Signals for invisible matter from solar – terrestrial observations

The Sun and its Planets as detectors for invisible matter

[ ]


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ICNFP, Kolymbari, Crete
11/07/2016
Are insisting anomalies/mysteries in the solar system the unnoticed manifestation of the dark Universe?
Solar Flares (1859 - Now)

".. One of the great solar mysteries" (2014)

- Bursts of X-rays
- Unknown physical mechanism
- **Seismic Waves**: many open questions (2016)
Solar Corona problem (1939 - Now)

“One of the outstanding unsolved problems in astrophysics” (2015)

- EUV excess
- Sun’s upper atmosphere much hotter than its surface => Why?
Earth’s Atmosphere (1937 - Now)

“a long standing unexplained annual anomaly” (2011)

- Annual anomaly

- **Total Electron Content:**

  \[
  TEC_{\text{DECEMBER}} > TEC_{\text{JUNE}}
  \]

  \[
  2.87 > 2.12 \times 10^{32} \text{e}\cdot\text{s}
  \]
Driving Idea

• Planetary gravitational lensing possible for non-relativistic particles $\Rightarrow$ in ideal case, flux enhancement up to $10^6$

• Focused stream(s) of invisible matter interact with the solar / planetary atmospheres

Search for (planetary) correlations

Origin
Solar Flares

Related work so far:

Fourier analysis of time series observations
Solar Flares - EARTH
Solar Flares - VENUS

[Graph showing the number of M-flares and X-flares at various longitudes on Venus, with percentage labels: 82% and 59%]
Solar Flares - MERCURY

![Graph showing solar flares on Mercury](image-url)
Solar Flares - MERCURY

![Graph showing solar flares on Mercury](image-url)

- 6091 M-Flares
- BIN=12°
- Nr. of M-Flares/12°
- LONGITUDE MERCURY [°]
Solar Flares - EARTH ⊗ MERCURY

1976-2014
1405 M-Flares

EARTH
MERCURY: 200°-260°

LONGITUDE_{EARTH}

Nr. of M-Flares/9°
Exposure-time corrected

3.7/5.3σ
50°
50°
130°
60%
~330°
Solar Flares - EARTH ⊗ MERCURY

ALL M-Flares

1405 M-Flares
Mercury: 200° - 260°
Solar EUV > 24eV

Unexpected for a 5800K bb
Solar EUV - MERCURY

![Graph showing Solar EUV intensity over Mercury's longitude. The graph indicates a peak at longitude 74° on 3/2/1999-17/9/2015.]

- Relative Intensity >24eV/16.37°/day
- Mercury longitude range: 0° to 360°
- Peak intensity at longitude 74° on 3/2/1999-17/9/2015
- 6% variation

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**Legend**
- Mercury
- Solar EUV
- 3/2/1999-17/9/2015

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**Notes**
- Longitudinal variation observed
- Peak intensity observed during specific timeframe
- Relative intensity measured over Mercury's longitude range

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**Technical Details**
- Measurement units: eV/16.37°/day
- Timeframe: 3/2/1999-17/9/2015
- Peak intensity at longitude 74°
M-Flares + EUV - MERCURY ⊗ VENUS
M-Flares + EUV - MERCURY ⊗ VENUS

Solar flaring activity ⇔ EUV emission
⇒ corona

>>> (partly) common origin?
X-Flares + EUV

Flare onset

02/04/2001
28/12/2001
01/11/2003
20/01/2005
08/09/2005

02/04/2001
28/12/2001
28/10/2003
04/11/2003
20/01/2005
07/09/2005
09/09/2005
Earth’s Ionosphere

Anomalies lasting for some decades:
First observations 1937/1938
Earth’s Ionosphere - EARTH

![Graph showing TECUs/day vs. Longitude over 1/1/1995 to 1/1/2013, with anomalies indicated.](image-url)
Earth’s Ionosphere - MERCURY ⊗ VENUS
Earth’s Ionosphere - MERCURY ⊗ VENUS ⊗ EARTH (Max / Min)
Earth’s Ionosphere - MOON ⊗ EARTH

![Graph showing TECUs/d and ΔTECUs/d over different lunar phases and longitudes.](image-url)
!!Sun’s Global Magnetic Field (1975 - 2015)!!

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**PRELIMINARY**
Conclusions

• The analysis of the data supports our working hypothesis that a stream of invisible particles focused by the planets triggers the onset of solar phenomena (flares and EUV-emission, ...).

• We observe a similar effect for the electron content of Earth’s Ionosphere.

• We cannot at this point claim anything about the nature of these invisible particles, but we are strongly suggesting the re-analysis of Dark Matter experiments, especially DAMA, following our approach.

• We are planning more complete analyses, which will combine the simultaneous effect of all planets.
Thank you!!!
Solar Corona: 1939 - >>> observational mystery.

Sun's upper atmosphere much hotter than its surface => why?

- "a major open issue in astrophysics"
- "one of the fundamental outstanding problems in solar physics"
- "for 77 years...one of the outstanding unsolved problems in astrophysics"


http://dx.doi.org/doi:10.1007/BF01488890
Solar Flares: 1859-

- physical mechanisms/relationship $\text{flare activity} \leftrightarrow \text{sunspot activity}$

2 of the hottest + biggest problems in solar physics 2013
(Hathaway 2010; Hudson 2011); http://www.astron-soc.in/bulletin/13December/237412013-feng.pdf

- ... solar flares + CMEs ... one of the great solar mysteries 2014
http://solarscience.msfc.nasa.gov/quests.shtml

- what powers a flare? what triggers it?
unpredictable for more fundamental reasons? C.J. Schrijver 2009

The “first flare”: 1st Sept 1859

Solar quakes: 1998-

- ... are still mysterious \textcolor{red}{arXiv:1402.1249v1}.

- “Surprising: in some cases, the sunquake initiating impacts are observed in the early impulsive or even pre-heating phase.. and even without a significant hard X-ray signal”
  
  Kosovichev; Sharykin; Zimovets 1/6/2014

- “… the energy transported downwards ... is somehow invisible ... the flux \textcolor{red}{in something} propagating downwards through the Sun’s atmosphere must be detected”. \textcolor{red}{arXiv:1508.07216v1} ApJ. (2015).

- “like ripples spreading from a rock dropped into a pool of water”
  
  \textcolor{red}{http://sohowww.nascom.nasa.gov/bestofsoho/Helioseismology/mdio26.html}

- many open questions ... most notably the nature of the excitation mechanism(s) comes from a source area 
  \textcolor{red}{~(3000km)^2 \Rightarrow 10^{11.11} \text{ erg/cm}^2} \textcolor{red}{arXiv:1602.08245} 2016

\[ \text{Figure 30} \]
Solar Flares - EARTH
Solar Flares - VENUS
Solar Flares – VENUS, EARTH

**VENUS**

**EARTH**

- (Graphs showing the number of solar flares per degree in longitude for Venus and Earth over the years 1976-2015.)
130-Flares + Visible

The effect of flares on Total Solar Irradiance (TSI)

Solar light in the visible

Onset of Flare

The excess time distribution of the TSI emission of 130 flares relative to the X-ray peak. 1 min resolution and smooth over 6 min. X-rays come ~5 min later than the extra light emitted during flares.

[M. Kretzschmar]

http://www.nature.com/doi/10.1038/nphys1741
130-Flares + ~Visible

Variation of the Mg-II index which is a measure of the solar EUV/UV activity. *Between 50 and 10 days before the event, the solar EUV/UV emission is a bit decreased.* Then a brightening occurs with a maximum on Day 0, coincident with the X-ray burst but wider in time.

Solar EUV

Graph showing the relative EUV solar irradiance and the number of M-flares with a bin of 4 days. The graph compares two periods: 28/12/1975 - 23/4/2014 and 16/2/1999 - SUM of 64x88 days. The EUV > 24 eV is highlighted with a 6% decrease. The M-Flares SUM=6089, 159 x 88 d is also indicated.
Wolf, 1859: solar dynamics is partially driven by planetary tides. a plausible physical mechanism has not been discovered yet... the planetary tidal forces are too small to modulate solar activity.. although more complex mechanisms can not be excluded.


..tidal effects of planets on the solar surface are $= 10^{-12} \cdot \text{SUN}_{\text{Gravity}}$


Critical Analysis .. of the Planetary Tidal Influence on Solar Activity
We found ... artefacts caused by the calculation algorithm ...
Earth’s Atmosphere: 1937

- ...peak electron density around December is greater than around June ≠ expectation a long-standing unexplained annual anomaly
- “the writers are inclined to the view that the cause is associated with the Earth or its motion…” 1938 doi: 10.1029/TE043i001p00015
- .. there is a global annual anomaly.
Earth’s Ionosphere

The F2 Layer
- $\rho_{\text{electrons}} \sim 10^5 / \text{cm}^3$
- Lifetime $\sim 20$ min

Altitude [km]
- Day ionosphere
- Night ionosphere
- Exosphere
- Thermosphere
- Mesosphere
- Stratosphere
- Troposphere

Electron density / cm$^3$
- 0 to $10^2$
- 10$^2$ to $10^3$
- 10$^3$ to $10^4$
- 10$^4$ to $10^5$
- 10$^5$ to $10^6$
- 10$^6$ to $10^7$
- 10$^7$ to $10^8$

Day Time
- F-layer
- E-layer
- Sporadic E

Night Time
- D-layer
- E-layer
- F-layers combine at night
- The ionosphere changes with the day-night cycle.
Earth’s Ionosphere - EARTH ⊗ MOON
DAMA

1996-Modulation $9\sigma$

TBD: RE-ANALYSIS