Hitchhiker’s guide to the solar system

8 min

The time it takes sunlight to reach Earth

Solar system ID

Our solar system has one star (the Sun①) and 8 planets (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune②). It extends as far as the Oort cloud, 10,000 billion kilometres away. The Sun is 150 million km from the Earth, or one astronomical unit (AU). Its radius is 109 times greater than the Earth’s, making it 1 million times bigger.

The heliospheric cocoon ③

This is the zone of magnetic influence of the Sun, protecting us from the interstellar medium filled with particles. It forms a cocoon of around 100 AU at the front of the Sun. The Voyager probes were the first human objects to pass through it.

Did you know?

The closest star to the Sun is Proxima Centauri, «only» 40,000 billion kilometres away!

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Journey to the center of the Sun

27 days
The time it takes the Sun to spin around

The “onion”-Sun

The Sun is made up of several layers, like an onion. It has 2 inner layers: the radiative zone①, comprising the nuclear core, and the convective zone②, comprising its surface (the photosphere). It then has 2 outer layers that make up its atmosphere: the chromosphere③ and the corona④.

The spinning Sun

The Sun spins like a top in about 27 days. Its interior rotates as a whole, but at the surface, the poles rotate more slowly than the equator: this is called differential rotation⑤.

Did you know?

The hottest part of the Sun is its core (15 million degrees), followed by its atmosphere (2 million degrees, and we still don’t know why!).

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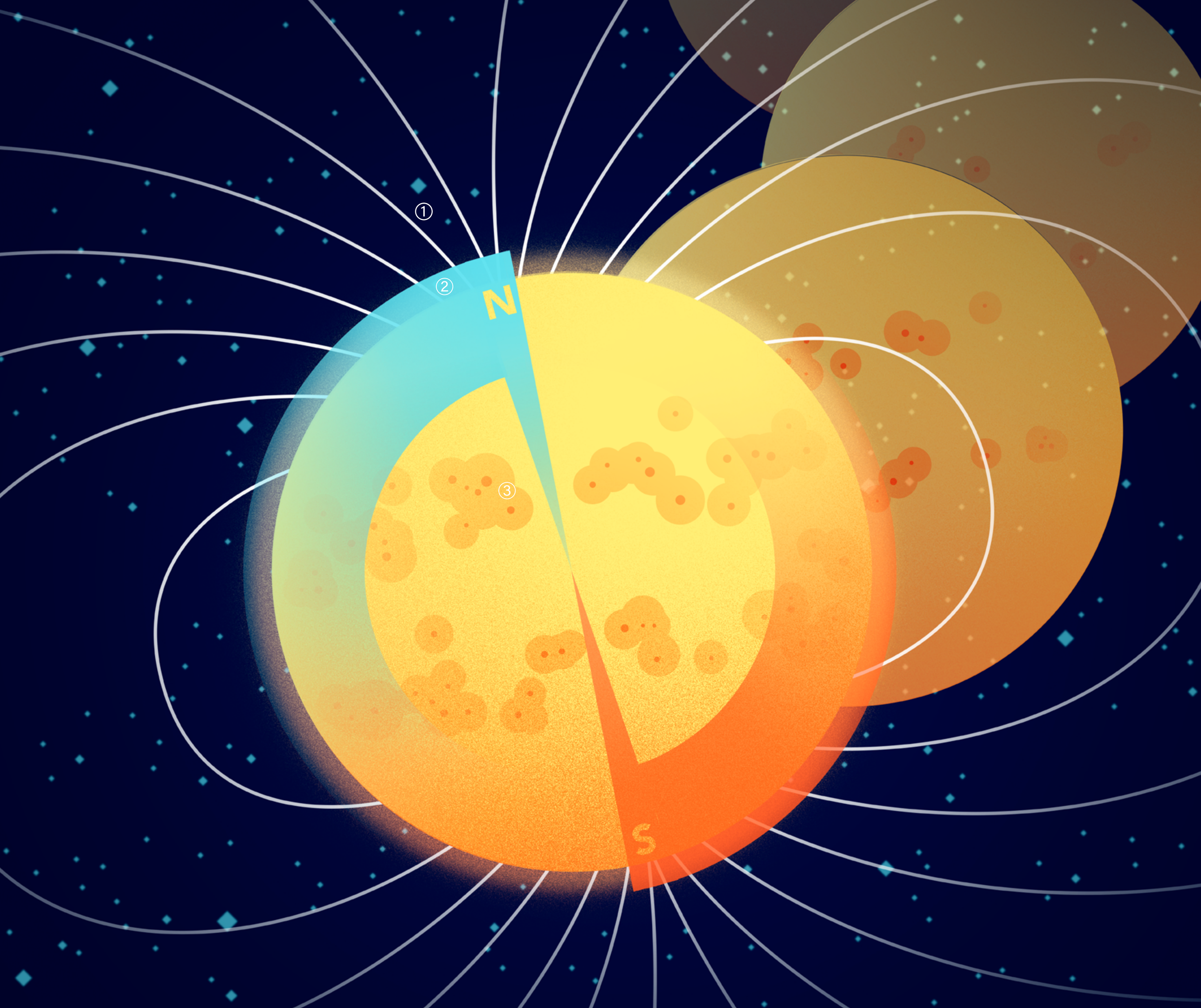

When the magnetic Sun isn’t always on time

11 YEARS
The time between two solar activity maxima

Common point between the Sun and a bicycle

Did you know that the Sun is actually a giant magnet? It works like a bicycle dynamo, except that instead of converting pedalling into electricity, it transforms its own rotation and churning convective motions into a magnetic field①.

The solar clock

Not only is the Sun a magnet, it also evolves in time! And it’s almost like clockwork: in 11 years (give or take 2 years), it gradually tilts its magnetic poles and changes their sign (+ or -)②. It passes through a phase of maximum activity, when the magnet becomes more intense and closer to the equator③.

Did you know?

The 11-yr cycle is called the butterfly cycle because of the patterns it draws on the Sun’s surface! The next solar maximum is estimated for 2025.

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The solar magnetic fireworks

15 min

The travel time of the energetic particles ejected by the solar eruption to reach Earth

Spots on the Sun?

The Sun's internal magnetic field eventually crosses its surface. It then emerges in loops①. whose feet are colder and darker, forming what are known as sunspots②.

When the Sun erupts

When these magnetic loops become too unstable, they collapse, producing an intense flash of light: this is known as a solar flare. This eruption releases large quantities of energy and matter, which are expelled far from the Sun.

Did you know?

Flares are strongly influenced by the solar cycle: from about 1 per day at minimum to more than 10 per day at maximum!

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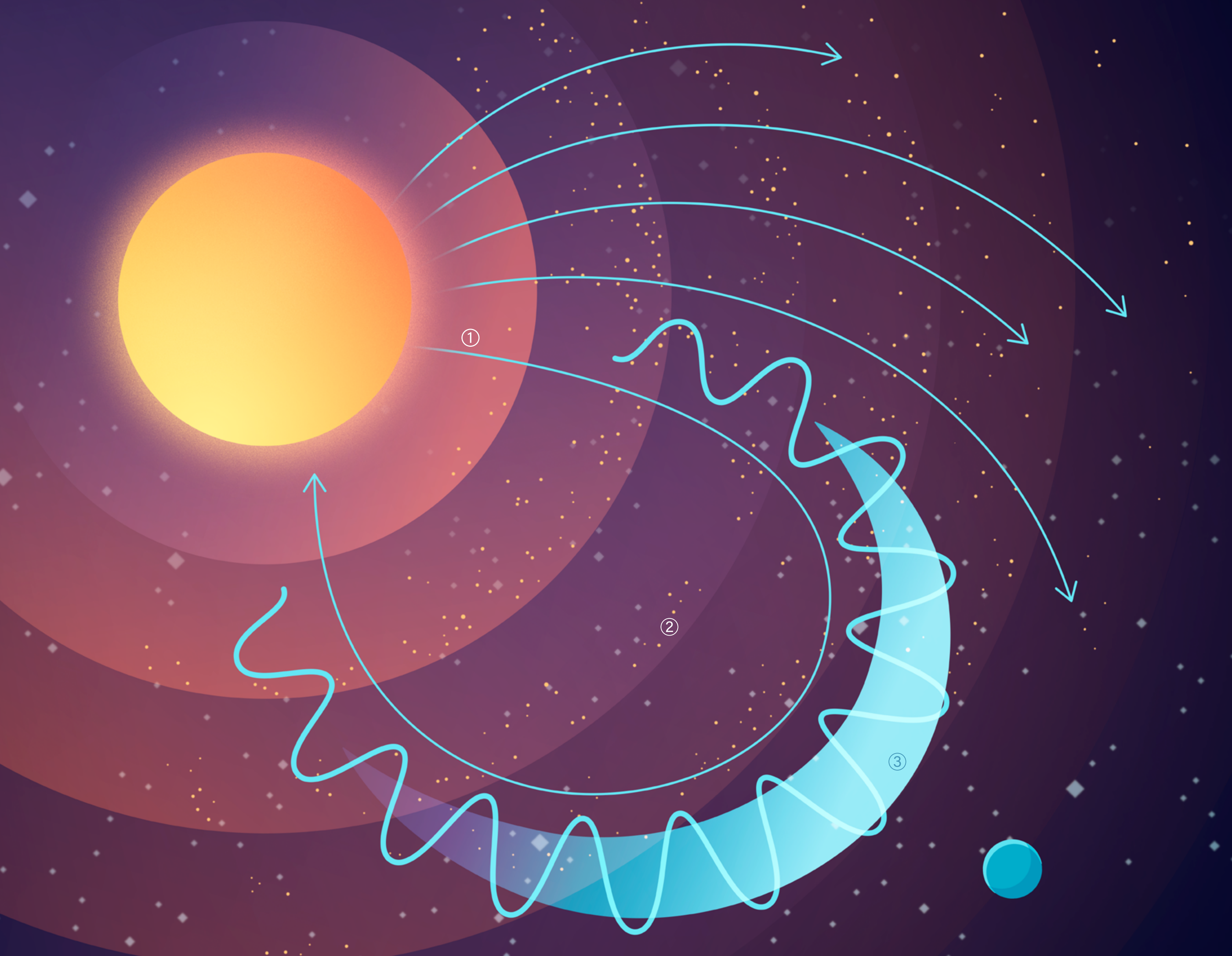

Where space isn’t as empty as it seems

15 hours
The time it took the fastest magnetic cloud to reach the Earth

Space isn’t empty

The Earth is bathed in the Sun’s extended atmosphere! There’s a magnetic field ① and a solar wind ② (a stream of electric particles ejected by the Sun at speeds of up to 3 millions km/h), both of which spiral as the Sun rotates.

When the Sun erupts

There are other, more violent disturbances, such as storms in the solar wind. The Sun can accelerate particles or eject matter on a large scale to form magnetic clouds ③. These propagate from the Sun, but do not necessarily reach the Earth.

Did you know?

What do you think the mass of a magnetic cloud is? Around 2 billion tonnes! But that’s only one billionth of a billionth of the mass of the Sun.

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Superheroes aren’t the only ones with super-powered shields!

20 nT

It’s the average magnetic field in the magnetosphere of the Earth (less than a magnet on your fridge)

A shield against solar storms

The Earth too has its own magnetic shield to protect us from space! It’s called the magnetosphere①. When this shield is attacked, we speak of a magnetic storm. No lightning or thunder, but superb polar auroras (northern lights)!

Rock’n’roll belts

You’ve heard of the rock band Van Halen, but have you ever heard of the physicist Van Allen? He discovered that particles can pass through the magnetosphere and become trapped in intense radiation belts②. These particles can damage satellites and endanger astronauts.

Did you know?

It is thought that the loss of the magnetic shield is one of the reasons why the small planet Mars lost all its liquid water!

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The Earth as a nesting doll

80 – 800 km

It’s the altitude of the northern lights

The structure of the Earth

Like the Sun, the Earth has several layers. It has 4 inner layers: it is in the liquid core that its magnetic field is created by the dynamo effect①. It also has 5 layers of atmosphere, enabling it to absorb the most dangerous sunlight (such as UV rays)②.

Polar aurorae③

Polar aurorae are magnificent green, violet and red glows that can be seen near the poles. They are located in the ionosphere (the layer of the atmosphere sensitive to electric currents), and are a reaction to magnetic disturbances in space.

Did you know?

The color of the aurora depends on the composition of the atmosphere. For example, they are green on Earth, but blue on Jupiter!

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When the Sun causes panic in all systems

9h It's the blackout duration in Québec due to the magnetic storm of 1989

Consequences in space ①: Satellites can be damaged by electrical particles, or crash due to changes in the atmosphere. Astronauts can also suffer health problems.

Consequences in the atmosphere ②: This can cause loss of GPS signal or radio communications. Radiation can also be dangerous for aircraft personnel.

Consequences on the ground ③: Even the Earth's crust is not immune to the Sun! Electrical currents in the atmosphere can generate currents on the ground, causing electrical surges.

Did you know?

In 1989, a magnetic storm disrupted Quebec's entire electric grid creating a blackout!

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