuition on one hand is the source of many of the greatest discoveries in physics through 'leaps of imagination', it can also be a 'dangerous tool' because it can lead to 'some very bad blunders' [3]. To avoid 'blunders', intuitive or heuristic conceptual models of physical processes must be in agreement with the underlying mathematics or at least not contradict it [4]. This is one reason why the content of the *Quran* 27:88 verse has captured our attention because it concern at least for 2 billion Muslims in the world, about 24% of the World's population. As the problem turns out to be fundamental, for the discussion this difference needs to be properly elucidated based mainly on Sciences.

II. The reformulation of the questions

The questions that arise are: Are the mountains *motionless* or not as the verse Q. 27:88 says and what does that mean?

Beforehand, these questions raise different translations since its appearance there are now more than 1400 years. Recall the verse Q. 27:88 again: "*Seeing the mountains you think them motionless*, while (in reality) *they are passing as the passing of the clouds* (in the atmosphere) . . . " . That this actually refers to the Earth orbiting in its orbit around the Sun and rotating around its own axis and the Sun lies motionless as well as probably to the movement of the tectonic plates.

On the one hand, we know from the *Isostasy theory* that the world scientific community has agreed that mountains have roots (pegs) that extend downward into the mantle under the mountain, and that these roots can reach, in general, several times deeper than their elevations above the surface of the ground [5-8]. From this point of view, the mountains are mechanically *firmly fixed* to the Earth's crust like the pegs of a tent. Recently it has been published also that the mountains are gravitational pegs that stabilize the Earth's motion in its orbit around the Sun [9]. Furthermore, modern Sciences have shown that mountains are slightly mobile rather than static due to the movement of the tectonic plates. Indeed, the lateral movement of the plates varies from about 1 to 10 cm/year [10-11]. Therefore, these speeds are very small because they are of the order of physical uncertainties compared to the vast dimensions of the continents, and cannot be those of mountains and clouds that are mentioned in the verse Q. 27:88 i.e., they aren't those of the clouds that we usually see in the atmosphere. On the other hand, the mountains are in relative motion. Why? This is because in physics, movement is always relative to the observer reference frame in which observations are made. Of all discoveries and opinions, none may have exerted a greater effect on the human spirit than, let us say, the "heliocentric theory of Copernicus". The opposition of the Catholic Church to

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the heliocentric theory, even if it appears as if it is against Galileo in person, was a deceptive reaction which led to the cover-up of the contributions of the Muslim astronauts who were the first to develop the heliocentric theory (the Earth rotating daily and orbiting around the Sun). This is because the theory of heliocentrism was published in 1543 by Copernicus himself before Galileo and there was nothing more to fear [12]. But its consequences are negative. Later, the Muslim scholars of the Middle Ages systematically have been ignored and denied into all subsequent scientific school and university books as the Muslim scholars like they didn't do anything in the Middle Ages. It's a humiliation. We don't know why! But the feedback will lead to the appearance of a new generation of researchers who began to seek since 1950 to understand why the jump in all books from the Greek era to the Renaissance without citing anything about the Muslim civilization concerning the Middle Ages. Results of these researchers are beginning to be published in the last few decades. And recently, some of the famous websites in the World begin to make place into their articles for Muslim scholars of the Middle Ages. The theory of heliocentrism originates from the Holy Qur'an more than 1400 years ago; just understand it at the time. This explains why the Ptolemaic system was rejected early before. [12]

The Holy Qur'an is full of scientific indications, arguments and enigmas (the miracles) on most of the scientific discoveries that we known and many others that are not yet on the agenda. The Quran mentions that the Earth was "spread out" [13] but it mentions also that the Earth was *oval* shaped like an egg [14]. From the 10^{th} Century, Muslim scholars continue to introduce the notion that the Earth is shaped like a sphere whereas some others continue to view the Earth as flat in response to those who claim that it is round like an egg [15-18]. For example, regarding the Qur'anic statements about the Earth spreading, the Tafsir al-Kabir written by Al-Razi in the 12^{th} Century states: "If it is said: Do the words 'And the Earth We spread out' indicate that it is flat? We would respond: Yes, because the Earth, even though it is round, is an enormous sphere, and each little part of this enormous sphere, when it is looked at, appears to be flat." As that is the case, this will dispel what they mentioned of confusion. In the 11^{th} Century, Ibn Hazm said that: "Evidence shows that the Earth is a sphere but public people say the opposite." He added: "None of those who deserve being Imams for Muslims has denied that Earth is round. And we have not received anything indicates a denial, not even a single word." [18].

As known, the Ptolemaic system was the prevailing astronomical model in the Europe during the Middle Ages. The Quran is also known to have descended upon humanity. Since, several Muslim scholars have questioned the apparent immobility of the Earth [19-20] and where is the centre that it occupies within the Universe [21-22]. The Quran speaks of planetary orbits (not circles) 1400 years ago (i.e., 10 years before 632 in Julian calendar). It is enough to read the Qur'an to see (into) indications introducing the *notion of the orbit* that the Moon, the planets of our solar system and the Sun, each is *swimming* in an orbit of their own [23]. To describe the movement of the planets of our solar system, including the Sun itself, the Qur'an of course uses literary in the verses Q. 21:33 and 36:40 [23] the words "*each swimming in an orbit*" which means planet oscillating while progressing in an open trajectory which is not a circle, but rather in the form of a helix (an open ellipse). Muslim scholars learned by heart the Qur'an, have understood the scope of the words used in all its verses.

Of course, it is known today that the Sun is travelling not around the Earth but in an orbit in the Milky Way galaxy with a speed of about 70 km/s. In effect, the distance between the Earth and the Sun is $1,496 \times 10^{11}$ m, and for the Sun to describe a circle whose radius is equal to this distance around the Earth during a period of 24 hour, it must move with a speed of $\sim 1,1 \times 10^{7}$ m/s. As we see, this speed is very close to the *speed of the light in vacuum* (3×10^{8} m/s). Of course, it is into the interval of relativistic speeds that practically impossible to reach by gigantic masses like the Sun. So to say that it's the Sun that rotates around the Earth in Physics is impossible.

A passage in Copernicus's *De revolutionibus* regarding the rotation of the Earth provides evidence that he was aware, whether directly or indirectly, of Islamic contributions dealing with this problem that goes back to the 12^{th} Century [19]. The Earth rotating around its axis was admitted by a very large number of Muslim astronauts such Al-Sijzi [24-26] who adopts the widespread idea at time "that the movement that we see is due to the movement of the Earth and not to that of the sky" to invent the astrolabe [25-26]. That others besides Al-Sijzi held this view is further confirmed by a

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reference from an Arabic work in the 13th Century which states: "According to the engineers, the Earth is in constant circular motion, and what appears to be the motion of the heavens is actually due to the motion of the Earth and not the stars." [25] The Maragha observatory in Persia, Somayaji and Nilakantha in India further developed non-Ptolemaic systems involving Earth's rotation. Research works on the astronomy of Ibn al-Shatir and his sources is finally the same as a number used by Copernicus [27]. That Copernicus was acquainted with a number of his Muslim predecessors has been evident since 1543, when Copernicus in *De revolutionibus* explicitly cited five Muslim authors. The latest of these authors, Al-Bitruji, flourished in Spain in the last part of the 12th Century, so Copernicus's references end around 1200, which is the approximate terminus date for Muslim authors who were translated into Latin. Any reader of Ragep's article [12] understand that Copernicus must have access to the models of his Muslim predecessors. How Copernicus learned of the models of his Muslim predecessors is not known but the relation between models is so close that independent invention by Copernicus is all but impossible [12].
Nowadays, of course we know that the Earth's globe is rotating from the West to East view of its North Pole. The article on the "aberration of light" published by Bradley in 1727 was the first experimental evidence of the Earth's rotating around the Sun. The Earth rotates around itself, demonstrated by the Foucault's famous pendulum in 1851, was foreshadowed by the Quran at a time when the Earth was believed to be flat and immobile, and it was the Sun that rotates from the East to West. Therefore, it is yet another miracle of the Quran because it goes to underline how even mountains move while we do not feel it (a scientifically correct fact revealed 1400 years ago!).

However, in most attempts to explain it, the *Quran* 27:88 verse has been emptied of its true content in the last few Centuries and has become meaningless, and rendered terribly incomprehensible. It is currently misrepresented and therefore misunderstood. More than that, the *Quran* 27:88 verse presented as if It's an event that's going to take place on Judgment Day after life on Earth is gone. But since the doomsday will be total chaos and disorder and what the *Quran* 27:88 verse says concerning clouds and mountains movements is order and not disorder so it is physics for one reason, the order probably cannot exist into doomsday, which means that the *Quran* 27:88 verse speaks about life on Earth and not what will happen after the life in doomsdays.

In this article, to elucidate that mountains pass like the passing of the clouds which in return implies that the Earth rotates on itself, the revelation mentioned in the Qur'an more than 1400 years ago, we will demonstrate firstly, that mountains are not absolutely motionless as they usually appear seen from the Earth's surface. Secondly, we will specify in which reference frame of coordinates the mountains are stationary and in which reference frame they are moving as the clouds and thirdly, we'll get to what the *Quran* 27:88 verse actually says.

III. Cloud backgrounds to compare.

No matter what shape or size or height in the sky they are, clouds play a critical role for life [28]. They are a part of the water cycle. Also, clouds are central to weather observations and forecasts. In the past, the only possible way to get an indication of how the weather might be in the near future was to observe the sky. The ability to recognize and interpret different clouds was very important for weather forecasts. Today, observations of clouds' motion with local details are done using very sophisticated measuring instruments such as nephoscopes [29-30], radars and satellites [31]; see Fig. 1. The observation of clouds and the measurements of their base heights above the ground and also their velocities are important for many purposes, especially for aviation, shipping and meteorology. The formation of clouds changes of state that the humidity undergoes in the atmosphere. Their movements are due essentially to wind velocity, and changes in temperature and pressure with altitude. There are several processes that can cause a change in the pressure into the atmosphere. In general, pressure of atmosphere as its temperature decrease with increasing altitude. The curves in Fig. 2 was obtained by considering that the air cools in function of the altitude at a rate of about 0,6°C per 100 meters [32].

Fig. 1 - Three popular techniques for observing the clouds: Satellites, radars, and airplanes.

There are several types of clouds that are, in general, classified in function of their position and appearance in the atmosphere seen from the ground. The atmosphere is divided into many layers. Most clouds can only form in the lower layer, celled the troposphere which is limited at the top by the tropopause. The methods of the classification of the clouds in widespread use are described in the report of World Meteorological Organization (WMO) of 2008 [33], a sub-organization of the United Nations. The International System of cloud classification in use today was made for the first time by Luke Howard in 1803 [34]. The clouds' classification was successively defined by the WMO Atlas in 1975 [35] and in 1987 [36-37], as a hard-copy book before the advent of the Internet which contain scientific descriptions of clouds and illustrations to aid in the identification of cloud types. Today, it is managed and constantly updated by this organization [38].

The International Cloud Atlas currently recognizes 10 basic cloud genera, which are defined according to where in the sky they form and their approximate appearance. The 10 genera are subdivided into species. In total, there are about 100 combinations [38].

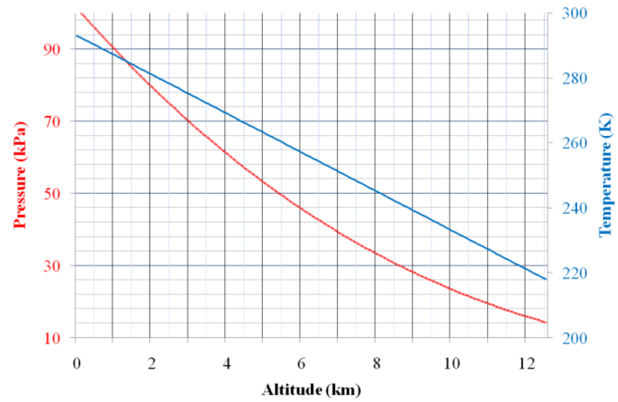

Fig. 2 – The law is : $p(z)= p_0exp(-Mgz/RT)$ where $p(z)$ is the atmospheric pressure at the altitude z, p_0 is the atmospheric pressure (in Pa) at sea level, M is the mean molar mass of the air, M=0,0289644 kg/mol, g is the gravitational constant, g= 9,80665 m/s^2, z is the altitude in meter, R is the perfect gas constant: R=8,31432 J/K.mol, and T is absolute temperature of the air, in Kelvin, at altitude z.

To facilitate the classification of the clouds, the troposphere in turn was divided into three levels: low, middle, and high into which most clouds can be grouped. These are sometimes called "étages". High-level clouds typically have a base above about 5 to 13 km and contain the Cirrus (Ci), Cirrostratus (Cs) and Cirrocumulus (Cc) clouds. Clouds of this family are often called "Cirrus" and they consist only of ice crystals and appear thin, white, and wispy. Middle-level clouds have a base that is usually between 2 and 7 km above the ground. Family of middle clouds have the prefix "Alto-" and consist of Altocumulus (Ac) and Altostratus (As). These clouds' types contain water droplets as well as ice crystals. Low–level clouds usually have their base at a maximum of 2 km. Family of these law-level clouds are designated by the word Stratus, a category that includes Stratocumulus (Sc), Stratus (St) and Nimbostratus (Ns), and they consist only of water droplets. It is to highlight that each type of cloud has its own forming *process* and moves with corresponding *velocity* in the atmosphere.

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According to the WMO Atlas [35-38], the clouds concerned by the *Quran* 27:88 verse are the clouds that the naked human eye is used to seeing pass into the atmosphere. This is because this verse was addressed to people more than 1400 years ago. At that time, people had no idea about Today's Sciences. Therefore, clouds concerned by the *Quran* 27:88 verse should be the clouds closest to the Earth's surface like Stratus clouds such as haze and fogs, and in the limit Alto clouds' families.

The clouds are omnipresent in the nature and so it is no surprise that several research works has been done with the aim of understanding them [39-41]. A certain number of them are on the estimation of cloud properties. Some include cloud obstruction of the sun [42], cloud thickness [43], cloud altitude [44], and the *velocity* of the clouds [45-46]. On its side, the cloud velocity is determined by meteorological conditions and the properties of the cloud itself. Hereford, it can change according to the weather and wind conditions and many other factors [35-38]. Also, the reference frame where the observer is located plays a key role in the determination of the clouds' appearance and motion.

To our knowledge, research works dedicated to the study of cloud velocity alone are rare. In the paper reported by Wang et al on Cloud Base Height determination from sky imager and cloud speed sensor [47], the measured velocity of clouds is situated between 5 to 40 m/s. Also, the values reported by Bandbury et al varies from 31,9 kt (16,4 m/s) to 57,4 kt (29,5 m/s) [48]. The cloud speeds in different seasons can be in interval from 3 to 35 m/s over 1 year of data [49-50]. Relative velocities of the clouds that are recorded in different meteorological stations in the Word vary from ~ 1 to 510 km/h. For example, Stratus clouds typically move around 50 to 200 km per hour relative to ground. It's easy to admit that low level clouds move slower than high level clouds because at the surface the wind slows down due to the friction layer with the Earth's surface due to shear stress forces that known in fluid Mechanics. Generally, a cloud moves as fast as the air it contains. In addition, the higher the cloud in the sky, the faster it moves. This is because clouds are homogeneous, amorphous and isotropic and we can't judge their distance. In fact, high Cirrus, clouds that are caught in jet streams, is the fastest.

As we see, the spectrum of cloud velocity is very wide. But in general, velocities of the clouds that usually are recorded in different meteorological stations are in orders of 1, 10 or 100 m/s [35-37]. In consequence, the velocity of the clouds cannot exceed 463 m/s (1670 km/h) as we will see below. Nevertheless, these values are sufficient to get an idea of the orders of magnitude of cloud velocities. For our purposes, it is not necessary to know their exact values for understanding what the verse Q. 27:88 is saying. They are not requested. The analogy between the movements of clouds and mountains is enough to understand what this *Qur'anic* verse says.

IV. Mountain velocity calculation

According to recently updated data [51], the Earth's equatorial radius is 6378 km and its polar radius is 6357 km. This is the reason why the Earth is slightly flattened which makes the Earth's globe drawn to scale, its shape resembles more a circle of a globally-average value radius 6371 with a 0,3% variability (±10 km) than an ellipse. And to simplify, we will adopt in this work *the spherical Earth approximation* which very closes to reality [4]. This model is a useful mathematical tool, for example in numerical weather prediction [52]. Although it will not change significantly the results but it is interesting to point out that, due to the attraction of the equatorial bulge, the gravitational vector, often denoted ***g**** (true gravity), is not directed exactly to the Earth's center (except at the Equator and the poles). Only if the total mass is concentrated in the center of the Earth would g* be directed to that point [53].

The mathematical tools that we will use here are based mainly on Newtonian mechanics. Our goal is to demonstrate in which reference frame of coordinates the mountains are motionless, and in which they are moving and we will calculate their velocities. In this respect, besides using the spherical coordinates system, the calculations are made in three different reference frames of coordinates which are: 1) Copernicus Reference Frame, $\Re_0(Sx_0y_0z_0)$, 2) Geocentric Reference Frame, $\Re_g(Ox_0y_0z_0)$, and 3) Terrestrial Reference Frame, $\Re_T(Oxyz)$. These are shown in *figure 3*.

III.1 Earth's velocity relative to the Copernicus frame

Considering the Copernicus reference frame, denoted by $\Re_0(Sx_0y_0z_0)$, which is nearly an inertial reference frame for planetary motion, i.e. the frame of reference where the Sun is at the origin of the coordinates system (Fig. 3). In this frame of reference, it has long been known that planets of our solar system as well as Earth rotate

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around the Sun, all in an orbit are “***swimming***” [23] or oscillating in helicoidally motion. See the scientific evidence that were revealed in the *Qur’an* 21:33 and 36:40 verses more than 1400 years ago concerning the Moon and the Sun, each is ***swimming*** in an orbit that means each of them oscillating in a helical trajectory.

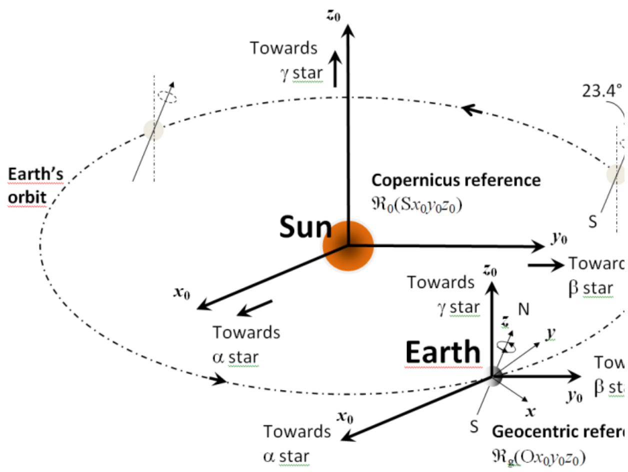

Fig. 3 – Copernicus, geocentric and terrestrial frames of reference. The $x_0y_0z_0$ axes are directed respectively towards α, β and γ "fixed" stars known in the Universe. Earth's axial tilt (the obliquity) is about 23.4°.

In Copernicus reference frame, the Earth’s globe orbits the Sun in a counterclockwise direction around the Sun when it is seen from above the North Pole. The Earth approximately takes 365,25 days (1 sidereal year) to travel one complete orbit, during which time it has traveled 940 million km. Ignoring the gravitational influence of other Solar System bodies, Earth's orbit is nearly an ellipse with the Earth-Sun barycenter as one focus, and the major axis, the Aphelion, is 152,10 × 10^6 km , the minor axis, the Perihelion, is 147,10 × 10^6 km (Fig. 4). Since these values are close to each other, the center of the orbit is relatively close to the center of the Sun compared to the size of the orbit. Thus, one can consider the Earth as if it oscillates around the Sun in a helical trajectory (due to the Sun’s motion in its orbit in the Universe) with an average radius of 149,6 × 10^6 km.

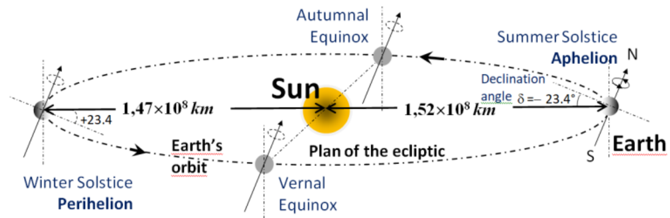

Fig. 4 – Exaggerated illustration of Earth's elliptical orbit around the Sun, showing the Aphelion and Perihelion orbital extreme points. Earth is farthest from the Sun when it is summer in the Northern Hemisphere.

According to Mechanics’ course, the law of kinematics that allows us to calculate the Earth’s velocity on its nearly circular trajectory around the Sun is: v = Rω where R = 1,496 × 10^{11} m is the mean distance between the Earth and the Sun, and ω = 2π/T is its angular velocity, in rad/s, where T = 365,25 day is the Earth oscillation period motion around the Sun in Universe. Substitution into the formula, the velocity of the Earth in the Copernicus frame of reference is 29,79 km/s. Therefore, the Earth's orbital speed average is 29,79 km/s (107224 km/h) relative to the Sun, which is fast enough to cover the Earth’s planet's diameter in 7 minutes and the distance from the Earth to the Moon in 4 hours. This average value of the Earth’s orbital speed enters into the category of very high speeds. But following the exact calculation, the Earth’s velocity actually varies. The Earth’s speed at Perihelion is 29,29 km/s, but at Aphelion it reaches 30,29 km/s.

To confirm the obtained value (29,79 km/s) for the Earth’s speed in the Copernicus reference frame, also we can use the dynamics study. To simplify, we always consider the Earth as if it oscillates in a perfectly closed circular orbit around the Sun. In such oscillation motion, the mutual gravitational attraction between the Sun and the Earth is always balanced by the centripetal force. Dynamical equilibrium of the Sun-Earth system will require that the sum of all forces acting on them should be zero. According to Newton's Second Law of motion, the equation of the Earth’s orbital movement is: $Mv^2/R = GMsM/R^2$ where M is the Earth’s mass, v is the Earth’s velocity on its orbit around the Sun, Ms = 1,989 × 10^{30} kg is the Sun’s mass, R = 1,496 × 10^{11} m is the mean distance between the Earth and the Sun, and G = 6,674 8 × 10^{-11} $m^3kg^{-1}s^{-2}$ is the gravitational constant. Once

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again, the Earth's velocity in its orbit around the Sun is the same as before: $v = 29{,}79$ km/s.

Next, taking into account the High-Velocity Clouds (HVCs) which is between 70 – 100 km/s [55], the speed of the Sun relative to the fossil cosmic radiation frame of reference is 70 km/s. These clouds of "gas" can be massive in size, some on the order of millions of times the mass of the Sun, and cover large portions of skies. By adding algebraically the HVC Sun's speed, the absolute speed of the Earth including its mountains oscillates between 40 km/s and 100 km/s relative to the cosmic background reference frame.

Since the mountains are *firmly fixed* to the Earth's crust by their roots [5-8], then they are entrained along with the Earth's globe in its movement around the Sun by almost the same Earth's velocity average. But as we see, this value is too high and can never be the speed at which the clouds are moving relative to the Earth's atmosphere. This speed which is an unusual speed for humans cannot be the speed by which the clouds of our Globe move and it is not this phenomenon which is mentioned in the *Quran* 27:88 verse. This is not the speed of clouds that occurs in our atmosphere and must be ruled out.

III.2 Mountains' motion in the Geocentric Reference

To demonstrate where the mountains are moving or not, it is necessary in advance to choose reference frames in which they effectively are moving or not. The suitable reference frames are geocentric and terrestrial frames (see Fig. 3 and Fig. 5).

In the Solid Mechanics, it is known that a rigid body can be considered as if it is formed of infinity of material points. The distance between any two points remains unchanged [56]. Mountains are big solid objects with big mass that contribute to the constitutions of the terrestrial crust, that's why one can consider each of them as a set of infinity of material points (or particles). Accordingly, the Point Mechanics allows us to study each of these points separately from the others. One can therefore represent each point of a mountain on the Earth's crust by a point M. Sometimes; we will need to replace a whole of the mountain by this same point M (Fig. 5). If mountains are really moving as mentioned in the Quran, since they are solid objects *firmly fixed* to the earth, then the velocity by which any one point like M is moving also would be approximately the velocity by which the entire mountain is moving. Knowing the speed of one of these points makes it possible to know the speed of the whole of the mountain.

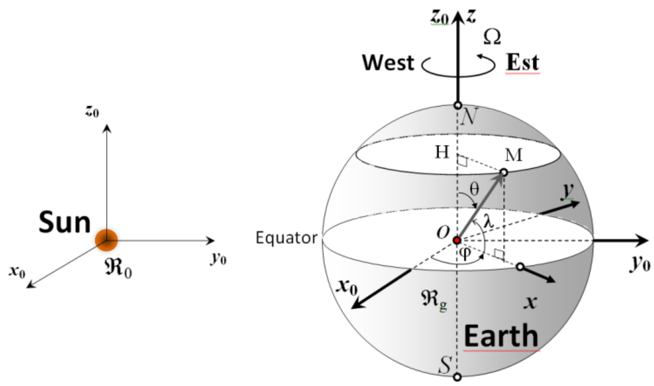

Fig. 5 – Point M represents a mountain on the Globe. Mountains located at the same latitude angle λ, whatever their longitude angle φ, are moving with the same tangential speed relative to the Geocentric Reference Frame.

In Point Mechanics however, one can isolate each material point of a mountain on the surface of the Earth's globe and then represent it by a material point M to study it (see Fig. 5). Our task now is to determine the velocity of each point M in order to deduce the velocity of the entire mountain. To demonstrate where the mountains are moving or not, it is necessary in advance to choose reference frames in which they effectively are moving or not. For this, we define two reference frames, one inertial and the other is *solidly fixed* to the Earth. The first one is the Geocentric Reference Frame, denoted GRF, and the second is the Terrestrial Reference Frame, TRF.

The Origin O of the GRF, previously denoted $\Re_g(Ox_0y_0z_0)$, which is in the framework of our purpose an Inertial Reference Frame of coordinates is at the center of the Earth mass and its coordinate frame is fixed with respect to already three well-defined stars in the Universe (Fig. 3). The $x_0y_0z_0$ axes are solidly fixed in this inertial frame of reference. As known, the reference frame is set by the object that is being held fixed. In other words, it is the object that position vectors, velocities and accelerations vectors are measure with respect to it. Here, reference objects are the Earth's center itself and the α, β, γ "fixed" stars. That is, the GRF is not fixed with respect to the Earth surface, it is a non-rotating Earth frame. However, for the TRF, previously denoted $\Re_T(Oxyz)$, is solidly attached to the Globe, its origin O

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also coincides with the Earth's center and its z-axis coincides with that of the GRF while its x and y axes are locally fixed in the equator plan of the Globe. More precisely, its x-axis originates from the Earth's center extends towards the intersection between the plan of equator and the Greenwich mean meridian at any time, and the z-axis is also aligned with the Earth´s rotation axis which is currently obliquity angle is 23,4° with respect to the axis perpendicular to the ecliptic's plane (Fig 3 and 4). In addition, the TRF freely rotates around z_0-axis of the GRF with the same angular speed as the Earth which sensibly is 2π per 24 hour.

The position of M on the Earth's crust relative to the GRF absolute frame of reference or equally to the TRF relative frame is given by the position vector $\boldsymbol{r}$ (OM = $\boldsymbol{r}$ is the radial mountain's position) [57]. Let us denote by θ the complement angle of the latitude angle λ which is by definition the angle between the plane of the equator and the position vector $\boldsymbol{r}$. The angle θ is one from spherical coordinates (r,θ,φ) which varies from 0 to 180° from the North Pole to the South Pole of the Globe whereas the latitude angle λ is the angle that varies from –90° at the South Pole to +90° at the North Pole, passing across 0° at the Equator of the Globe (see Fig. 5).

The *absolute velocity* of a mountain is the vectorial sum of its velocity relative to TRF frame of reference and the tangential velocity of the Earth itself at this point M with respect to the GRF frame of reference. The time derivative of the position vector $\boldsymbol{r}$ in GRF frame of reference gives us the absolute velocity of the point M with respect to GRF frame of the coordinates. Or by using the law of composition of movements, the definition of the *absolute velocity* is:

$$\boldsymbol{v}_a(\mathrm{M}/\Re_g) = \boldsymbol{v}_r(\mathrm{M}/\Re_T) + \boldsymbol{v}_e(\mathrm{M}/\Re_g) \qquad \text{(eq. 1)}$$

where $\boldsymbol{v}_r$ denote the *relative velocity* of the point M with respect to $\Re_T$ turning frame of reference, it is the velocity observed by an Earth-bound observer with respect to the Terrestrial Reference Frame; $\boldsymbol{v}_e$ denotes the *entraining velocity* with respect the GRF non-rotating frame i.e., the velocity of the Earth seeing, for example, by an observer fixed in space and watching the Earth rotates, for example, an astronaut observer in distant space.

By definition, the *entrainment velocity* vector is:

$$\boldsymbol{v}_e(\mathrm{M}/\Re_g) = \boldsymbol{v}(\mathrm{O}/\Re_g) + \boldsymbol{\Omega}(\Re_T/\Re_g) \wedge \boldsymbol{r} \qquad \text{(eq. 2)}$$

where $\boldsymbol{\Omega} = 2\pi/24\text{h}\ \boldsymbol{u}_z$ is the Earth's angular velocity vector with respect to the GRF absolute reference frame. The second term in right-hand side of the entraining velocity represents the velocity of the Earth due to rotation about the z-axis.

For our purpose, the point M is at rest with respect to the TRF, i.e. $\boldsymbol{v}_r = \boldsymbol{0}$ in eq. 1. Also, we have $\boldsymbol{v} = \boldsymbol{0}$ in eq. 2 because the center O note move with respect to GRF frame of reference. After simplification, the entrainment velocity becomes:

$$\boldsymbol{v}_e = \Omega r sin(\theta)\,\boldsymbol{u}_y \qquad \text{(eq. 3)}$$

so the orientation of the entraining velocity vector, $\boldsymbol{v}_e$, is always eastward, greatest at the equator and null at the Earth's poles. HM in Fig. 5 or 6 which is equal to $rsin(\theta)$ = $rcos(\lambda)$ is the shortest distance from the z-axis of rotation to the point M in question. Note that the entrainment velocity, $\boldsymbol{v}_e$, points always into the direction which is perpendicular to both Earth's angular velocity vector, $\boldsymbol{\Omega}$, and the position vector $\boldsymbol{r}$ plan. That's why the entrainment velocity in eq. 3 must be necessary tangential at any point M on the Earth's surface.

Then, after simplification of eq. 1, the absolute velocity is:

$$\boldsymbol{v}_a = \Omega r sin(\theta)\,\boldsymbol{u}_\varphi \qquad \text{(eq. 4)}$$

As we see, in the case of mountains, the absolute velocity of the point M is purely equal to the entrainment velocity of M in GRF frame of reference**.** This is because the mountains effectively are entrained by the Earth's rotation motion. The orientation of both is always eastward, greatest at the equator and null at the Earth's poles. It should be noted that the mountain velocity varies slightly with their height via the radial distance r. In other worlds, the value of the absolute velocity varies slightly with the mountain's height as exactly the entrainment velocity variation and therefore differs from the summit of one mountain to that of another to their roots.

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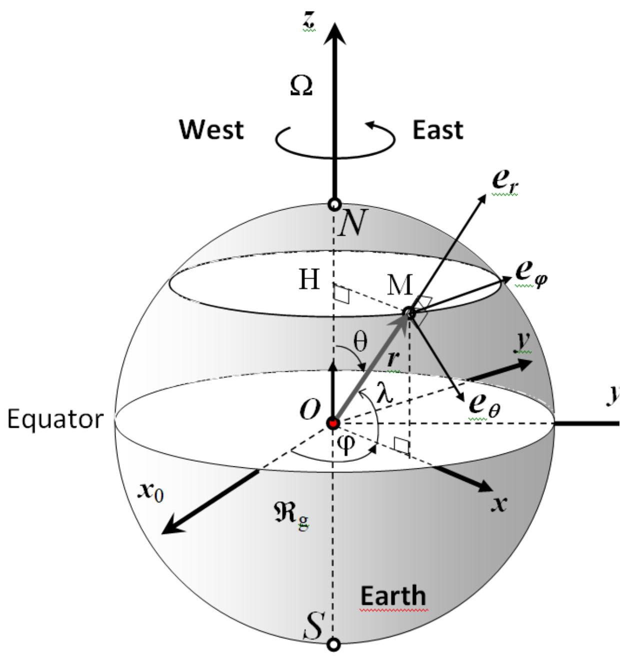

Fig. 6 – Geocentric and terrestrial references frames of coordinates. Earth's rotation is towards the East. The unit vector $\boldsymbol{u}_\varphi$ of unit vectors spherical basis indicates that the entraining velocity vector $\boldsymbol{v}_e$ and equally $\boldsymbol{v}_a$ are always towards the East with a magnitude $\Omega r\sin(\theta)$.

This parameter contributes to the broadening of the velocity distribution. For mountains at the Earth's equator, i.e. $\lambda = 0$, at the Earth's equatorial radius is 6378 km, we have:

$$\boldsymbol{v}_a(\mathrm{M}/\Re_g) = 463{,}82\ m/s\ \boldsymbol{u}_\varphi \qquad \text{(eq. 5)}$$

which is equal, after conversion, to 1670 km/h. But for the mountains at Earth's poles, the latitude λ is $\pm 90°$ then $\boldsymbol{v}_a = \boldsymbol{0}$.

We are oblivious to this rapid motion because everything in our frame of reference is traveling at the same velocity. Note that the absolute velocity decreases with increasing latitude angle as shown in Fig. 7. As we see, the value of the absolute velocity of the mountains in GRF absolute reference frame is zero only at North Pole and South Pole singular points, but it varies from 0 to reach approximately 463 m/s (~1670 km/h) from North Pole or South Pole to the equator's points. Furthermore, the unit vector $\boldsymbol{u}_\varphi$ that appears in eq. 4 instead of the unit vector $\boldsymbol{u}_y$ in eq. 3 means that the mountains absolute velocity vector always points towards the East (the mountains are moving counterclockwise when viewed from the Globe's North Pole).

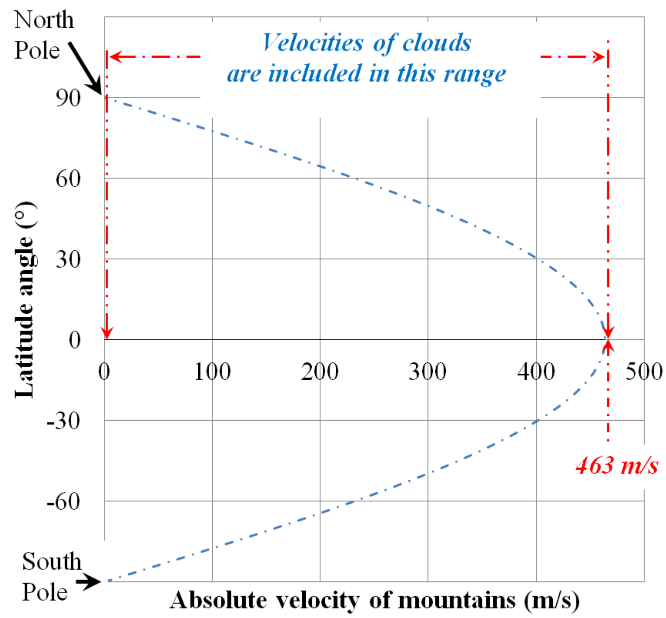

Fig. 7 – The *entrainment velocity* of the mountains in function of their latitude angle relative to the GRF frame of reference *vice-versa*.

Nevertheless, the result obtained as it has never been done will be the correct interpretation of the physical law which is implicitly mentioned in the *Quran* 27:88 verse for more than 1400 years ago. *The result shows that the mountains are moving even though they are seen as if firmly fixed to the ground*. In the GRF frame of coordinates, the mountains are moving. And since they are solidly fixed to the Earth's crust which entrains them by the entrainment motion, in conclusion the Earth rotates in the GRF frame like the mountains, and this is the important discovery that the *Quran* 27:88 verse is saying 1400 years ago, the Earth rotates on itself. Intuitively, *if the mountains rotate, also the Earth's globe rotates*. On the contrary, because the relative velocity is zero ($\boldsymbol{v}_r = \boldsymbol{0}$), the mountains are *motionless* in the TRF frames of coordinates. Therefore, mountains appear evidently immobile in the TRF frames of reference

because simply they are *solidly fixed* to the Earth as always seen by everyone since long ago. The Muslim astronauts read and understood the Qur'an and they were aware of several important scientific Qur'anic indications among them this one [12, 54]. The idea that the Earth rotates around itself was in the *Qur'an* and the Moslem astronauts were racing against time during the Middle Ages up Renaissance area, they were doing the mathematics to explain it right. I have no arguments to prove that the Muslim astronauts drew their heliocentric theory, directly or indirectly, from the *Quran* but there are some credible indications. The most important among them is that the Qur'an is full of signs, indicators, arguments and enigmas on most of the scientific discoveries that we known today and several Muslim have questioned Ptolemaic system [19-22], many of them rejected it very early [12].
As we can see, the mountain's motion depends strongly on the reference frame of the observer, and this is the enigma. An Earth-bound observer that rotates with the TRF rotating frame of reference sees the mountains as if they are *stationary*. In the contrary, an observer fixed in space and watching the Earth rotates, for example, an astronaut in distant space sees the mountains rotating just like any other object or tree. Hence, the mountains' velocities, like any other motionless body on the Earth's surface, depend strongly on the observer's reference. To account for this weird phenomenon, the Earth-bound observer must add apparent forces to the real forces that act on mountains in order to be able making mathematics work for explain the observed motion from the perspective of someone standing on the rotating Earth's globe.
Next, to study the mountains effect on the Earth's, we need now to study their motion using the laws of the dynamics. For this, we will start by introducing the mountain motion accelerations by also using the law of composition of movements introduced in the kinematics course of the point Mechanics. Taking the time derivative of the *absolute velocity* given by the eq. 1, the *absolute acceleration* of the point M in question relative to the GRF absolute frame is:

$$\boldsymbol{a}(\mathrm{M}/\Re_{\mathrm{g}}) = \boldsymbol{a}_r(\mathrm{M}/\Re_{\mathrm{T}}) + \boldsymbol{a}_e(\mathrm{M}/\Re_{\mathrm{g}}) + \boldsymbol{a}_c(\mathrm{M}/\Re_{\mathrm{T}})$$
(eq. 6)

The first term on the right-hand side of eq. 6 is the *relative acceleration* of the point M with respect to the TRF frame of coordinates which is a real acceleration, the second term is the *entrainment acceleration* of the point M with respect to the GRF absolute reference frame which is a centripetal acceleration, and the third term is the *Coriolis acceleration* of the point M with respect to the TRF frame, sometimes called the *complementary acceleration*. The last two terms are apparent accelerations. They are proportional respectively to the centrifugal force and the Coriolis force which they are apparent forces in their turn.
Now, we are ready to simplify eq. 6 and give the physical meaning for each of its terms. Indeed, the term $\boldsymbol{a}_r = \mathbf{0}$ because it is the derivative to time of $\boldsymbol{v}_r$ which is already zero. The expression of *entrainment acceleration* is:

$$\boldsymbol{a}_e(\mathrm{M}/\Re_{\mathrm{g}}) = \boldsymbol{a}(\mathrm{O}/\Re_{\mathrm{g}}) + \frac{d\boldsymbol{\Omega}}{dt} \wedge \boldsymbol{r} + \boldsymbol{\Omega} \wedge (\boldsymbol{\Omega} \wedge \boldsymbol{r})$$
(eq. 7)

in which the absolute acceleration, $\boldsymbol{a}$, of the point O is zero due to the origin O which is not moving relative neither to the GRF absolute reference frame of coordinates nor to the TRF moving reference frame. The position vector $\boldsymbol{r}$ denotes the distance from the centre of rotation O to the mountain [57]. The central term of right-hand side of eq. 7 also is zero in the case of the mountains because the angular acceleration, $\dot{\boldsymbol{\Omega}}$, doesn't change with respect to the GRF of coordinates as mentioned before. The third term in right-hand side of eq. 7 is the *entrainment acceleration*. It's the centripetal force per unit mass.
For the mountains' systems, the calculation gives us:

$$\boldsymbol{a}_e = -\Omega^2 r sin(\theta)\, \boldsymbol{u}_x$$
(eq. 8)

This is the centripetal acceleration which points toward $-\boldsymbol{u}_x$ (see Fig. 8).

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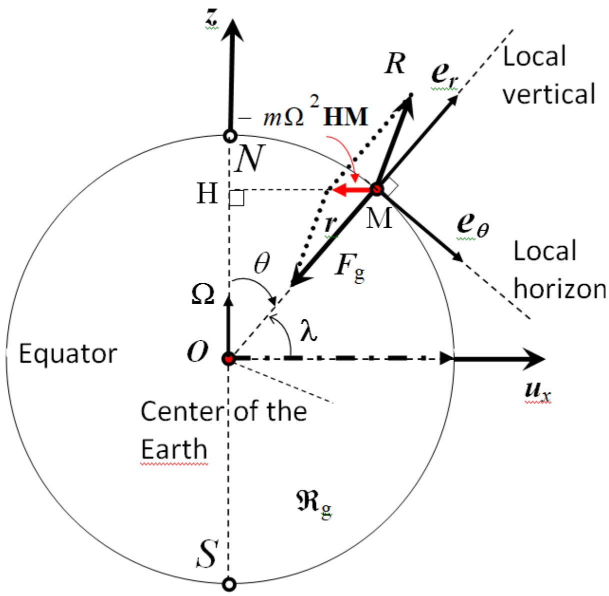

Fig. 8 – A schematic image of the spherical Earth with the gravitational force vector Fg (true gravity) and the centripetal force Fent (apparent force) due to the Earth's rotation. The vector Fg is the gravitational Force and the vector R is the reaction force that ensure the dynamic equilibrium of the mountain relative to the Geocentric Reference Frame. Fg is always locally collinear to the local vertical which is very useful because the vertical coordinate (the radial spherical coordinate) designated by the unit vector er is always perpendicular to Earth's surface, so that Fg is only in the radial *r* direction.

By definition, the *Coriolis acceleration* is:

$$\boldsymbol{a}_c(\mathrm{M}/\Re_\mathrm{T}) = 2\boldsymbol{\Omega} \wedge \boldsymbol{v}_r(\mathrm{M}/\Re_\mathrm{T}) \qquad \text{(eq. 9)}$$

The deflective mechanism through the Coriolis term $2\boldsymbol{\Omega}\wedge\boldsymbol{v}_r$ also is zero because mountains not move with respect to the TRF reference frame of coordinates i.e., $\boldsymbol{v}_r = \boldsymbol{0}$ [9]. As we see, the *Coriolis acceleration* of mountains is zero. This obvious result shows that mountains will be in stationary equilibrium in any TRF reference frame of coordinates that is why the mountains usually are seen *motionless* in these types' frames of reference. Finally, the *absolute acceleration* of the point M in GRF reference frame of coordinates simply is:

$$\boldsymbol{a}(\mathrm{M}/\Re_\mathrm{g}) = -\Omega^2 r\sin(\theta)\,\boldsymbol{u}_x \qquad \text{(eq. 10)}$$

As we see, the unit vector $\boldsymbol{u}_x$ that appears in equation 10 means that the *absolute acceleration* of mountains relative to GRF of coordinates is constantly perpendicular to the *z*-axis of rotation. In addition, the minus sign (–) indicates that the mountains absolute acceleration, like their *entrainment acceleration*, points not towards the center of the Earth, but orthogonally towards the *z*-axis which is the Earth's rotation axis.
The magnification of the *absolute acceleration* of mountains, like any other stationary body, at the Earth's equator at points where $r = 6378$ km is:

$$\boldsymbol{a}(\mathrm{M}/\Re_\mathrm{g}) = -3{,}37\times10^{-2}\,m/s^2\,\boldsymbol{u}_x \qquad \text{(eq. 11)}$$

Also, the minus sign (–) appearing before the absolute acceleration value in eq. 11 means that the absolute velocity of the mountains that are located at the equator falls by 3,37 cm/s every second. Certainly, the mountains are moving. But at the Earth's poles, the absolute acceleration of the mountains relative to GRF frame of reference also is zero due to the their speed which is zero at these singular points.
Now, one can study the point M from a point of view *the dynamics* of the Point Mechanics either in the GRF absolute reference frame or in the TRF relative reference frame. Either way the physical reality doesn't change. The mass *m* of a mountain is in *static equilibrium* in the TRF rotating reference frame of coordinates because its relative velocity and acceleration vectors with respect to this frame are zero. We then define the weight of the mountain. The Earth's gravitational attraction force, Newtonian gravity or true gravity that acts on a mass *m* is simply the weight of the mountain's mass, which is given in the TRF reference frame in spherical coordinates system (r, θ, φ) with corresponding unit basis vectors ($\boldsymbol{e}_r$, $\boldsymbol{e}_\theta$, $\boldsymbol{e}_\varphi$), see Fig. 6 below, by:

$$\boldsymbol{F}_g = -\frac{GM}{r^2}\,m\,\boldsymbol{e}_r \qquad \text{(eq. 12)}$$

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where M is Earth's mass (5,9722 x 10^{24} kg), r is the distance originating from the Earth's center O to the point M, and G is the universal gravitational constant (6,6741 × 10^{-11} m^3 kg^{-1} s^{-2}). The local vertical line which is supported by the radial unit vector $\boldsymbol{e}_r$ direction (see Fig. 8) is defined by the direction of the mountain's weight – in other words, the gravitational force points directly towards Earth's center in the opposite direction of the radial unit vector $\boldsymbol{e}_r$. It is everywhere collinear to the local vertical (see Fig. 8). It should be noted that the mountains' weights are real forces. Contrary to what one might believe, here, the gravitational vector (true gravity), denoted $\boldsymbol{g*}$ is directed exactly to the centre of the Earth as shown in Fig. 9 below. By definition,

$$\mathbf{g}* = -\frac{GM}{r^2}\boldsymbol{e}_r \quad \text{in m/s}^2.$$

The application of the Fundamental Principle of Dynamics (*FPD*) to the point M in the GRF absolute reference frame gives us:

$$\sum \mathbf{F}_a = m\boldsymbol{a} \quad \text{with} \quad \sum \mathbf{F}_a = \boldsymbol{F}_g + \boldsymbol{R} \qquad \text{(eq. 13)}$$

where the absolute acceleration, $\boldsymbol{a}$, is given by eq. 6 above.
The $\boldsymbol{F}_g$ vector is the *gravitational Force* in eq. 12. The local vertical line is the direction line of the force vector $\boldsymbol{F}_g$ (Fig. 8). The $\boldsymbol{R}$ vector is the *reaction force* exerted by the Earth on the mountain. Of course, $\boldsymbol{F}_g$ and $\boldsymbol{R}$ vectors are real forces. We put the subscript "*a*" in the Σ symbol into eq. 13 to indicate "absolute" because they are true in an inertial reference frame such as GRF frame of reference.
Now, taking into account eq. 6, the eq. 13 can be written as:

$$\boldsymbol{F}_g + \boldsymbol{R} = m\boldsymbol{a}_r + m\boldsymbol{a}_e + m\boldsymbol{a}_c \qquad \text{(eq. 14)}$$

The first term on the right-hand side of eq. 14 is the *relative acceleration* vector with respect to the TRF reference frame.
Nevertheless, the mass m of the mountain is in equilibrium in both GFR and TFR frames of reference so its relative acceleration is zero ($\boldsymbol{a}_r = \mathbf{0}$). Also, the *Coriolis force* is zero because mountains are *firmly fixed* to the Earth's crust by their roots and they don't move with respect to it [9]. It remains only the central term which is the *centrifugal force*. In these circumstances, the equation 14 can be written under another version only in terms of forces:

$$\underbrace{\boldsymbol{F}_g + \boldsymbol{R}}_{Real\ forces} = \underbrace{\mathbf{F}_{ent} + \mathbf{F}_{Cor}}_{Apparent\ forces} \qquad \text{(eq. 15)}$$

in which the $\boldsymbol{F}_{\mathrm{Cor}}$ is zero.

The terms on the left-hand side of eq. 15 are equal to the absolute acceleration in the GRF reference frame multiplied by the mountain's mass m (see eq. 13). Indeed, these are real forces. Terms on the right-hand side are apparent forces. The first one is the centripetal force and the second is the Coriolis force which they are proportional to centripetal and Coriolis accelerations respectively.
Replace each term by its value obtained above and substitute eq. 10 and eq. 12 in the eq. 15, we obtain:

$$m\,\boldsymbol{g}* + \boldsymbol{R} = -m\Omega^2 r \sin(\theta)\,\boldsymbol{u}_x \qquad \text{(eq. 16)}$$

This equation is very interesting. It shows that in the GRF absolute reference frame, the sum of real forces that act on the mountain is balanced by its centripetal force which is, of course, an apparent force as shown in Fig. 8. As we see, the term on the right-hand side of eq. 16 is not zero except at Earth's poles. Particularly at Earth's poles, $\boldsymbol{F}_{\mathrm{g}} = \boldsymbol{R}$ contrary to what one might think. Despite these poles' singular points at rest, this means that mountains are permanently in *dynamic equilibrium* relative to the GFR frame of reference. It follows that mountains are not motionless in the geocentric reference frame. Obviously, the mountains are rotates relative to this reference frame which equally means that the Earth revolves around the z-axis since the mountains are *firmly fixed* to the Earth by their roots. This result is very important, it is a great scientific discovery never made before for following reason: because it is the first time in human history that we have scientifically demonstrated what the *Quran* 27:88 verse exactly says over 1400 years

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ago by using mathematics and physics. It is worth recalling here the first sentence of this *Qur'anic* verse: "*And you see the mountains, thinking them motionless, while they pass as the passing of the clouds…*" Indeed, the mountains are rotate in the Geocentric Reference Frames with velocities as these of clouds relative to the TRF Frames (see Fig.7). This is why the Quran exactly says by *the mountains pass as the passing of the clouds*. The mountains'

velocities are relative to GRF and clouds velocities are relative to TRF frames of reference.
Now, rearranging the eq. 14 to adapt it into the TRF relative reference frame as follows:

$$m\boldsymbol{a}_r = \boldsymbol{0} = \boldsymbol{F}_g + \boldsymbol{R} - m\boldsymbol{a}_e \qquad \text{(eq. 17)}$$

This is the Newton's second law, the *FPD*, applied to the mountain physical system but righting this once, in the TRF Earth's rotating frame of reference. Substitute once again eq. 10 and eq. 12 in the eq. 17, we obtain:

$$m\boldsymbol{a}_r = \boldsymbol{0} = m\,\boldsymbol{g}^* + \boldsymbol{R} + m\Omega^2 r\sin(\theta)\,\boldsymbol{u}_x \qquad \text{(eq. 18)}$$

Since the TRF relative frame of coordinates rotates around the GRF absolute reference frame, also it is appropriate to introduce the *apparent weight* of the mountain as:

$$\boldsymbol{P} = m\boldsymbol{g} \qquad \text{(eq. 19)}$$

where $\boldsymbol{g}$, the "apparent" gravity, is the vector that keep the mountain in static equilibrium on the Earth's surface. Obviously, it is the sum of the gravitational vector (true gravity), denoted before $\boldsymbol{g}^*$, and the centrifugal acceleration vector which is none other than apparent acceleration vector.
Also, it should be noted that the weight $\boldsymbol{P}$ of the mountain is totally in the opposite direction to the reaction force $\boldsymbol{R}$ that the Earth acts on the same mountain (see Fig. 8). It is for this reason that allows us to identify eq. 20 with the forces' resultant $\boldsymbol{P}+\boldsymbol{R}=\boldsymbol{0}$ in the following way:

$$\boldsymbol{R} + \boldsymbol{P} = m\boldsymbol{g}^* + \boldsymbol{R} + m\Omega^2 r\sin(\theta)\,\boldsymbol{u}_x \qquad \text{(eq. 20)}$$

The true gravity already has been introduced in eq. 12, although it has no horizontal component (Fig. 8), to emphasize the almost identical mathematical structure between eq. 16 and eq. 20. In spite of their strong similarities the equations nevertheless, as noted above, yield quite different motions, both in a relative and an absolute frame of reference. The eq. 20 shows that into the TRF Earth's rotating reference frame, the vector sum of real forces ($\boldsymbol{R} + \boldsymbol{P}$) and the alone apparent force that acts on the mountain is zero. In the latter case a real force, the component of the Earth's gravitational attraction, non-parallel to the local vertical, plays a central role by balancing the centrifugal force [4]. As we see, the term on the extremeness right-hand side of the eq. 20 is always zero (after eq. 18). This means that the vectorial sum of the real forces ($\boldsymbol{R} + \boldsymbol{P}$) must always be zero whatever the point M on the surface of the Globe and this, so that the mountain is always in *static equilibrium* on the Earth's surface. In consequence, mountains are motionless in any TRF frame of reference. This is also true in all local TRF frames of reference. And that's what the *Quran* 27:88 verse exactly says. Recall another time the first sentence of the *Quran* 27:88 verse: "*And you see the mountains, thinking them motionless, while they pass as the passing of the clouds…*" Indeed, you see the mountains, thinking them motionless with respect any TRF frame of reference as they are usually seen by humans with respect to the Earth's surface. This is what the *Quran* 27:88 verse says by "*And you see the mountains, thinking them motionless, …* ". Mountains are effectively motionless relative to TRF frames of reference as they appear habitually to people who see them immobile relative to the ground since long ago.
The centrifugal force that acts on mountains is directed perpendicularly towards the *Oz* axis of rotation of the Earth. Since the existence of life on Earth, any object that makes up the Earth has adjusted over time to the sum of the real gravitational force $\boldsymbol{F}_g$, the weight, which is constantly directed towards the Earth's center, and to the apparent centrifugal force which is always perpendicular to the *z*-axis of the Earth's rotation and oriented towards the outside of the Globe at its point of application M on the body in question (Fig. 9).

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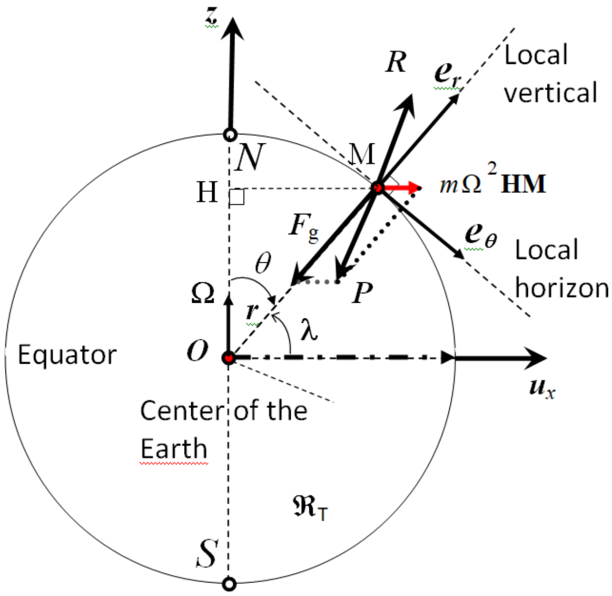

Fig. 9 – The F_g = mg^* and R vectors are respectively the gravitational force and the reaction force that ensure the *static equilibrium* of the mountain relative to the Terrestrial Reference Frame. The local vertical designated by the unit vector e_r is perpendicular to Earth's surface, so that F_g is only in the radial r direction. The apparent weight P of mountain does not point towards the Earth's center except at the poles and the equator positions.

The force of gravity we feel, F_g, is always locally perpendicular to the Earth's surface which appears as if it is planar at its point of application. The resulting gravity that all objects on Earth, whether moving or not, and the Earth itself feel is the vector sum of these real and apparent vector forces. And by comparing the left-right side of eq. 20 to its right-hand side, the gravity vector, or the 'apparent gravity' (**g**) which is the resultant between the gravitational vector and the centrifugal acceleration vectors is:

$$\boldsymbol{g} = \boldsymbol{g}^* + \Omega^2 r \sin(\theta)\, \boldsymbol{u}_x \qquad \text{(eq. 21)}$$

Vectors that appear into eq. 21 are shown in Fig. 10.
As the *centrifugal force* depends on the radial distance r and the angle θ, the apparent vector g has some extrema. It reaches its maximum at the equator and its minimum at the Earth's poles. Nevertheless, according to Newton's third law of action and reaction, centrifugal forces which are the direct feedback of centripetal forces that the gigantic masses of the mountains exert on the Globe contribute to its deformation just like ocean waters. In fact, the biggest mountains being located at the equatorial region where their angular momentum is higher (see Fig. 7). This is why the Earth is almost, but not quite, a perfect sphere. Its equatorial radius is 6378 km, but its polar radius is 6357 km [51]. In other words, the Earth is slightly *flattened* due to the contribution of the mountains' centrifugal forces in addition to the flattening that the Earth's rotation causes on itself. And this flattening phenomenon contribution constitutes again tangible proof that the mountains are not immobile, but they are in motion relative to the GRF frame of reference.

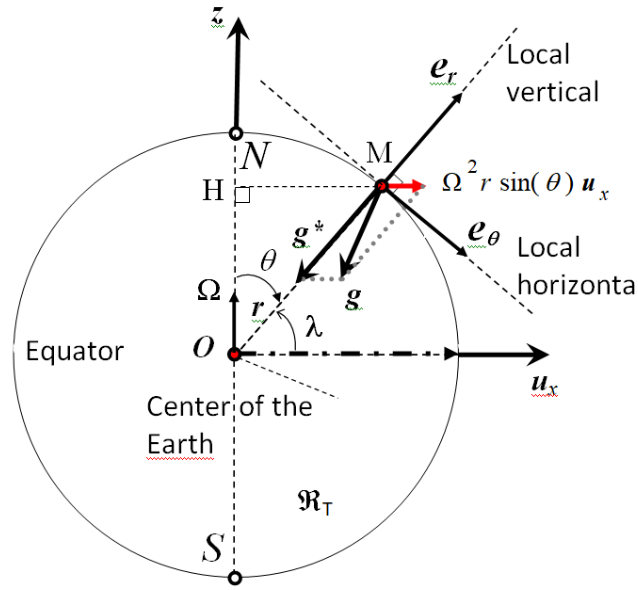

Fig. 10 – A schematic image of the spherical Earth with the gravitational vector **g*** (true gravity) and the centrifugal force, per unit mass, due to the Earth's rotation. Their resultant **g** (apparent gravity) is not parallel to the local vertical and not perpendicular to the local horizontal (dashed lines).

I. Velocity of the clouds

Early physical models of cloud dynamics were developed by meteorologists and atmospheric scientists.

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The laws of physics often used for the study of fluid dynamics in the atmosphere are mainly the Navier-Stokes equation. Substitution few other laws in this one allow to describe the comportment of clouds and comparable phenomena such as smoke and fire [52]. In addition, all cloud dynamics modeling approaches involve solving the Navier-Stokes equation [58-59]. Although this approach might at first seem unrealistic, it actually matches the behavior real volumes of air quite well [28].

Let us consider a *cloud parcel* moving into the atmosphere. In fluid mechanics, the absolute velocity of this cloud parcel, which we denote it by the point *P*, with respect to the GRF reference frame of coordinates is:

$$\frac{D_a \boldsymbol{r}}{Dt} = \frac{D_r \boldsymbol{r}}{Dt} + \frac{D_e \boldsymbol{r}}{Dt} \qquad \text{(eq. 22)}$$

where $\boldsymbol{r}$ is the position vector from Earth's center to *P*.

In fluid Mechanics, the *particulate derivative*, denoted in eq. 22 by the capital letter, *D*, is general and applies not only to the position vector, $\boldsymbol{r}$, but also to any other vector. By using it in the equations 6, 7 and 9 above, we can relate the acceleration of the cloud parcel in the GRF absolute reference frame to its acceleration in the TRF rotating reference frame as:

$$\underbrace{\frac{D_a \boldsymbol{U}_a}{Dt}}_{\boldsymbol{a}} = \underbrace{\frac{D_r \boldsymbol{U}_r}{Dt}}_{\boldsymbol{a}_r} + \underbrace{\frac{D\boldsymbol{\Omega}}{Dt} \wedge \boldsymbol{r} + \boldsymbol{\Omega} \wedge (\boldsymbol{\Omega} \wedge \boldsymbol{r})}_{\boldsymbol{a}_e} + \underbrace{2\boldsymbol{\Omega} \wedge \boldsymbol{U}}_{\boldsymbol{a}_c} \qquad \text{(eq. 23)}$$

where $\boldsymbol{a}$ is the absolute acceleration, $\boldsymbol{a}_r$ is the relative acceleration, $\boldsymbol{a}_e$ is the entrainment acceleration, and $\boldsymbol{a}_c$ the Coriolis acceleration of the cloud parcel, denoted P before.

We can further simplify eq. 23 to make sense of it physically. As introduced above, the Earth's angular velocity, $\boldsymbol{\Omega}$, does not change in time, so its derivative can be set to zero. Then, we have simply:

$$\underbrace{\frac{D_a \boldsymbol{U}_a}{Dt}}_{\boldsymbol{a}} = \underbrace{\frac{\partial \boldsymbol{U}_r}{\partial t} + (\boldsymbol{U}\nabla)\boldsymbol{U}}_{\boldsymbol{a}_r} + \underbrace{\boldsymbol{\Omega} \wedge \boldsymbol{r}}_{\boldsymbol{a}_e} + \underbrace{2\boldsymbol{\Omega} \wedge \boldsymbol{U}}_{\boldsymbol{a}_c} \qquad \text{(eq. 24)}$$

The relative velocity $\boldsymbol{U}$ in eq. 24 is the velocity of the cloud parcel relative to the TRF frame of reference. This term represents the velocity vector of the cloud seen by an observer fixed to the Earth's surface as the *Quran* 27:88 verse exactly says. Its magnitude gives the instantaneous cloud's speed value, and its unit vector indicates the cloud's direction into the atmosphere. Measurements of this term are usually done, for example, in weather stations and airports using radars and satellites (see Fig. 1). Nevertheless, the recorded cloud speed values are usually in the orders of magnitude of 1 m/s, 10 m/s or 100 m/s as mentioned already before.

Now, where the clouds exist, they are moving through the atmosphere. In general, the clouds are in equilibrium into the atmosphere under action of three forces: gravitational force, pressure- gradient force, and friction forces. The vector sum of all those forces, the net force, is:

$$\sum \mathbf{F} = \boldsymbol{F}_g + \boldsymbol{F}_p + \boldsymbol{f} \qquad \text{(eq. 25)}$$

Substituting each term by its expression, we obtain:

$$\frac{\sum \mathbf{F}}{\rho \mathrm{dV}} = \boldsymbol{g}^* - \frac{\nabla p}{\rho} + \nu \Delta \boldsymbol{U} + \boldsymbol{f} \qquad \text{(eq. 26)}$$

where ρdV is the mass of the cloud parcel, *p* is the pressure, ρ is the air density, $^{\nu}$ its kinematic viscosity and $\Delta = \nabla \wedge \nabla$ is the Laplace operator. The first term of right-hand side of eq. 26 is the gravitational force per unit mass; the second term is the pressure gradient force per unit mass, the third and fourth terms on the right-hand side are the shear stress of a fluid or shearing forces molecular friction and turbulent friction forces per unit mass respectively. All these forces are real forces.

If the mass ρdV of cloud parcel is moving with a constant velocity, which is often the case of the most clouds in the atmosphere, then the cloud is in dynamic equilibrium, even instantaneous, in both GFR and TFR frames of reference so its relative acceleration relative to the ground is zero ($\boldsymbol{a}_r = \mathbf{0}$). Contrary to the mountains, the Coriolis force acting on the clouds is not zero because they are moving relative to the ground. In these circumstances, eq. 26 can be written simply under another version in terms of forces which is:

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$$\underbrace{\boldsymbol{F}_g + \boldsymbol{F}_p + \boldsymbol{f}}_{Real\ forces} = \underbrace{\mathbf{F}_{ent} + \mathbf{F}_{Cor}}_{Apparent\ forces} \quad \text{(eq. 27)}$$

By applying the Fundamental Principle of Dynamics (*FPD*) to the cloud parcel in the GRF absolute reference frame, we obtain the *momentum equation*. For this, we should combine the equations 24 and 26 as follows:

$$\sum \mathbf{F} = \rho dV \frac{D_a \boldsymbol{U}_a(P,t)}{Dt} \quad \text{(eq. 28)}$$

In general, clouds are free to move in the atmosphere and this is why they are often considered into the *incompressible* fluids. So, taking their incompressibility into account, and substituting each term of eq. 28 by their expression in eq. 24 and 26, the *momentum equation* takes this form:

$$\boldsymbol{g}^* - \frac{1}{\rho}\nabla p + \nu\Delta \boldsymbol{U} + \boldsymbol{f} = \frac{\partial \boldsymbol{U}}{\partial t} + (\boldsymbol{U} \cdot \nabla)\boldsymbol{U} + \boldsymbol{\Omega} \wedge (\boldsymbol{\Omega} \wedge \boldsymbol{r}) + 2\boldsymbol{\Omega} \wedge \boldsymbol{U}$$
(eq. 29)

$\nabla \cdot \boldsymbol{U} = \mathbf{0}$ for incompressible fluids
(eq. 30)

Eq. 29 is the Navier-Stokes equation. It is the fundamental equations that govern the evolution of atmospheric motions. The terms on the left-hand side of eq. 29 are the real forces *per unit mass*. The second term on its right-hand side is the *convective force*; third and fourth terms are respectively the centrifugal force and the Coriolis force *per unit mass*, all are apparent forces; the eq. 30 is the incompressible clouds equation. At the steady state of the cloud's motion, the relative velocity's derivative is zero. Then, eq. 29 becomes very attractive. It shows that in the GRF absolute reference, all real forces that act on clouds are balanced only by centripetal force and Coriolis forces which only are apparent forces. It should be noted that the Coriolis forces are not zero for the clouds contrary to the mountains for which they do not exist. The Coriolis force forces cloud motion to become increasingly complex [4, 52]. The study of the effect of the Coriolis force on the dynamics of clouds is outside our present purpose.

As we see, the remaining terms on the right-hand side of eq. 29 are in general not zero but rather they can vary. This means that clouds cannot exist in the atmosphere without being even instantaneously in *dynamic equilibrium* in the GFR frame of reference with non-zero velocity, even for the case of clouds which appear and disappear successively in space. And the interpretation of this is obviously that the clouds are, as mountains, in motion with respect to GRF frames of reference. Indeed, the mountains are moving in the GRF frame of coordinates with velocities (see Fig. 7) quite comparable to those of the clouds in TRF frames of reference. This is what the Quran is saying by *the mountains pass as the passing of the clouds* but each in its frame of reference. The mountains are moving with velocities in GRF frames of reference but clouds are in TRF frames of reference.
Now, the application of Newton's second law but this time in the TRF reference frame consists to isolate the relative velocity's derivative by rearranging equation 29 as follows:

$$\frac{\partial \boldsymbol{U}}{\partial t} = \boldsymbol{g} - (\boldsymbol{U} \cdot \nabla)\boldsymbol{U} - \frac{1}{\rho}\nabla p + \nu\nabla^2 \boldsymbol{U} - 2\boldsymbol{\Omega} \wedge \boldsymbol{U} + \boldsymbol{f}$$
(eq. 31)

where the apparent weight of the cloud parcel per its mass, $\boldsymbol{g}$, is given by eq. 21 above in which the position vector $\boldsymbol{r}$ should be from the Earth's globe to the cloud parcel center to center. As we see, it is possible to solve these Navier-Stokes equations on computer [58-60] but it is not useful for us here.
The *momentum* equation, eq. 31, shows that in the TRF Earth's rotating reference frame, the vector sum of real forces ($\boldsymbol{F}_g + \boldsymbol{F}_p + \boldsymbol{f}$) and apparent forces ($\boldsymbol{F}_e + \boldsymbol{F}_{Cor}$) that act on the cloud parcel are not zero, but contrary to the mountains, the relative velocity of the clouds with respect to the ground is not zero. Although, the terms' sum of the right-hand side of eq. 31 is equals zero only if $\boldsymbol{U}$=*cnst*. This is because the clouds are often in dynamic equilibrium, even if instantaneous, in the TFR reference frame. This result leads us to state that clouds are moving in all terrestrial reference frames. That's what the *Quran* 27:88 verse exactly says. Clearly, clouds are moving with respect to any terrestrial observer.
The Coriolis force per unit mass in eq. 31, $-2\boldsymbol{\Omega}\wedge\boldsymbol{U}$, acts on a cloud parcel only because just it is moving relative

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to the ground. Some clouds appear motionless but the most widespread case that exists in nature is that of moving clouds [35-38]. The Coriolis force usually acts orthogonal to the plane containing the Earth's angular velocity vector, $\boldsymbol{\Omega}$, and the cloud parcel's relative velocity vector, $\boldsymbol{U}$. Hence, the direction of the Coriolis force depends on that of the relative velocity of clouds with respect to the Earth. In addition, clouds have often a random and unpredictable behavior, they can move in any direction into the atmosphere with any velocity [4, 52].

In spherical coordinates (r,θ,φ), the relative velocity vector and its components are given by: $\boldsymbol{U} = u\,\boldsymbol{e}_\varphi + v\boldsymbol{e}_\theta + w\,\boldsymbol{e}_r$ where ($\boldsymbol{e}_r$, $\boldsymbol{e}_\theta$, $\boldsymbol{e}_\varphi$) are corresponding unit basis vectors and u, v and w are eastward, northward, and vertically upward components of the relative velocity of the cloud parcel into the atmosphere, respectively [52].

After neglectful friction forces, the original momentum equations, eq. 31, become in spherical coordinates in the zonal, meridional, and vertical directions [52] respectively:

$$\frac{Du}{Dt} + \frac{uw - uv\tan\lambda}{r} = -\frac{1}{\rho r\cos\lambda}\frac{\partial p}{\partial \varphi} - 2\Omega w\cos\lambda + 2\Omega v\sin\lambda$$
(eq. 32)

$$\frac{Dv}{Dt} + \frac{vw + u^2\tan\lambda}{r} = -\frac{1}{\rho r}\frac{\partial p}{\partial \lambda} - \frac{1}{\rho r}\frac{\partial \Phi}{\partial \lambda} + 2\Omega u\sin\lambda$$
(eq. 33)

$$\frac{Dw}{Dt} - \frac{u^2 + v^2}{r} = -\frac{1}{\rho}\frac{\partial p}{\partial r} - \frac{\partial \Phi}{\partial r} + 2\Omega u\cos\lambda$$
(eq. 34)

Here φ is longitude, λ is latitude, r is the radius, and u, v, w are associated relative velocity components; t is time, ρ denotes density, p is pressure, Ω is the Earth's angular velocity ($7{,}292 \times 10^{-5}$ rad s^{-1}), and Φ is the gravitational potential. The three variables commonly used in these momentum equations in spherical coordinates are: φ, longitude angle, θ : complement angle of the latitude angle λ, and r : radial or local vertical distance to the cloud parcel (see Fig. 10), and by z from the Earth's surface, where $r=R+z$ with R is Earth's radius.

Directions of spherical unit basis vectors, ($\boldsymbol{e}_r$, $\boldsymbol{e}_\theta$, $\boldsymbol{e}_\varphi$), change with position. For example, for a cloud parcel at the equator, the meridional unit vector, $\boldsymbol{e}_\theta$, is parallel to the Earth's rotation axis, whereas for a cloud parcel near one of the poles, $\boldsymbol{e}_\theta$, is perpendicular to the Earth's rotation z-axis.

In this work, to, simplify, we adopt a local Cartesian coordinate system representing the Earth's surface as locally ‘‘flat’’. The momentum equations can be derived from eq. 32 to 34 by appropriate scaling and then making an expansion in small parameters L/R and H/R, where L and H denote the characteristic horizontal and vertical scales of the cloud's flow, respectively. In general, cloud thicknesses are very thin compared to the mean radius of the Earth (R); hence the inequality $|r–R|/R << 1$ is always satisfied, regardless the kind of motion under consideration. The *Coriolis parameter* is: $f = 2\Omega \sin\lambda$. The usual west-east, south-north, and vertical Cartesian coordinates are introduced via $x = (R\cos\lambda)\varphi$, $y = r\lambda$, and $z = r–R$. This entails several approximations [52]. The gradient ∂Φ/∂λ can indeed be neglected, while ∂Φ/∂r reduces to a constant g. Another natural approximation, seemingly, is to replace r by R in the metric terms in eq. 32 to eq. 34, as is common practice in textbooks on geophysical and astrophysical fluid dynamics. This leads to the set

$$\frac{du}{dt} + \frac{uw - uv\tan\lambda}{r} = -\frac{1}{\rho}\frac{\partial p}{\partial x} - 2\Omega w\cos\lambda + 2\Omega v\sin\lambda$$
(eq. 35)

$$\frac{dv}{dt} + \frac{vw + u^2\tan\lambda}{r} = -\frac{1}{\rho}\frac{\partial p}{\partial y} + 2\Omega u\sin\lambda$$
(eq. 36)

$$\frac{dw}{dt} - \frac{u^2 + v^2}{r} = -\frac{1}{\rho}\frac{\partial p}{\partial z} - g + 2\Omega u\cos\lambda$$
(eq. 37)

As we see, each equation of motion of this system has several terms in them. The question that arises is, “which ones are the largest and, thus, the most important?” The answer is, “It depends on the form of the cloud and its conditions.” Let's use *scale analysis* to determine which terms to keep and which ones we can neglect or even ignore when solving these cloud motion equations. We can follow these steps:

First, let us consider a cloud of the Mid-level clouds. We can equally consider a cloud of High-level clouds or Low-level clouds, these equations apply to all types of the clouds. A typical cloud parcel has a volume of around 1 km^3. The density of clouds is around 1,003 kg/m^3 – about 0,4 per cent lower than that of the surrounding air. The *Coriolis parameter* is: $f = 2\Omega \sin\lambda$. At λ=45°N, $f \sim 10^{-4}\ s^{-1}$. The clouds are considerably thinner in their vertical extent (scale height 10 km) than in its horizontal extent. The largest scales of motion are in the horizontal direction and form the basis for the *general circulation* of the atmosphere. We will concern ourselves first with these horizontal motions.

To compare the magnitudes of the terms in eq. 35, 36 and 38, we should determine the typical characteristic (i.e.,) lengths and times over which the clouds' phenomenon occurs. The typical length L ~ 1000 km. Vertical movements in Altostratus clouds are weak, of the order of less than one meter per second, but are exerted on a great thickness of the atmosphere [60]. Clouds can move over a typical height H ~ 7 km, the relative velocity of the clouds which moves locally horizontally is of the order U ~ 10 to 100 m/s and even more, Δp ~ 1 mba = 1 hPa (in the horizontal variation); times over which the cloud's phenomenon occurs: $t \sim L/U = 10^6$ m /10 m/s = 10^5 s; $W = H/t = 10^4$ m/10^5 s = 10^{-1} m/s. The kinematic viscosity of the clouds is about $\nu = 2$ to $5 \times 10^{-6}\ m^2/s$. By doing the scale analysis, we have the following orders of magnitude (in m/s^2): $du/dt \sim \Delta U/\Delta t \sim 0$, $GM/r^2 \sim GM/(R+H) \sim 10$, $2\Omega v \sin\lambda \sim fU \sim 10^{-3}$, $2\Omega w \cos\lambda \sim fW \sim 10^{-5}$, $uv/R \sim UW/R \sim 10^{-7}$, $uv \tan \lambda/R \sim U^2/R \sim 10^{-5}$, $\partial p/\rho\partial x \sim \Delta p/\rho L \sim 10^{-3}$. By conserving just the dominant terms, eq. 35 to 37 in the three directions indicted by unit basis vectors ($\boldsymbol{e}_r$, $\boldsymbol{e}_\theta$, $\boldsymbol{e}_\varphi$) becomes as:

$$\frac{1}{\rho}\frac{\partial p}{\partial x} - fv = 0 \qquad \text{(eq. 38)}$$

$$\frac{1}{\rho}\frac{\partial p}{\partial y} - fu = 0 \qquad \text{(eq. 39)}$$

$$\frac{1}{\rho}\frac{\partial p}{\partial z} + g = 0 \qquad \text{(eq. 40)}$$

The dominant terms in equations 38 and 39 are the pressure gradient force and the Coriolis force. Indeed, these equations of motion show that the *geostrophic* balance of the clouds is horizontally assured by these two forces only. The vertical momentum equation, the eq. 40 shows that the vertical distribution of mass in the clouds is determined by a balance between gravity and the pressure-gradient forces. In the horizontal direction, when gravity doesn't work, the balance of forces usually involves equilibrium between the pressure gradient force and the Coriolis force, and the resulting steady flow is called the geostrophic flow. Below 1 km altitude, the horizontal flow is modified by friction with the Earth's crust and mountains and this effect is outside our current purpose.

Conversely, from eq. 38, the cloud velocity is:

$$v = \frac{1}{f\rho}\frac{\partial p}{\partial x} \qquad \text{(eq. 41)}$$

Different clouds carry different amounts of water droplets and so they have different densities. The water density of brilliant white cumulus clouds, for example, have densities of 0,5 g/m^3. Therefore, cumulus clouds have a density of about 1,005 kg/m^3. A typical cloud weighs around a million tons. If Δp ~ 100 mbar, then we have:

$$v = \frac{1}{10^{-4}}\frac{10^4}{(1)(10^6)} = 100\ m/s$$

If Δp ~10 mbar, then v ~10 m/s, and for Δp ~1 mbar, v ~1 m/s.

As we can see, the resolution of the Navier-Stokes equation shows that the cloud velocities are in the range of 1, 10 to 100 m/s. And according to the Holy Quran, as the mountains pass as the passage of the clouds in the atmosphere and vice-versa, the velocity of the clouds, like that of the mountains, cannot exceed the limit of 463 m/s as shown in Fig. 7 above. Therefore, the *Quran* 27:88 verse allows us to postulate that the speed of clouds varies between ~ 1 m/s for clouds that are almost motionless and 465 m/s for extremely fast clouds like a Concorde aircraft which had a maximum cruising speed of 2179 km/h and that the speed of clouds never exceeds the limit of 465 m/s (~1670 km/h).

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VI. Discussion

As we see, the mountains' velocities in GRF frame of reference are comparable to those of the clouds in TRF frame of reference. Otherwise, velocities of clouds relative to the Earth are quite included in the interval of those of mountains but on condition that the former are in TFR frames of reference and the latter in GFR reference frame. Indeed, the interval of mountain velocities covers all the values of cloud speeds which are known up today. It is only in these frames of reference, the TRF and GRF frames, that we can compare, if it is possible, velocities of mountains with those of clouds. Otherwise, mountains' velocities and clouds can never be compared relative to the same frame of reference because they are simply incomparable due to the fact that the mountains are motionless in the TRF frames of reference. Consequently, knowing exact values of cloud and mountain velocities is not the main objective of this research work because what the *Quran* 27:88 verse says is not to compare the velocity's values of mountains to those of the clouds above them value to value, but it just indicates the fact that the mountains are not in absolute immobility to push scientist people to start doing astrophysics more than 1400 years ago. Indeed, deducing the speed of a mountain from that of the clouds (even if they pass over it) is inconceivable because the speeds of the clouds are chaotic or even unpredictable, and the speed of the mountains depends on the latitude angle (see Fig. 7) and also the height of mountains. For example, the velocity of mountains at latitude angle 0° at the equator's parallel is about 463 m/s (~1670 km/h) which is comparable to the velocity of the Concorde airplane, while the speed of clouds is often very small compared to this value.

Nevertheless, everyone see the clouds moving through the atmosphere. In pedagogy, when we opt for an analogy to understand an important abstract concept, to give it a better explanation, on make the analogy with something that is familiar with everyone. And as it is very difficult to accept, even today, that the mountains as pegs are isolated bodies that move because on the contrary the people see them usually motionless in their places, to make it clear that the mountains are not absolutely immobile (which is a priori not easy to admit), the better analogy was revealed in the *Quran* 27:88 verse by saying that the mountains pass as the passing of the clouds in the atmosphere. This important indication in the Qur'an, among many others, was enough to draw, at least, scientist people's attention to the fact that the mountains are not immobile, that the mountains move to sensitize them to understand precisely that the mountains are not absolutely immobile. Why? This is one of best analogies that the Quran reveals 1400 years ago. The Quran gives people opportunity to admit and accept that the mountains are not stationary and that in fact they are constantly moving, and in consequence departing from the *Quran* 27:88 verse, they will also understand that the whole of the Earth is moving since these mountains are *firmly fixed* to it. Finally, they will understand early that the Earth rotates around its axis, and deduce to place the Sun at the center of the Solar system in the Universe, stationary, with Earth and the other planets orbiting around it at uniform velocities. From this epoch until the Renaissance era, objects that move faster than all other such horses, camels or even some kinds of birds are winds or clouds. The wind is invisible. Only the clouds remain that are big objects visible to the naked eye. Obviously, the people see the clouds pass much faster than those kinds of animals, and at this epoch the analogy between the clouds and the mountains motions was enough to explain the *Quran* 27:88 verse. In addition, the size of the mountains is comparable to that of the clouds. The resemblances between them are therefore plausible. Mountains are huge objects, clouds too. Mountains are very useful objects for life on Earth and its stability, clouds too. Naturally, the analogy between the movement of clouds and that of mountains was a source of inspiration for Muslim scholars during the Middle Ages. It is a miracle of the Holy Quran. At least, it is a strong indication enough at the epoch to push many Muslim astronauts to reject the Ptolemy's geocentric model, at the same time, knowing that the Earth is shaped round they immediately invented the heliocentric theory from the 10th Century contrary to what public people believe [12,19-20]. Unfortunately, this heliocentric theory was appropriated by Copernicus *et al.* from the beginning of the 16th Century although the theory was posed by the Muslim scholars long before him. Especially since Copernicus as a Christian scientist, was in contact with the Catholic Church which held all information and data on the Science's progress in the Word of the Middle Ages.

The earlier audience of the Quran, with their belief in a flat and static Earth planet, struggled to make sense out

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of this seemingly 'bizarre' claim in the *Quran* 27:88 verse about the cloud-like flux, fluidity and motion of the mountains. In this universal flux, the apparent immobility of the mountains is only an illusion. As they couldn't grasp the complexity of the idea due to the inadequate scientific information of their time, they tried hard to explain away the cloud-like passing of mountains as a future event, thus misreading the verse as simply one of the verses related to the world's end. Their understanding failed to take into account the following observations: The starting phrase "Seeing the mountains you THINK them motionless" points out our superficial perception that mountains are immobile. Then it is negated by its immediate antithesis "while (in reality) they are passing …", which identifies this perception as an illusion. And, because the second statement negates the first, both of them must be logically interconnected within the context of the same present event rather than referring to a future cataclysm.

Then the verse goes on defining this unnoticed phenomenon as an expression of God's artistry or creativity (made of God), which, clearly, cannot be about the chaos at the destruction of the Universe at the world's end. Thus the narration doesn't fit into the revelations of the verses about the last Hour that mentioned in the Holly Quran, which would involve a calamity of cosmic magnitudes with serious disorder and devastation, while causing an utmost shock and panic among the witnesses. Finally, the concept God's artistry or creativity is explicated by a reference to His organized order and perfection in creation ("Such is the artistry of God, who has ordered everything thoroughly to perfection"). This leaves no room for traditional confusion: The end of the world, with its chaos and destruction, is neither the perfection of art, nor an imperceptible event.

II. Conclusion

The main objective of this article was to elucidate, for the first time, what saying the *Quran* 27:88 verse by assimilating the movement of mountains to these of clouds. It is now worth recalling the integral of the verse: *And you see the mountains, thinking them motionless, while they pass as the passing of the clouds. [It is] the handiwork of Allah, who perfected all things. Indeed, He is acquainted with that which you do***.**

All in all, the strength of the first sentence of the *Quran* 27:88 verse lies in the fact that it amazingly combines two equilibriums of the mountains at the same time: static equilibrium of the mountains with respect the TRF frames of reference and their dynamic equilibrium relative to the GRF absolute frames of reference. Indeed, we have shown that mountains pass, like the passing of clouds but each in its frame of reference. The mountains' velocities are relative to GRF and these of clouds relative to TRF frames of reference. The mountains' velocities in GRF reference frame are comparable to those of the clouds only in TRF frames of reference but they are uneven in most cases. The velocity of both is, in all cases, in the order of 1 m/s, 10 m/s and 100 m/s. Then, the velocity of mountains and clouds does not exceed these orders of magnitude. In addition, the intervals of their speeds thus overlap but they are often different. The interval of mountain velocities contains all the values of cloud speeds which are known up today (see Fig. 7). It is only in these two frames of reference *i.e.*, TRF and GRF frames, that we can compare velocities of mountains to those of clouds. Otherwise, velocities of mountains and clouds can never be compared relative to the same frame of reference because simply they are incomparable due to the fact that the mountains are quite stationary in all terrestrial frames of reference. Furthermore, the speed of mountains depends mainly on the latitude angle unlike that of clouds which depends on the altitude and many other parameters, and what the *Quran* 27:88 verse says is not to compare the speed's values of mountains to those of the clouds above them, but it mainly indicates that the mountains are not in absolute immobility to get people to use their brains, to think about doing astrophysics more than 1400 years ago. This is why the knowledge of neither clouds nor mountains speed's values was not important to understand what the *Quran* 27:88 verse is saying. It suffices to know that the mountains move in relation to some objects of the reference such as, for example, fixed stars in the Universe. Now, the Qur'an had shown since the dawn of time that even if we see the mountains as stationary relative to the Earth, in fact they are not: they pass like clouds. It is not necessary even today to know the exact values of the speeds of all the types neither of clouds nor all mountains to understand what the *Quran* 27:88 verse is saying. First of all, this verse says that the mountains appear as if they are motionless but in reality they pass like the passing of the clouds, this does not require to know exact values of velocities.

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Finally, we have shown in this work, and this is where our idea lies, that mountains are not motionless in the geocentric reference frames of reference, on the contrary, they are in motion at uniform speeds. Indeed, the mountains rotate on circular trajectories centered on the *Oz* axis of rotation of the Earth's globe. And if the mountains rotate around *Oz* axis with uniform velocities, then clearly the Earth rotates also around the same axis because they are *firmly fixed* to its surface by their roots. Normally, this discovery led to position the Sun at the center of the Universe, stationary, with Earth and the other planets *swimming* each in its orbit around it [23], and at uniform velocities. So, want it or not, the phenomenon that Earth rotates on itself was is one of the great revelations of the Holy Qur'an more than 1400 years ago.
Of course, this is one miracle among many others mentioned into the Qur'an. This explains why the Muslim scientist early rejected the Ptolemaic system [12]. Otherwise, we have clarified, as it should be, that this apparent immobility of mountains is a relative phenomenon since it depends on the observer's frame of reference. We understand how hard these concepts are to assimilate by public people, but we also believe that through this modest research work, the scientific realities revealed in the *Quran* 27:88 verse and which unfortunately public people were still unable to comprehend since 1400 years ago have now become plausible than they ever were before.

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