Pioneer Anomaly

collected and *written by Hamid*

"The Pioneer anomaly or Pioneer effect is the observed deviation from predicted accelerations of the Pioneer 10 and Pioneer 11 spacecraft after they passed about 20 astronomical units (3×10^9 km; 2×10^9 mi) on their trajectories out of the Solar System. The apparent anomaly was a matter of tremendous interest for many years.

Both Pioneer spacecraft are escaping the Solar System, but are slowing under the influence of the Sun's gravity. Upon very close examination of navigational data, the spacecraft were found to be slowing slightly more than expected. The effect is an extremely small acceleration towards the Sun, of $(8.74\pm1.33)\times10^{-10}$ m/s2, which is equivalent to slowly accelerating to a velocity of one kilometer per hour (0.6 mph) over a period of ten years. The two spacecraft were launched in 1972 and 1973 and the anomalous acceleration was first noticed as early as 1980, but not seriously investigated until 1994. The last communication with either spacecraft was in 2003, but analysis of recorded data continues." **- *Wikipedia***

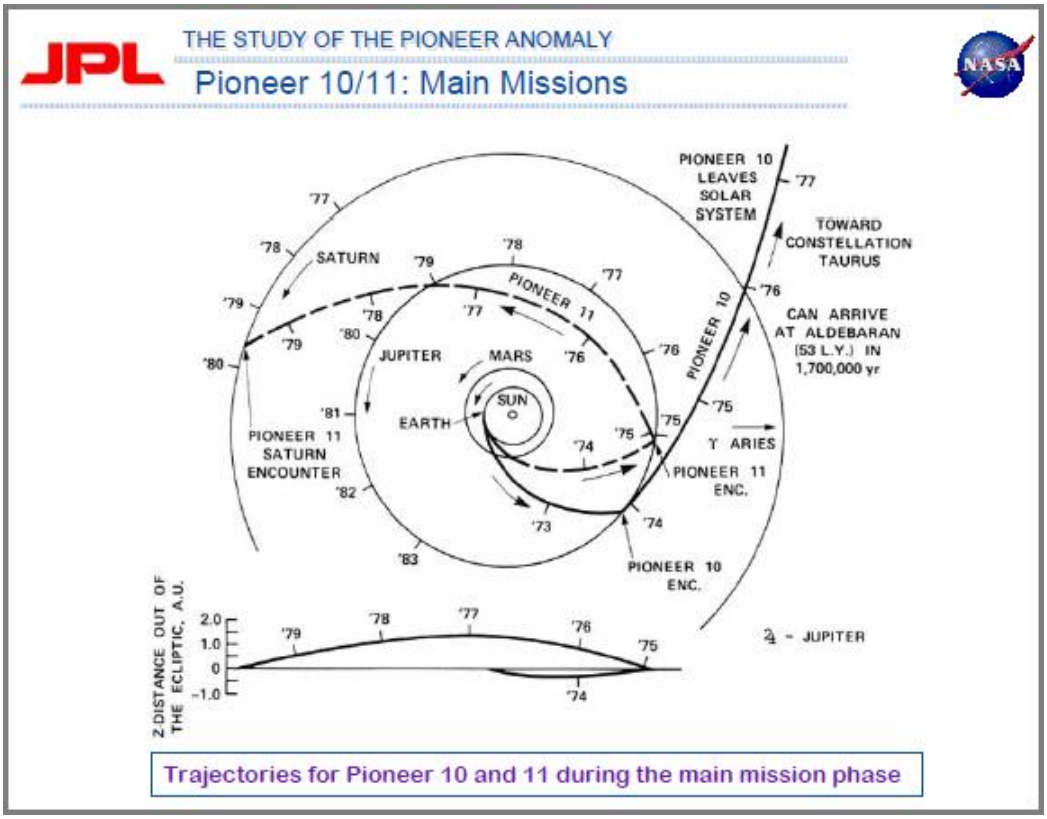

Figure 1- Pioneer 10/11: Main Missions
http://www.slac.stanford.edu/econf/C041213/presents/0310_TLK.PDF

***Latest news (June 2012)**: The Pioneer Anomaly appears to have been solved in a paper published in the journal **Physical Review Letters**.*

Introduction to the puzzle

*"**The Pioneer 10 and Pioneer 11 deep space probes were not where they were supposed to be**. Radio telemetry received from the spacecraft, over a period of many years before contact was lost with both probes, indicated that they were slowing down slightly more than expected with the result that each year they traveled about 5,000 km (3,000 miles) less than mission controllers had projected. The slowing down was tiny, amounting to a deceleration*

toward the Sun of (8.74 ± 1.33)×10^{-10} m/s2, i.e. than a nanometer (a billionth of a meter) per second per second. This is equivalent to just one ten-billionth of the gravity at Earth's surface. However, although incredibly small, the effect was persistent over several decades. When mission controllers last heard from Pioneer 10, it was a quarter of a million miles from where it was supposed to be – roughly the distance from the Earth to the Moon. When ***NASA*** *lost touch with Pioneer 11, several years earlier, it was heading for a similar deviation.*

The anomalous deceleration of the twin Pioneers was inferred from a small, constant, anomalous Doppler shift in the frequency of radio signals received from the spacecraft. Various explanations were put forward to account for the so-called Pioneer Anomaly. Although it was always suspected that there might be a systematic origin to the effect, such as thrust from a gas leak, none had been found. ***Some scientists therefore began to consider more exotic explanations, including the possibility that our understanding of gravity might need to be revised****." -* ***David Darling*** *(The World of David Darling)*

http://www.daviddarling.info/encyclopedia/P/Pioneer_anomaly.html

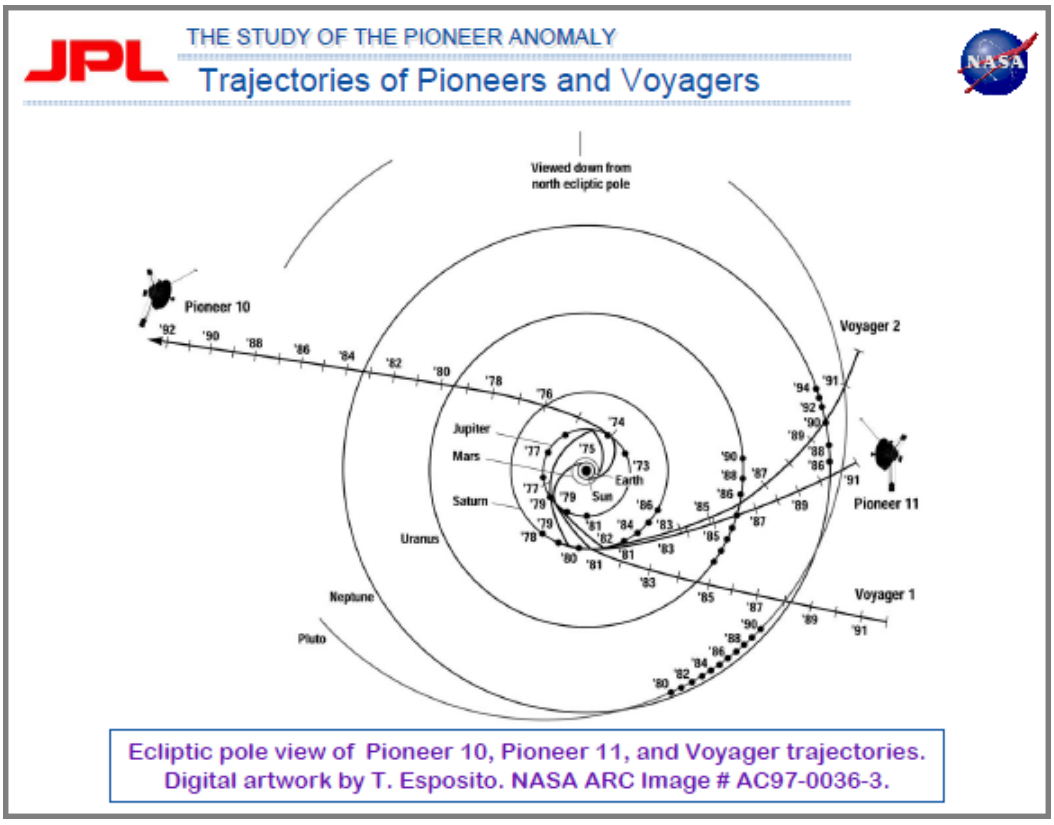

Figure 2- Trajectories of Pioneers and Voyagers
http://www.slac.stanford.edu/econf/C041213/presents/0310_TLK.PDF

The existing explanations of *Pioneer Anomaly* could, of course, be analyzed and judged by related specialists, particularly by those who have been involved in the design and data collection of the project. It is certainly far from my knowledge and experience.

I personally consider the possibility that our understanding of gravity needs to be revised in order to discover the key point required for explaining this anomaly. My approach in this regard is to apply the rules of ***Quantum Gravity*** to solve the most important aspect of this problem.

Based on the analysis set forth in my article ***(Exact Planck Length Unveils Quantum Gravity)***, gravity is quantum in nature and therefore "**G**" is not a fundamental constant, its value at each

point of the space depends on the speed of light "**c**" at that point. The quantum value of "G" is computable by using this formula: $\mathbf{G= \xi c^3}$, in which **ξ**= 2.475890015 $\times 10^{-36}$ m^2/ (J.s). "**ξ**" is a new fundamental physical constant. It is worthy of mention that this formula is not based on a vague opinion or on a belief, but it has been derived from a plausible mathematical interpretation of quantum mechanics, rooted in ***Gaussian Normal Distribution***.

At first glance and considering the accessible data about trajectories of Pioneers, it appears that the average quantum value of "G", that is to say 6.671038654 $\times 10^{-11}$ $m^3/(kg.s^2)$, is valid only for a very small part of the universe in which we live (the Solar System, most probably). If it would be true, then my prediction based on my mathematical analysis of quantum gravity would be confirmed! It is here necessary to remind that at present time the obtained value for "**G**", as a fundamental constant, is equal to 6.673 84 x 10^{-11} $m^3/(kg.s^2)$. I think this issue is another thing that could affect seriously the calculations of trajectories of Pioneers.

Note:
This writing was for the first time published in **Toquest.com** on October 9, 2014.

(December 31, 2016)