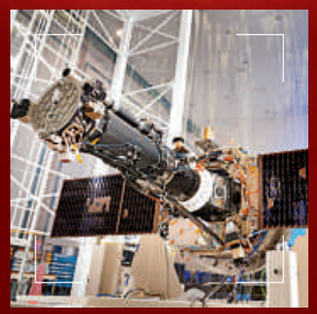
Into the unknown in 2014

The chromosphere's temperature increases with distance from the Sun's surface, rising from 4,400K at its interface with the photosphere to 35,000K at the transition layer.

Space exploration will reach new frontiers, with probes exploring comets, the Sun and the Milky Way – and we'll test-fly a future manned Mars-mission craft. By Lucie Green



INTERFACE REGION IMAGING SPECTROGRAPH

In 2014 the first results will come through from Nasa's Interface Region Imaging Spectrograph (Iris) space probe, which is observing how energy and plasma travel through the Sun's chromosphere. The chromosphere, the middle of three layers of the Sun's atmosphere, is usually invisible due to the brightness of the photosphere below it.

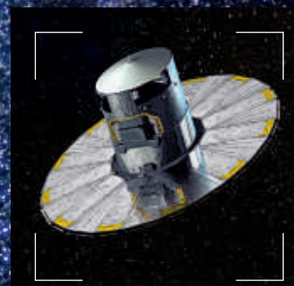
PHOTOGRAPHY: ESA/SOHO-EIT; LOCKHEED MARTIN; NASA AMES; CORBIS

LADEE LUNAR PROBE

In 2014, Nasa's LADEE probe will spend 100 days orbiting the Moon, analysing its exosphere and gathering samples of the dust that floats up from the surface. This may explain why Apollo astronauts saw an "atmospheric glow" on the Moon at sunrise and sunset. Here, LADEE is undergoing spin-testing to ensure it is perfectly balanced.

The lunar exosphere comprises only about 10^6 molecules per cm^3, compared with Earth's 10^{19} molecules per cm^3 at sea level.

● The sail is made of Kapton, a polyimide film able to withstand temperatures of -269°C to +400°C. It measures 38 metres x 38 metres x 5 microns, and weighs 32kg.



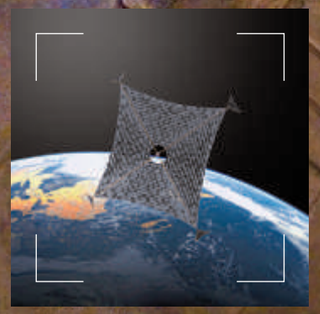
GAIA OBSERVATORY

The European Space Agency's Gaia space observatory will begin a five-year observation of the Milky Way when it arrives at the L2 Lagrangian Point during 2014. It will measure the positions and velocities of more than 1bn stars – about one per cent of our galaxy – to produce an unprecedented 3D map.

● As well as distant stars, Gaia is also expected to identify 7,000 planets beyond the solar system.

SUNJAMMER

In November 2014, Nasa will launch its Sunjammer solar sail, as a payload on SpaceX's Falcon 9 rocket. Folded, it's about 1m³; unfurled to 1,200m², it will use solar radiation to sail towards the Sun, to a region of space beyond the L1 Lagrangian Point, steering with secondary sails at each corner. Once there, it will measure impending solar storms.



PHOTOGRAPHY: NASA; CORBIS;ESA/D DUCROS

ROSETTA

The European Space Agency's Rosetta spacecraft is scheduled to reach comet 67P/Churyumov–Gerasimenko in mid-2014, after ten years in space. On arrival, it will launch a craft to attempt the first ever landing on a comet's nucleus. Then it will measure changes in the comet as it reaches perihelion in August 2015.

ORION

In September 2014, Nasa will carry out the first test-flight of its next-generation Orion Multi-Purpose Crew Vehicle, designed to undertake crewed missions to the Moon, asteroids and Mars. The craft combines technologies developed during the Apollo and Space Shuttle missions, and is designed to support deep-space activities that will last up to six months.

The crew module is a relatively spacious 3.3 metres long and 5.5 metres in diameter, with an interior volume of 6m³ – that's around 2.5 times more room than the Apollo astronauts had on their missions.

In an emergency during launch or ascent, a solid-fuel rocket system (*not shown*) will pull the crew module away from the service module.

Lucie Green is Royal Society research fellow at the Mullard Space Science Laboratory, University College London

● On its test flight, Orion will fly, uncrewed, for 5,000km in space, reaching speeds of 32,000kmh before re-entering the Earth's atmosphere.

PHOTOGRAPHY: EAS/CNES; ESA/J HUART; NASA