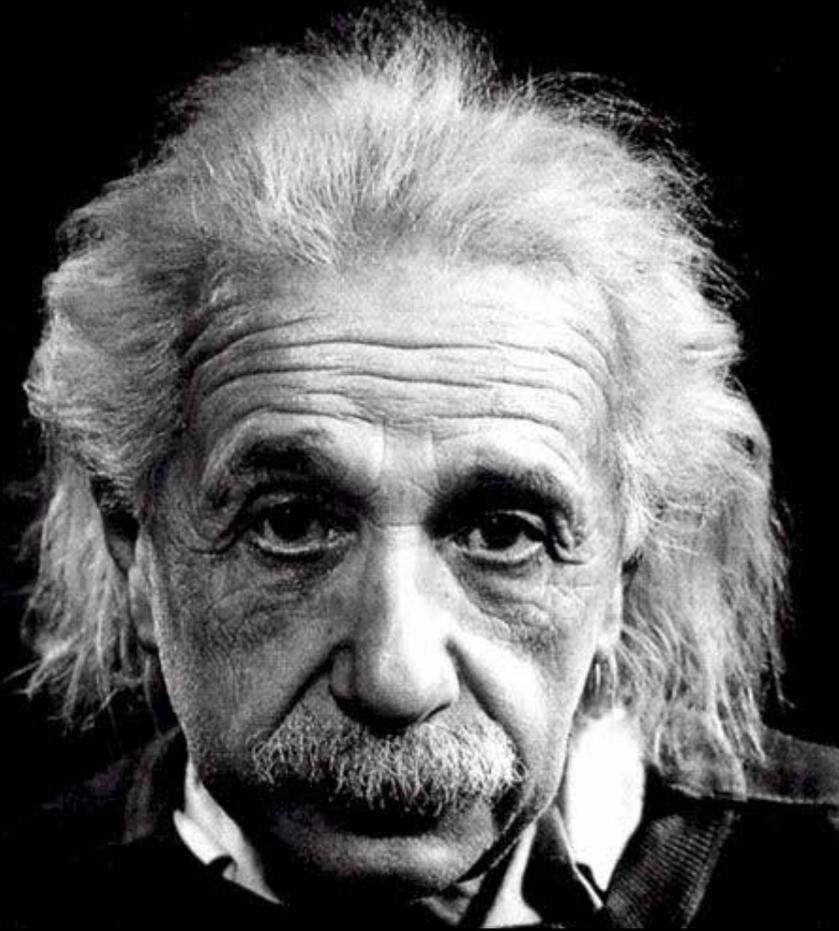


Einstein's Credo



Modern Physics

Thomas Naumann

Deutsches Elektronen-Synchrotron

DESY

**If I am going to speak of God repeatedly,
then not for theological,
but for physical reasons.**

**Einstein used to speak so often of God
that I tend to believe he has been a
disguised theologian.**

Friedrich Dürrenmatt,
Talk on Einstein's centenary,
ETH Zürich, 1979.

- **Einstein's Credo**

- General Relativity - 100 years after
- Quantum Theory

- **Epistemology**

- The Law: Why is the world comprehensible ?
- Truth and Beauty
- The Best of all Worlds ? Anthropic fine-tuning

The Old One and gravitation

- to Abraham Pais 1947:
Had God been satisfied with inertial systems, he would not have created gravitation.
- Einstein's assistant Ilse Rosenthal-Schneider asked him in 1919 what if Eddington had not confirmed the light deflection by the Sun:
"Then I would have been sorry for the dear Lord. The theory is correct."
- In 1918, Hermann Weyl tried to unify gravity and electromagnetism. Einstein: "Should one **accuse the dear Lord to be inconsequent** if he missed your idea to **harmonise the world** of physics?"
- **Today:** Did **He** use Supersymmetry - Supergravity - Superstrings ?

The Old One

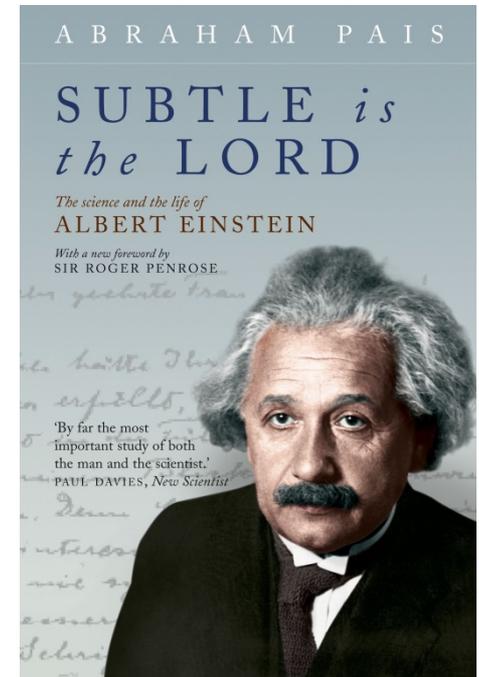
- 1921 lectures at Princeton University on a measurement contradicting his theory of gravitation

„**Subtle is the Lord, but malicious He is not.**”

„**Raffiniert ist der Herr Gott,
aber boshaft ist Er nicht.**”

engraved above the chimney
in Princeton’s Jones Hall

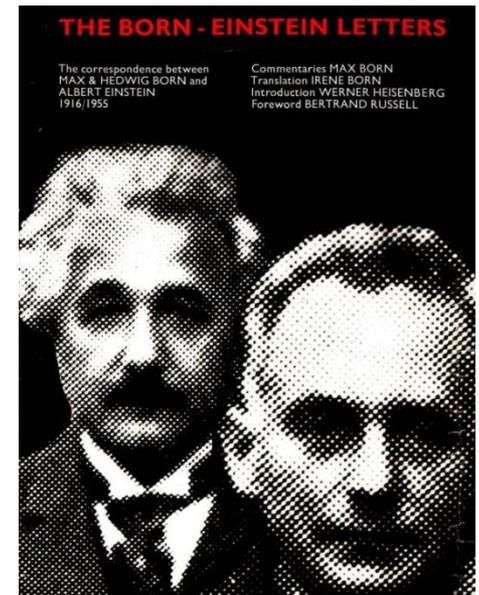
- Asked what he meant by this
he replaces God by Nature:
“**Nature** hides her secret
because of her essential loftiness,
but not by means of ruse.”
- 1923 to Vladimir Bargmann:
“I have second thoughts.
Maybe God is malicious.”



The Old One and quantum theory

- letter to the Hungarian mathematician C. Lanczos 1921:
„It seems hard to sneak a **look at God's cards**.
But that He plays dice and uses 'telepathic' methods...
I cannot believe for a single moment.“
- to James Franck: “...laws that **compel God to throw dice**
in each individual case, I find highly disagreeable.”
- letter to Max Born 1926:
„Quantum mechanics ... does not really bring us
any closer to **the secret of the 'Old One'**.
I ... am convinced that **He does not throw dice**.“

Einstein talks to the **'Old One'**
as if he had a **direct link**
to the God of his fathers.



Stop telling God what to do !



Bohr to Einstein

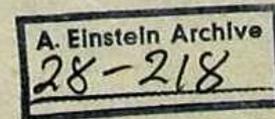
My Credo

Mein Glaubensbekenntnis

Caputh 1932

Recorded for the German League of Human Rights

Das Schönste und Tiefste, was der Mensch erleben kann,
ist das Gefühl des Geheimnisvollen. Es liegt der Religion sowie
allem tiefen Streben in Kunst und Wissenschaft zugrunde.
Wer dies nicht erlebt hat, erscheint mir wenn nicht ^{wie ein} ~~F~~ ^{wie ein} ~~F~~
so doch ^{wie ein} ~~B~~ ^{wie ein} ~~B~~linder. Zu empfinden, dass hinter dem Erlebbar
ein für unseren Geist Unerreichbares verborgen sei, dessen
Schönheit und Erhabenheit uns nur mittelbar und in
schwachen Widerschein erreicht, das ist Religiosität.
In diesem Sinne bin ich religiös. Es ist mir genug, diese
Geheimnisse staunend zu ahnen und zu versuchen, von
der erhabenen Struktur des Seienden in demut ein
mattes Abbild geistig zu erfassen.

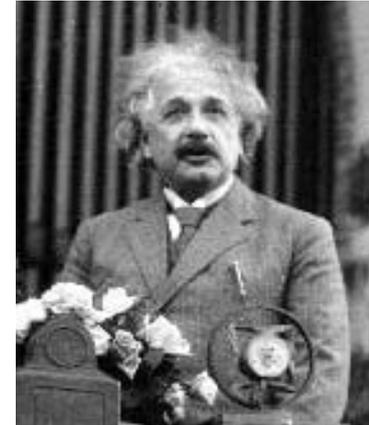


My Credo



Caputh 1932

Recorded for the
German League of Human Rights



**The most beautiful and deepest
experience a man can have
is the sense of the mysterious.**

**It is the underlying principle of religion
as well as all serious endeavor in art and science.
He who never had this experience seems to me,
if not dead, then at least blind.**

**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 - this is religiousness.**

In this sense I am religious.

**To me it suffices to wonder at these secrets
and to attempt humbly to grasp with my mind
a mere image of the lofty structure of all that there is.**

The New York Times

25. April 1929

“Professor Albert Einstein, the author of the theory of relativity, professed belief in ‘Spinoza's God’ in a radiogram received here yesterday from Dusseldorf, Germany, by Rabbi Herbert S. Goldstein of the Institutional Synagogue, 37 West 116th Street.

The message came in response to a cablegram to the scientist asking him in German:

‘Do you believe in God ?

Prepaid reply fifty words.’“

Einstein delivered his credo in 27 words:

**I believe in Spinoza's God
Who reveals Himself in the
orderly harmony of what exists,

not in a God
who concerns himself with the
fates and actions of human beings.**

**I am a deeply religious nonbeliever ...
This is a somewhat new kind of religion.**

letter to Hans Mühsam 1954

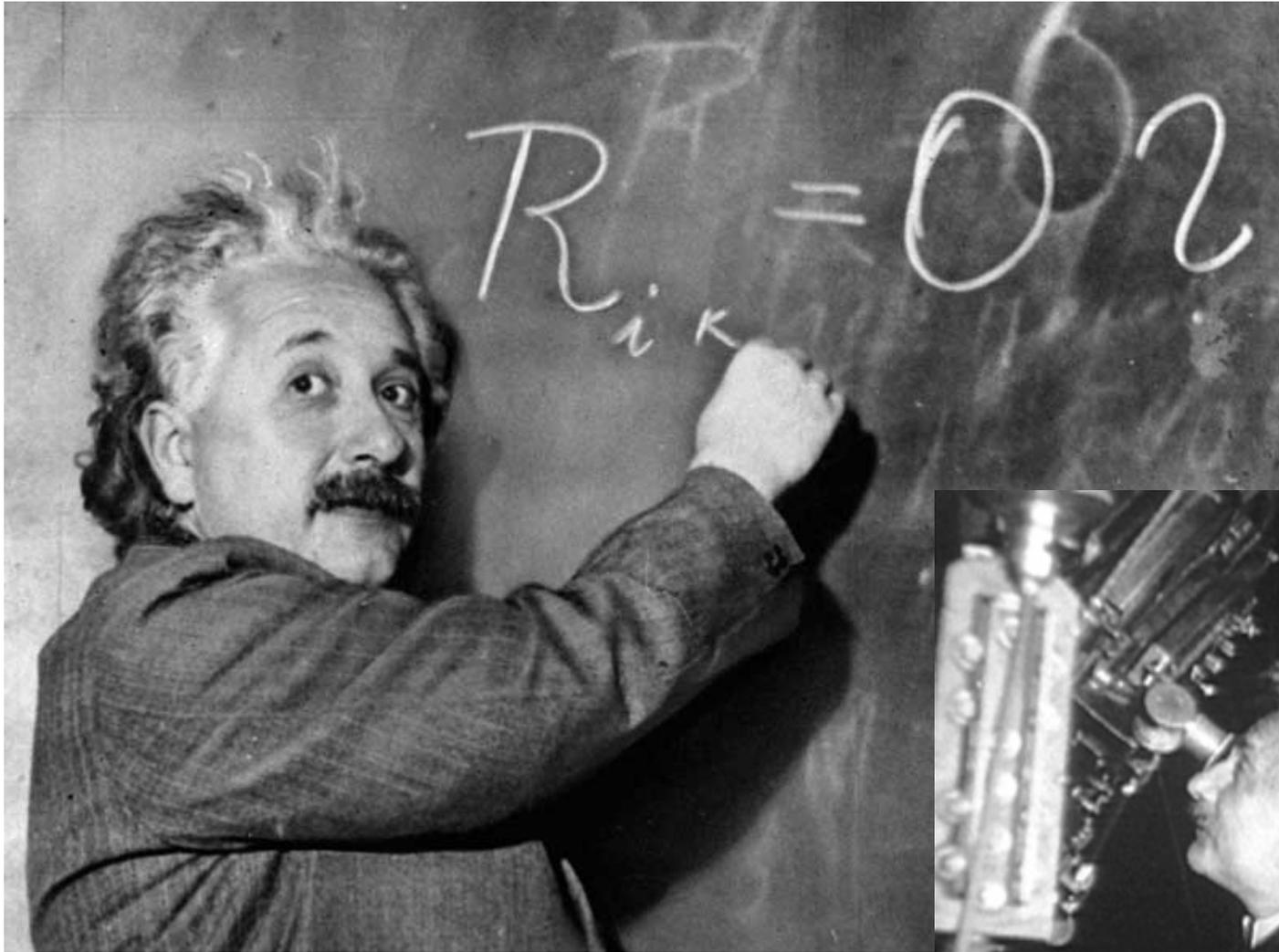
Spinoza + Pantheism

Letter to an aged Talmud scholar 1947:

It seems to me that the idea of a personal God is an anthropomorphic concept which I cannot take seriously. I feel also not able to imagine some will or goal outside the human sphere.

**My views are near to those of Spinoza:
admiration for the beauty of and belief in
the simplicity of the order and harmony
which we can grasp humbly and only imperfectly.**

Epistemology



The Law

- letter to his student Esther Salaman in Berlin, 1922:
I want to know how God created this world.
I am not interested in this or that phenomenon,
in the spectrum of this or that element.
I want to know His thoughts.
The rest are details.
- ‘Physics and Reality’, Journal of the Franklin Institute, 1936:
The eternal mystery of the world is its comprehensibility...
The fact that it is comprehensible is a miracle.
- conversation with William Hermanns from Princeton in 1954:
I do not believe in the God of theology
who rewards good and punishes evil.
My God created laws that take care of that.
His universe is not filled by wishful thinking,
but by immutable laws.

The Law

Moses, Spinoza, Marx, Kafka, Einstein

- God gives the **Laws** to **Moses** and the Jews:
People of the Book.
find the **Law**: ancient Jewish tradition
- **Marx**, Capital: **Law** behind the chaos of the markets
- **Freud**: the **Law** of psyche
- **Kafka**: parable ,Before the **Law**' in novel ,The Trial'



The Ten
Commandments

Einstein:
physics as divine service:

approach the **Old One**
look at **His cards**
find the **Law**

Epistemology

1st Conference on **Science**, Philosophy and **Religion** at
Union Theological Seminary, New York 1940:

To this there also belongs the **faith** in the possibility
that the regulations valid for the **world** of existence
are **rational**, that is, **comprehensible to reason**.

I cannot conceive of a genuine **scientist**
without that profound **faith**.

The situation may be expressed by an image:

**Science without religion is lame,
religion without science is blind.**

Epistemology

- 'Physics and Reality', Journal of the Franklin Institute, 1936:
The eternal mystery of the world is its comprehensibility.
- I. **Kant**, Critique of Pure Reason:
A priori of cognition: space and time, causality
Einstein: relativity, quantum theory
- B. **Brecht**, Life of **Galileo**, Galileo to his friend:
I **believe** in human **reason**.
Without that **belief**
I couldn't get out of bed each morning.

The Best of all Worlds ?

- Einstein to his assistant Banesh Hoffmann:
When I am judging a theory, I ask myself whether, if I were God, I would have arranged the world in such a way.
- to Ernst Gabor Straus, his assistant 1940-1948:
What really interests me is whether God could have created the world any differently; in other words, whether the demand for logical simplicity leaves any freedom at all.
- Leibniz' question whether we live in the **'Best of all Worlds'** in physics
- **Anthropic** question:
Why is our world so fine-tuned for life?
Observers only in habitable world - anthropic selection ?
Tautology ?

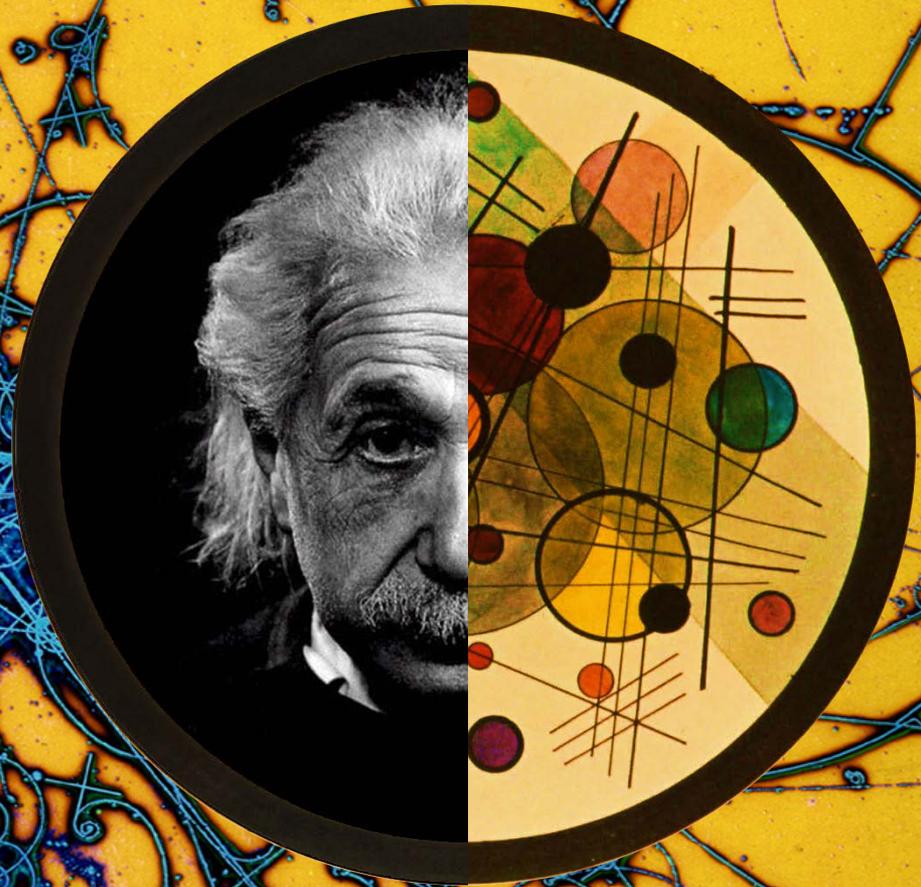
The Best of all Worlds ?

Einstein: **Had God a choice?**

anthropic fine tuning: What if ...? :

- nr of **dimensions**
- **flatness:** $\Omega_{\Lambda+m} = 1.001 \pm 0.003$ Why, and just now?
- **Why** is cosmol. constant so tiny: $\Lambda_{\text{cosm}} \sim 10^{-55} \Lambda_{\text{Higgs}} \sim 10^{-123} m_{\text{Pl}}^2$?
naturalness, hierarchy problem; role of scalar fields (inflation, Dark Energy, Higgs)
- **interactions** + symmetry breaking: $[E8 \rightarrow SO(10)] \rightarrow U(1) \times SU(2) \times SU(3)$
- **coupling** constants: Why is $\alpha_G = G_N m_{p,e}^2 = 10^{-39,-45} \ll \alpha_{\text{elm,s,w}}$ so tiny?
- **Why** is there this tiny bit of matter - and not an empty light bubble: $N_{\text{baryon}} / N_\gamma \sim 10^{-10}$
- **What if** $m_d \geq m_u$? $m_p > m_n$ neutral universe
- **What if** $m_e > 1.3 \text{ MeV}$? $p e^- \rightarrow n n$ neutral universe
- **What if** n-n or p-p (+2%) binding attractive?
- **He bottleneck:** bind decaying neutrons: no elements except H
- stellar **nucleosynthesis:** $3 \alpha \rightarrow C$ needs very specific resonance

Beauty and Truth



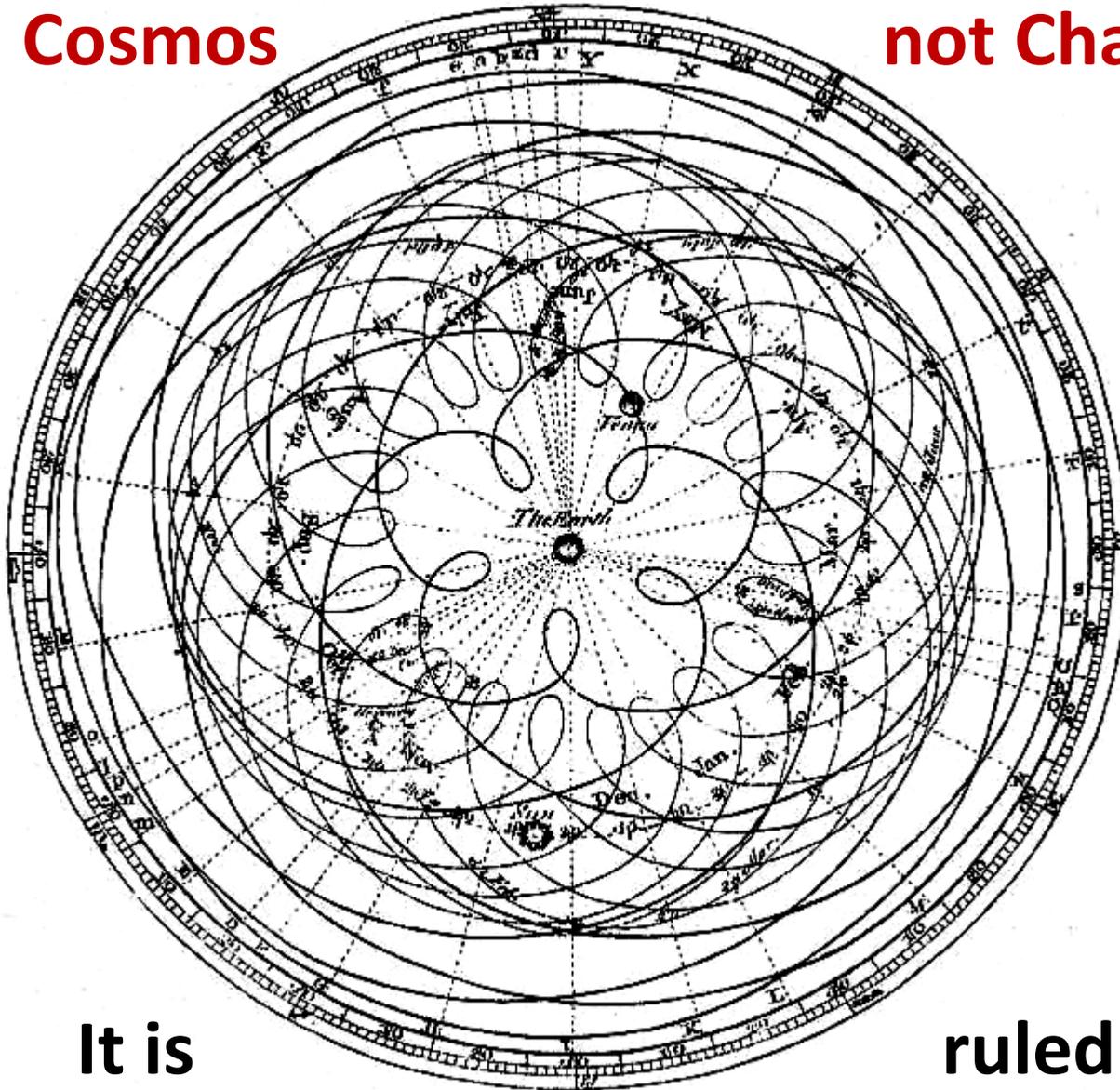
Truth and Beauty

- **Leibniz 1695: pre-established harmony:**
all substances interact causally because they have been programmed by God to harmonize with each other
- **L. Boltzmann 1893**, preface of „Vorlesungen über Maxwells Theorie der Elektrizität und des Lichts“:
„War es ein Gott, der diese Zeichen schrieb?“ (Faust)
- **H. Weyl:**
“My work always tried to **unite the true with the beautiful;**
but when I had to choose one or the other,
I usually chose the beautiful.”
F. Dyson in Chandrasekhar, “Beauty and the quest for beauty in science”
- Are **beauty, elegance, simplicity criteria of truth** –
or only a successful reduction of reality?

The world is

Cosmos

not Chaos



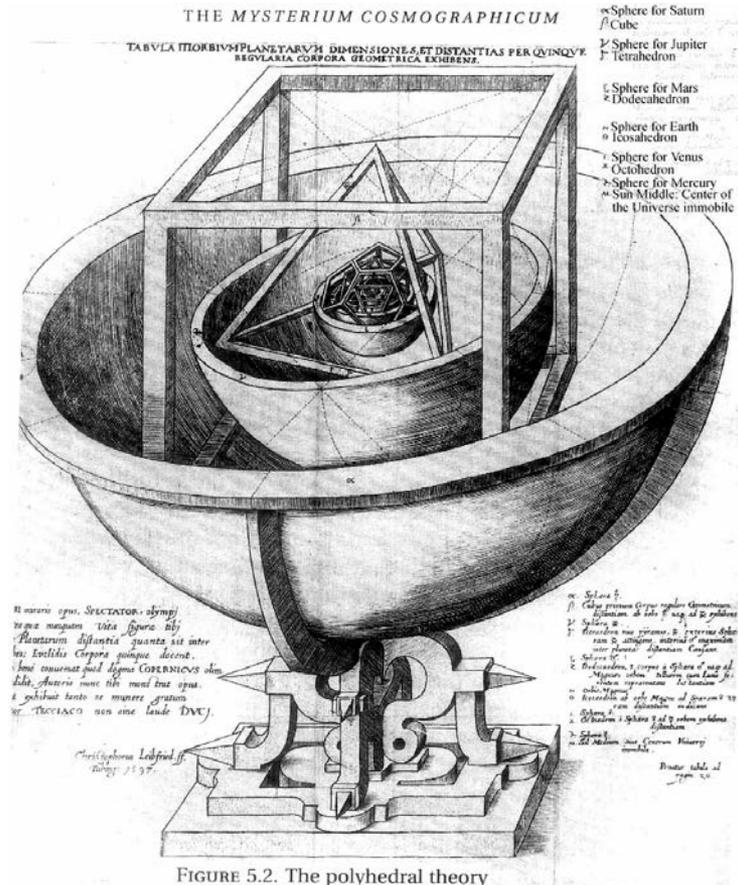
It is

ruled by

Law Harmony Order

Harmonice Mundi

- **Five Platonic Solids** = building blocks of matter:
tetrahedron, octahedron, cube, icosahedron
dodecahedron: **Cosmos**
- **Aristotle**: essentia quinta - ether
Einstein: dynamic metric = new ether
Today: fundamental scalar fields
- **Kepler 1596**:
Mysterium Cosmographicum:
orbits of 5 known planets
behave like radii of the Platonic bodies
- **Kepler 1619**: **Harmonice Mundi** -
harmonies of the Spheres:
God's creation is
harmonic and beautiful



Universe - Multiverse

- **Kepler**, *Mysterium Cosmographicum* + *Harmonice Mundi*:
- two ways out of the *Mysterium* - **both** were true:
 - **statistical**: more planets + planetary systems
 - **fundamental**: search for underlying law - from Kepler to Newton !
- **Today**: inflation and landscape
 - **statistical**: 10^{500} universes - **Multiverse**
 - **fundamental**: Superstrings
- **Aristotle**: *Physica* → *Metaphysica*
- **Today**: **Universe** → **Multiverse**
Physics of our **Meta-Physics**
Best of all Worlds in a positive sense



Raphael: The School of Athens
Plato and Aristotle

Einstein's Credo

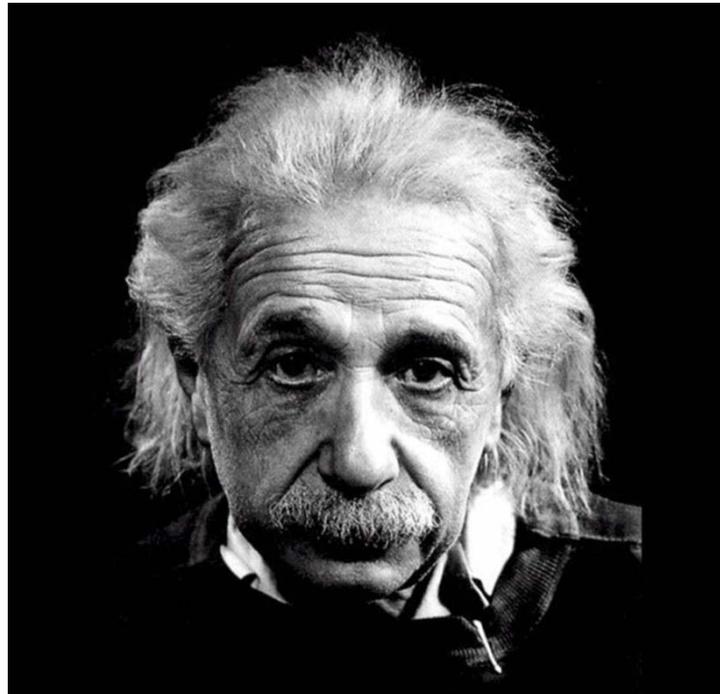
Einstein had a **belief** -
a precondition of his thinking:

The world is
harmonic, beautiful
and
comprehensible.
It is ruled by **laws.**

To uncover these laws is
Cosmic Religion:
Science as Service

Einstein asked **whether God had a choice** and **could have created the world any differently:**

- anthropic principle
 - fine tuning
 - multiverse



After 100 years still the big questions of physics!