19 May'03: A lettter to remind you about **the Pioneer Anomoly.**

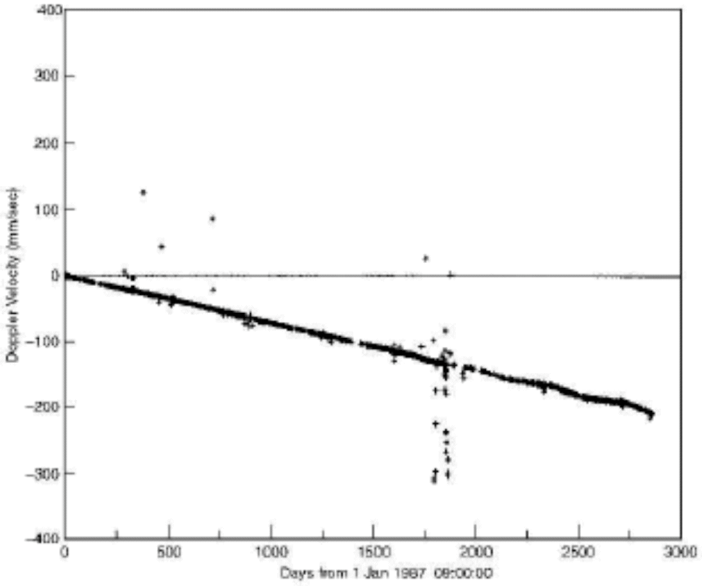
Starting over 30 years ago, a few brave men began to push for a measurement of dynamics far away from earth. Motivated simply that maybe something other than our standard mechanics might appear. This became part of the space program, and resulted in launching of several space probes. Most significant are Pioneer 10 and 11. Former is now still escaping fron our Sun, some 80 AU distant, and moving outward with a velocity of some 13 10^5 cm/sec.

As part of this effort, JPL has also carefully installed radio ranging equipment which fits into other very precise astrometric measurements as well. You can begin to learn about this by looking at Phy.Rev.Lett **81**, 2858,(1998). Or Eprint *qr-qc9808081*.

Ignore all the fascinating technical details for now, but concentrate on the figure from there that I reproduce below. Their claim is: after correcting for all known effects they and many others have thought about,, **there is an unexplained systematic velocity(t) shift.** As if there is an extra force pulling the Pioneer10 back toward the sun, beyond the gravity force that we know about.

[1] arXiv : gr – qc / 104064 v4 11 Apr 2002 and earlier reports too.

[2] Gary Godfrey told me about Pioneer Anomaly Dec' 02.



e-mail url is *sruby@earthlink.net*. Phone number here is: (408)354-1495.

A plausible, but so far ignored, explanation for this effect, is that a **Vacuum Drag Force exists**. Some elderly physicists still remember how Drag forces in absorbers became the origonal explanation for range-energy relationships. The overall picture was quite simple. Fast particles loose kinetic energy by 'jostling' the still charged particles of the absorber. Via near collisions at smallish impact params. Easy to see how this generates a theory of Stopping Power(v) $\rho \left(\frac{\text{Mev}}{\frac{\text{gm}}{\text{cm}^2}} \right)$. Where ρ is density of absorber matter.

What do I mean by vacuum Drag force? Remove the absorber, keeping the fast charged particles in a vacuum drift tube. This would bring ρ to 0, and expectation has always been that the Drag Stopping Power force would disappear. Another possibility is that ,even w/o charges of the absorber, the fast particle is still moving through a gravitational potential φ_{Gravity}. Might this perhaps still make some Drag? All Stopping Power measurements have been made in the presence of

standard φ_E (h=0), Vacuum Drag Force is a conceivable Drag force that operates between a fast particle and more distant atoms in the vacuum pipe, walls and floors of the room, and in fact , perhaps anywhere in Earth. Formally, φ_E represent a forcefield whose source is all those atoms. Some have suggested that at ultrarelativistic vels, spherical Coulomb forces are tranformed into flattened ellipses, reaching out into the transverse directions. The vacuum drag force can be assumed to be velocity dependant as well.

Key point is that stopping power should now be proportional to $\frac{\varphi(r)}{\varphi_E}(1+\rho)$, so that when $\rho \to 0$, removing the interaction with matter close to the particle's path, there still remains a possible coupling with the more numerous distant earth atoms.

Further thought suggests that the velocity dependent coefficient for drag is just the Poincare/Einstein $\gamma(v)$. Instead of following the now standard interpretation of velocity dependent mass, I suggest a return to the traditional idea of a velocity dependent Kinetic Energy. If interested in total mass, the total energy W of a fast particle is just the rest mass of the still particle, plus whatever work had to be supplied to accelerate it up to velocity v. That work being required to overcome the Drag forces encountered during the acceleration. That $W[\beta] = m_o \gamma(\beta)$ is experimentally exact, is demonstrated with every new accelerator that we build. Suggests then that Kinetic energy is not $\frac{m_o v^2}{2}$, but $m_o \gamma(\beta) - m_o$. And so, early ke(v) definition becomes now only the low β limit.

Have reached: **Stopping Power(β) = Drag force = $\frac{\varphi(r)}{\varphi_E}(1+\rho)\,\gamma(\beta)$** **(1)**

Will show you later, how (1) fully explains the Pioneer anomaly. So that one can claim that the Pioneer Anomaly is in fact the first measurement of the new vacuum drag force.

Hans, I would really enjoy seeing an straightforward earthly measuremnt of Vacuum Drag though , before I die. And have thought a little bit about how some measurements with < 100 Mev electrons would be able to do this. How would you go about it?

I do not have sufficient credability to get others interrerested in this adventure. But you would. 1960 was the most enjoyable year of my life. Might be that in 2004, we could drive a terrestial confirmation of vacuum drag. Do you want to play?

One more remark: I am already a believer in vacuum drag, mainly because the new interpretation of $\gamma(\beta)$ is so clearcut, and consistent with other ideas too. Where velocity dependant mass is *ad hoc* , and invented only for ultrarelativistic case.

Presently engaged in checking whether I can go from experimental Stopping Power(v) data to predicted ranges using (1). If the predicted ranges are also close to experiment, this provides another cross check on (1). This is a lot quicker than a new measurement, but not as nearly as satisfying.

If there are fish physicists, there is a question whether they would know about water. So ubiquitous, so omnipresent, so uniform in density, might easily be that some of its properties would be transformed into general statements about properties of fishes. Seems to me that we human physicists have behaved a bit like the fishy ones. All our Drag measurements have been made in presence of a local φ_E that generates g and $\overrightarrow{\text{down}}$ all the time. When we tried to become less parochial, and assumed equicompetent physicists in all kinds of other coordinate frames, we have assumed that those those other physicists will have local value of φ. Not knowing about vacuum drag here, we naturally omit it there too as well. If there is a vacuum drag force operating in the Pioneer measurement, every reason to assume it will also appear here on Earth.

Hans, are you ready for another adventure?