Seeking God in Einstein’s Universe
Into the Vastness

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Why God & Einstein?

My personal journey
trying to make sense of the universe
that I am in love with

★ Intellectual Journey
- love of nature drove me to study forestry then
geology, then astronomy and physics

★ Spiritual Journey
- have a nagging sense of “who-ness” to the
universe ... a sense of relationship with a higher,
loving intelligence
This SOAR Coarse

★ Some of the incredible wonders we've discovered about our universe:
  ° Scale of things
  ° Origins of the elements we're made of
  ° Origin & evolution of the universe
  ° Weirdness of matter & energy

★ How I connect these to my sense of God
  ° How weird is God?
  ° What can we know about God?
  ° What do others say about God?
This SOAR Coarse

★ 9/7: Into the Vastness
   ☀ A bit about my journey
   ☀ Discussion of your interests
     ♦ Why are you here? What do you hope for?
   ☀ Cosmic scales of space & time

★ 9/14: In the Beginning
   ☀ Origin & Evolution of the universe

★ 9/21: The Substance of Ourselves
   ☀ Origin of elements we & Earth are made of

★ 9/28: The Children of Earth
   ☀ History of Earth & Life
Faith and Science

★ Can science and faith be integrated within?

囟 SCIENCE - data, questioning, challenging
囟 FAITH - transient, ineffable experiences of us and others throughout history that can’t be reproduced or challenged.

★ Current US culture says “no”.
囟 Because faith is defined as literalist & fundamentalist?

★ Vatican Observatory says “yes”.
囟 Staffed by scientist/priests since 1582
囟 But can the world views be integrated?
Define Science and Religion

Define science
- Systematic study of the sensory universe
- Based on *reproducible* data

Define faith
- A gift
  - Religious/Spiritual experiences come unbidden
  - We don’t have to invent everything for ourselves
    ... but we must examine what we’re given!
- A decision
  - Experiences can be interpreted as interactions with God
    *OR* as coincidence, accident, etc.
- *Not contrary to reason*
  - Faith in God ≠ belief in magic
  - Faith is not (or need not be) blind or stupid
Faith is A Gift

☆ A sense of a “whoness” to the universe
  Unbidden, difficult to deny
☆ Grew up in a Catholic family
  Learned the rituals
  Learned the prayers
  Learned some of the tradition
  Sense of a whoness affirmed ... imprinted?
  Found the Church (big C) hooey
    Didn’t follow its own teachings
    Seemed stuck in middle ages
      Sexism, hierarchy, costumes ...
    Taught rules, not the spiritual journey
Faith is a Decision

★ Left Church when I left for college
   ○ Attributed my sense of whoness to nature
★ Lost need for God to create the universe or us
   ○ Laws of physics, chemistry & biology enough
★ Lost belief in God
   ○ Sense of whoness = brain damage
case due to childhood exposure to incense
   ○ Tried to ignore it, deny it as “unscientific”

But the universe was too lonely!
Faith is a Decision

★ Found “Godless” universe too lonely
  ◾ The “imprinting” of a Catholic childhood?
  ◾ A character flaw?
★ Read & thought about the question (secretly!)
★ Realized great minds come down on both sides
  ◾ No absolutely compelling argument either way
★ Realized I could choose to believe that my sense of whoness was a sense of God.

Experiences that seem like interaction with God ...

Brain Damage? Coincidence? God?
Faith is not Contrary to Reason

★ Does not require
  ◐ Disregarding personal experience of the world
  ◐ Believing that laws of nature get suspended
    God is clever!

★ The universe is weird!
  ◐ Weird enough for light to be particle & wave at the same time!
  ◐ Weird enough for me to exist ... and I'm fairly weird!
  ◐ May be weird enough for God to exist ... so how weird is God?
“We do not need God to explain the universe as we see it today. But once I believe in God, the universe as I see it today has a great deal to say about that God.”

-- Fr. George Coyne, S.J.
AOD’s View of S & R

☆ Both are seeking “truth”
  ⊙ Seeking understanding of the universe
    - Exterior world = science
    - Interior world = faith
  Not that these worlds are truly separate!

☆ Both require human community
  ⊙ Experiments can be done alone in a basement
  ⊙ Science requires testing, challenging and vetting by the scientific community
  ⊙ Spiritual experiences can be had alone anywhere
  ⊙ Faith, seeking truth, requires reflecting, analyzing, comparing one’s experience with others’

Both science and religion can produce kooks in the absence of skeptical community!
AOD’s View of S & R

☆ Science and religion are ways of trying to figure out the universe

☆ Both science and religion require
  - Questioning the data
  - Testing the conclusions
  - Open inquiry
  - Realistic skepticism
  
  The role of skeptical scientific & religious communities.

☆ Both science and religion require
  - Faith ...
    - ... in the reality of our experience
    - ... in our ability to understand & know { the universe, God.}
Comments & Discussion

What are you seeking here?
Population of the Cosmos

~100 Billion Galaxies = 10^{11} Galaxies

~ 100 Billion Stars in each galaxy = (10^{11} \text{ stars})(10^{11} \text{ Galaxies}) = 10^{22} \text{ stars}

~ 10 planets around each star = 10^{23} \text{ planets}

... potentially lots of company, but it's very far away!
Earth-Moon Distance
250,000 miles

Earth-Sun Distance
93,000,000 mi = 1 AU

Closest other star
4 ly = 4(63,200 AU)

(1 ly = 6x10^12 mi)

Milky Way Diameter
100,000 ly

Nearest Galaxy
2,000,000 ly

Farthest Galaxy
13.23 Billion ly

Abell 1835 IR1916 - the Farthest Galaxy - Seen in the Near-Infrared
(VLT ANPU + ISAAC)

ESO PR Photo 05a/04 (1 March 2004)
Universe Mostly Empty Space

☆ For proton = golf ball
   ◀ electrons 300 yards away (1800 times smaller)

☆ Sun is 100 times size of Earth
   ◀ squeeze out space between atoms
     ⇒ Sun is size of Earth (12,756 km = 7,926 mi)
   ◀ squeeze out space within atoms
     ⇒ Sun is 10 km (6.2 miles) in diameter

⇒ 0.0008% of the sun is matter!
Motion of Earth

Rotation on axis
$V_{\text{Equator}} \sim 1000 \text{ mph}, V_{\text{Canton}} \sim 700 \text{ mph}$

Orbit about Sol
$V_{\text{Earth}} \sim 70,000 \text{ mph}$

Orbit about center of Milky Way
$V_{\text{Sun}} \sim 560,000 \text{ mph}$

Milky Way in Local Group
$V_{\text{MW}} \sim 280,000 \text{ mph}$

Local Group falling toward Virgo Cluster
$V_{\text{LG}} \sim 1,750,000 \text{ mph}$
Solar System

Inner Worlds: Mercury, Venus, Earth, Mars

1 AU = 150,000,000 km = 93,000,000 mi

You Are Here!

Positions at 17:00 UT, 1/23/04
Solar System

Outer Worlds: Jupiter, Saturn, Uranus, Neptune, Pluto

SS width ~ 12,000,000,000 km
~ 7,500,000,000 mi

Positions at 17:00 UT, 1/23/04
Solar System Sizes

★ Sun’s diameter is 100 times Earth’s
Contents of the Solar System

★ Moons

🔥 ☉ - Luna

♂ ♀ - Phobos, Deimos

♀ - Loads!

♂ Io

♂ Europa, Ganymede, Callisto

♀ - Loads!

♂ Titan, Mimas

♂ ♀ - Loads: Miranda

♂ ♀ - Loads: Triton

Contents of the Solar System
The Milky Way Galaxy
~ 300 Billion Stars, some with planets
The Milky Way Galaxy

Sun ~ 30,000 ly from center
Galactic Year ~225,000,000 yr
(Sol is ~22)

M87, a galaxy much like the Milky Way

Clusters of Galaxies

Hundreds to thousands of galaxies bound by gravity

Galaxies act as gravitational lenses for more distant galaxies!
Clusters of Galaxies

Gravitational Lenses

Light is bent by gravity of intervening galaxy

Distributed mass creates arcs & smudges
Clusters of Galaxies

Sol is in the "Local Group" part of Virgo Supercluster
Fate of the Milky Way

★ Andromeda Galaxy & MW approaching

_tiles will meet in about 2 billion years_
Fate of the Milky Way

🌟 Sun likely to fly off in gravitational tide
The Sky Tonight
Observing Opportunities:
Tuesdays ~9:15 pm when it’s clear
TONIGHT: 9 pm (with telescope)