Stadium Generale on May 23, 2019 Seeing the sky through funnel(s) == Challenges of X-ray Astronomers ==



Emeritus professor of Nagoya University Hideyo Kunieda

ISAS/JAXA

Moon landing conspiracy theories It's up to you whether you believe it or not



Astronauts Buzz Aldrin and Neil Armstrong in NASA's training mockup of the Moon and lander module.



<u>Photo of Buzz Aldrin taken</u> on the Moon <u>by</u> Neil Armstrong whose image can be seen on the face glass.

Moon landing conspiracy theories

Hoax claims

- 1. In some photos, the crosshairs appear to be behind objects.
- 2. Crosshairs are sometimes rotated or in the wrong place.
- 3. The quality of the photographs is implausibly high.
- 4. There are <u>no stars in any of the photos;</u>
- 5. The angle and color of shadows are inconsistent.
- 6. There are identical backgrounds in photos taken miles apart.
- 7. The number of photos taken is implausibly high.
- 8. The photos contain artifacts like the two seemingly matching 'C's on a rock.
- 9. Who filmed Neil Armstrong stepping onto the Moon?
- 10. The flag placed on the surface by the astronauts fluttered

"That's one small step for man, one giant leap for mankind" by Neil Armstrong







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Laser beam

Lunar Laser Ranging Retro-Reflector



Time of flight gives accurate distance to the Moon. 2x380,000km/300,000km~2.5sec



For any incident angles, 180 degree reflection

100 km





Craters on the Moon record impacts of meteorites.

Craters on the Earth are weathered by rain and wind.

Meteorites melt and vaporize in the atmosphere.

Atmosphere warms up and stabilize the temperature of the Earth by the green house effects.

(Temperature of the Moon ranges from -170 to 110 degree C)

Miracle !!

#1 Needle Astronomy has been established by Seeing the sky through a funnel of the atmospheric window at optical band

For other wavebands, Observation with telescopes in orbit to avoid atmospheric absorption

The Sun

X-ray observation reveals violent phenomena of the Sun

Space exploration race

(1) Sputnik crisis

Kick off of the "Space Race" First satellite and manned mission by Russia Kennedy's "The Moon Speech": *"achieving the goal, before this decade is out, of landing a man on the moon*"

May 25, 1961 → Apollo Program

https://ja.wikipedia.org/wiki/%E3%82%B8%E3%83%A7%E3%83%B3%E3 %83%BBF%E3%83%BB%E3%82%B1%E3%83%8D%E3%83%87%E3%82% A3 2019/7/24

Sputnik(Soviet) October 4, 1957

Yurii Gagarin April 12, 1961

http://spaceinfo.jaxa.jp/ja/kaihatu_astronauts _gagarin.html 2019/7/24

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(2) Exploring X-rays from the sky X-rays from the Sun is known but it is too weak to detect if we put the Sun at several light years away. But,,,,,

How is the Solar X-ray irradiation to the Moon? How much reflection?

https://ja.wikipedia.org/wiki/%E3%82%B8%E3%83%A7%E3%83%B 3%E3%83%BBF%E3%83%BB%E3%82%B1%E3%83%8D%E3%83%8 7%E3%82%A3 2019/7/24

Sputnik(Soviet) October 4, 1957 http://spaceinfo.jaxa.jp/ja/sputnik_1.html 2019/7/24

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First observation of an X-ray star

What is the X-ray Star?

Optical image observed at Okayam, on June 17, 1966 Luminosity of the X-ray Star is million times X-ray luminous than the Sun

Blue faint star

Periodical Variation || Orbital Motion

X-ray Binary

What is the X-ray Star?

X-rays from near the Black hole Gravitational energy of Accretion flow --> Hot Disk → X-ray Emission

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Japanese X-ray Astronomy Satellites

ISAS/JAXA

Japanese X-ray Astronomy Satellites

Tenma (1983) 200kg

ISAS/JAXA

X-ray Telescopes

No reflection with large angles

-->**Grazing Optics** ($\theta \leq 1 \text{ degree}$)

ంగుర్రశ్రర Reflection by the inner surfaces of cones. Nesting hundreds of thin cones coaxially

https://science.nasa.gov/science-news/scienceat-nasa/1999/ast08jul99_1 2019/7/29

Production of X-ray telescope at Nagoya University

Installation to telescope housing

#3

Assembled Telescope

1278 shells/Telescope

Why X-ray astronomy?

	Minimum
Density	1 Atom/cc
Temperature	2.7 °K
Magnetic F.	μGauss
Gravity	μG
Mass	10 ⁻³⁰ kg
Size	10 ⁻¹²⁻¹⁵ m
Time	10 ⁻¹⁵ sec

Human Maximum 1g/cc $10^{14} \, \text{g/cc}$ 10^{8°} 300° Κ K 10¹²⁻¹⁴ Gauss 1 Gauss >10¹³ G 1 G 10^2 kg 10⁴⁴ kg 10²⁶ m 1 m 10⁹ sec 4x10¹⁷sec

Why X-ray astronomy?

Experiments in extreme conditions

	Minimum	Human
Density	1 Atom/cc	1g/cc
Temperature	2.7 °K	300°
Magnetic F.	µGauss	1 Gauss
Gravity	μG	1 G
Mass	10 ⁻³⁰ kg	10 ² kg
Size	10 ⁻¹²⁻¹⁵ m	1m
Time	10 ⁻¹⁵ sec	10 ⁹ sec

Maximum 10¹⁴ g/cc 10^{8°} K 10¹²⁻¹⁴ Gauss >10¹³ G 10⁴⁴ kg 10²⁶ m 4x10¹⁷sec

Why astrophysics?

Experiments in extreme conditions

Apply knowledge we got on Earth to observed phenomena

If it does not work

New principles

P.30

Why astrophysics?

Experiments in extreme conditions

Confirm new principles in space environments

If it can not be tested on Earth

New principles

$$\Delta \theta = 4 \text{GM/c}^2 \text{p} = 2 \text{r}_{g} / \text{p}$$

p : Impact parameter(=Solar radius) r_g : Black hole radius (3 km)

 $\rightarrow \Delta \theta = 8.5 \times 10^{-6}$ rad =1.75 arcsec for M_{Solar}, R_{Solar}

Solar eclipse in 1919 by Eddington

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Extra subject

Do you believe "Extra Terrestrial Intelligence"? Drake's equation: $N = R \times f_p \times n_e \times f_l \times f_l \times f_c \times L$

10	N : Number of ET intelligence in our Galaxy
10	R : Birth rate of stars in our Galaxy / year
0.5	f _p : Possibility for a star to poses planets
2	n _e : Number of habitable planets of a star
1	f1: Possibility for lives to emerge there
0.01	fi: Possibility for lives to evolve to high intelligent level
0.01	<i>fc</i> : Possibility for intelligence which can communicate
104	L : Life time of civilization (y)

The final factor for finding an ET Intelligence is the life time of the civilization without collapse 4.5 Billion years