How rubbing with a microfiber manage to shatter the "bullet proof" windshield of Musk Cybertruck?

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Abstract

I learned about the Musk Cybertruck windshield that was told to be "bullet proof" but turned out to be quite not so. Even worse, it has been found that interaction with microfiber and the material of Musk Windshield creates some specific style of resonance that would then shatter that material. This brings to mind opera sopranos shattering wine glasses.

Why should one build complex new physics scenarios for how sopranos manage to break wine glasses? Hasn't this been understood a long time ago. But is this really the case? We are used to thinking that physics somehow mysteriously transforms from quantum to classical on some scale. Quantum coherence, which is not possible above atomic scales, would be replaced by classical coherence on long scales. If this is assumed, glass-breaking sopranos cease to look mysterious. This thinking has actually no justifications but only restates what is a fact. When you give this thinking up, the imagined self-evidences collapse. Phenomena that were undeniably a bit strange become impossible.

In TGD, a new view of spacetime comes to rescue. The spacetime surface defines the coherence region in both classical and quantum sense. Field bodies make long-scale quantum coherence and classical coherence, possible. Space-time surface defines the coherence region. Classical and quantal long-scale coherence would be related to classical long-range gravitational and electromagnetic fields. Gravitational and em Planck's constants, whose values can be enormous compared to h, quantify the hypothesis. This windshield effect is just one example of many.

The proposed TGD based model for the phenomenon relies on gravitational quantum coherence predicted to be possible in astrophysical scales and also possible quantum criticality. The gravitational magnetic bodies of both the Sun and Earth are assumed to play a key role. The reason is that macroscopic quantum coherence requires very large values of the effective Planck constant. It is assumed that the gravitational Compton frequency of the Sun defines a gravitational quantum coherence scale and sets a lower bound for the frequencies assignable to the acoustic oscillations inducing the instability of the windshield .

One can also consider other mechanisms of macroscopic quantum coherence. Cyclotron frequencies for the endogenous magnetic field of Earth are in EEG range and would correspond to energies above thermal energy and play a key role in the TGD inspired quantum biology and might be involved with the microfibers. This would require transformation of dark cyclotron radiation to sound waves and require a ferro electret property typical for organic materials. Quantum criticality making possible a generation of large h_{eff} phases is involved and warping deformations possible for planar or nearly planar systems are considered as a possible realization of the quantum criticality.

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1 Introduction

I learned from Heikki Hirvonen about the Musk Cybertruck windshield that was told to be "bullet proof" but turned out to be quite not so (see this). Even worse, it has been found that interaction with microfiber and the material of Musk Windshield creates some specific style of resonance that would then shatter that material. This brings to mind opera sopranos shattering wine glasses. One might think that the system considered must be critical so that very small periodic perturbations can induce very large changes if they are of the right kind and have a correct frequency.

1.1 Why should one worry about sopranos shattering wine glasses?

One might wonder what the point is in building complex new physics scenarios for how sopranos manage to break wine glasses. This has been understood a long time ago. But is this really the case? We are used to thinking that physics somehow mysteriously transforms from quantum to classical on some scale. Quantum coherence, which is not possible above atomic scales, would be replaced by classical coherence on long scales. If this is assumed, glass-breaking sopranos cease to look mysterious. This thinking has actually no justifications but only restates what is a fact. When you give this thinking up, the imagined self-evidences collapse. Phenomena that were undeniably a bit strange become impossible.

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1.2 Background observations and assumptions

It is good to start with some background observations.

1. The super strength of the glass could mean that it does not break under the deformations studied. Throwing piece rock and rubbing with microfiber do not belong to the class of allowed deformations. So what could be the deformations that do not break the glass?

   Could it be that only deformations have been tested where pressure is applied to the windshield, i.e. an impulse current in the direction of the impulse, but not deformations involving shear, i.e. the direction of the impulse current is perpendicular to the transferred impulse. The second difference is that there is a direct contact with the microfiber.

   Rubbing creates a shear. The microfiber is pressed against the surface and pushed horizontally at the same time: both pressure in the normal direction and shear in the direction of the surface are created. For example, in hydrodynamics, the very poorly understood generation of vortices at the interface (turbulence is due to shear). The creation of vortices is forced by the conservation of angular momentum. In TGD based quantum hydrodynamics, this process is essentially a quantum critical process on macroscales [K3].

Could it be that the strength of the glass, as defined in the way I guessed, was exactly the reason for the breakage. Would the glass be too rigid in this sense and unable to flex and break? Or could the glass be fragile in terms of certain types of deformations that have not been taken into account? Pressure wouldn't create them, but shear could do so. The characteristics of the microfiber could also be important.

2 TGD inspired model for the shattering of the windshield

The TGD based model for the phenomenon relies on gravitational quantum coherence predicted to be possible in astrophysical scales and also possible quantum criticality. The gravitational magnetic bodies of both the Sun and Earth are assumed to play a key role. The reason is that macroscopic quantum coherence requires very large values of the effective Planck constant. It is assumed that the gravitational Compton frequency of the Sun defines a gravitational quantum coherence scale and sets a lower bound for the frequencies assignable to the acoustic oscillations inducing the instability of the windshield .

One can also consider other mechanisms of macroscopic quantum coherence. Cyclotron frequencies for the endogenous magnetic field of Earth are in EEG range and would correspond to energies above thermal energy and play a key role in the TGD inspired quantum biology and might be involved with the microfibers. This would require transformation of dark cyclotron radiation to sound waves and require a ferro electret property typical for organic materials. Quantum criticality making possible a generation of large h_{eff} phases is involved and warping deformations possible for planar or nearly planar systems are considered as a possible realization of the quantum criticality.

2.1 What kind of model could be imagined for the phenomenon?

1. Could the strength of the glass be defined so that when a weight is placed on the glass plate, it does not develop dent: this would mean that no curvature is generated. For example, a planar sheet of metal is a good example. It does not break easily.

   However, a flat metal or glass plate (flatness is important!) is very sensitive against development of warping, which only bends but does not curve the flat surface so that it remains flat (curvature tensor vanishes). The fluttering of a metal plate is a good example of this. Another kind example is a sheet of paper unstable against fluttering. Such time-dependent warpings would decompose to 1-dimensional plane waves propagating along the surface of the metal of glass. They would be very much like transversal sound waves.

   What is important is that warping is a critical phenomenon due the large number of flat warped surfaces (the warping profile can correspond to any differentiable function). In TGD criticality involves the development of large h_{eff} phases and long-range quantum correlations, which gives strong clues concerning the understanding of the situation.

2. Already Euler thought about what happens when a weight is placed on a bar bent upwards (Euler buckling) (see this). At a critical weight, a collapse occurs. This is one of the basic applications of catastrophe theory. The critical amplitude of the warping wave would be analogous to the critical weight for which the glass would break.

3. One might think that the action principle contains an energy density term that is proportional to the square of the 2-D curvature scalar (see this) for the induced metric and vanishing for warped configurations. There would be an enormous vacuum degeneracy. Stability against deformations generating curvature requires that the coefficient of this term is very large. A lot of energy would be needed to produce a dent. But bending without curving brings in the Troyan horse.

   Action would of course also contain a term proportional to the surface area, which would correspond to the normal tension that tends to oppose the increase of the surface area. For warping, the energy would be only needed to increase the surface area. Could warping waves, possibly created by the rubbing with microfiber, lead to the breakage? Shear should provide the needed momentum and energy resonance should strengthen the warping wave.

2.2 What happens when the window shield breaks?

1. A catastrophe theorist might state that the system is characterized by, for example, a cusp catastrophe. When the critical shear is reached, the system undergoes a sudden transition: the system breaks down.

2. If one starts from the quantum level, the reduction of quantum coherence comes first to mind. In collapse the quantum coherence length would decrease dramatically from the size of the whole system to the size of the fragments. If the quantum coherence with the magnetic body of the glass surface takes care of the coherence of the glass, then it would have to decrease. In the h_{eff} distribution, the average value of h_{eff} would decrease.

   This is however only the outcome, not the primary cause. Long-scale quantum coherence and quantum criticality together with energy feed occurring at resonance frequency and increasing the value of h_{eff} would be the reasons leading to the limit at which the system collapses.

3. Why would rubbing with microfiber induce a critical shear leading to the breaking and loss of quantum coherence? Warping waves are a good candidate. The windglass would start to shake in the vertical direction. When the amplitude of the warping wave would exceed the critical limit, the result would be collapse and breaking into pieces. Rubbing with microfiber would feed into the system the necessary energy needed to generate h_{eff} phases and this would occur at quantum criticality associated with the warping waves.

2.3 Identifying the resonance frequency

This should include a frequency resonance that would correspond to the wavelength of the wave identifiable as a natural length scale for microfiber and/or glass. One would expect the flutter frequency to be on the Hertz scale and the acoustic resonance frequency of the windshield is a good guess. The sequel will certainly arouse academic head shaking, but it is based on the fact that in the TGD world, the planets and the sun form a quantum-coherent system, the effect of which can be seen on Earth at all levels, especially in biology. Second justification was given already in the beginning: our belief that we understand the classical world is based on an illusion about a mysterious transition from quantum to classical.

1. Microfiber has a wavelength $\lambda \simeq 1$ micrometer as a natural scale. The IR energy scale 1 eV of infrared photons would correspond to that and it can be assumed to be the basic scale. Could photons with this energy transform into bundles of dark photons with much longer wavelength; they, in turn, would eventually end up via intermediate steps into bundles of ordinary phonons or even into a Bose-Einstein condensate or a coherent state as a quantum analog of classical state.

2. Let's start with the Earth's gravitation [L1, L2, L3]. The gravitational Compton length $\Lambda_{gr} = GM_E/\beta_0$ related to the Earth's gravitation Planck's constant is for $\beta_0 = v_0/c = 1$ equal to $\Lambda_{gr} = .5$ cm (half of the Schwartschild radius), independently of particle mass, and the associated frequency is $f_{gr} = 67$ GHz. The frequency is quite too big. Furthermore, the Earth's gravitation is now not decisive because the warping is not in the vertical direction but closer to the tangential direction. In any case Earth's gravitation is not enough.

3. One must follow the example of Icarus and hope for better luck. The Sun's gravitational constant gives a frequency of $f_{gr} = 50$ Hz, which is the average EEG frequency and important resonance frequency of the EEG central in communications between the brain and its magnetic body [K2, K1] [L4]. This is a reasonable frequency. The corresponding gravitational wavelength $\Lambda_{gr} = c/f_{gr}$ is half the radius of the Earth.

   Needless to emphasize that this makes no sense unless one accepts the astrophysical quantum coherence assigned with gravitation and that the oscillation takes place on the magnetic body of the glass plate on the scale of the Earth's radius.

4. A strong objection is that f_{gr} does not depend at all on the geometry of the glassy system, in particular on the size scale of the windshield. A reasonable expectation is that the model should apply also to shattering of wine glasses.

A more general assumption is that the allowed frequencies are above the threshold defined by $f_{gr} = 50$ Hz defining the gravitational quantum period. At frequencies above f_{gr} gravitational quantum coherence would make itself visible. However, the frequencies coming as harmonics of f_{gr} could be especially interesting. This assumption is analogous to that appearing in the proposal for how gravitational quantum coherence could become important in classical computers [L3]. In any case, the assumption $f \geq f_{gr}$ is rather strong and gives lower bounds for the quantal resonance frequencies.

Could the resonance (basically acoustic warping wave) correspond to a frequency above f_{gr} or be identifiable as the frequency of dark photons generated at the magnetic body of the Sun?

1. The phonons of the acoustic wave would couple to the dark photons, produced by shear, at the magnetic body. This is where microfiber would take the role of a Trojan horse. Note that in liquid flow for which shear occurs near boundaries, the conservation of angular momentum forces the production of vortices which in TGD based hydrodynamics would be associated with dark monopole flux tubes. Also now, Z^0 magnetic vortices could be created.

2. The frequencies above f_{gr} would be the same, but the energy of a dark photon would correspond to the energy of many "warping phonons": a Bose-Einstein condensate/coherent state analogy of phonons would be created. Assuming proton-Earth pair, one has $\hbar_{gr}(Earth, proton)$ proportional to $m_p M_E$. This gives 1 eV energy scale, which corresponds to 1 micrometer wavelength for ordinary photons. The critical reader has probably noticed that the magnetic bodies of both the Sun and the Earth are included, characterized by $\hbar_{gr}(Sun, proton)$ and $\hbar_{gr}(Earth, proton)$ respectively. The gravitational Compton length $\Lambda_{gr}(Sun, proton)$ of Sun is $R_E/2$, which is the size scale for the Earth's magnetic body. Also $\hbar_{gr}(Earth, proton)$ is required.

   Could one think that dark photons with $\hbar_{eff} = \hbar_{gr}(Sun, proton)$ are created first, and that these break up into bunches of dark photons with $\hbar_{eff} = \hbar_{gr}(Earth, proton)$. The frequency would remain the same. These in turn break up into bunches of "warping phonons" with the same frequency.

3. If the propagation speed of the warping wave is roughly estimated to be the sound velocity in glass, that is $v = 4540$ m/s, then the wavelength would be $\lambda = v/f = 90.6$ m if one assumes that the value of f is smallest possible that is $f = f_{gr} = 50$ Hz. The wavelength is quite too long as compared to the dimensions of the windshield. v should be 2 orders of magnitude smaller, coincidentally(?) the same order as the conduction velocity of the nerve impulse. Note also that a micrometer is the scale of a cell nucleus. However, $f_{gr} = 50$ Hz defines only a lower bound for the quantum resonance frequency. A resonance frequency dictated by the geometry is in question and roughly scales like the inverse size of the system.

   In the case of wine glass, one expects a frequency scale, which is by two orders of magnitude larger, in the kHz scale. The E note at the hearing threshold corresponds to 20.6 Hz and for wine glass some octave of E is a reasonable estimate for the resonance frequency. The resonance frequency is k:th octave of this frequency and assuming that λ is of order .1 m, one obtains an estimate that 7:th octave is a reasonable guess. This is of order kHz. In the case of a windshield, one would expect λ to be 5 to 10 times longer so that the frequency could be around 3 or 4 octaves higher.

2.4 Summary

Microfiber rubbing would induce warping waves, whose amplitude would increase in resonance and lead to shattering.

1. First, dark photons (piezoelectricity) would be generated at the solar magnetic body and then decay to bunches of dark photons at the magnetic body of Earth with energy of order eV, corresponding to the scale of the basic structure of the microfiber. Their frequency would be abe $f_{gr} = 50$ Hz corresponding to the gravitational Compton wavelength of the Sun, which is of the order of the $R_E/2$, where R_E is the Earth radius. The dependence of the resonance frequency on the geometry requires that f_{gr} defines only a lower bound for f and its interpretation of f_{gr} is as a quantum coherence period.

2. $h_{eff} = h_{gr}(Earth, proton)$ photons would in turn decay to a "warping phonon" beam with frequency above $f_{gr} = 50$ Hz. Phonons would form a coherent state or BE condensate. This could lead to an acoustic laser effect and amplification, and the result would be resonance and catastrophe, analogous to Euler buckling, when the warping amplitude becomes too large. Here, quantum criticality, which is naturally associated with warping waves, would be essential, it would make the Trojan horse effect possible.

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