Advanced Civilizations Below the Dyson Net Level:Terraformed Goldilocks Planets

Part 1 of the Power Point

To make it fit in email

Advanced Civilizations Below the Dyson Net Level:Terraformed Goldilocks Planets

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North America, Earth, Sol,Milky Way

So do we qualify as an Advanced Civilization?

"A little learning is a dang'rous thing;
Drink deep, or taste not the Pierian spring:
There shallow draughts intoxicate the brain,
And drinking largely sobers us again."

Alexander Pope. Essay on Criticism (Part 2)

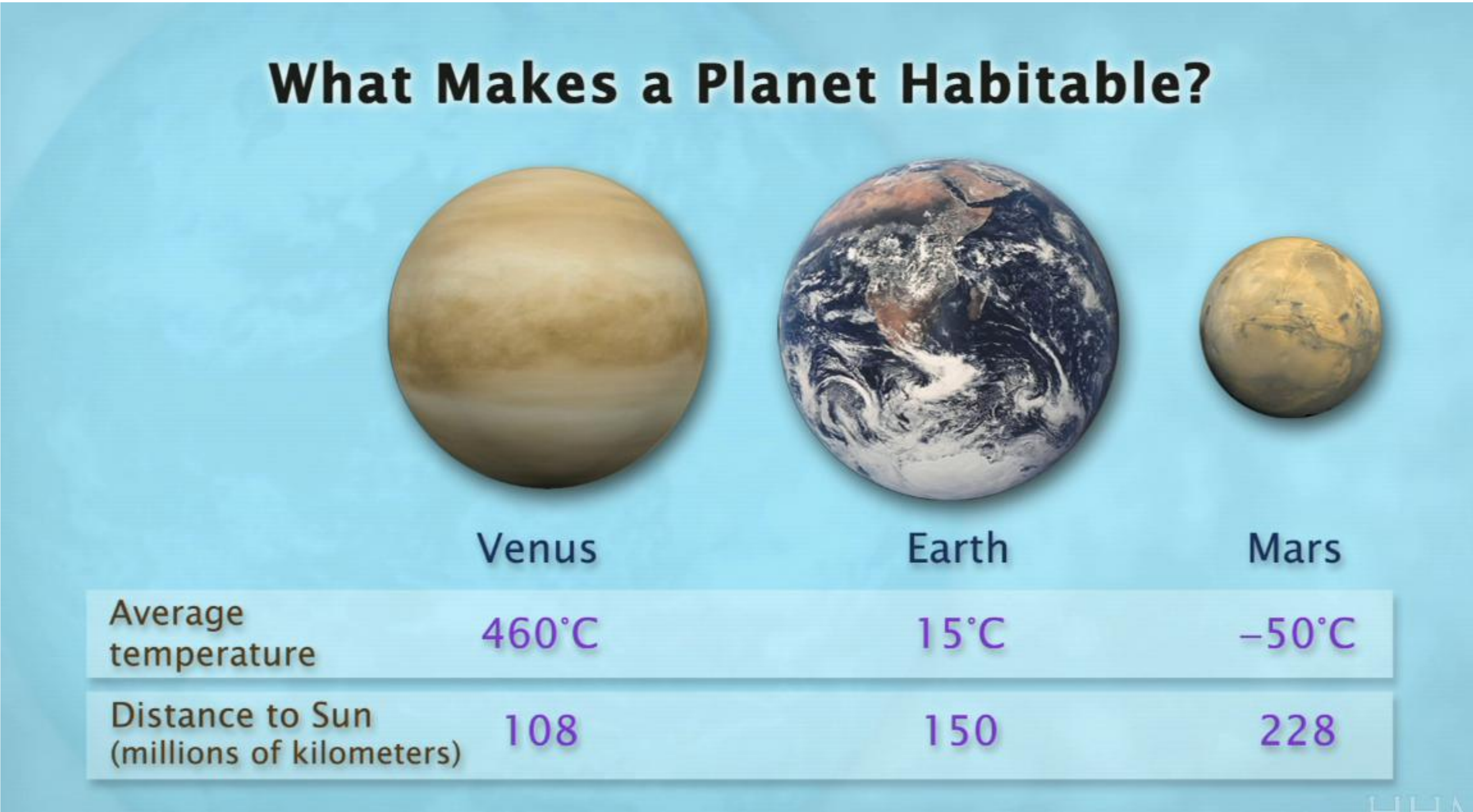
http://www.poetryfoundation.org

Not yet …

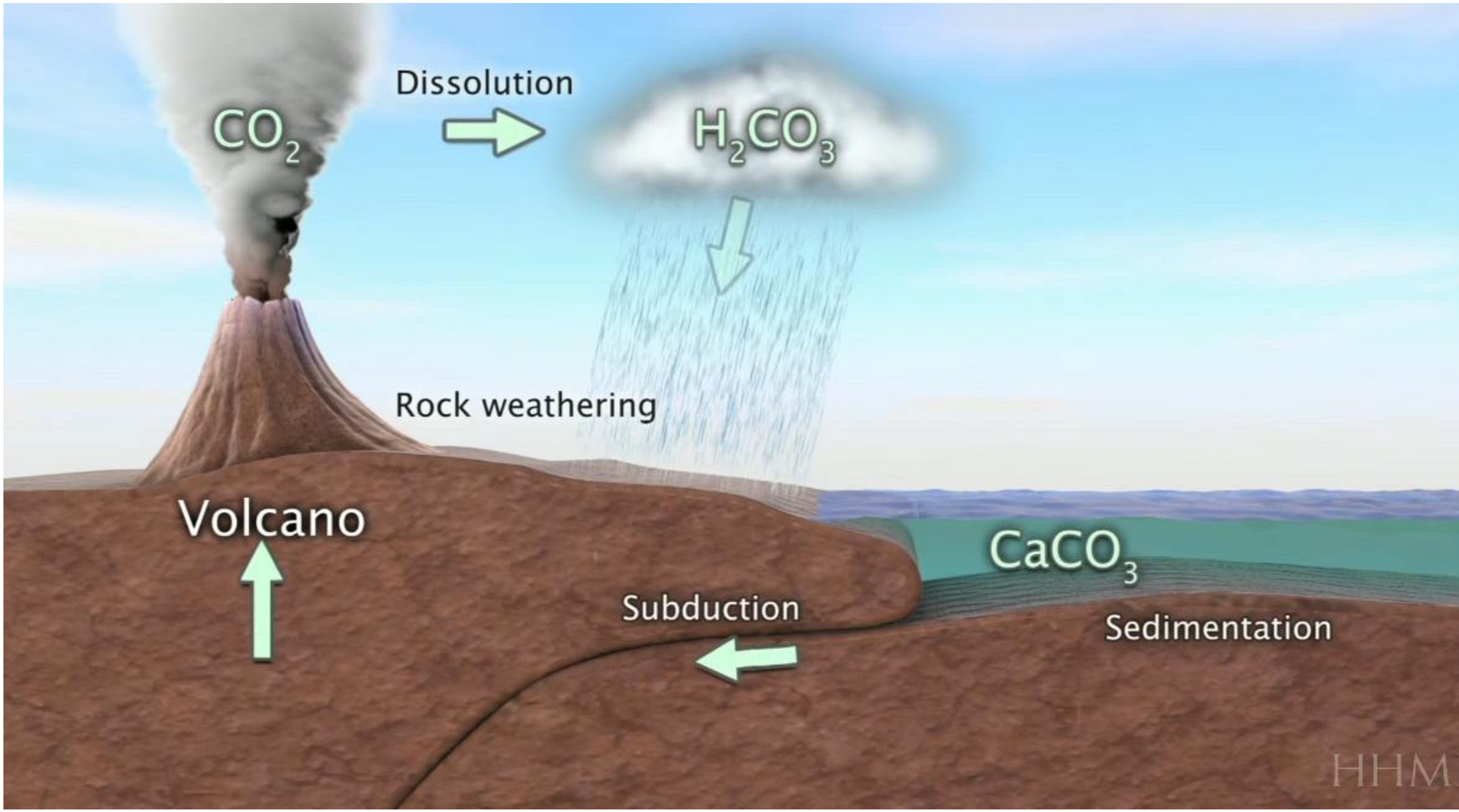
"A little knowledge is a dangerous thing....
So is a lot." Attributed to Albert Einstein

http://www.goodreads.com/quotes

Sol’s Three Planets in the “just right for liquid water” or “Goldilocks” Temperature Zone. The name refers to the “just right” porridge temperature from the children’s folk tale *Goldilocks and the 3 Bears*



The Geologic Carbon Dioxide Cycle on Earth



Weathering Is a Series of Chemical Reactions

Granite

Clay

Limestone

$$CO_2 + CaAl_2Si_2O_8 + 3H_2O \rightleftarrows Al_2Si_2O_5(OH)_4 + CaCO_3$$

Weathering Is a Series of Chemical Reactions

$$2CO_2 + 2H_2O \rightleftarrows 2H^+ + 2HCO_3^-$$

$$CaAl_2Si_2O_8 + 2H^+ + H_2O \rightleftarrows Ca^{2+} + Al_2Si_2O_5(OH)_4$$

$$Ca^{2+} + 2HCO_3^- \rightleftarrows CO_2 + CaCO_3$$

(Calcite or aragonite)

Weathering Is a Series of Chemical Reactions

$$2CO_2 + 2H_2O \rightleftharpoons 2H^+ + 2HCO_3^-$$

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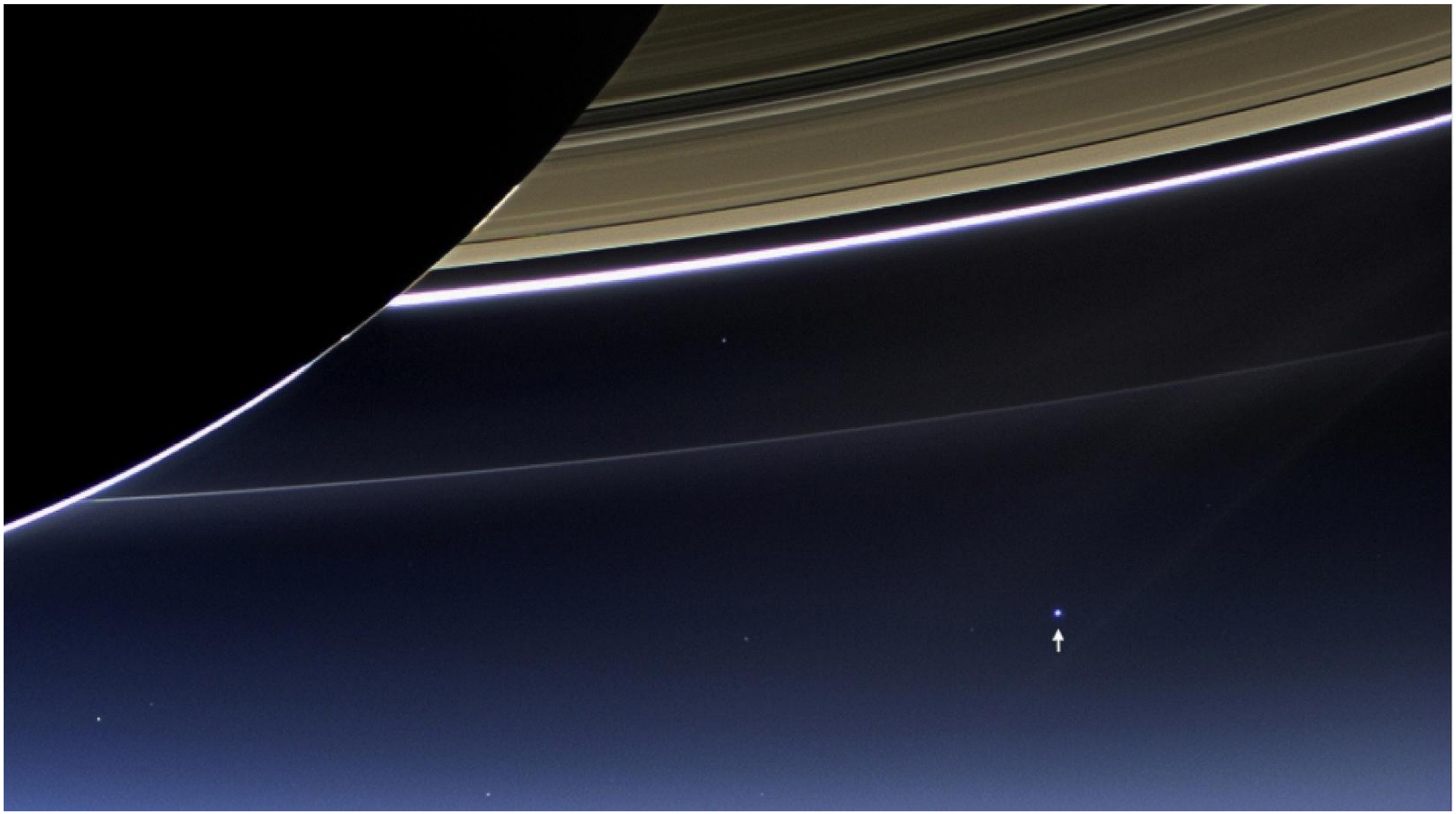
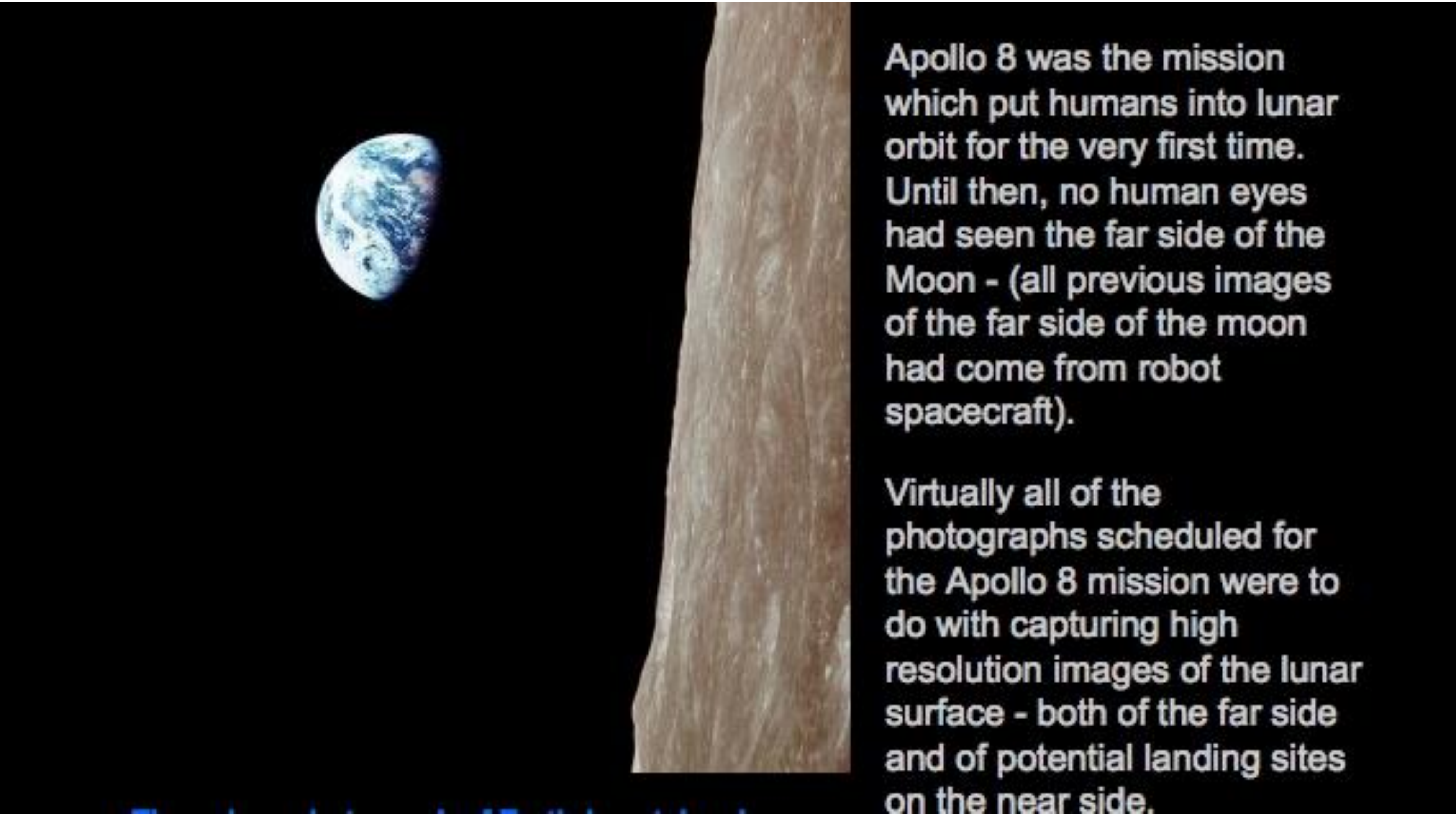
$$CO_2 + CaAl_2Si_2O_8 + 3H_2O \rightleftharpoons Al_2Si_2O_5(OH)_4 + CaCO_3$$

Our Earth Photographed from Saturn by the Casinni Spacecraft July 19, 2013. It's all We've Got and it Looks Pretty Small from that Far Away



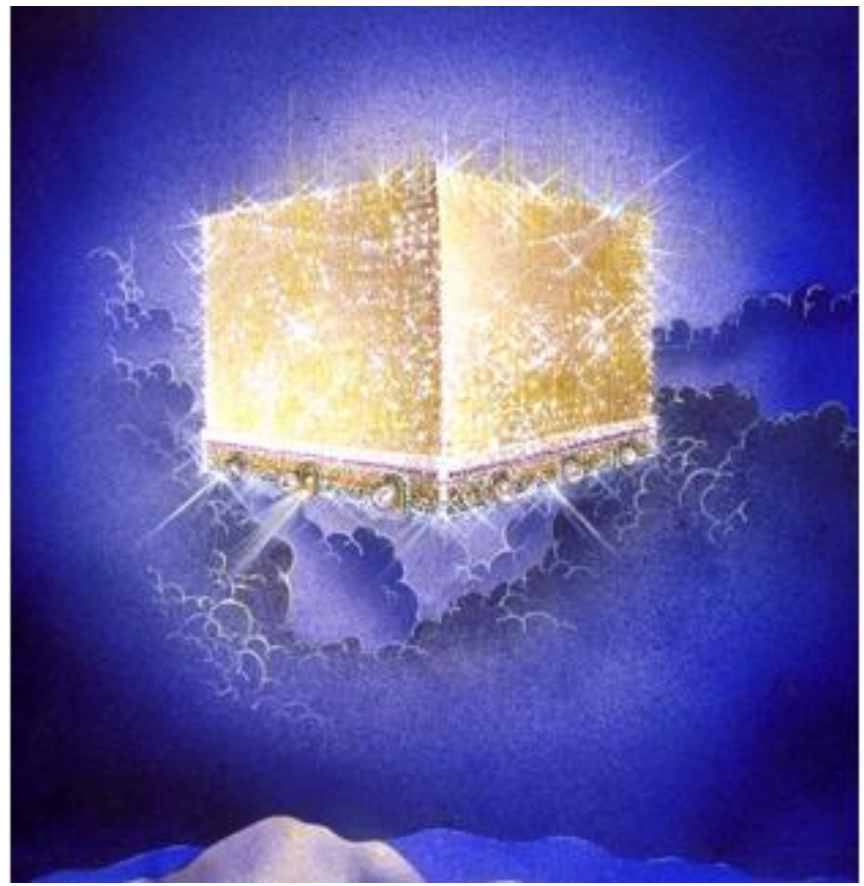
Our Earth Seen from the First Apollo orbit of the Moon



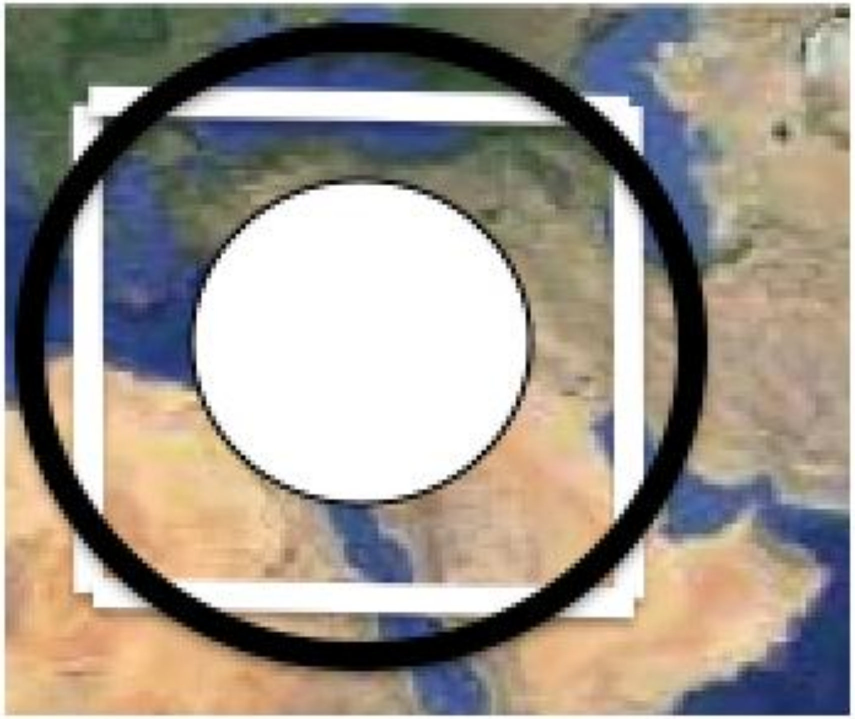
Artist's Interpretation of the Top Overlord Karellin from the novel Childhood's End

New Jerusalem Painting; Map of Africa, Europe and the Arabian Peninsula; the New Jerusalem Base Superimposed as a Square on the Map (centered over Jerusalem)

Centaur of Ice Equivalent to Earth's Oceans (Solid White Circle) Saturn's moon Titan (Black Circle)

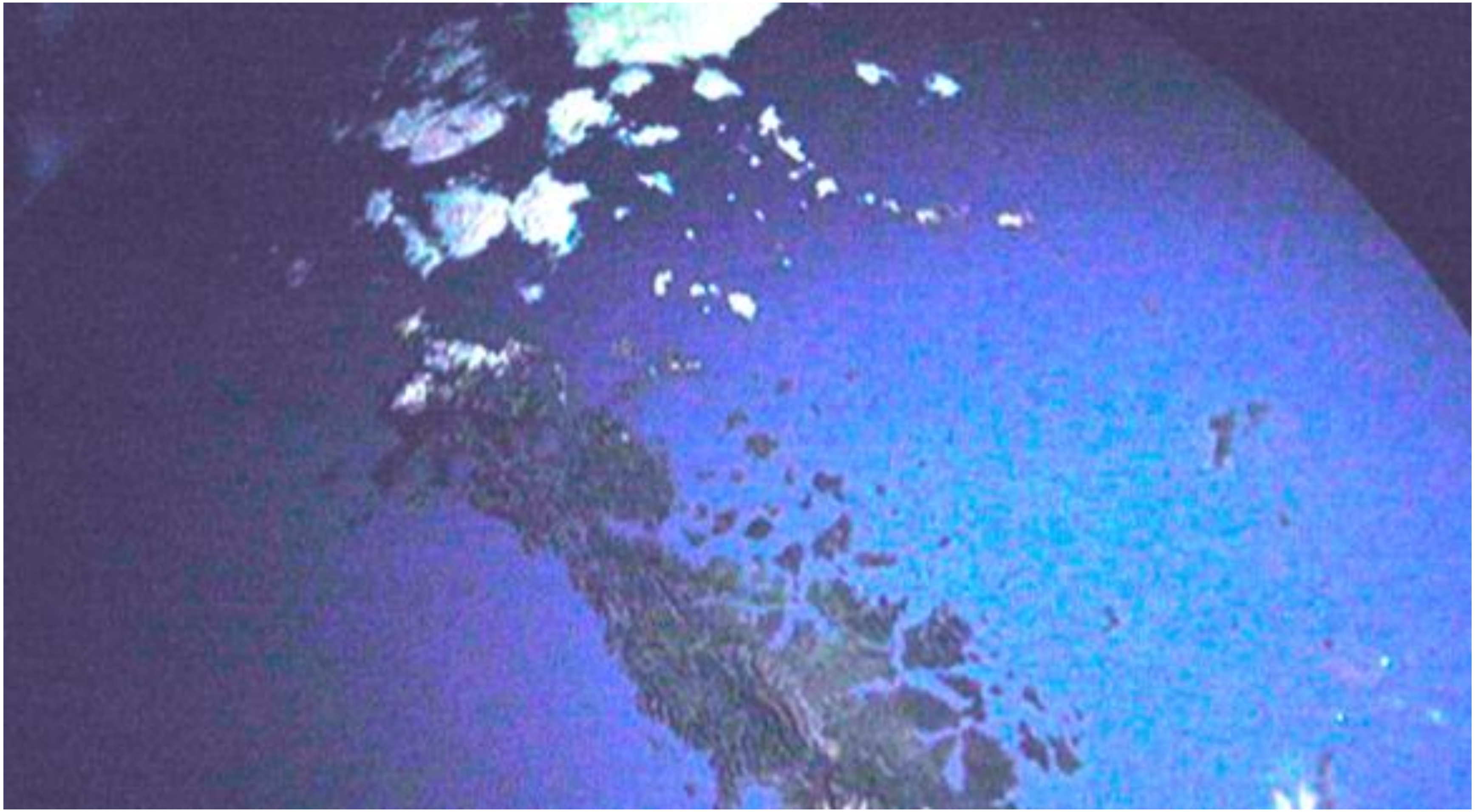


Impact Circles Compared to New Jerusalem: Square is New Jerusalem base outline. Solid White Circle is Rhea's diameter. Open Black Circle is Titan's diameter projected onto the map.



Deep Impact: Accidently Hit Earth with Objects Intended for Venus

Water World: Accidently Double the Volume of Water in the Oceans



Accidental Return to Hadean Era

Advanced Civilizations Below the Dyson Net Level:Terraformed Goldilocks Planets (continued)

Part 2 of the Power Point

To make it fit in email

Finding the Formula for Kinetic Energy of an Object in Circular Orbit Using Kepler's 3rd Law

$T^2/R^3 = 1$

Velocity	$V = 2\pi R / T$ for circular orbits
Period	$T = R^{3/2}$
	$V = 2\pi R / R^{3/2}$
	$V = 2\pi / R^{1/2}$
Kinetic energy	$KE = ½ M V^2$

$KE = ½ M(2\pi / R^{1/2})^2$

$KE = 2\pi^2 M / R$

Finding the Formula for the Change in Kinetic Energy of an Object in One Circular Orbit Dropping to Another Circular Orbit

The change in kinetic energy needed to change orbits is:

$$\Delta KE = 2\ \pi^2\ M\ /\ R_f\ -\ 2\ \pi^2\ M\ /\ R_i$$

$$\Delta KE = 2\ \pi^2\ M\ (R_i - R_f)/RiR_f$$

Determining the Mass of a Small Moon Made of Ice with a Diameter of 850 Miles
{and a chance to use what's called unit analysis (if you are a physicist) or stoichiometery (if you are a chemist)}

$M_{ice} = \rho V = \rho * (4/3 * R^3)$ assume most of the interior ice is at 1.4 Gpa pressure

Ice density = 1.37 gm/cm^3 (this is called Ice IX)

$$M = \frac{1.37\ \cancel{g} \;*\; 1\ kg \;*\; 10^6\ \cancel{cm^3} \;*\; 4 \;*\; \pi \;*\; (425\ \cancel{mi} \;*\; 5280\ \cancel{ft} \;*\; 0.3048\ \cancel{m})^3}{1\ \cancel{cm^3} \;*\; 1000\ g \;*\; 1\ \cancel{m^3} \;*\; 3 \;*\; 1 \;*\; (1 \;*\; 1\ \cancel{mi} \;*\; 1\ \cancel{ft})^3}$$

$M = 1.836 \times 10^{21}$ kg

V^2 => units of velocity^2 are A.U.^{2}/Years^2

Determining The Drop in Kinetic Energy to Move a Small Moon from the 79 A.U. to the Orbit of Venus (more unit analysis)

V^2 => units of velocity^2 are A.U.^{2}/Years^2

$\Delta KE = 2\,\pi^2\,(1.836 \times 10^{21}\ \text{kg})\,(R_i - R_f)/R_iR_f$

$\Delta KE = 2\,\pi^2\,(1.836 \times 10^{21})\,(0.723 - 79)/(0.723 * 79)\ \text{kg*A.U.}^2/\text{Year}^2$

$$\Delta KE = \frac{-49.667\ \text{kg} * 1\ \cancel{\text{A.U.}}^2 * 1\ \cancel{\text{Year}}^2 * (1.45 * 10^{11}\ \text{m})^2 * 10^{21}}{1\ \cancel{\text{Year}}^2 * (60 * 60 * 24 * 365.25\ \text{sec})^2 * 1\ \cancel{\text{A.U.}}^2}$$

$\Delta KE = -\,9.85 \times 10^{29}$ joules;

Determining The Drop in Kinetic Energy to Move a Small Moon from the Orbit of Saturn to the Orbit of Venus (still more unit analysis)

2.) What about a slowing down the same size ice moon from Saturn's distance 9.582 A.U. to the Venus distance 0.723 A.U.?

$\Delta KE = 2\,\pi^2\,(1.836 \times 10^{21}\ kg)\,(R_i - R_f)/RiR_f$;

Conversion factor: $1 A.U.^2/1 yr^2 = 0.21112 \times 10^8 m^2/s^2$

$= 2\,\pi^2\,(1.836 \times 10^{21})*(0.723 - 9.528)/(0.723*9.528)\ kg*A.U.^2/Year^2$

ΔKE = -2.35 x 10^{29} joules (a little less energy but a heck of a lot closer)

Determining How many One Megaton Explosions are Needed to Slow Down a Small Moon to Move it to the Inner Solar System to hit Venus

So how does one slow down a small moon?
Consider fusion explosions. A drive based on the principles developed in Project Orion[9] is a possibility. It is analogous to a one piston, external explosion engine.
The energy released in a **one-megaton** explosion is **4.20×10^{15} joules**.
3.) A simple number of explosions estimate is:

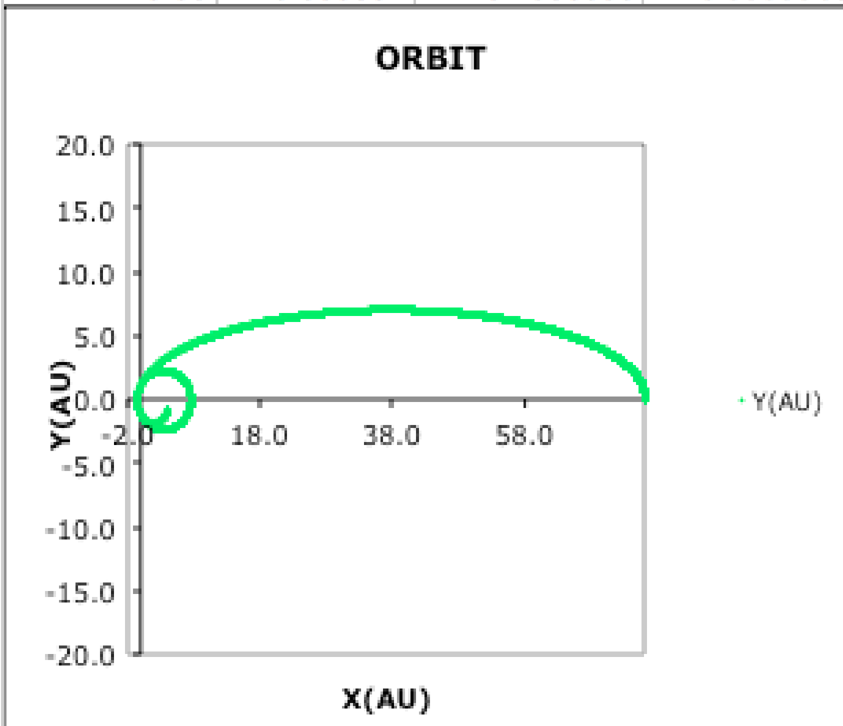
# of explosions = 2.347×10^{29} joules/(4.2×10^{15} joules/explosion)

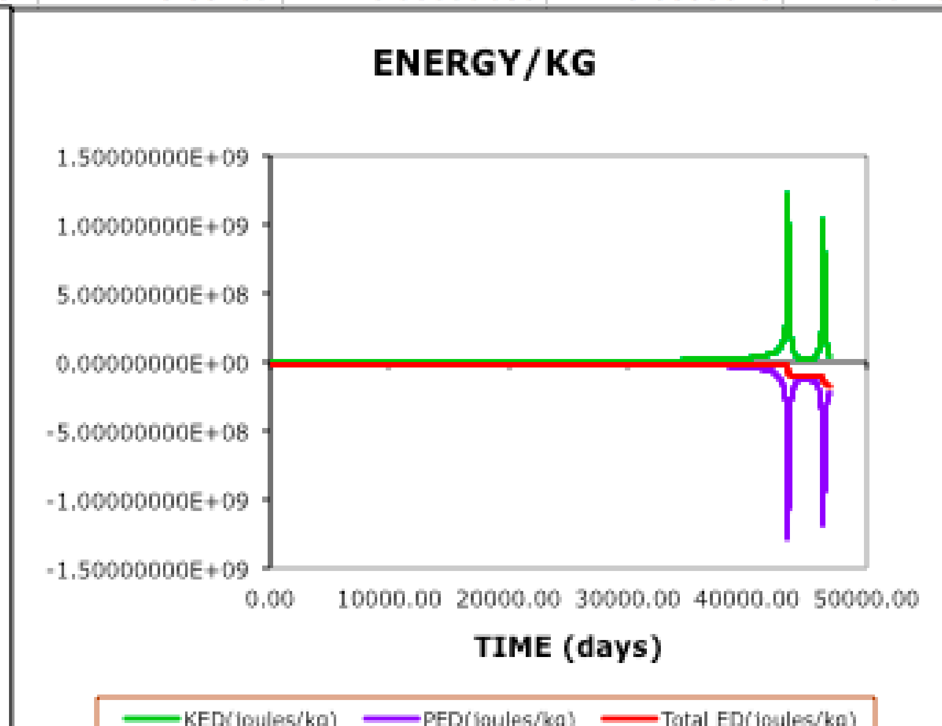
# of explosions = 5.59×10^{13} (55.9 trillion explosions. That's a lot!)

This is not something we can do. It is something a more advanced civilization might be able to do.

Spread Sheet Simulation: Ice Centaur Slowed; Changes from 76 A.U. to 0.723 A.U. Circular Orbit

2-D 2-Body Orbit		ENTER/MODIFY DATA IN GREEN CELLS ONLY			Sun Earth model		
	physical parameters					**constants**	
	MSun=	2.00E+30	kg			G =	6.67E-11
	iteration parmeters					1AU =	1.50E+11
	dt=	2.50E+00	days			1 day =	86400
						1 km/sec =	1000
	planet data						
t(days)	Vx(km/sec)	Vy(km/sec)	X(AU)	Y(AU)	R(AU)	A(m/s^2)	Ax(m/sec^2)
0.00	0	0.450	76	0	76	-0.0000010	-0.000001
2.50	-0.000222	0.4500000	75.99999968	0.00065	75.99999968	-0.0000010	-1.03E-06
5.00	-0.000443	0.4500000	75.99999904	0.00130	75.99999905	-0.0000010	-1.03E-06
7.50	-0.000665	0.4500000	75.99999808	0.00194	75.99999811	-0.0000010	-1.03E-06
10.00	-0.000887	0.4500000	75.99999681	0.00259	75.99999685	-0.0000010	-1.03E-06



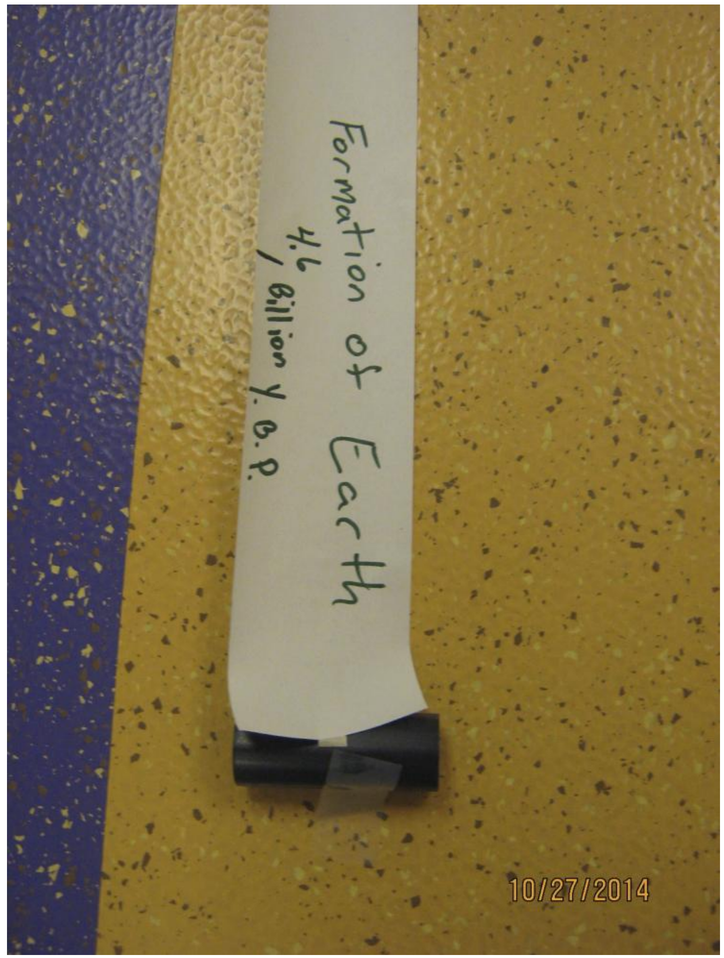


Drake's Equation for Estimating the Probability of Finding an Advanced Civilization

$$N = R^{*} \times f_{p} \times n_{e} \times f_{l} \times f_{i} \times f_{c} \times L$$

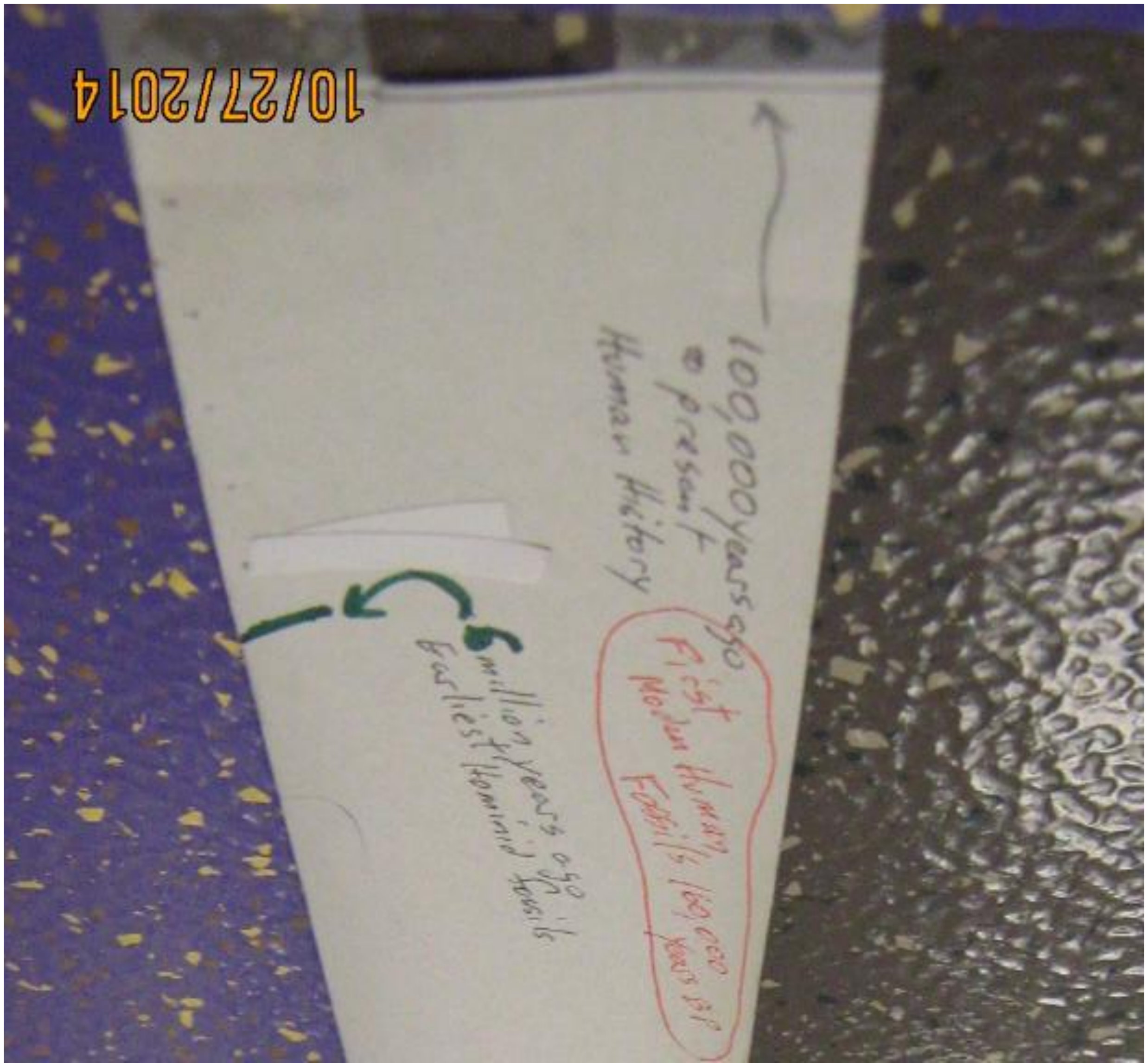
The Drake equation, formulated in 1961, estimates the number of alien civilizations we could detect. Recent discoveries of numerous planets in the Milky Way have raised the odds.

Looking Down at the Formation of Earth Starting Point of the 45 meter Timeline Tape Representing 4.5 billion Years of Earth History



Earth's Geologic Timeline: Standing at the Formation 4.5 billion Years ago Looking towards Recent Times

Reaching the Far End of the Tape from the Formation of Earth Looking at the Last Millimeter that Represents the Most Recent 100,000 Years of Human History



Advanced Civilizations Below the Dyson Net Level:

Terraformed Goldilocks Planets

If stars with all their Goldylocks planets transformed are out there, that implies that civilizations can survive for a LONG time