

Our Cosmic History*

Lecture #1 - April 1, 2010

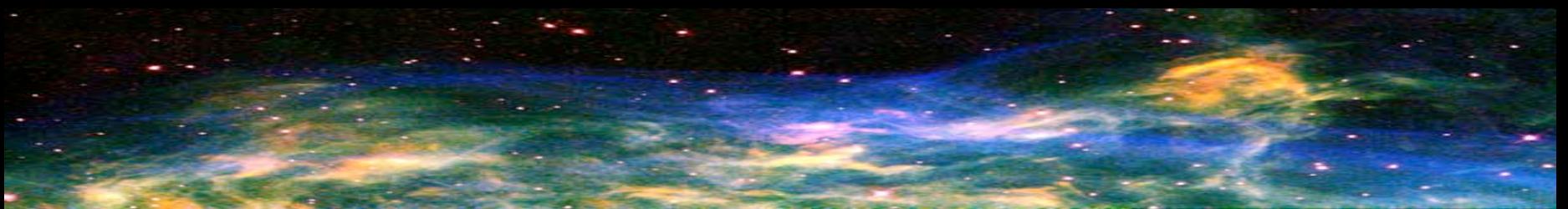
“The Value of a Cosmic Perspective”

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** Lecture series sponsored by the PSU Center for Science Education & the Science Integration Institute, and made possible by a generous grant from the Oregon Dept. of Education*



Themes of the series...

- Reflecting on what it means to be *you*, in this moment, within the context of the universe as we currently understand it. What is the cosmic *story* we are part of?
- Gaining perspective on how we connect to the universe: we are children of the *whole cosmos*, not just our immediate surroundings
- Framework for teachers and students to see how the details of science fit into a big picture that gives meaning and context to those details

(B. Greene essay, NYT June 1, 2008,
“Put a Little Science in Your Life”)



Series Web Site...

...for schedule, resources, & continuing discussion...

<http://oregonteacherscholars.pbwiki.com/Our-Cosmic-History>

(or link from www.scienceintegration.org)

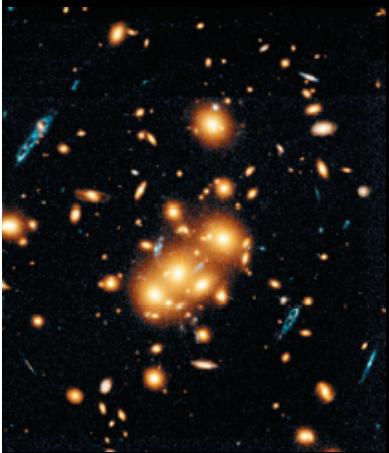
Upcoming...

Lecture #2:

“The Early History of the Cosmos”

April 8th at 7 pm

(same location - 71 Cramer)



Today's Core Theme

It's worth cultivating a big picture ("cosmic") perspective because it affects how you think, feel, & act in everyday life.

Many of our difficulties (individual, social, planetary) arise from *narrowness of perspective*. We forget that there is always another way to see things, and we mistake our limited perception for absolute truth.

By expanding our awareness, a cosmic perspective helps us avoid being stuck or trapped in one way of seeing things.

Concrete illustration of changing perspective

Consider the difference between your narrow frame of mind when someone just cut you off in traffic, and the expansive feeling of connection while lying on a blanket looking at the stars on a summer night, wondering if someone out there is looking back at you...



We are made by our stories...

For example:

- “College is key to life success” narrative
- “I’m a victim” narrative
- “No one will like me if...” narrative
- “Recognition = success as a human being” narrative
- “US tax code is meaningful” narrative
- “Scientific materialism” narrative
- “Don’t trust corporations” narrative
- “Don’t trust government” narrative
- “Environmental morality” narrative

“In human affairs an idea is a greater moving force than any physical influence... So the shape of our future will depend to a large extent on our understanding of our role in the cosmic process.”

~ Louise B. Young

“All professions, all work, all activity in the human world finds its essential meaning in the context of a people's cosmic story.” ~ Brian Swimme

Our Common Story...

“For the first time in human history, it is now possible to tell a unified and increasingly factual story of humanity, the planet, and our universe. Every time we pick up a cell phone or pump 200 million-year-old fossil fuel into our cars, we affirm this story in deed if not in thought and understanding. Integrating this new evolving, scientific story is key to our common future at a dangerous moment in the cultural evolution of our species and the natural history of our planet...”



... How can we solve epic problems in the world today, if we do not understand the epic of evolution in which we have come to thrive and may yet fail? Reframing human history in the context of the evolution of life and the universe, including the cognitive, cultural and technological evolution of humans, will help to re-orient humanity away from bitter ideological and ethnic conflicts of the past towards pragmatic problem-solving in the future.”

~ William Grassie

“A Teachable Moment: Our Common Story”

http://www.grassie.net/articles/2009_Teachable_Moment.html

“It is necessary to change our understanding of the true purpose of what we are and what we do in the world. Only such a new understanding will enable us to develop new models of behavior and new scales of values and goals, and thereby investing the global regulations, treaties, and institutions with a new spirit and meaning.”

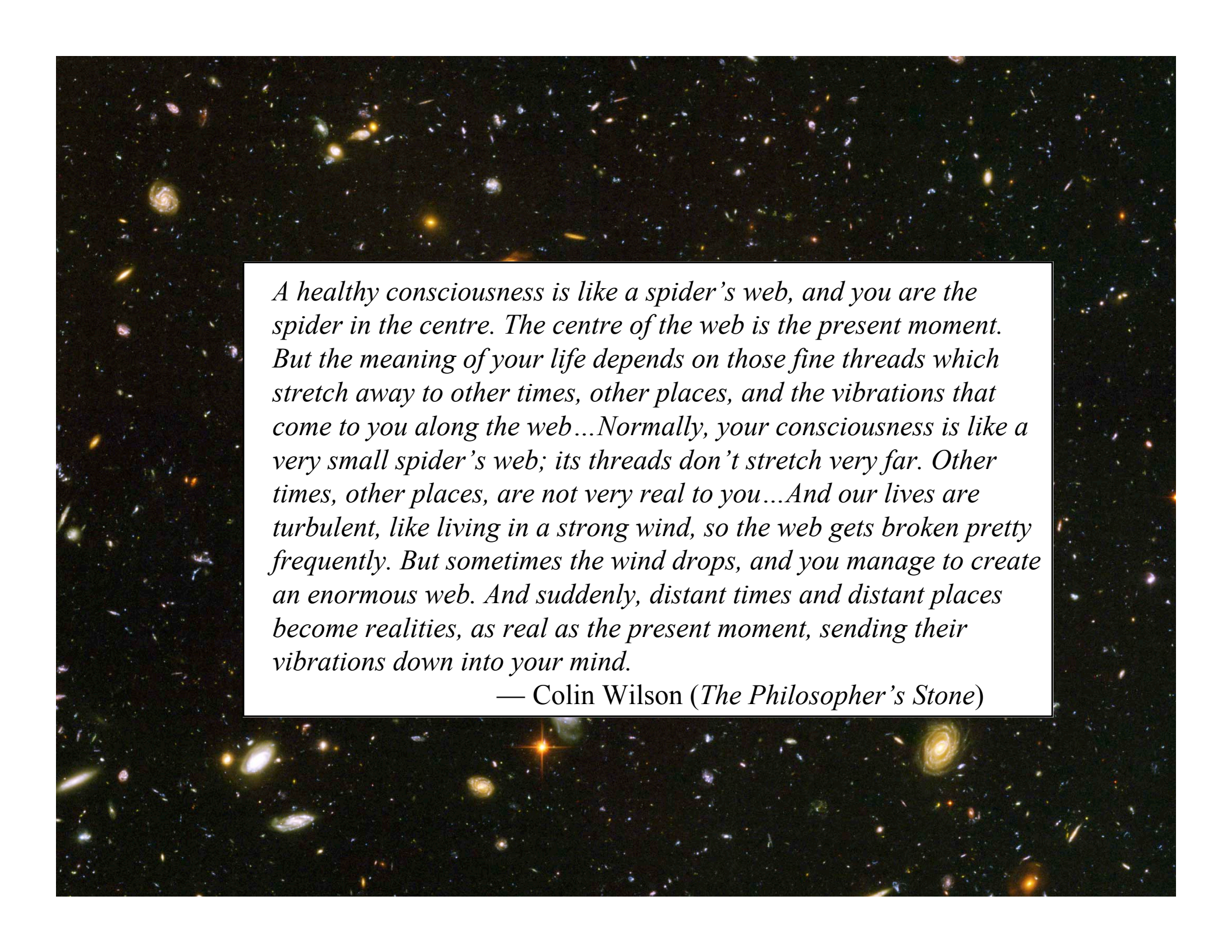
~ Vaclav Havel

Your Self-image within the Universe

- I am one cog in a giant machine.
- I am the “eyes of the Milky Way” – a way for the universe to notice and appreciate itself.
- I am a cosmic artist – a contributor to a universal creative process.
- I am a participant in a definite cosmic plan or purpose, with some assigned role to play in carrying out that purpose.
- I am a random speck in a vast uncaring universe.

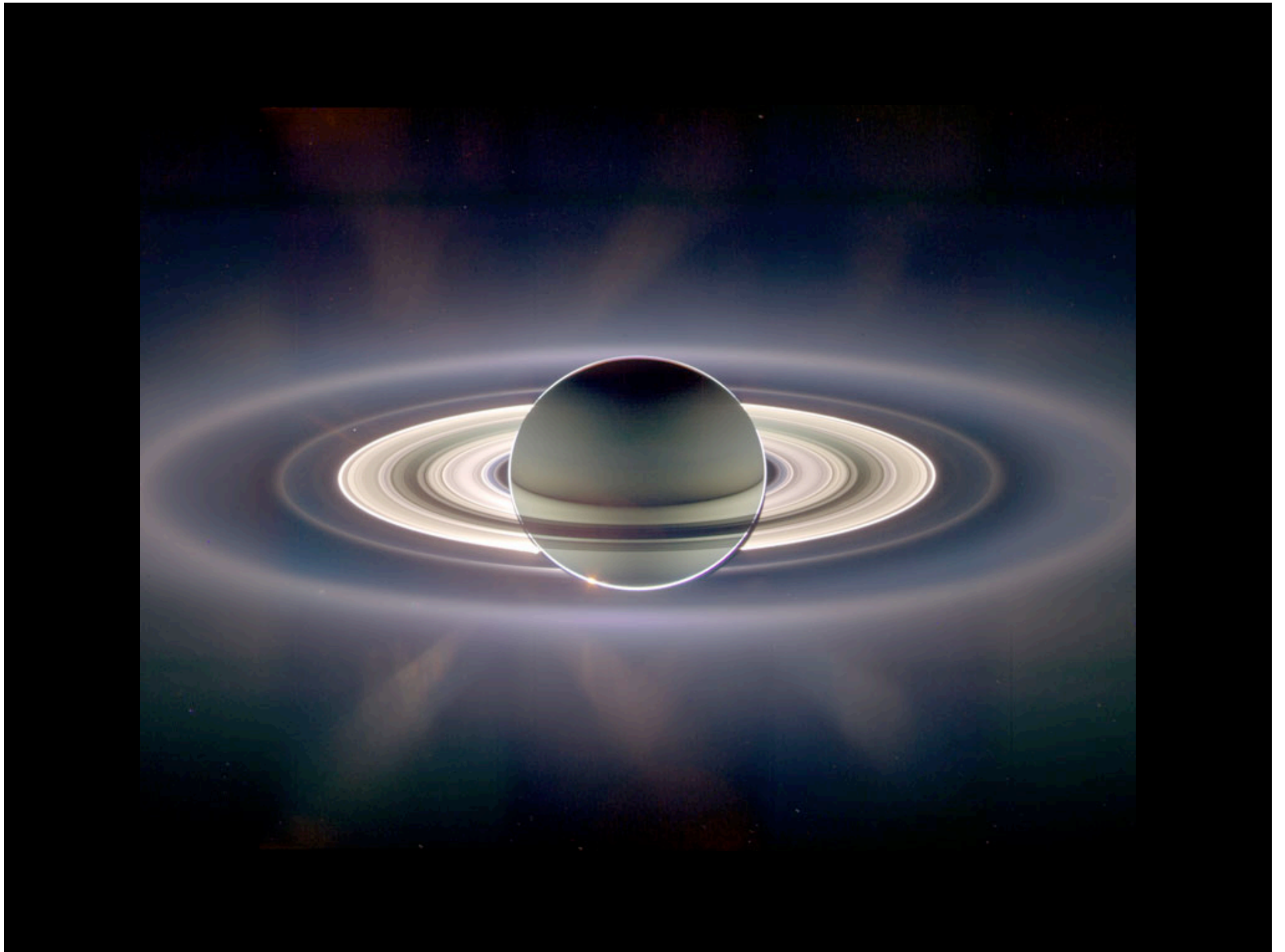
Bonding through chemistry...

In every breath you probably inhale an atom of nitrogen that was in the *last* breath of your favorite historical figure

A deep space photograph showing a vast field of galaxies and stars against a black background. The galaxies are scattered across the frame, some appearing as bright, colorful spirals and others as smaller, more distant points of light. The overall scene is a rich, multi-colored tapestry of cosmic objects.

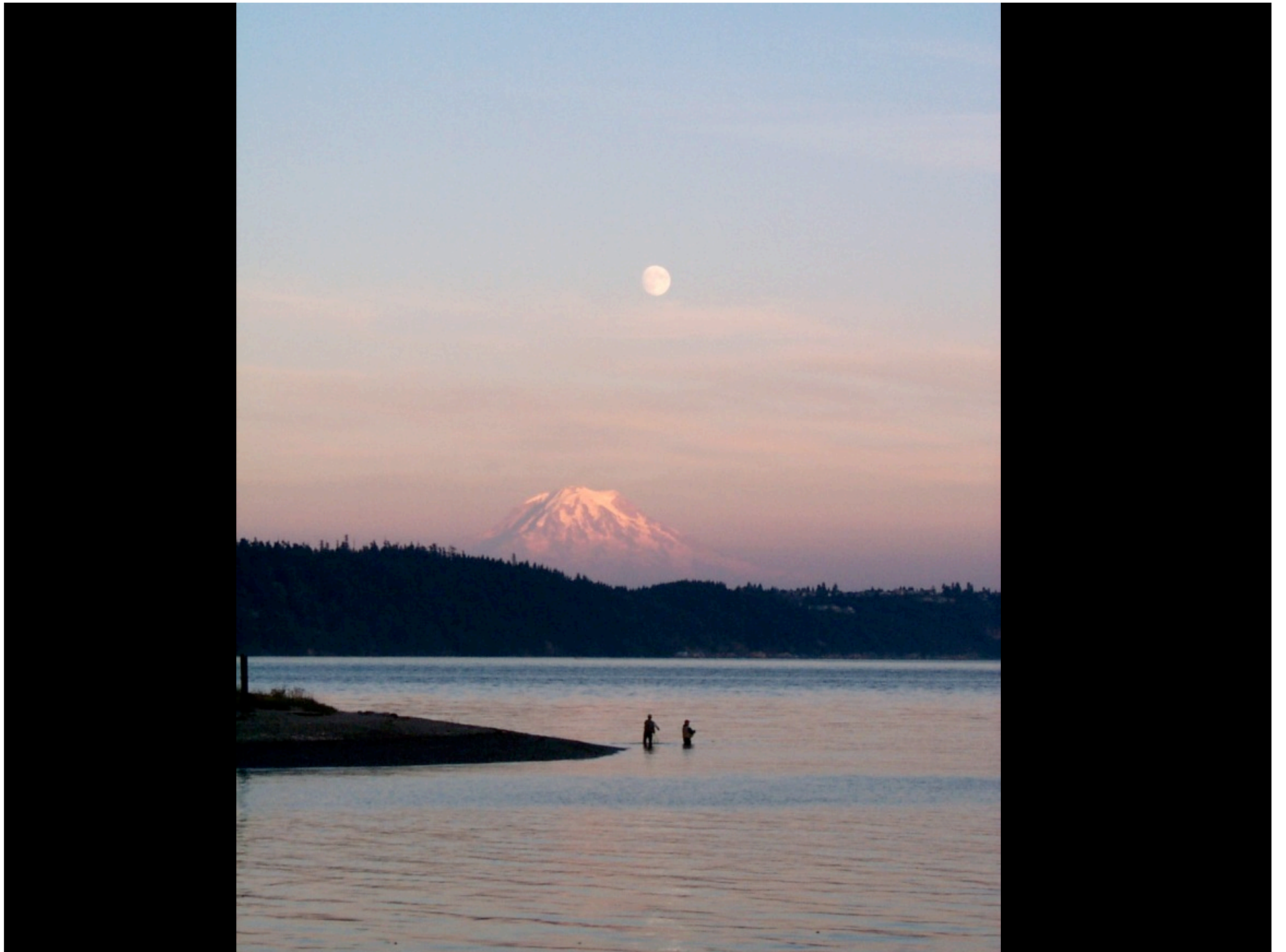
A healthy consciousness is like a spider's web, and you are the spider in the centre. The centre of the web is the present moment. But the meaning of your life depends on those fine threads which stretch away to other times, other places, and the vibrations that come to you along the web...Normally, your consciousness is like a very small spider's web; its threads don't stretch very far. Other times, other places, are not very real to you...And our lives are turbulent, like living in a strong wind, so the web gets broken pretty frequently. But sometimes the wind drops, and you manage to create an enormous web. And suddenly, distant times and distant places become realities, as real as the present moment, sending their vibrations down into your mind.

— Colin Wilson (*The Philosopher's Stone*)





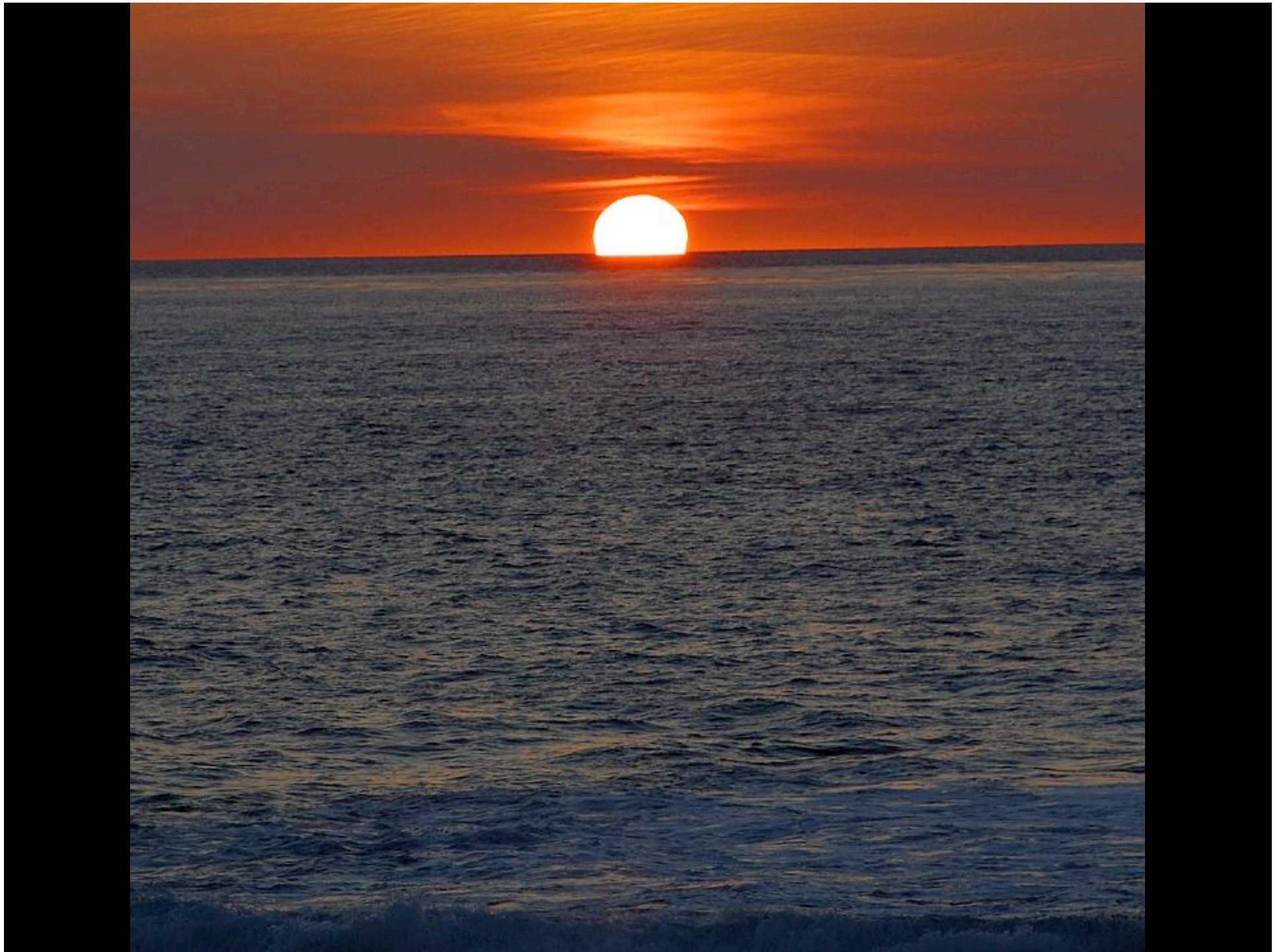


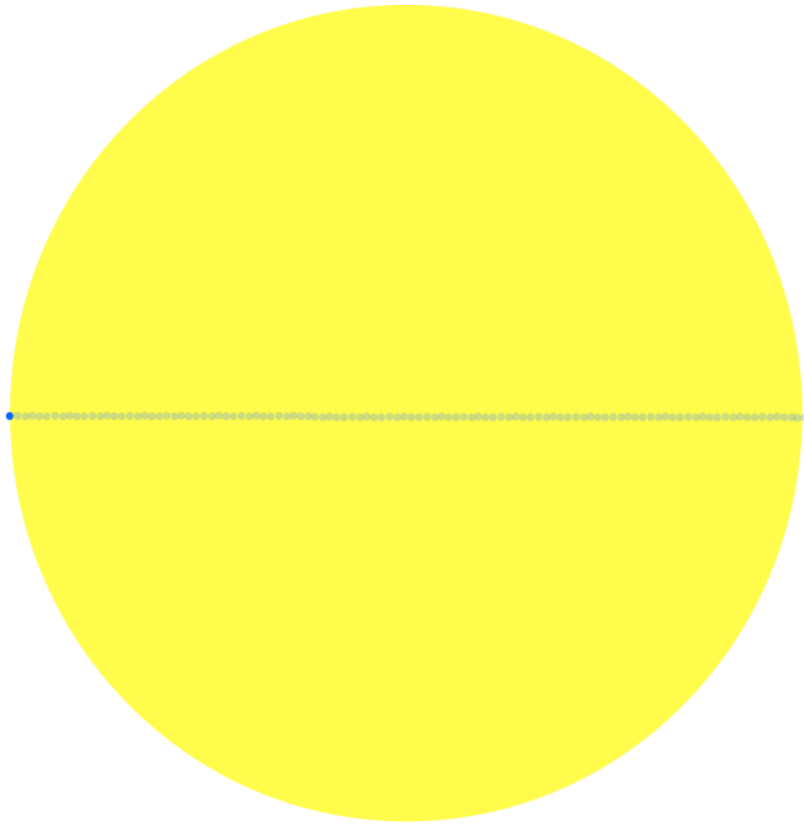


Scale of Earth-Moon System

Moon is 1/4 Earth's diameter, and about 30 Earths span the distance to the Moon (about 384,000 km on average):







About 109 Earths fit across
the face of the Sun

Distance from Earth to Sun (1 Astronomical Unit)
is about 150 million km

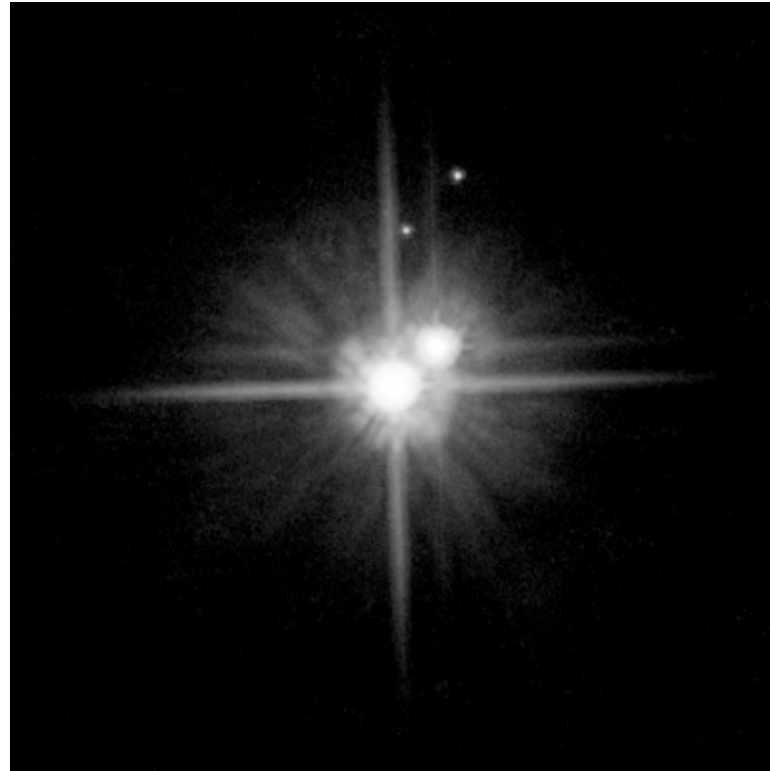
Astronomical Distances

- To make the numbers somewhat manageable, take the fastest thing we know of (light: 300,000 km/s), and express distances in terms of how far light would get in a certain amount of time.

1 light year = the distance light travels in 1 year
= about 10 trillion km (10^{13} km)

To convince yourself that this really is a distance, think of looking at a car speedometer. If you ride in a car at 50 miles/hour, for 1 hour, you will go 50 miles. If you travel at that speed for 2 hours, you go 100 miles. Most people would just call that 100 miles, but you could also call it “2 car hours.” A light year is the same sort of unit.

Solar system scale



40 AU (about 5 light hours) to Pluto

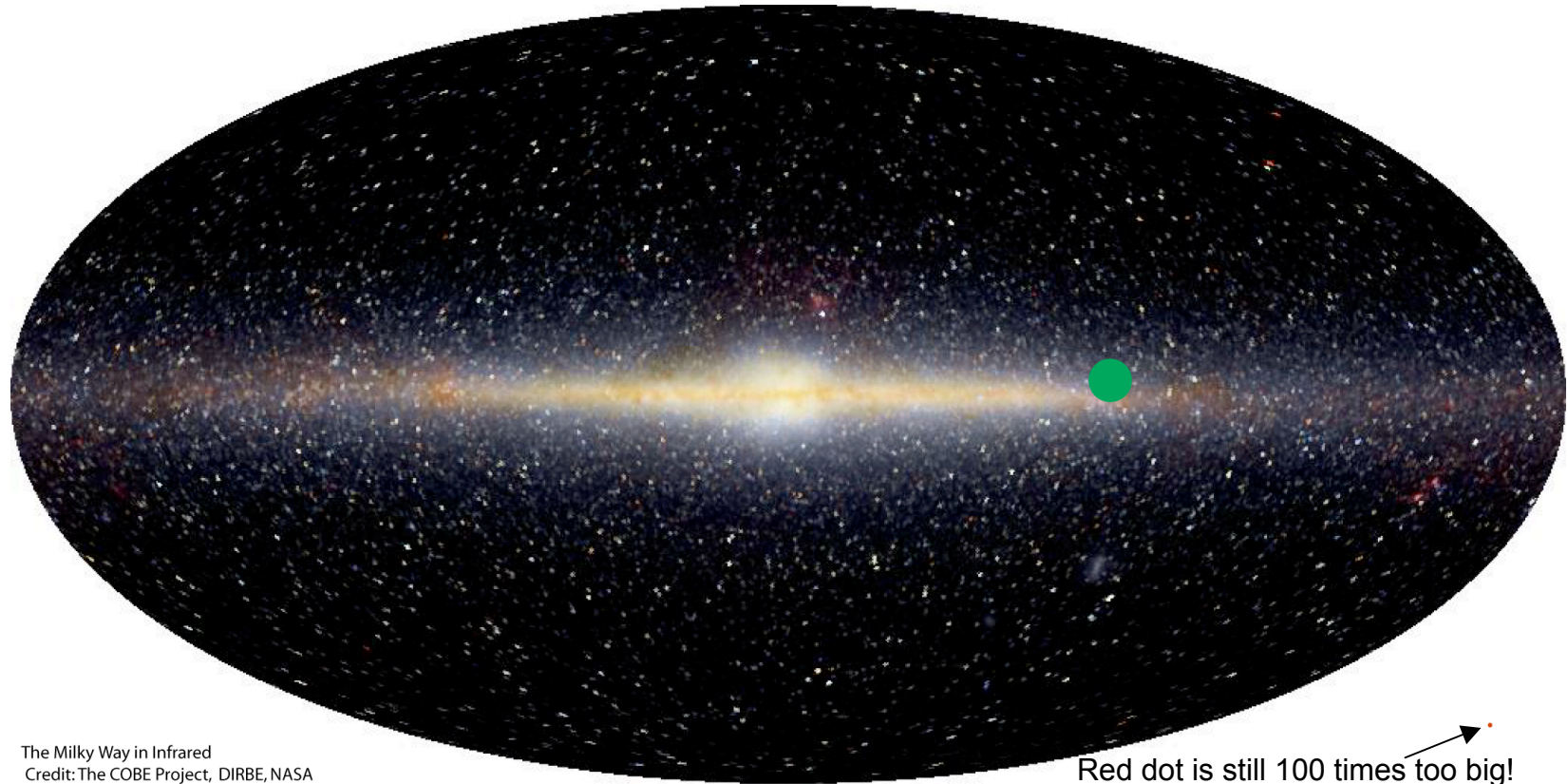
How far away are the stars?

The closest star, Proxima Centauri, is 4.2 light years away

That's almost 7,000 times the Sun – Pluto distance!!



We reside in a galaxy of ~ 300 billion stars. On this image of our Milky Way Galaxy, diameter of green circle is 1000 times bigger than the distance from our solar system to Proxima Centauri !!!



The Milky Way in Infrared
Credit: The COBE Project, DIRBE, NASA

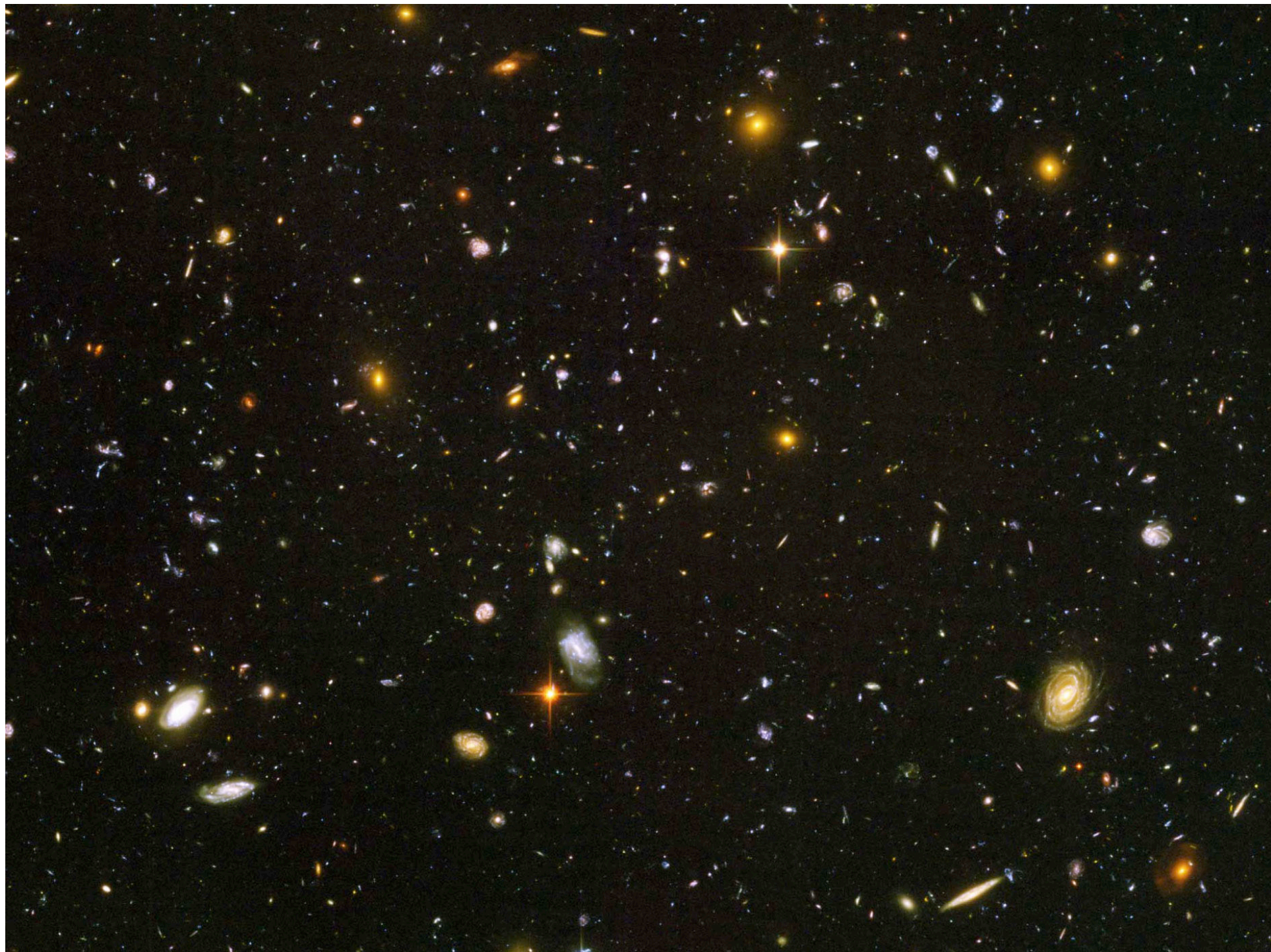
Red dot is still 100 times too big!

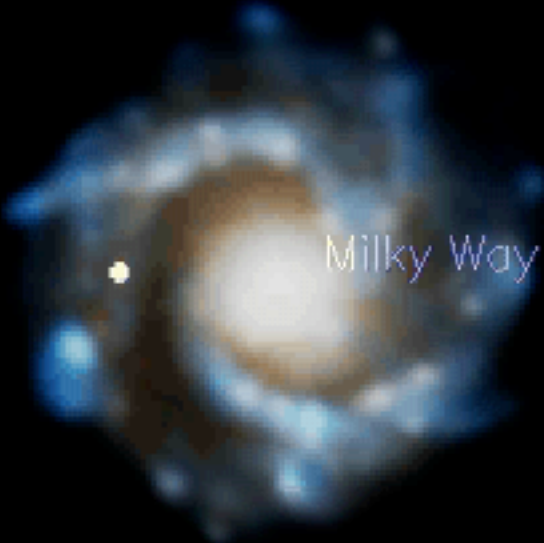
Andromeda Galaxy (M31)



Whirlpool Galaxy (M51)

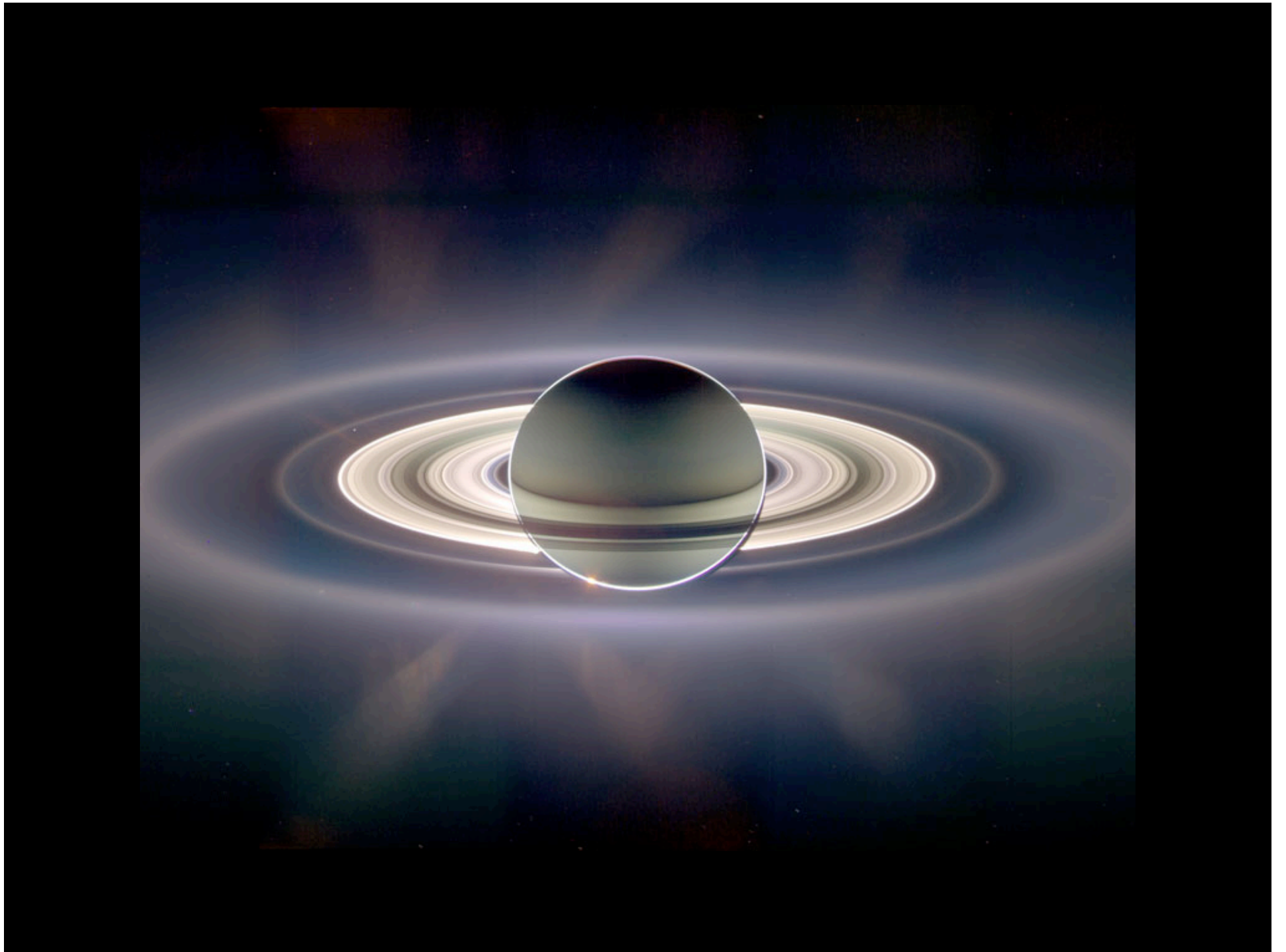






Summary of Distance Scale

- Portland to Eugene ----- about 150 km
- Earth (circumference) ----- ~40,000 km
- Distance to Moon ----- ~384,000 km (~ 1 light *second*)
- Distance to Sun ----- ~ 8 light-*minutes*
- Distance to nearest star (beyond sun) --- ~ 4 light *years*
- Milky Way Galaxy (diameter) ---- ~ 100,000 light years
- Distance to nearby galaxy ----- ~ 2 million light years
- Most distant visible galaxies ----- ~ *billions* of light years



“Precisely when we grasp the vastness of the universe we also grasp an equally vast interior, the enormous geography of the soul, so to speak. Words may fail afterward, forcing us to rely on hackneyed descriptions that emphasize our insignificance, but what we actually sense, if only for an instant, is largeness of spirit.”

~ Edwin Dobb (Harpers, Feb. 1995, p.40)

“The most beautiful experience [we] can have is a sense of the mysterious....To sense that behind anything that can be experienced there is a something that our mind cannot grasp and whose beauty and sublimity reaches us only indirectly and as a feeble reflection...”

~ Albert Einstein

“There are many windows through which we can look out into the world, searching for meaning...Most of us, when we ponder on the meaning of our existence, peer through but one of these windows onto the world. And even that one is often misted over by the breath of our finite humanity. We clear a tiny peephole and stare through. No wonder we are confused by the tiny fraction of the whole that we see. It is, after all, like trying to comprehend the panorama of the desert or the sea through a rolled-up newspaper.”

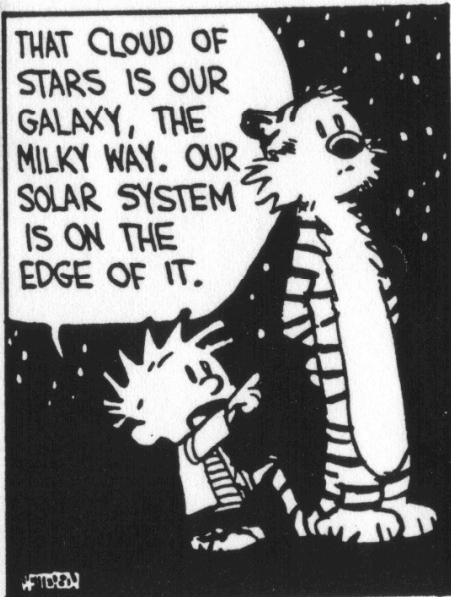
~ Jane Goodall

Infinite Possibilities?

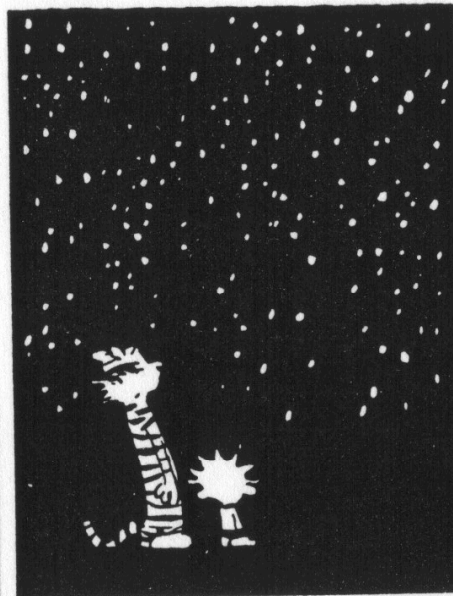
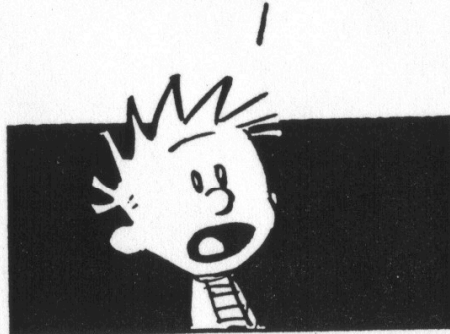
Evidence suggests that the universe may very well be infinite... what does this mean?

Is this lecture happening repeatedly throughout the universe, and every variation on it? What does it feel like for each of the participants?

Do some Earths survive environmental catastrophe, while some are destroyed, no matter what we do??



WE HURL THROUGH AN INCOMPREHENSIBLE DARKNESS. IN COSMIC TERMS, WE ARE SUBATOMIC PARTICLES IN A GRAIN OF SAND ON AN INFINITE BEACH.



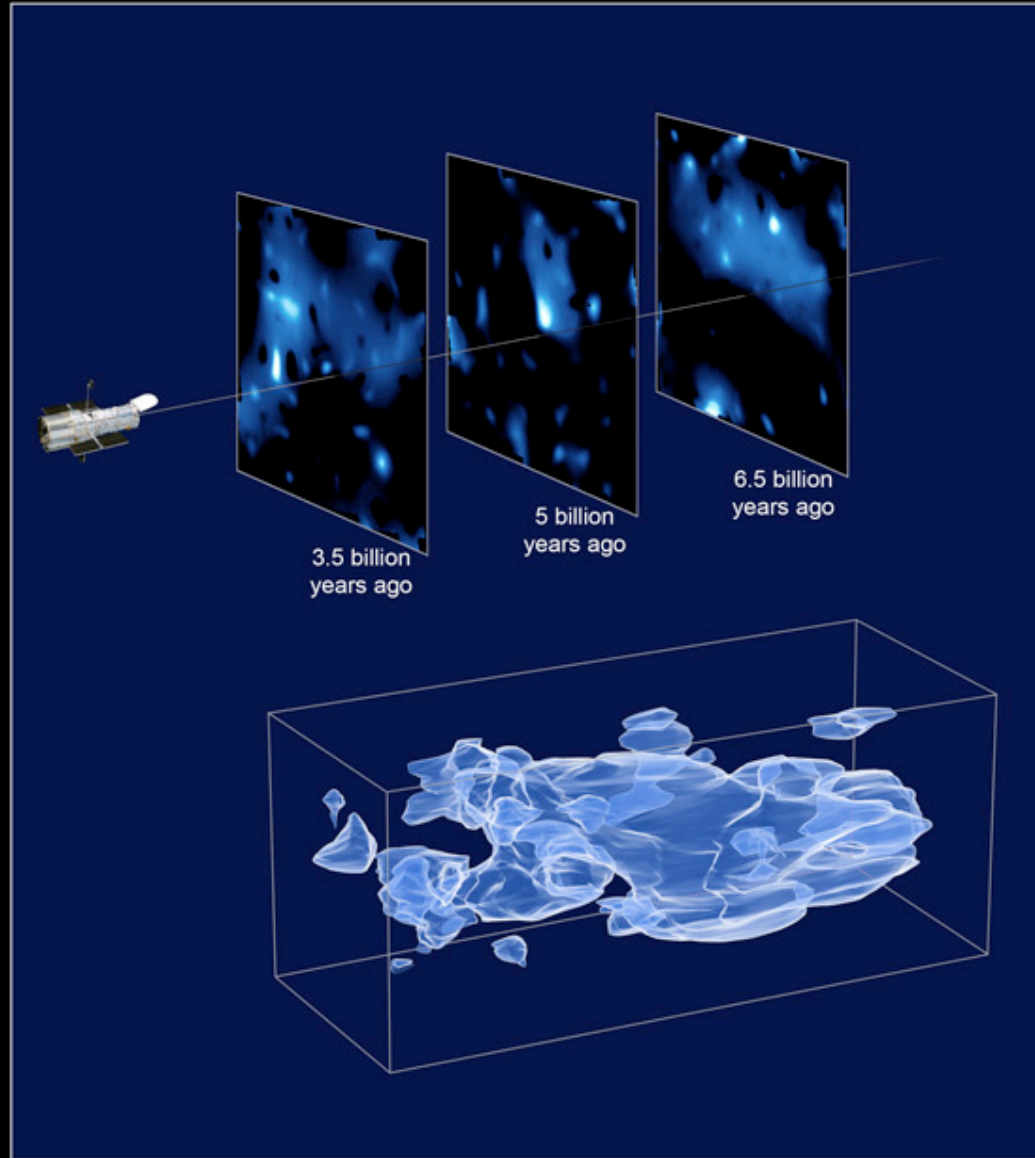
Composition of the Universe

- The stuff we're made of (baryonic matter, e.g. protons and neutrons) only comprises $\sim 4\%$ of the energy content of the universe
- $\sim 4\%$ of energy is baryonic matter, $\sim 23\%$ exotic dark matter, and $\sim 73\%$ dark energy



Distribution of Dark Matter

HST ■ ACS/WFC



NASA, ESA, and R. Massey (California Institute of Technology)

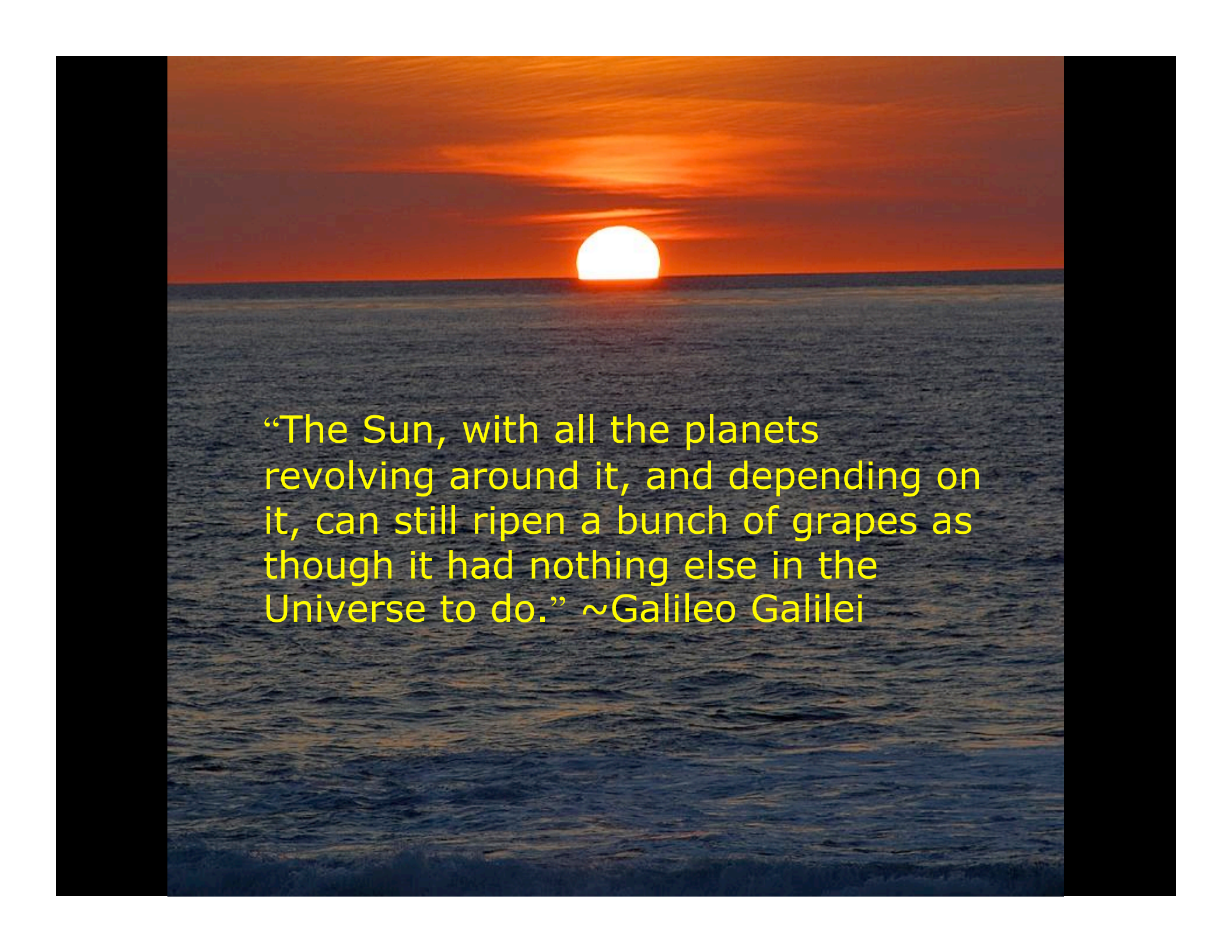
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Large Hadron Collider

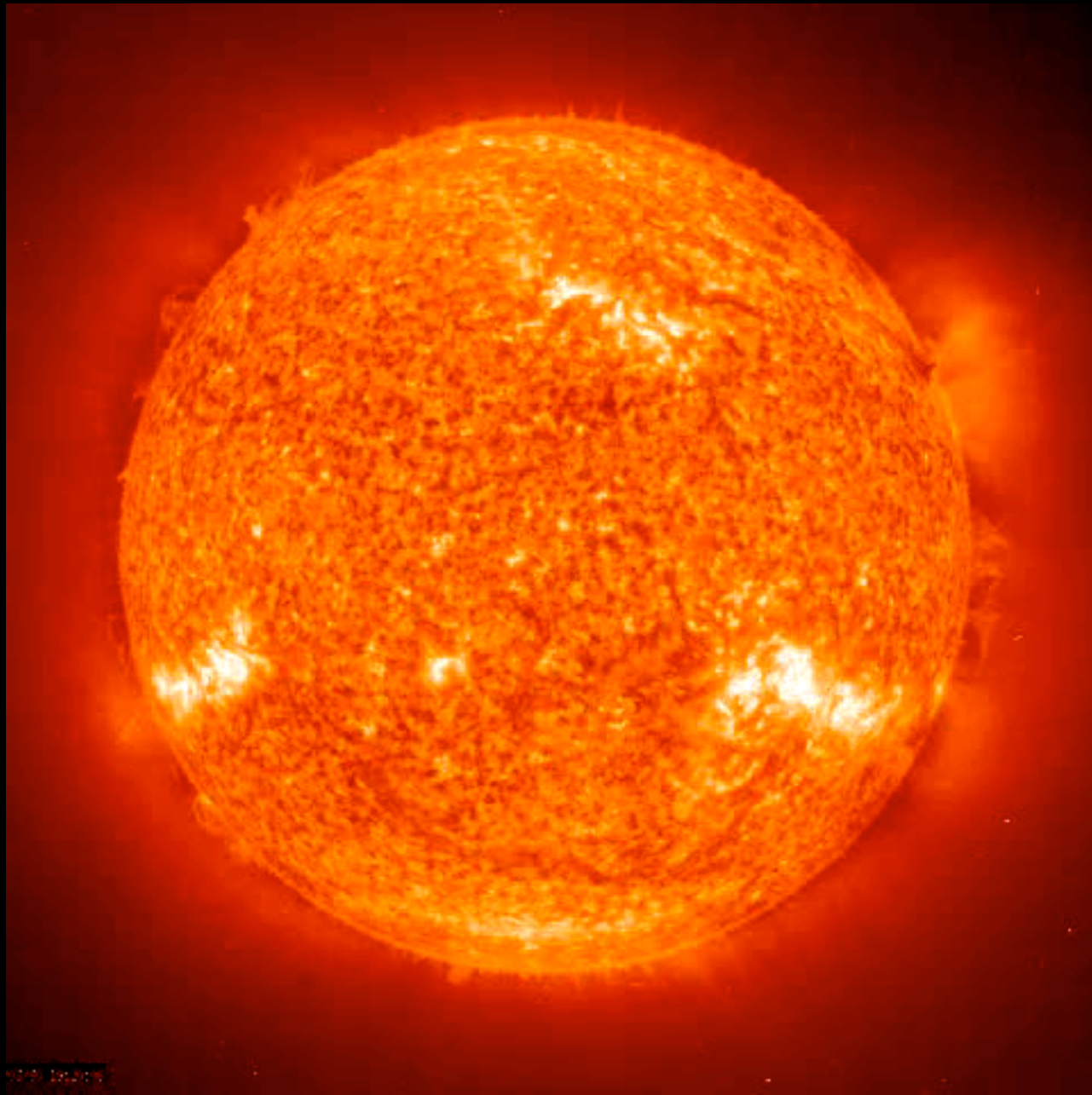
- Search for dark matter “WIMP” particles

- LHC rap -

<http://www.youtube.com/watch?v=j50ZssEojtM>

A photograph of a sunset over a vast, dark blue ocean. The sun is a bright, glowing orb positioned exactly on the horizon line, casting a shimmering path of light across the water. The sky above is a gradient of orange and red, with some wispy clouds. The entire image is framed by a black border.

“The Sun, with all the planets revolving around it, and depending on it, can still ripen a bunch of grapes as though it had nothing else in the Universe to do.” ~Galileo Galilei



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Cosmic History in a Nutshell

Adapted from *Girl Meets Boy: A Comedy about the Universe*, by Melinda Lopez

(http://cfa-www.harvard.edu/seuforum/exhibit/resources/GMB_CUESCRIPT.pdf)

“This story of the universe, and all of our separate meta-narratives within it, are woven together on a cosmic loom, each of us a thread in a greater tapestry of unfolding truth. If we listen carefully to each other and to nature, ... then our common future may also be a self-transcending process leading to greater truth, beauty, and goodness.”

~ William Grassie



“There are more things in heaven and Earth...than are dreamt of in your philosophy.” ~Shakespeare (*Hamlet*)



Thanks to...

- Oregon Dept. of Education Math/Science Partners Grant (primary funding for this series)
- Portland State University Center for Science Education
- Beaverton and Hillsboro School Districts
- Pacific University
- Science Integration Institute

References/Suggested Reading

- Greene, “Put a Little Science in Your Life” (NY Times opinion essay, June 1, 2008)
- Grassie, “A Teachable Moment: Our Common Story” http://www.grassie.net/articles/2009_Teachable_Moment.html (2009)
- Christian, *Maps of Time*, introduction (2004)
- Duncan & Tyler, *Your Cosmic Context*, chs 1-2 (2009)
- Duncan, *An Ordinary World*, chs 1-5 (2009)
- Cosmus education web site (tour of the universe, etc.): <http://astro.uchicago.edu/cosmus/>
- Sloan Digital Sky Survey: <http://www.sdss.org/>
- * Collected resources: <http://www.scienceintegration.org>