For Muslims, the Holy Koran is the Speech of God that made itself into a Book in a human language, the Arabic. God chose the meanings, the words, the sentences, the structure of the chapters of the Book.

For Muslims, Prophet Muhammad did not know writing and reading. He was not the author of the Koran. He was only a Messenger.

The Koran comes to teach the human being « what he knew not » (*mâ lam ya’lam*)
God the Creator (*al-Khâliq*)

- God created the world “in six days, and then He established the Throne”
- God created the world “out of nothing”
  - “Were they created out of nothing (*min ghayri shay*), or are they their own creators?” (52:35)
  - But: “He directed himself to the heaven while it was a smoke (*dukhân*).” (41:11)
- God renews the creation at every instant (*tajdîd al-khalq, 13:5, 21:104, 32:10*)
- Mainstream theologians think God created the world “in time” (that is, there was a period (*hîn*) when only God existed, and nothing else).
The Two Books

- The Book of Existence (kitâb at-takwîn)
- The Book of Revelation (kitâb at-tadwîn)

Created by God’s speech
- God says: “Be!” (kun!) to a thing and “it is”
- The Book shows God’s signs (âyât) through the contemplation of phenomena

Revealed by God’s speech
- God says: “Read!” (iqra’) to the Prophet and “he reads”
- The Book shows God’s verses (âyât) through the reading of the Holy Text.
The Intelligibility of the World

- This intelligibility is part of the divine plans for the world, since God, who knows everything, created both the world and the human from His Intelligence.

- Then He put intelligence in the human.

- The fact that God is One, guarantees the unity of the human and the cosmos, and the adequacy of the Human intelligence to understanding (at least part of) the world.
The regularities that are observed in the world are not due to necessary causal connection, but to a constant conjunction between the phenomena, which is a “habit” (sunnah) or “custom” ('âdah) established by God's Will.

- “There is no change in God's creation” (30:30). “You will not find any change in God’s custom”, 48:23). The “stability” of the rules of Creation reflect God's immutability.

- Mathematical regularities?: “The Sun and the Moon [are ordered] according to an exact computation (husbân)” (55:5)
Farmers who used to grow date palms asked the Prophet whether it was necessary to graft these date palms. The Prophet answered “no”, and they followed his advice. They then complained that the date crops were very bad. The Prophet answered that he was only a human like them. He said “You are more knowledgeable than I in the best interests of this world of yours” (Muslim).

There is a field in which religion simply has nothing to say, a field that is neutral with respect to the ritual end ethical teachings of revelation.
Reason and Islamic Revelation I: Al-Ghazali (Algazel, 1058-1111)

- Reason is God-given and there is only one truth.
- Well-guided reason ('aql) cannot be in contradiction with textual indications (naql) given by the Koran and Prophetic tradition.
- Wherever science apparently contradicts textual indications, it is the fault of the scientists who surely have made errors in their scientific works, as far as they have been led to conclusions which are at odd with revealed truth.
Reason is God-given and there is only one truth.

According to Revelation, knowing Creation and meditating upon it with the use of philosophy (and science) is mandatory (wâjib).

There is only one truth, and wherever the results of rational examination contradict the textual indications, this contradiction is only apparent, and the text has to be submitted to allegorical interpretation (taʾwîl).

Otherwise, we would make God say things that are obviously wrong.
For Ibn Sina (980-1037), the emanation of God’s intelligibility produces the world. God (the only necessary being *bi dhatihi, per se*) is so intelligible that he cannot help creating the world (which becomes necessary *bi ghayrihi, per altrum*). So the world is eternal, and all its patterns are necessary (*darûrî*).

Al-Ghazali (1058-1111) tries to show that not everything is necessary in the world: there are non-necessary patterns that manifest God’s choice (e.g., the motions and axes of celestial spheres). The world is contingent (*muhdath*) and has a temporal origin.

Ibn Rushd (1126-1198) argues to defend Ibn Sina’s viewpoint. For him, God creates the world eternally. Creation means a metaphysical dependence, not necessarily temporal origination.
The criticism of (Aristotelian) causality by Al-Ghazali did not mean the absence of causation

- The metaphysical criticism of causality by mainstream Islam did not hamper the development of the Islamic science at the same epoch.

- Deductive thinking that goes from causes to effects cannot be considered as sufficient to investigate the realm of nature.

- On the contrary, a deeper examination of the world is needed to determine what the “habit” or “custom” proposed by God actually is.

- One has to observe and experiment to see what is actually happening.
“…The Graeco-Arabic translation movement of Baghdad constitutes a truly epoch-making stage, by any standard, in the course of human history. It is equal in significance to, and belongs to the same narrative as, I would claim, that of Pericles’ Athens, the Italian Renaissance, or the scientific revolution of the sixteenth and seventeenth centuries…”

Almost all non literary Greek texts were translated into Arabic during the early Abbasid Caliphate starting with Al-Mansur (754-775), Al-Mahdi (775-785) and Al-Ma’mun (813-833).

The initial thrust was mostly political, ideological and apologetic. But it triggered an extraordinary interest for science.
The corrections of errors in Ptolemy’s *Almagest*, e.g. the duration of the Lunar month, $P = 29.53059$ days in Al-Hajjaj.
Islamic Astronomy: the importance of observing…

“The Book of Fixed Stars” by Abd-ar-Rahman Al-Sufi (903-986)

Astronomical instruments: e.g. the astrolabe (al-Fazari, d. 806)

Hence the improvement of astronomical data, e.g. inclination of Earth axis, precession of equinoxes, etc.
The Maraghah School of Astronomy (Azarbaijan)

The Tûsî couple allows astronomers to get rid of Ptolemy’s equant

Nasir al-Din al-Tusi (1201-1274)

Spherical trigonometry

\[
\frac{\sin A}{\sin a} = \frac{\sin B}{\sin b} = \frac{\sin C}{\sin c}.
\]

\[
\cos c = \cos a \cos b + \sin a \sin b \cos C.
\]
Equants and eccentrics in Ptolemy’s astronomy

Uniform circular motion of the centre $C'$ of the epicycle with respect to the Equant
Ibn al-Shatir model was the first model whose agreement with observations was better than Ptolemy’s model of the Sun, Moon and planets (and not “just as good”).
The Influence of Arab-Muslim Astronomers on Copernicus

In his *De Revolutionibus*, Copernicus used the Tusi couple, and shows an almost identical figure (with same letters).

Copernicus used the same Lunar model as Ibn al-Shatir, and the same Mercury model (with a mistake).
The Zij-i-Sultani (1437), the best star catalogue
The best determination of the sidereal year
The best determination of the Earth inclination

Why didn’t modern science develop in the Islamic world?

In his book: “The Secret of the West” (not translated into English so far), Swiss physicist D. Cosandey reviews scores of explanations proposed in the literature for the origin of the scientific revolution of the sixteenth and seventeenth centuries; none appears to be really convincing.

According to him, the condition for scientific progress is a system of several stable, wealthy states. Empires or unstable states do not make it. This system was made possible by the specific geography of Europe, with seas that separate/interconnect states.
Creation, Origins, Creationism

- Creation: a theological question
  - The relationship of the world to God: ontological dependence of the world with respect to God (contingency).
  - Can be temporal origination out of nothing, or eternal gift of being by God.

- The origins: a scientific question
  - The relationship of what is to what was.
  - Deal with efficient causes and temporal origination from previous stages.

- Creationism: neither theology nor science
  - A literalistic reading of the sacred texts (without any historical or linguistic context).
  - Concordism: sacred texts and science are considered as dealing with similar issues.
“The pale blue dot”: Earth seen at a distance of 6 billion kilometres by Voyager 1 in 1990.
The Andromeda galaxy, M31, our close neighbour…
The standard Big-Bang Model: cosmic evolution

The universe is expanding. It was much denser and hotter in the past.

Pre-Big Bang cosmology

So it is dangerous to interpret the Big Bang model as evidence for Creation in time.

Mathematical singularity of the Big Bang model

13.7 billion years
1st Stars about 400 million yrs.

Dark Ages
Development of Galaxies, Planets, etc.
Dark Energy Accelerated Expansion

Afterglow Light Pattern 400,000 yrs.
Inflation
Quantum Fluctuations
The Hubble Ultra Deep Field ($t_{\text{exp}} = 10^6 \text{ sec, ACS + NICMOS}$)

10,000 galaxies in 11 arcmin$^2$

A sense of awe…
The puzzle of apparent fine-tuning in cosmology: the global properties of the universe are shaped by just six numbers.
“Explaining” Fine-Tuning

- **Agnosticism:** fine-tuning is just “happenstance”. We are reaching the limits of human explanation.

- **Design:** there is a teleologic principle acting in/on nature. eg: a trend of matter to become aware of itself (pantheism), an intelligent actor (theism). Divine providence in monotheistic religions.

- **Multiverse:** our universe is drawn from a large ensemble of realizations in a “cosmic lottery” that explores the range of possibility.
Superstring theories suggest the existence of a “multiverse”:

Space has 10 dimensions. Some of them are “compactified” and become very small.

There are $10^{500}$ ways to compactify them...

There may be a reason why only one way is possible (Brian Greene) or...

we must contemplate the idea that these possibilities are realized: “the landscape” (Leonard Susskind).
Our observable universe

Chaotic inflation

Different patches of the universe have different laws of physics

Laws X

Laws Y

Laws Z

Laws Q

Laws K

...an eternal «multiverse»
exoplanets everywhere?

Questions about the significance of the human kind…
Detection of exoplanets by the method of radial velocities
Detection of exoplanets by the transit method
Planet Candidates
As of February 27, 2012

Data in this region are being acquired.
Mass-Radius Relation

- Kepler-11e
- Kepler-11d
- Kepler-11f
- GJ 1214b
- 55 Cnc e
- Kepler-10b
- CoRoT-7b
- Venus
- Earth
- Neptune
- Uranus

Density Lines:
- 0.5 g cm$^{-3}$
- 1.0 g cm$^{-3}$

Composition Lines:
- Water Planet (50% water by mass)
- Earth Composition
- Maximum Iron Fraction
An artist’s view of Gliese 667Cc

A planet in the habitable zone (it receives an amount of radiation that equates 90% of Solar radiation), with $M=4.5 \, M_{\text{Earth}}$
CURIOSITY ON MARS: IN SEARCH OF EXTRATERRESTRIAL LIFE...
Spectrum of an exo-earth including absorption bands of oxygen, ozone and \( \text{CO}_2 \), and ground effects associated to chlorophylla.
SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE

But where are they?
Does a galaxy filled with habitable planets mean humanity is doomed?

Last week, we reported on the astounding confirmation that all solar systems in the Galaxy probably have planets, and that Earthlike planets are more common than previously thought. While this seems like good news for SETI-enthusiasts, the revelation is actually quite disturbing.

Given that we have yet to meet any extraterrestrials, the finding could mean that...
Our endangered Earth...
A brief conclusion

- The Islamic community has to recover the intellectual thrust of the golden age. This recovery should not be only a better appraisal of the extraordinary contribution of Arab-Muslim scientists to the scientific endeavour. It has to be a participation in the contemporary endeavour.

- Modern cosmology offers an awesome picture of a universe that is:
  - Complex but governed by simple laws
  - Very large and diverse
  - Very old, with the continuous appearance of novelty through cosmic, geological, and biological evolution.

- All that nicely fits in an Islamic metaphysical worldview in which the size, beauty and diversity of the world is a sign of God’s power and majesty.
Science cannot be separated from ethics

- God created the human (male and female) as His vice-regent of earth.
- The human must act as a good garden-keeper in the garden.
- *We can eat the fruits of the garden, but we must not uproot the tree.*
- *We must care after all creatures.*

Adam and Eve in Eden, with their offspring