

NOVEL PLANETARY SIGNATURES FROM THE DARK UNIVERSE

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"Dunkle Materie" (DM) came from unexpected cosmological observations. Nowadays within our solar system, diverse observations also defy conventional explanations, like the main physical process(es) underlying the heating of the different solar atmospheric layers. Streaming DM offers a viable common scenario following gravitational focusing by the solar system bodies. This fits as the underlying process behind the solar cycle, which was the first signature suggesting a planetary dependency. The challenge, since 1859, is to find a remote planetary impact, beyond the extremely feeble planetary tidal force. We stress the possible involvement of an external impact by some overlooked "streaming invisible matter", which reconciles all investigated mysterious observations mimicking a not extant remote planetary force. Unexpected planetary relationships exist for both the dynamic Sun and Earth, reflecting multiple signatures for streaming DM. The local reasoning a la Zwicky is also suggestive for searches including puzzling biomedical phenomena. Favourite DM candidates are anti-quark-nuggets, magnetic monopoles, dark photons, or the composite "pearls". Then, anomalies within the solar system are the manifestation of the dark Universe. The tentative streaming DM scenario enhances spatiotemporally the DM flux favouring conditions for direct DM detection or extracting energy from the not-so-invisible as anticipated dark sector.

Keywords: *planetary relationship: dark sector: invisible matter: gravitational focusing*

1. *Introduction.* The discovery of "Dunkle Materie" (DM) by Fritz Zwicky came from unexpected cosmological observations. Today we know that our Universe is dominated by a mysterious DM. Its name is synonymous with the widely used definition, namely: DM does not emit or absorb or reflect electromagnetic radiation, making it difficult to detect. Following the reasoning of this work, this definition is misleading. Because, as we present here, several counter-examples might be caused by DM, while, at first sight, contradicting the definition of DM. Our working hypotheses are: Planetary (and solar) gravitational effects on the non-relativistic "invisible massive particles" can be focused on solar and planetary atmospheres (Fig.1). They also might interact "strongly", i.e., they can have a large cross-section with normal matter and radiation; such DM constituents

interact already in the outer atmosphere. Therefore, the screening by the upper atmospheric region is significant, strongly suppressing possible signals in deep underground experimental sites.

With time, a planetary alignment with an incident invisible stream will repeat provided the stream lasts much longer than the corresponding planetary periodicity. Often, an observed periodicity reflects either a single planetary orbital period or a synod of two or more planets, resulting in a signal enhancement. For example, the 11 years solar cycle coincides with the well-established synod of Jupiter-Earth-Venus. This probably not random coincidence was suggestive for the streaming DM scenario as it was proposed in [1] and underpinned by several follow-up signatures in solar and terrestrial observations along with long series of medical data on diagnosed melanomata (a type of skin cancer) [2-7]. A planetary correlation of any observable is then the novel signature for the dark sector, even though there is not a remote planetary force beyond the extremely feeble and smooth tidal force. Fortunately, for the streaming DM scenario, the gravitational deflection of an invisible stream depends inversely proportional to its velocity squared [8]. This favors enormously non-relativistic speeds like the ones widely assumed for the constituents of the dark Universe ($v \sim 0.001c$).

This scenario makes also any exo-solar planetary system of potential interest, since, as for the solar system, they also consist of orbiting gravitational lenses being probably appropriate to gravitationally focus constituents from the dark sector (whatever they are made of). After all, gravitational lensing depends considerably on the velocity of particles. In fact, even the Moon can focus DM particles on the Earth with velocities up to about 400 km/s covering thus a large fraction of the DM phase space [3,9,10]. Notice, throughout this work we often refer to "invisible matter", to distinguish it from the widely used DM which mainly refers to the celebrated candidates like axions and WIMPs.

The planetary gravitational lensing effects within the solar system become enormous only if invisible matter consists, at least partly, in the form of streams. Interestingly, recent cosmological considerations [11] arrived at a very large number of "fine-grained" DM streams in our Galaxy (up to $\sim 10^{14}$). Thus, to explain unusual or anomalous observations in our vicinity, we also converge on the existence of streaming "invisible matter" (see e.g. [1,3]). Notice that an invisible streaming scenario is suggested also by cosmological considerations [11,12], which are founded on a different reasoning. A posteriori we conclude that both findings, namely anomalous observations within the solar system, or the cosmological "fine-grained" axion streams, while they are based on a different logic, both converge towards streaming DM, or invisible matter that includes also other theoretically not yet foreseen candidates from the dark sector.

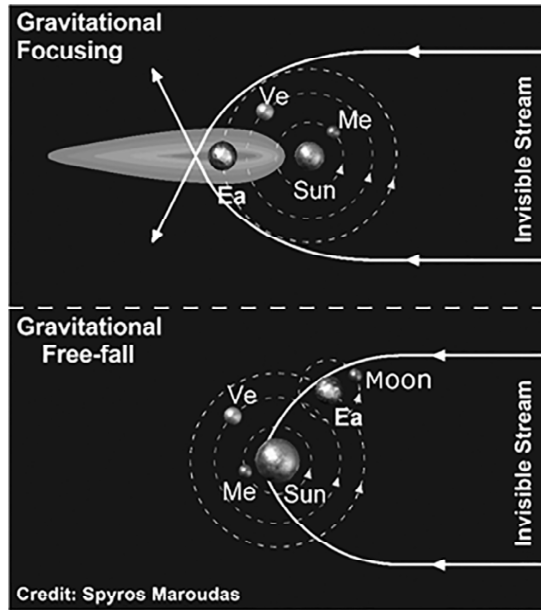


Fig.1. Schematic representation of gravitational focusing effects of a DM stream by the solar system. (Top) gravitational focusing by the inner solar system. In this configuration, the galactic center is on the right side and in the opposite direction of the incident invisible stream; (Bottom) the free-fall effect of incident low-speed streams may dominate planetary gravitational focusing towards the Sun since the flux enhancement increases with $(v_{\text{escape}}/v_{\text{incident}})^2$, with v_{escape} being the escape velocity from the Sun and v_{incident} the initial particle velocity far away from the Sun. The flux towards Earth can also be gravitationally modulated by intervening planets. The Moon focuses particles towards the Earth with an incident velocity near the Moon up to ~ 400 km/s [3,8-10].

2. Some striking signatures. The underlying idea behind this work goes along with the reasoning used by Zwicky that has led to the discovery of DM on cosmological scales. Namely, in the last ~ 160 years, starting with the quasi ubiquitous 11 years solar cycle, several unexpected energetic observations within the solar system defy conventional explanation (see e.g. [3]). This could be due to the dark Universe [1], whose manifestation at small scales has been overlooked. Driven by observation, we converge on a class of "invisible" particle candidates from the dark sector, which could interact with a large cross-section with normal matter and are different than the parameter phase space for axions and WIMPs following failed direct searches since a few decades. In fact, we conclude that although axions or WIMPs are not fitting in, they remain inspiring.

Thus, the striking mysterious heating of the solar corona with its unnatural step-like temperature inversion, the unpredictable solar activity, the dynamic Earth's atmosphere, and other observations might all arise from otherwise invisible streams giving rise to spatiotemporally strong flux enhancements due to gravita-

tional lensing effects, within the solar system, by one or more solar system bodies, including the Sun [3]. The underlying dark constituents can be of diverse nature, being eventually theoretically not yet introduced, which makes their identification even more challenging (see below).

Energetic observations include the unpredictable flaring Sun, its irradiance, and more generally Sun's dynamical behavior [3,13] as it is manifested by the widely accepted proxy for the dynamic Sun using the solar radio line (F10.7) at 10.7 cm wavelength. The most energetic planetary relationship is the Sun's size variation during one solar cycle [13] by about 1 km, with the relative size variation being at the level of $\sim 10^{-6}$. Of note, the required energy to lift 1 km thin layer of the photosphere ($\rho \approx 10^{-7}$ gram/cm³) by 1 km, is enormous ($\sim 10^{30}$ ergs). In addition, a remarkable planetary dependence of the Sun's elemental composition is observed [3,14], which makes a widely discussed issue more of a riddle within known physics; this resembles the planetary relationship observed for solar EUV irradiation above ~ 20 eV photon energy, which is another manifestation of the otherwise still mysterious solar corona heating [15]. Similarly, the elemental magnetic bright points on the solar surface also show planetary relationships [3]. R.Wolf (1859) with his sunspots observation (see [3] and [7] therein) was the first to suspect a planetary cause behind the workings of the Sun [1], though with the underlying process remaining elusive within known physics.

In addition to the otherwise unexpected planetary relationships of various solar observables, also several nearby terrestrial anomalous phenomena occur in our upper atmosphere, which is known since the 1930s. For example, what is the mechanism behind the ionosphere's dynamical behavior that shows also unexpected planetary relationship [2]? To put it differently, why is there annually about 25% more atmospheric ionization around December than six months apart around June? This anomaly is known since 1937 [16]. We recall two extraordinary facts about the ionosphere: (A) The ionosphere is the most outer terrestrial region that is directly exposed to outer space. Then, any "invisible" constituents from the dark Universe may appear first up there, if they interact with normal matter with a large cross-section (see e.g. [17]). Interestingly, this is still possible for DM constituents following recent publications [17]. Therefore, this requirement is not invented here just to support the assumed scenario of this work. In contrast, we recall that the deep underground direct DM searches address extremely feebly interacting DM particles due to the screening of "strongly" interacting dark constituents by the overhead Earth's layers including its atmosphere. (B) Some cross-disciplinary observations of societal relevance, while the ionosphere is occasionally also involved:

- 1) The not randomly appearing Earthquakes [14,18], probably happen by accumulating energy deposition inside the Earth, triggering finally an Earthquake,

occurring somehow similar to the aforementioned solar radius variation over relatively long-time intervals. Apparently, it is not necessary for the invisible stream(s) or clusters (see e.g., [19,20]) to provide spatiotemporally confined the entire energy liberated during an Earthquake. Though, it can be the external trigger for an Earthquake to occur. Remarkably, during the largest Earthquakes, also the ionosphere's plasma state changes over long distances as has been observed by the orbiting GPS satellites that continuously register the ionospheric plasma for self-calibration purposes [18].

2) Melanoma diagnoses [4-6] show planetary relationships following Mercury's 88 days orbital period. The observed periodic modulation of daily diagnosed melanoma cases strikingly coincides with the lunar geocentric sidereal periodicity of 27.32 days [6]; both periodicities point at a cause of exosolar origin, which fit-in the tentatively predicted streaming invisible matter scenario [1].

Of note, the aforementioned observations have a common feature. Namely, they all show an otherwise unexpected planetary relationship, while there is not some remote planetary force to cause any of the unexpected observations. With time, more and more results emerge following this kind of out-of-the-box approach. This might allow us to finally corner the microscopic nature of the suspected stream(s), being not as "invisible" as it is widely thought to be [3].

Moreover, following the reasoning underlying this work, it is interesting to find out whether similar behavior is encountered in exo-solar planetary systems [21]. With near-Earth exoplanetary systems, one might be able to establish also there similar "exoplanetary" relationships, or even also a cross-correlation with the dynamical behavior of our solar system. Such observations have the potential to expand our horizon within our Galaxy as well as towards the dark Universe, validating the actual working hypotheses behind such a scenario.

In this work, we pinpoint a simple feature as the common signature behind such observations within the solar system. For example, the widely discussed dark sector constituents with a velocity around $\sim 0.001 c$, while being in the form of streams, can be efficiently gravitationally focused or deflected within the solar system [1,2,12,19,20].

3. Energy source and dark matter direct detection. The observations made with long series of data have established also socially relevant results [4-6]. Recently P.Sikivie proposed DM axions as a potential source of clean energy [22]. Though, using the present constraints on axion interaction strength with normal matter as determined by the CAST experiment [22,23], the expected profit is quite small. However, following the diverse peaking planetary relationship for several observables [3,13,14], this proposal deserves further attention, since DM dominates over normal matter in the Universe.

Noticeably, we consider here generic not yet identified DM constituents being eventually more appropriate than axions as a clean energy source. Among the already multiply established planetary dependencies with solar and terrestrial observables [3], some might lead us to spatiotemporally optimum conditions allowing to extract efficiently considerable clean energy. Earth-related time windows of opportunity might be fixed annually, while other planetary peaking relationships can be spread during a year and be more profitable.

We recall that occasional streaming DM flux enhancements due to gravity effects by the solar system bodies can be several orders of magnitude, i.e., amplification factors of up to about 10^5 to 10^8 seem realistic [8,11,24] for reaching a significant converted energy density. For example, in January in the northern hemisphere, the annually peaking stratospheric temperature has been observed live [25,26]. Also, probably more planetary relationships may be discovered, which can be of practical use for energy conversion.

Interestingly, NASA has developed scientific balloons (see [27-30]) which can stay for months in the upper stratosphere with a payload of up to a few tons. This is encouraging for the present reasoning since planetary relationships have already been observed for the upper stratosphere's temperature [7] and the ionosphere's degree of ionization [2]. For the stratosphere [7] a strong peaking planetary relationship has been observed using the orbital positions of Mercury and Venus. In fact, combining Venus and Mercury's orbital positions, a clear peaking relationship for stratosphere's temperature variation in early January in the northern hemisphere [7], might pave the way to:

- a) perform DM searches in the upper atmosphere [7,25] contrary to the widely preferred underground searches, and
- b) investigations proposed here aiming to establish the optimum conditions to extract energy from occasionally much more invisible matter in the Earth's atmosphere.

The possible use of the upper stratosphere in January as a possible converter of DM to energy is just one example. Future investigations could provide additional places in the atmosphere of potential interest, firstly to search directly for DM, and secondly to extract energy from the dark Universe. Thus, planetary lensing or Earth's gravitational self-focusing have the potential to enhance temporally the local DM flux by up to several orders of magnitude thus providing new perspectives for DM detection and possibly even an alternative clean energy source.

4. *Summary.* Observationally driven, we conclude here that a planetary relationship can be a key signature pointing on its own at exosolar impact for a certain observable. So far, the only viable common explanation we have for a plethora of observations with diverse behavior combined with an otherwise un-

expected planetary dependency is the gravitational focusing of streaming "invisible" matter from one solar system body to another one, including the Sun and the Moon. We tentatively identify the assumed streams with constituents from the dark Universe, interacting eventually also with a large cross-section with ordinary matter. Now, we only can speculate about the possible particle candidates which are already suggestive for more new searches of otherwise unexpected planetary relationships.

Implications in ongoing or future DM experiments are obvious. Therefore, we urge all experiments searching for direct DM signatures, to perform a statistical re-analysis following the reasoning underlying this approach, or modify their data acquisition procedure accordingly for future measurements [3]. If a planetary dependency is found also in direct DM searches, this will strengthen the concept of "invisible streams" in our vicinity, which can be formed by tidal forces in our galaxy or other neighboring galaxies. Probably, most invisible streams are cosmological in origin [11].

We are aiming to widen the appearance of such new signatures being probably still hidden also to other observations. One day one might decipher the properties of the invisible stream(s). Along these lines of reasoning emerged also the medical observations made with long series of data of cancer diagnoses (= melanoma) [4-6]. Surprisingly, the main two planetary signatures appeared so far in medicine are:

- 1) The 88 days orbital periodicity of Mercury using mean monthly data from the northern hemisphere (USA) [4], which have been independently confirmed [5]. However, the author did not give the appropriate attention to his analysis, which confirmed our previous results, and this is even for most cancer types, and
- 2) The sidereal geocentric lunar periodicity (= 27.32 days) using daily melanoma diagnoses data from the southern hemisphere (Australia) [6]. Interestingly, following the planetary scenario and the possible signatures that already have been observed [1-3,13,14,18], the underlying stream(s) can only be exosolar in origin if the periodicity is sidereal since it refers anyhow to a reference frame fixed to remote stars (i.e., outside our solar system). Of course, a DM stream is of cosmic origin, even if it happens to be trapped by the solar system during its birth. Also, this last scenario is of no minor importance for direct DM searches, or for indirect ones following astrophysical/cosmic observations.

In short, a wide diversity of signatures showing also planetary relationships may allow us to identify the otherwise "invisible" components of the dark Universe.

Finally, some favored "invisible candidates" following the observations made thus far, are:

- a) Anti-Quark Nuggets (AQNs) as they have been invented in 2003 by Ariel Zhitnitsky [31] (see also [32-35]). These peculiar objects are inspiring many investigations spanning from the origin of the solar corona heating mystery to the

direct detection of fast axions.

b) Magnetic monopoles as their interaction with the ubiquitous magnetic fields make different energy deposition scenarios of potential interest.

c) Dark photons, as they can even resonantly convert to real photons if the local plasma density fits in the rest mass of the hidden photon. Contrary to axions or axion-like particles, the kinetic mixing between real photons with hidden sector photons does not require a magnetic field as a catalyst, and this makes them attractive.

d) Pearls [36,37]. A quantitative investigation as it has been undertaken for the AQNs would clarify whether these composite particles also fit in, at least some of the observations made so far, starting with the mysterious solar corona heating, the unpredictable solar flares, and the entire dynamic and mysterious Sun.

e) Some other constituents to be invented yet, this remains always an option.

5. Conclusion. The expected signal amplification due to gravitational focusing effects by the solar system bodies including the self-focusing effects by the inner Earth [9,10,24] by orders of magnitude might bring the necessary breakthrough not only for the direct DM detection. The interaction strength with normal matter would be large [17], and also only it could open the way for a substantial and clean energy source.

The most inspiring particle constituents fitting in several observations are AQNs, magnetic monopoles, and dark photons. Though, more emerging candidates, like the pearls, should be investigated whether they fit the reasoning of this work. Thus, insisting anomalies/mysteries within the solar system might be the unnoticed manifestation of the dark Universe, and they deserve further attention aiming to identify their elemental composition and properties.

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НОВЫЕ "ПЛАНЕТАРНЫЕ СЛЕДЫ" ТЕМНОЙ ВСЕЛЕННОЙ

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Понятие темной материи (DM) введено для объяснения неожиданных результатов космологических наблюдений. В настоящее время разные явления, наблюдаемые в нашей солнечной системе, также не поддаются традиционным объяснениям, например, основные физические процессы, лежащие в основе нагрева различных слоев солнечной атмосферы. Концепция потоков DM с их последующей гравитационной фокусировкой телами Солнечной системы предлагает жизнеспособный общий сценарий для понимания таких явлений. Возможно это основной процесс, ответственный за солнечные циклы, у которых были обнаружены первые признаки зависимости от параметров планет. Уже в 1859г. была поставлена задача найти удаленное планетарное воздействие, отличное от чрезвычайно слабой планетарной приливной силы. Мы подчеркиваем возможную причастность внешнего воздействия неучтенного "потока невидимой материи", что согласуется со всеми загадочными наблюдениями, ранее исследованными с привлечением несуществующей удаленной планетарной силы. Множество следов "потоковой" ТМ проявляются в разного рода неожиданных связях, как динамического Солнца, так и Земли. В частности, рассуждение в духе Цвикки наводит на размышления о поиске загадочных биомедицинских явлений. Предпочтительными носителями ТМ являются - крупницы антикварковой материи, магнитные монополи, темные фотоны или составные "жемчужины". Таким образом, аномалии внутри Солнечной системы являются проявлениями темной Вселенной. Неявный сценарий потока темной материи расширяет пространственно-временное распределение темной материи, создавая лучшие условия для прямого обнаружения или извлечения энергии из ранее недооцененного темного сектора. Предложенный предварительный сценарий предполагает усиление пространственно-временного потока темной материи, создавая условия для прямого обнаружения темной материи или извлечения энергии из невидимого, как предполагалось, темного сектора.

Ключевые слова: *планетарные отношения: темный сектор: невидимое вещество: гравитационное фокусирование*

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