esa

UK SPACE CONFERENCE 2017

an academic view

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AIRBUS DEFENCE & SPACE

e2v

An academic view of UK Space Sector & Update on Gaia mission

Universities are working steadily harder to promote STEM awareness more widely

"**Record numbers of students accepted to UK universities and colleges this year, UCAS report**"

Growth of BigData science

Enthusiasm for cubesats shorter "doodle to data" time

Hang on a minute lads – I've got a great idea

The future is Brexit

- 60% of the UK's internationally-authored research papers involve authors from the EU

- **Cambridge:**
  17% of research funding from EU
  25% of staff are non-UK EU
  10% of undergraduate students
  17% of postgraduate students

- Open collaboration is at the heart of what we do and how we do it

- Future? Risk.

We live in exciting times

UK Space Agency projects

UK SPACE AGENCY

here and now

- Alsat Nano
- Cassini
- Cluster
- Gaia
- Herschel
- Hinode
- Lisa Pathfinder
- Rosetta
- Stereo
- Swift

underway

- JWST
- JUICE
- Bepi Colombo
- Solar Orbiter
- Euclid

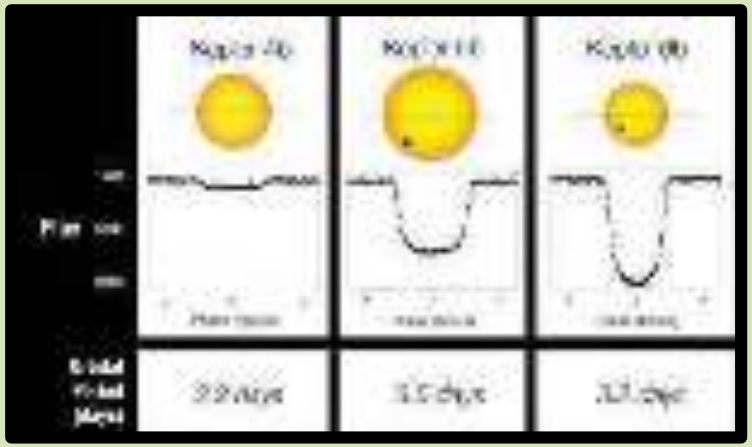
to come

- Athena
- PLATO
- L3
- M4
- M5

We have a scientific roadmap – based on disruptive discoveries in the last 20 years

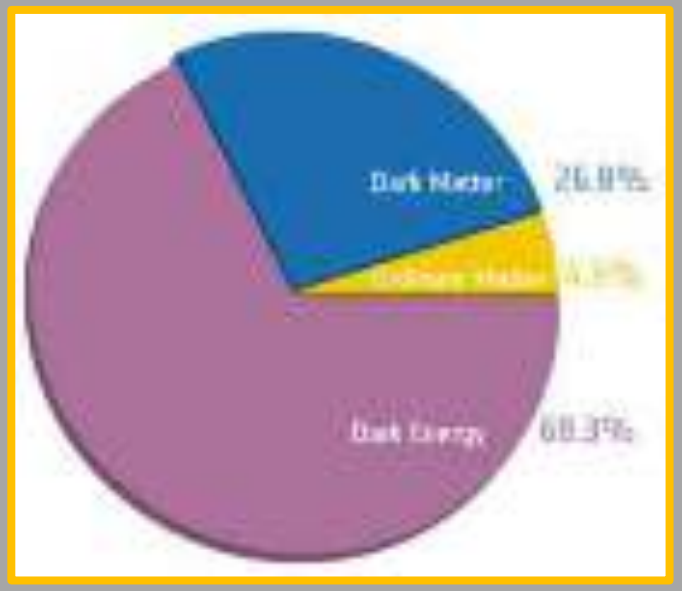
Steps to exo-biology (first exo-planet – 1995)

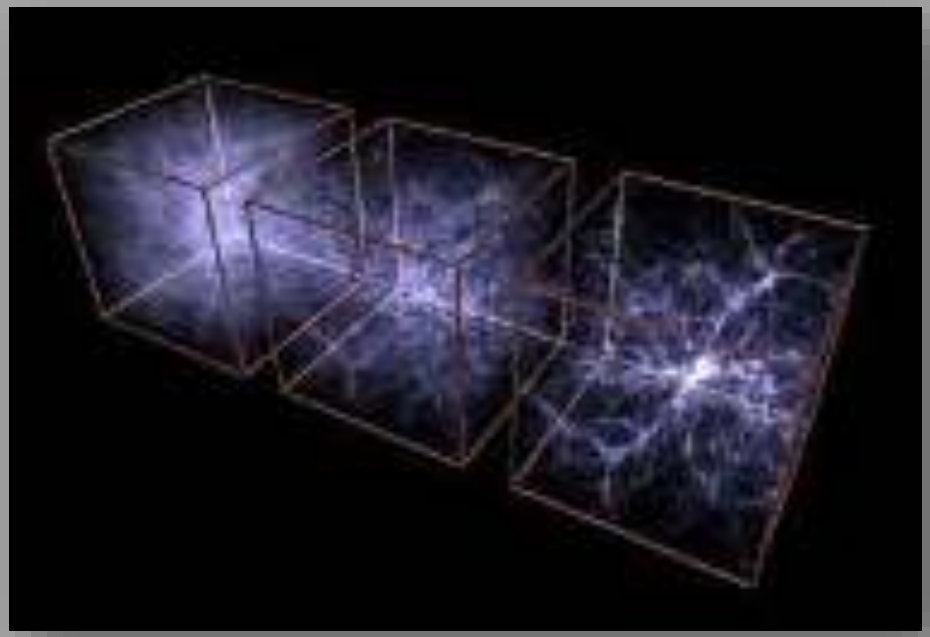
- Map our Solar System – for knowledge and earth-management.
- Exoplanets and exo-biology will become mature sciences
- Watching an exo-Earth go green in summer?
- Mapping the variety of life signatures in exo-planet atmospheres
- Planet discovery by transits dimming the parent star is already close to an industry. Rapidly advancing. This finds a few percent of larger planets.



Milky Way to Dark Matter

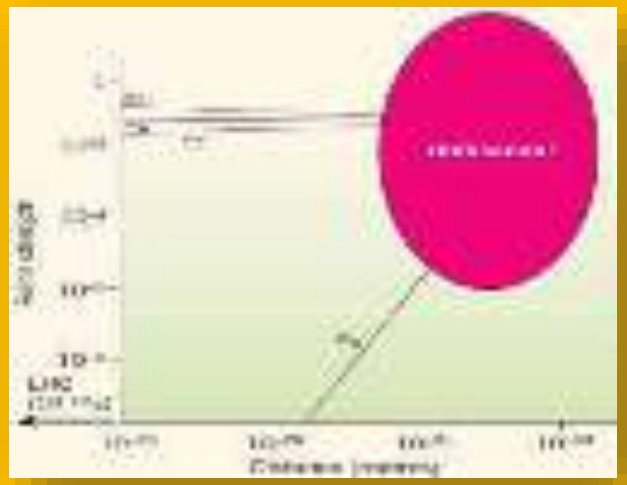
- The matter of which we are made, the matter we study, is insignificant in the Universe – reality is “Dark Matter”.
- Discovered only in astrophysics, moving beyond the particle physics Standard Model.
- Cold Dark Matter shown to match observation in the 1990s.

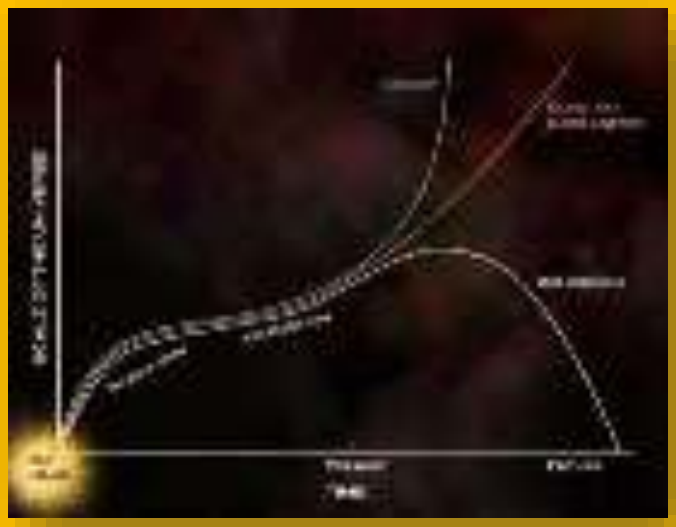




The structure of space-time

- The Universe expanded at super-light speed early, inflation ended, expansion slowed under gravity, and now is accelerating again.
- Explaining these needs a model beyond General Relativity, with quantum gravity. And possibly other new things. We have no guide from theory.
- Dark Energy “found” in 1990s.
- Gravitational waves detected 2015.
- **The rate of disruptive discovery remains high – expect the unexpected**





Gaia

Γαῖα δέ τοι πρῶτον μὲν ἐγείνατο ἶσον ἑωυτῇ
Οὐρανὸν ἀστερόεντ', ἵνα μιν περὶ πάντα καλύπτοι,

The goddess who came into being after Chaos and generated the starry sky

(Hesiod, Theogony 116/117 and 126/127)

a contrast to the unintelligible and generator of the explorable

Gaia is transformational – the first 3-D galaxy

precision distances and motions for 1 billion stars

- Astrometry, photometry, spectroscopy, spectrophotometry,

Teff, log g, Av, [Fe/H], binarity, planets, periods for variables,…

Launch	12/2013
Work started	~1993
Project approved	2000
Operations start	7/2014
	5-9.5 years data
Project end	2026+
Total cost	960M€

The heart of Gaia is a large camera array, 1 giga-pixel, sending us a video of the sky for 5-9 years.

The imaging data is being processed in Cambridge.

Gaia data processing develops “Big Data” technologies and training

Gaia delivers the extreme precision needed to measure stellar distances

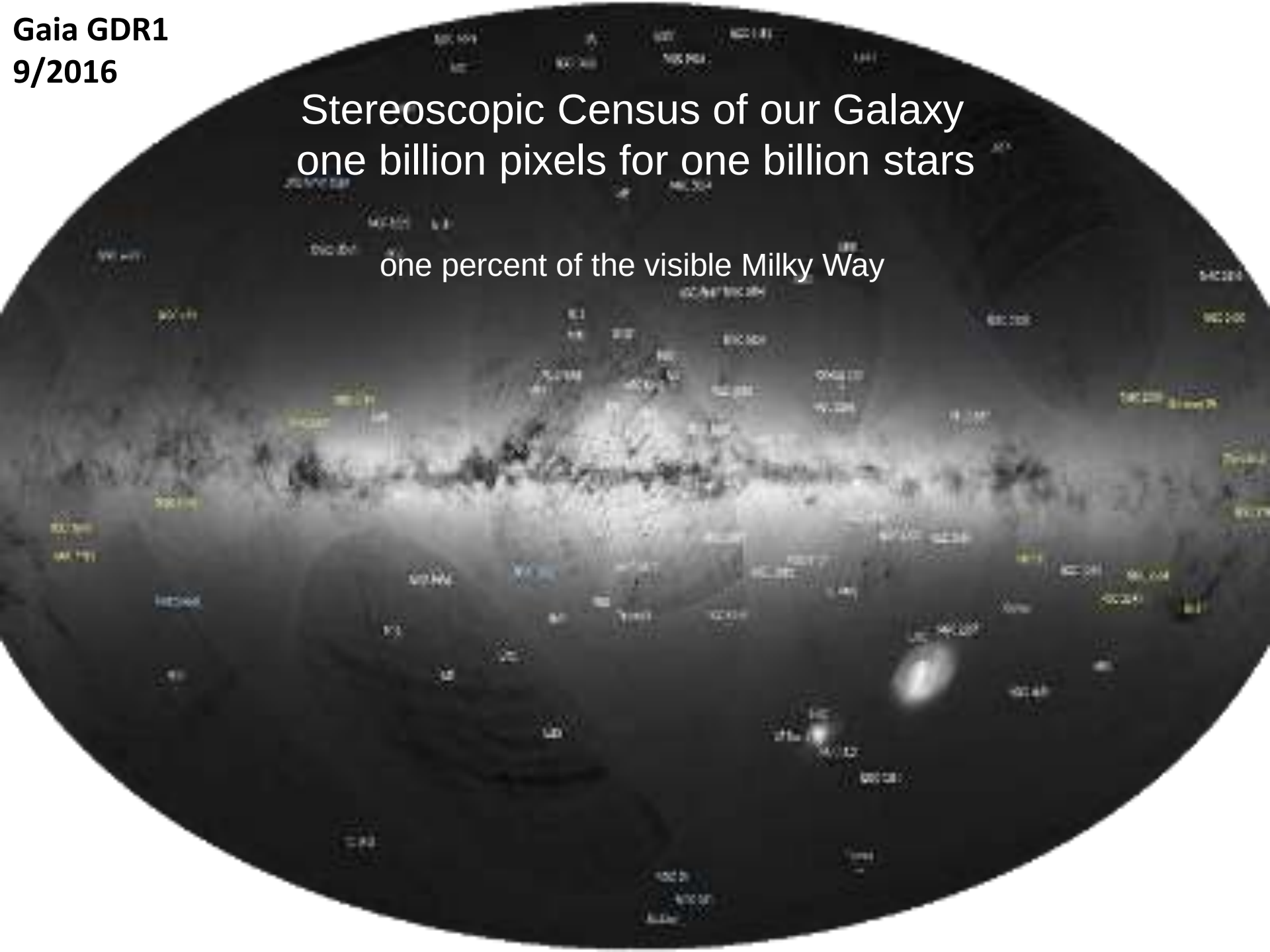
Wikipedia Fact:

"A microarcsecond is about the size of a period at the end of a sentence in the Apollo mission manuals left on the Moon as seen from Earth.

Gaia GDR1
9/2016

Stereoscopic Census of our Galaxy
one billion pixels for one billion stars

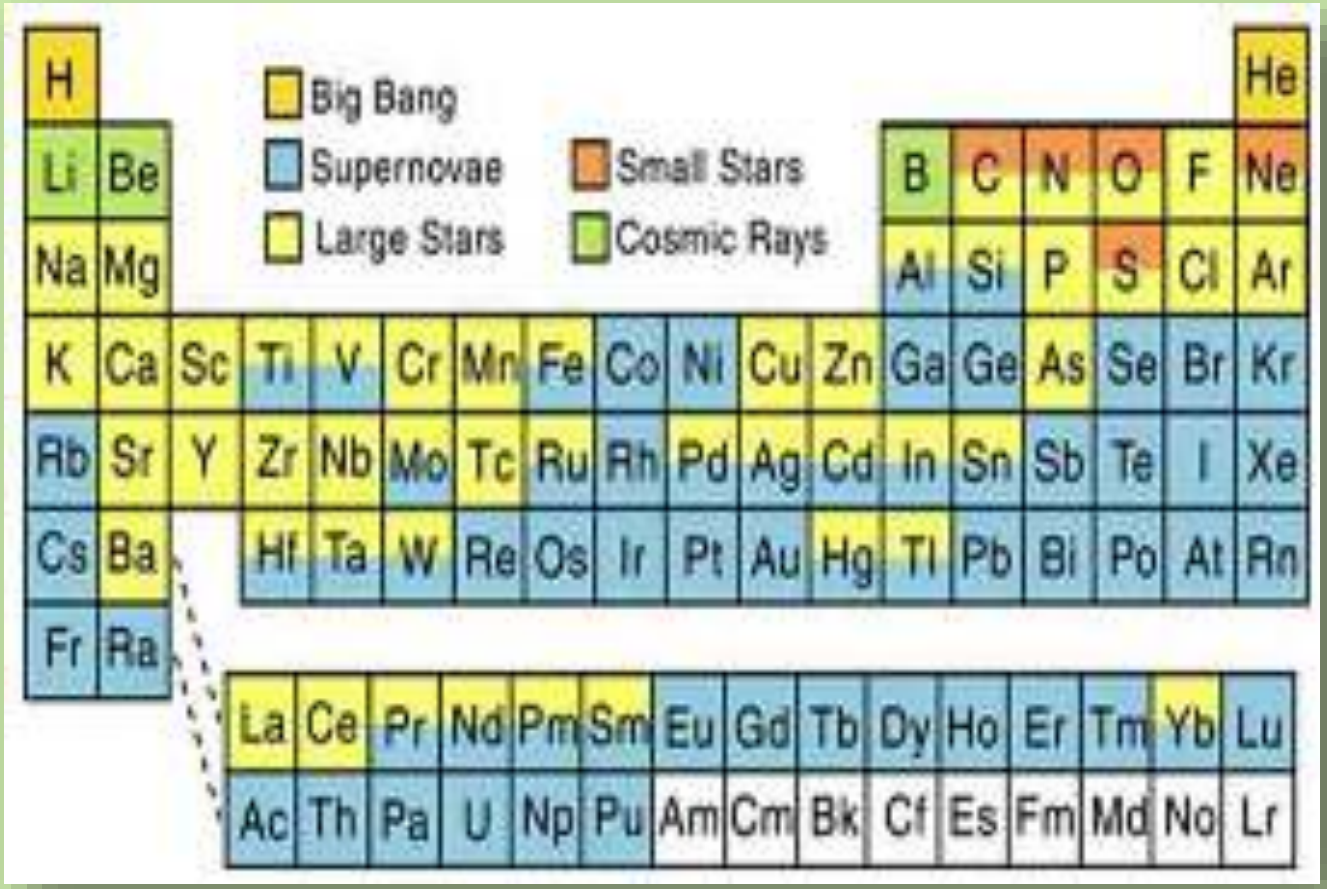
one percent of the visible Milky Way

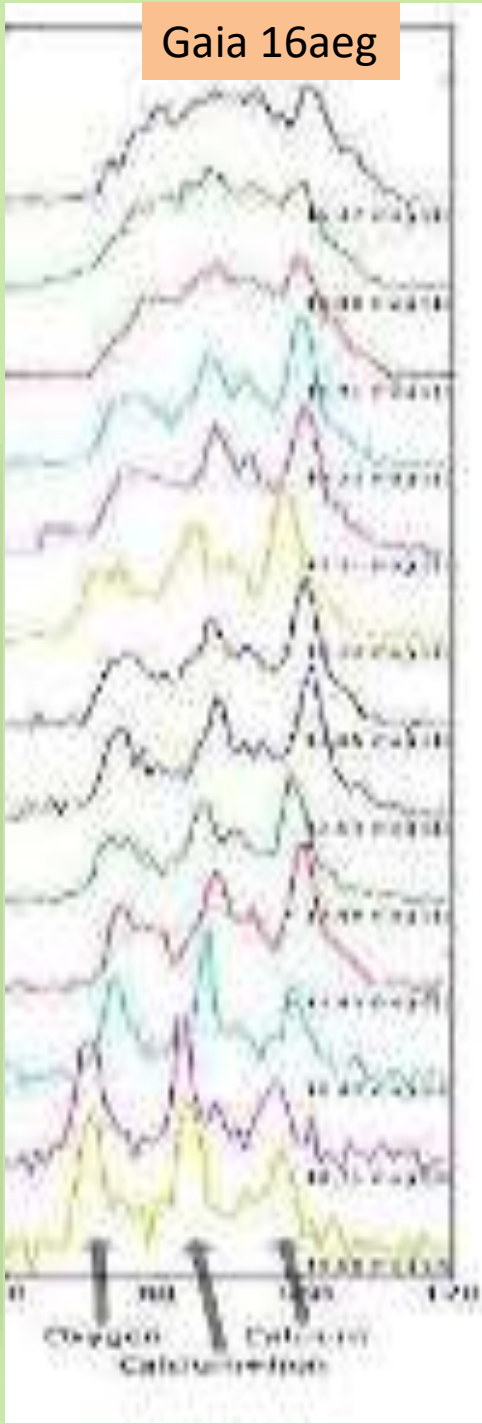


Tracking stardust: origins of the chemical elements

H, He & Li are ashes from the Big Bang. All other elements are created in (or by) stars, becoming available to form new stars, planets, and people.

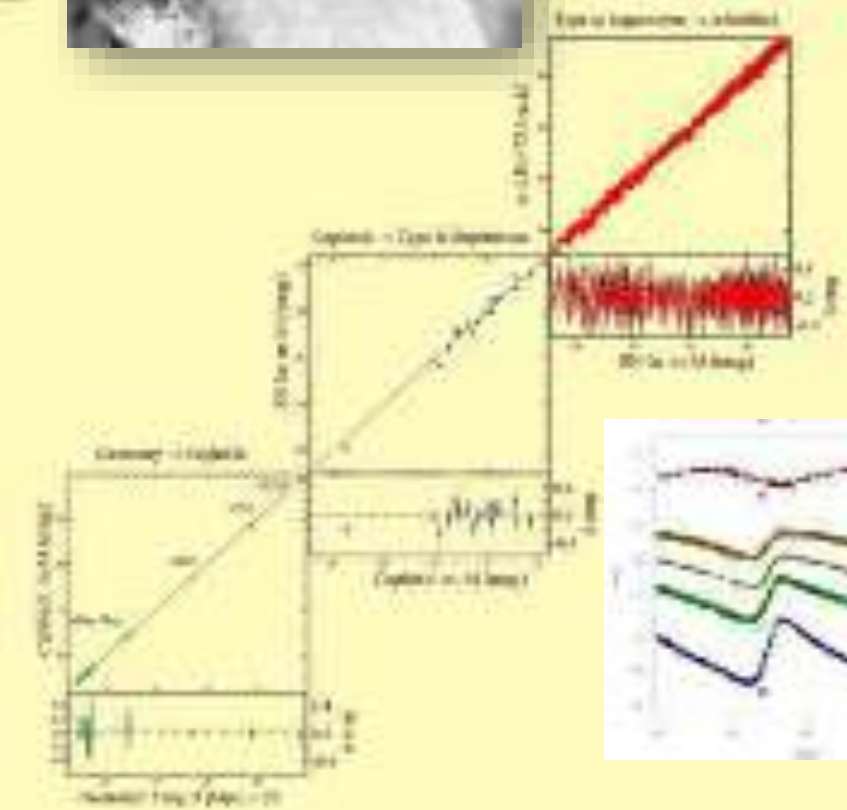
The elements form a cosmic clock, which allows us to decode the sequence of events which began 13Gyr ago, and which continues today

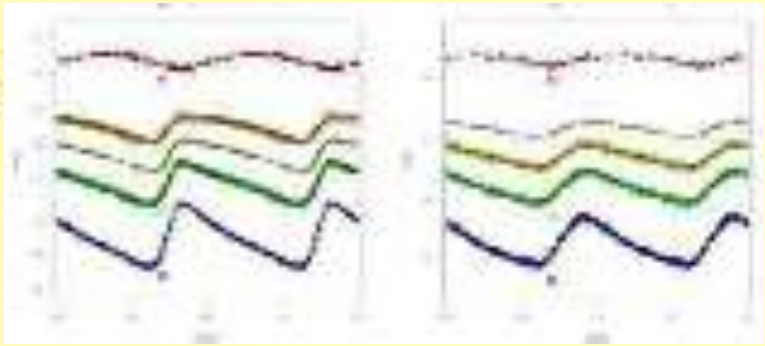


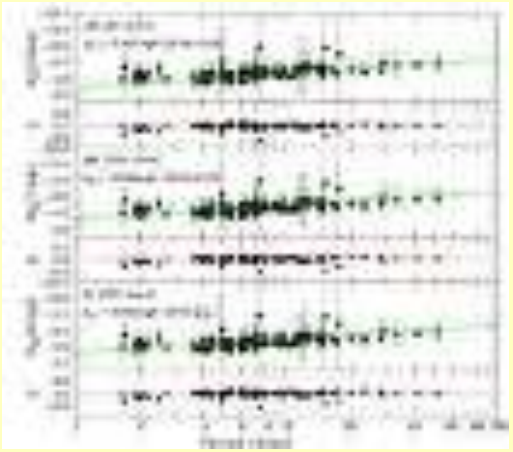


Gaia daily science alerts https://gaia.ac.uk

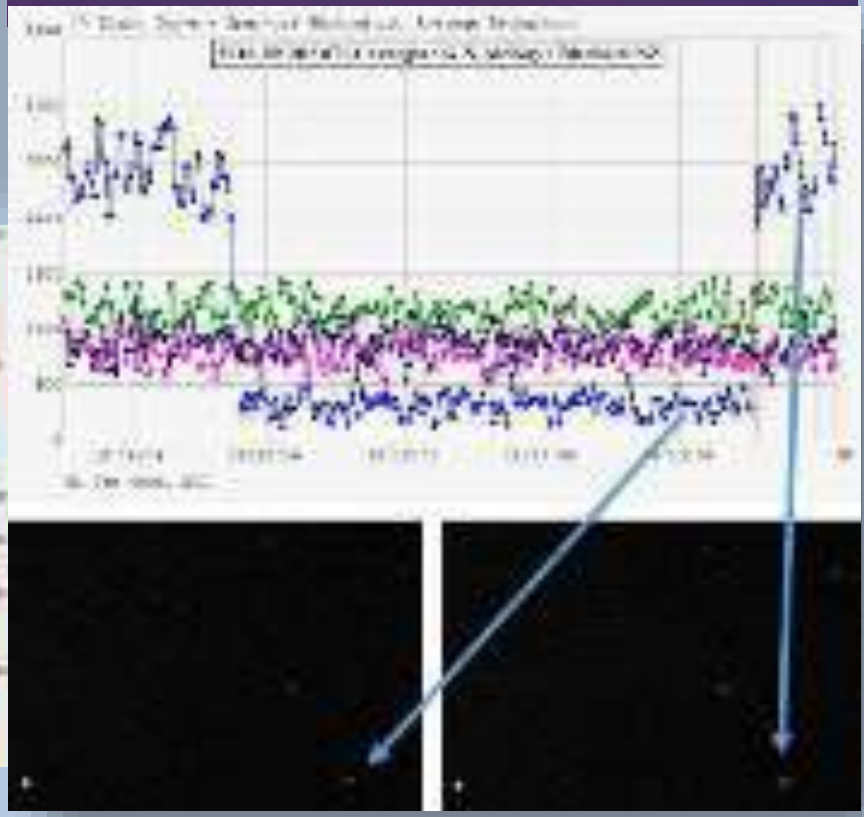
The scale of the Universe: calibrating the calibrators
The Henrietta Leavitt law for Cepheid variable stars

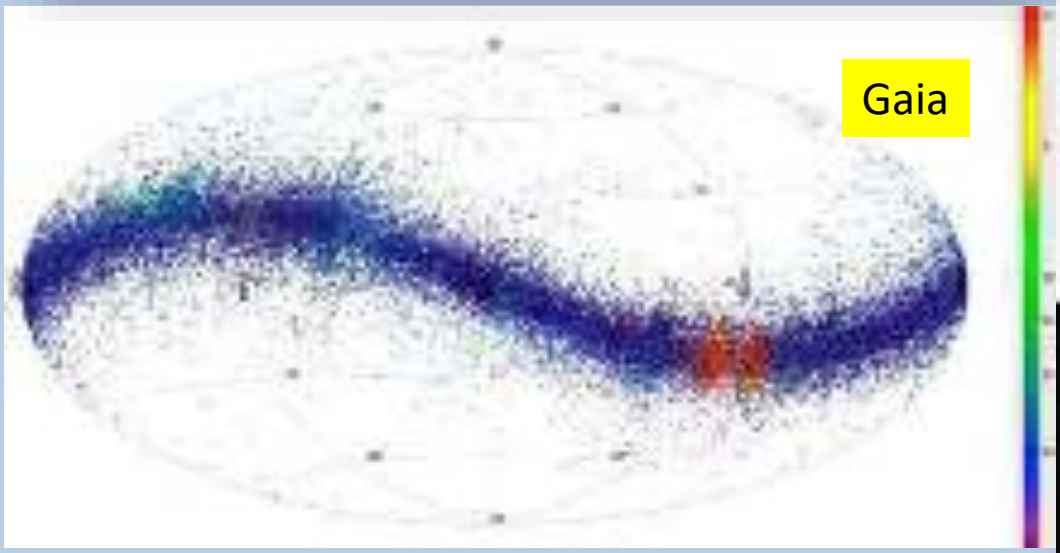






Gaia is providing a survey of NEO-threat asteroids with orbits interior to Earth, and improved orbits for main-belt asteroids➔ masses, radii,…





Gaia Statistics @ 30-May-2017

MISSION STATUS NUMBERS

CURRENT DATE AND TIME	2017-05-30T09:50:44 (TCB)
MISSION STATUS	
Satellite distance from Earth (in km)	1,617,093
Number of days having passed since 25 July 2014	1040
OPERATIONS DATA (collected since 2014/07/25)	
Volume of science data collected (in GB)	49,803
Number of object transits through the focal plane	96,184,211,423
Number of astrometric CCD measurements	948,101,512,597
Number of photometric CCD measurements	155,215,583,196
Number of spectroscopic CCD measurements	14,402,615,814
Number of object transits through the RVS instrument	6,032,303,696

Gaia data provide an important pathway to Data Intensive Science training and research

https://gaia.ac.uk get the app! http://www.cosmos.esa.int/web/gaia

The people behind Gaia

Gaia sees a changing sky