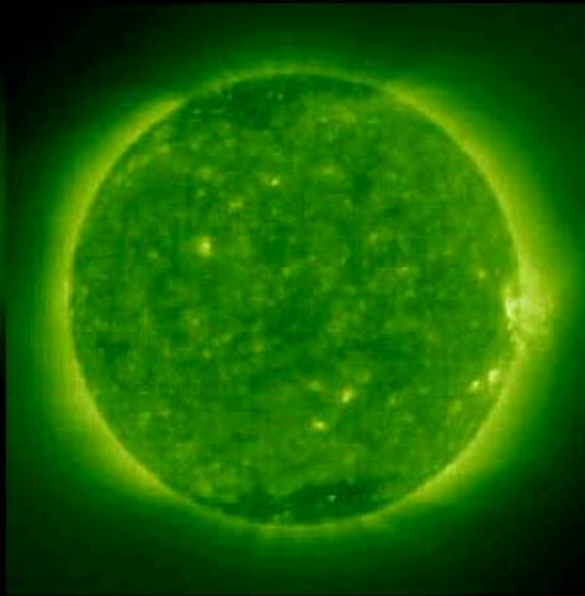


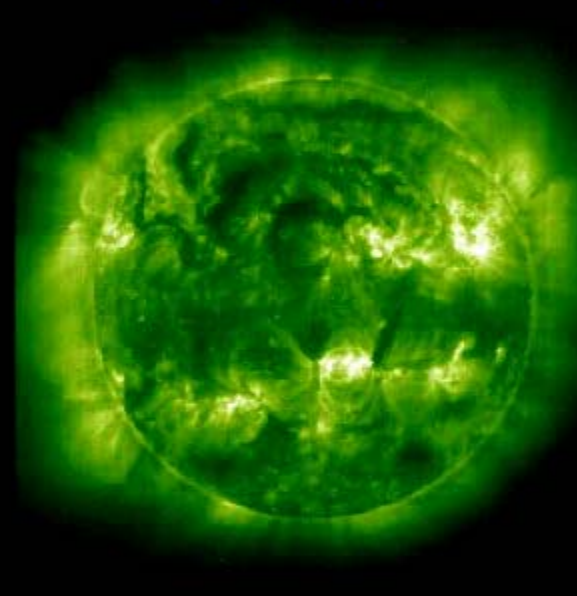
FROM MINIMUM TO MAXIMUM



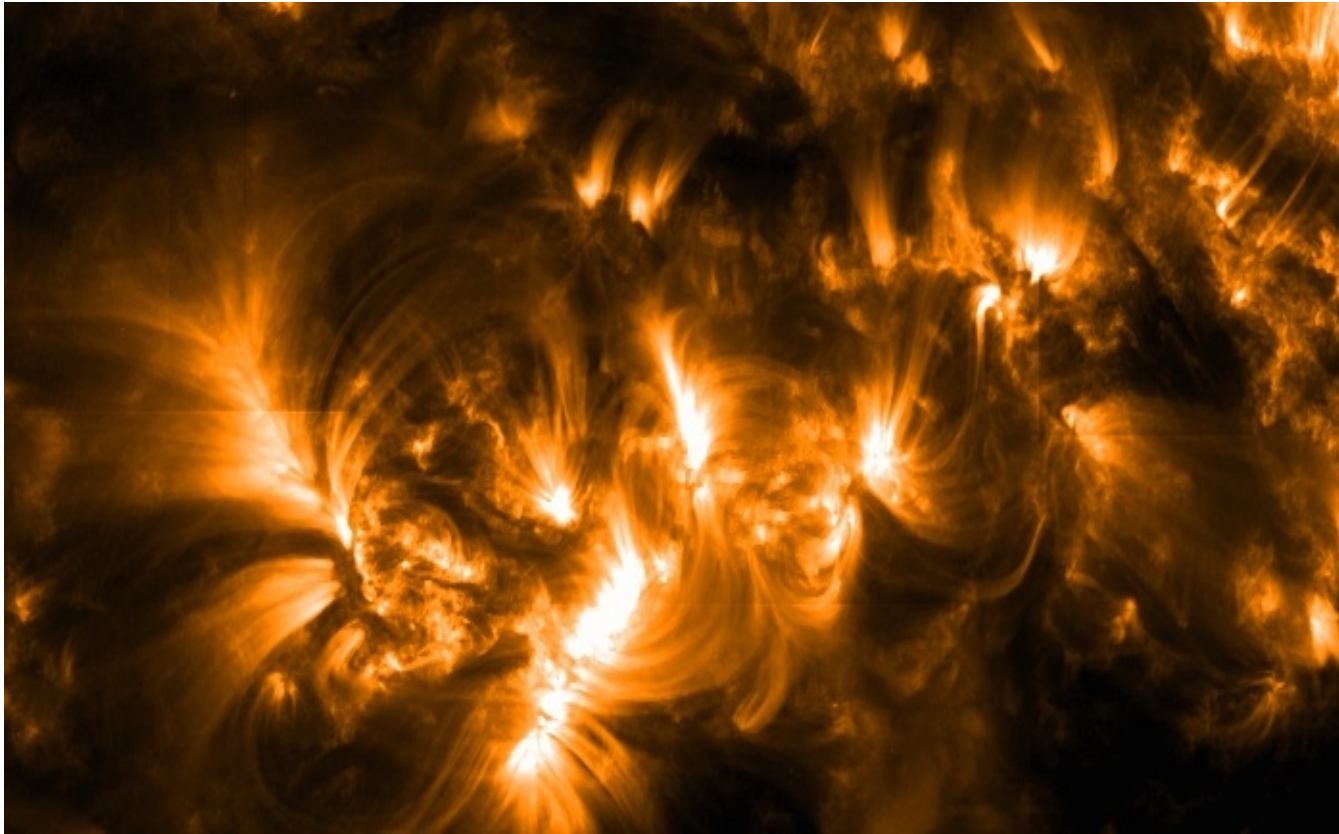
EIT 195 Å
Dec. 1996



EIT 195 Å
June 1999

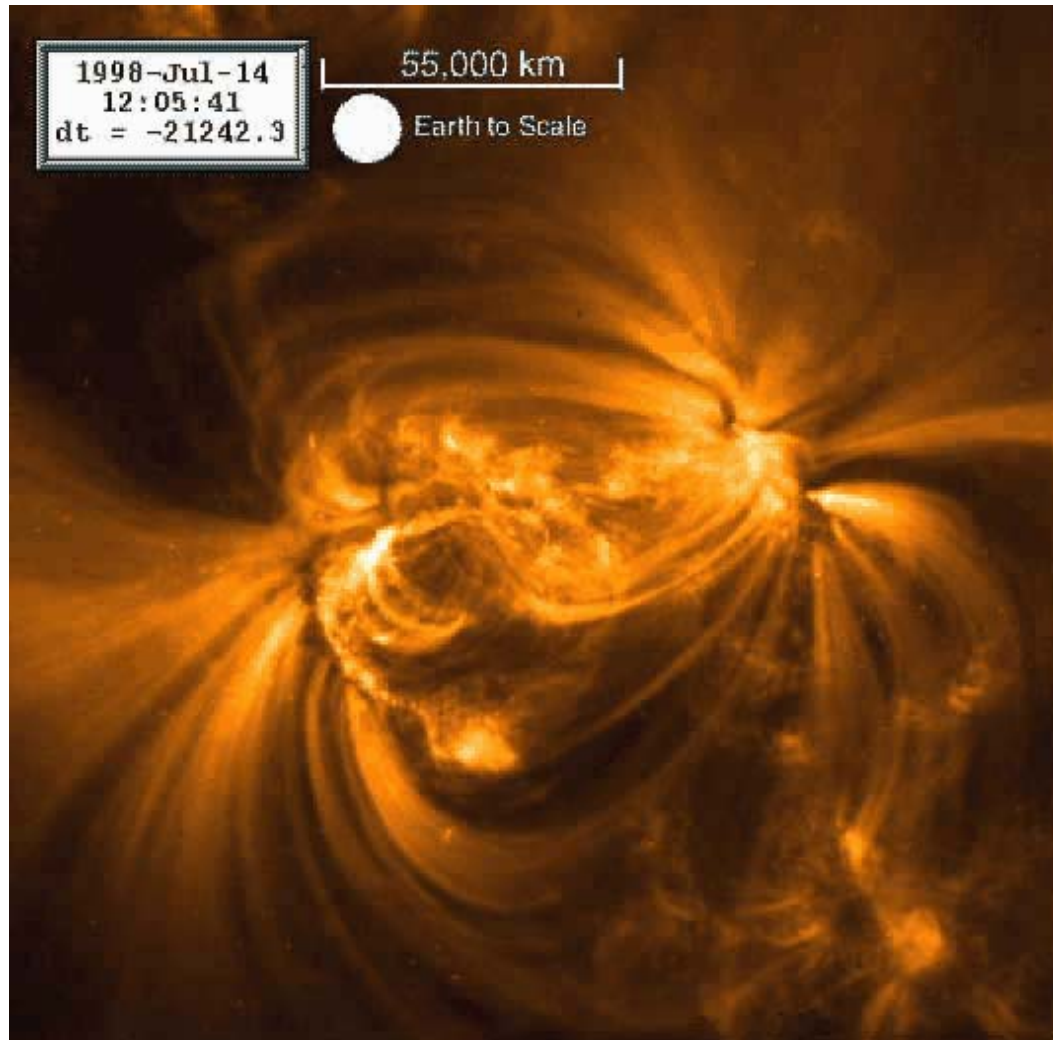


MAGNETIC RECONNECTION



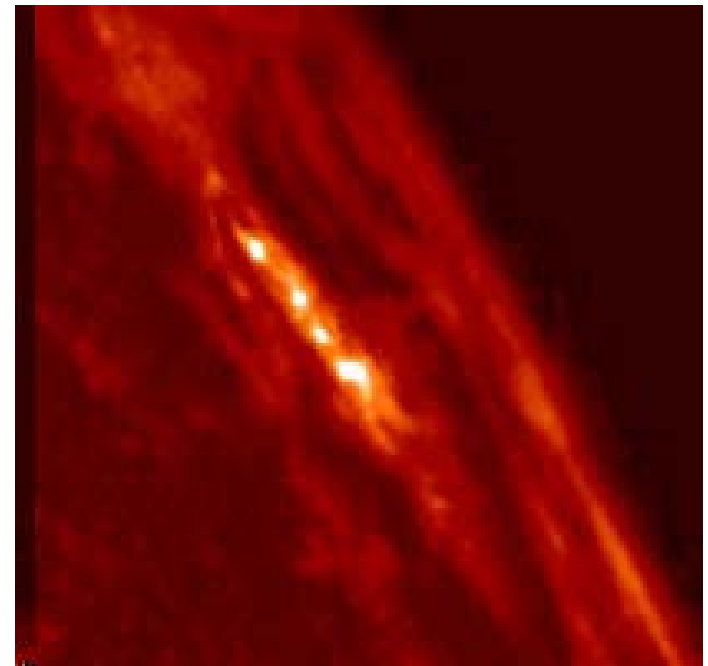
**The corona is hot because it is pervaded by very dynamic magnetic fields
Reconnection of the magnetic field at very small scales occurs above the
photosphere and in the lower corona itself**

SOLAR ERUPTIONS



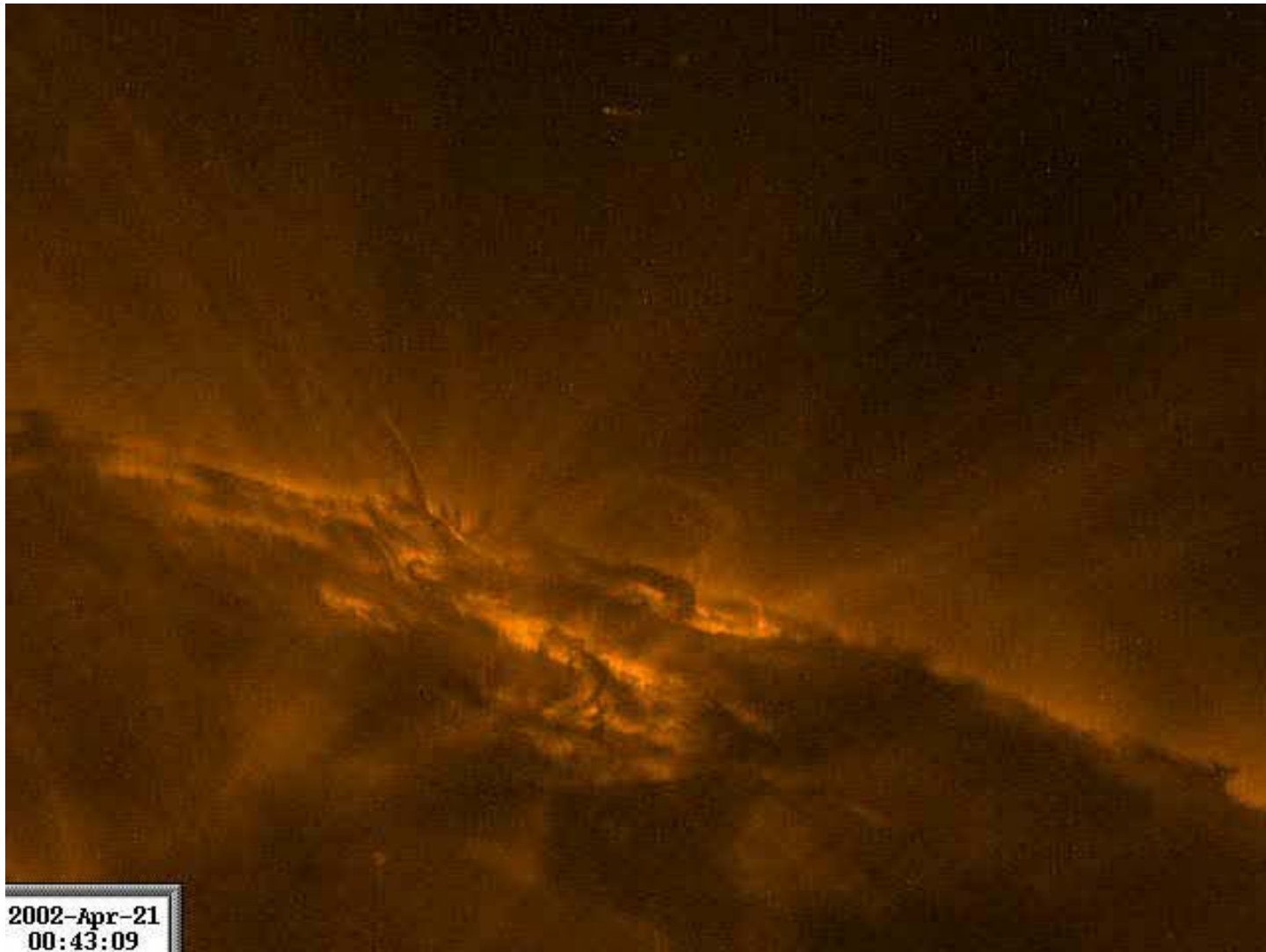
Post flare waves observed by MDI

Solar eruptions observed by TRACE

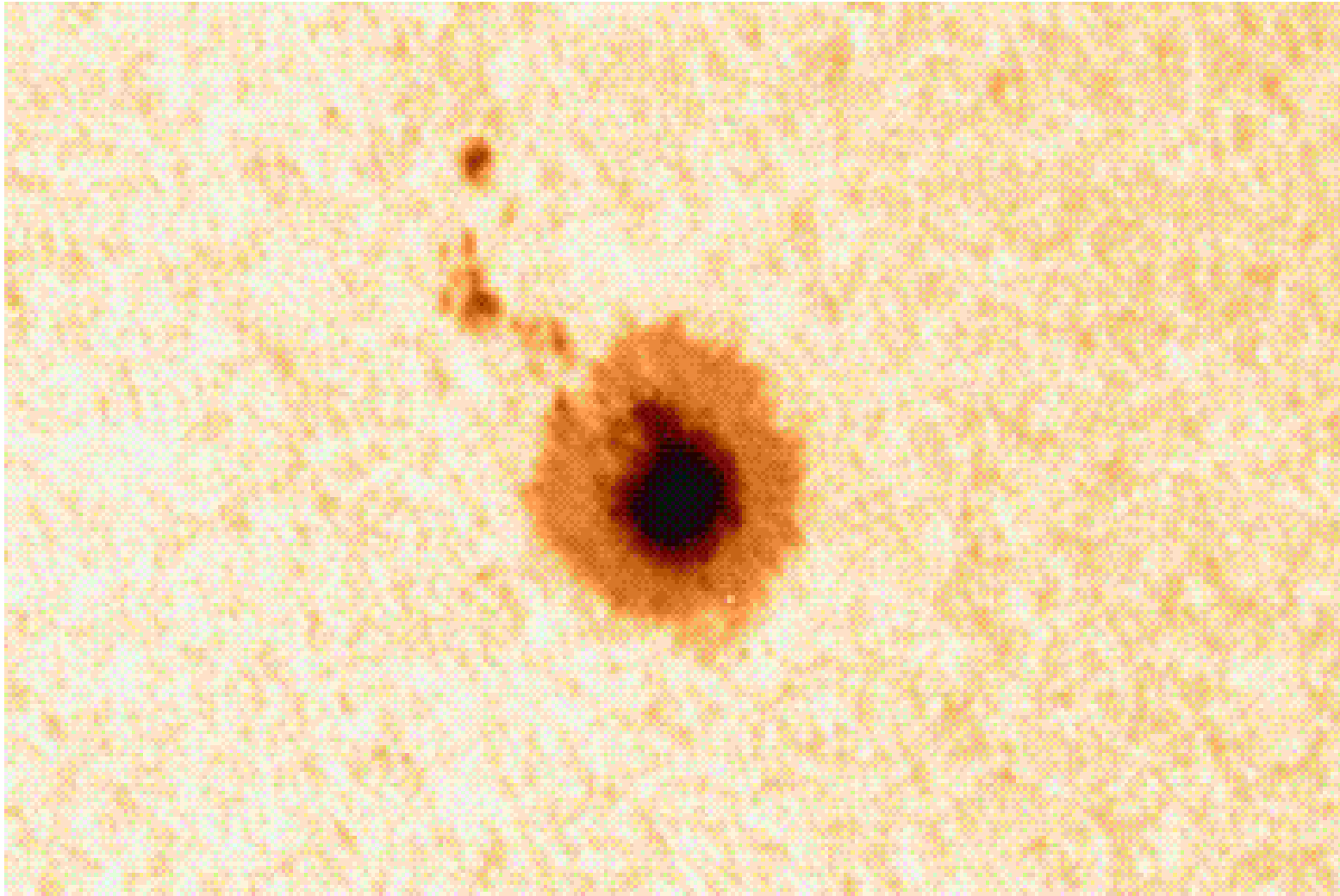


Magnetic reconnection

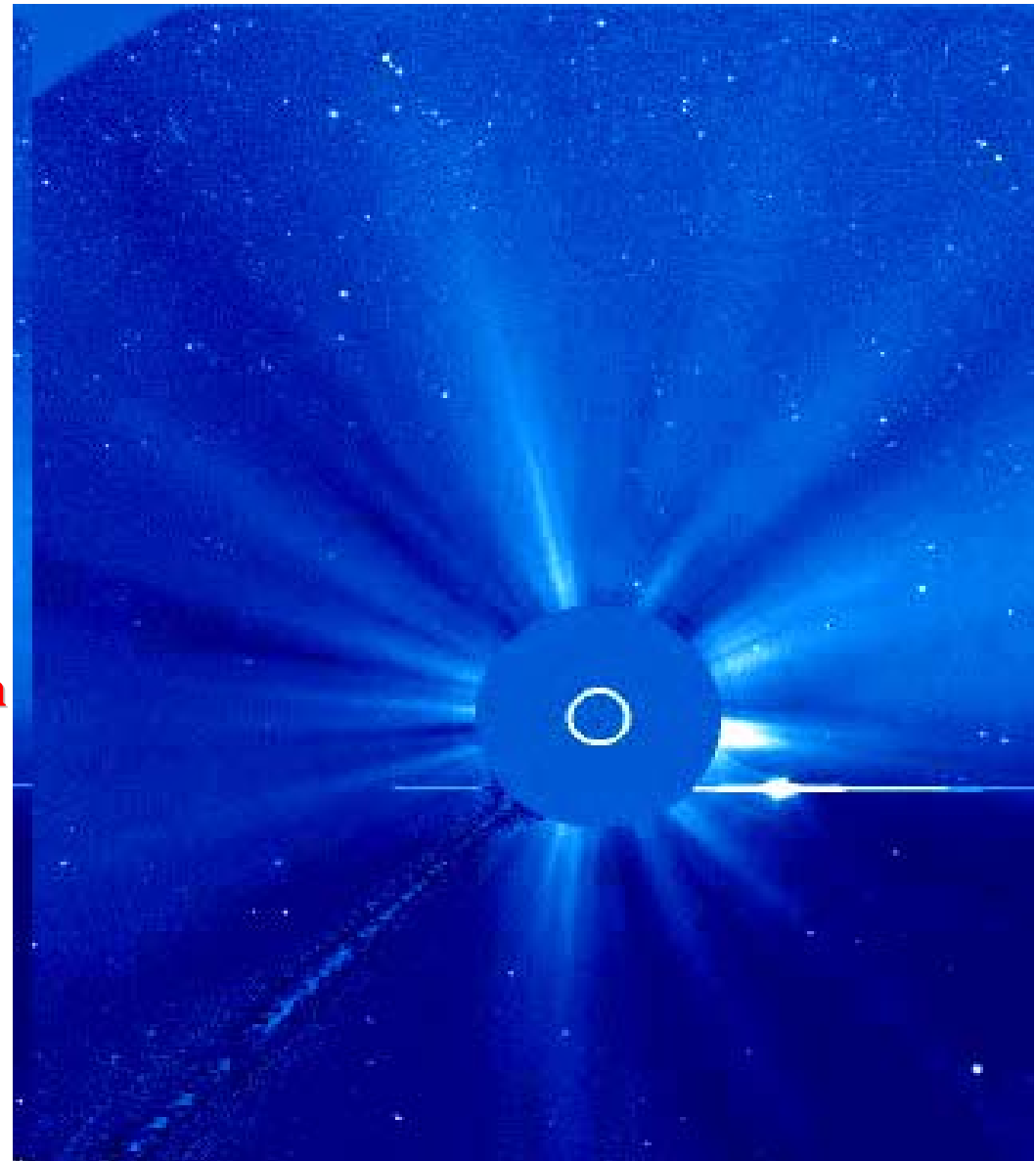
MAGNETIC LOOPS OBSERVED BY TRACE



TOMOGRAPHY OF A SUNSPOT



Credit: S. Kosovichev (Stanford)



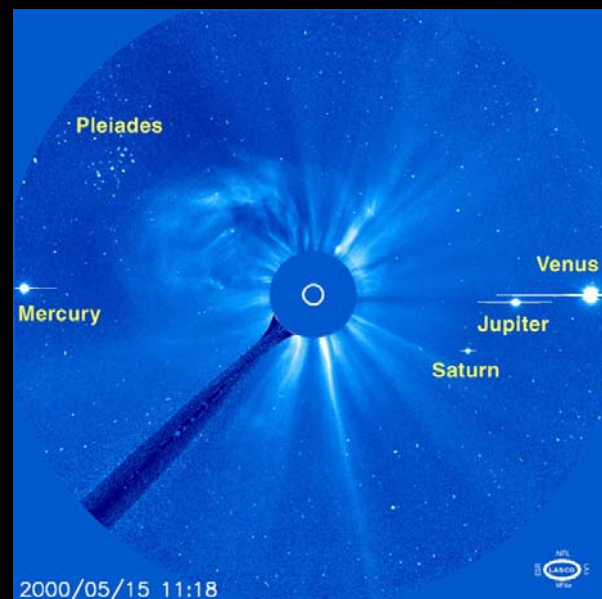
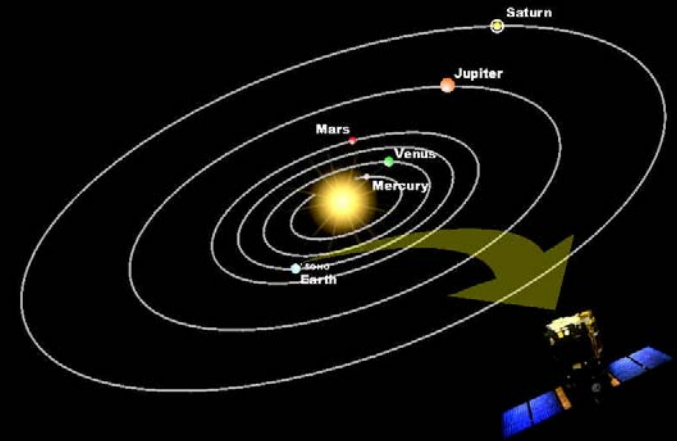
On 14 January 2002, Comet Machholz turned around the Sun and offered a unique demonstration of Biermann's interpretation of the plasma tail being structured by the solar wind and always directed opposite to the Sun.

ANOTHER VIEW OF THE UNIVERSE

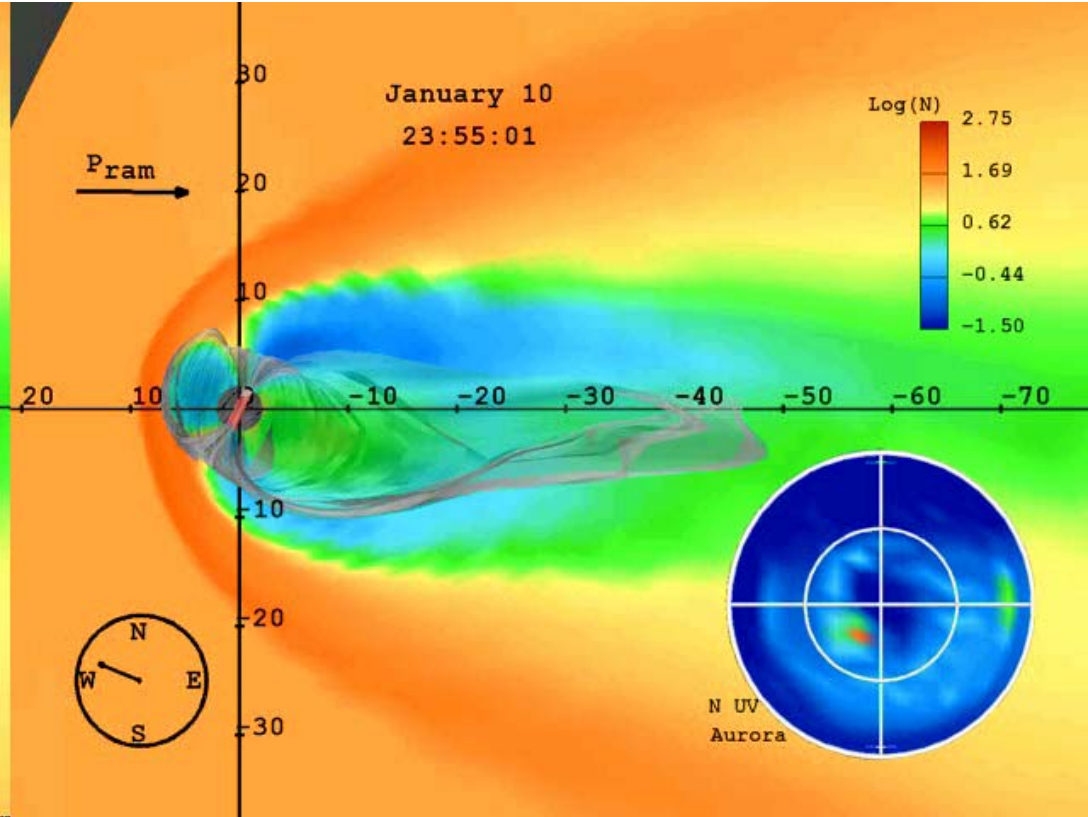


The corona is a very dynamic part of the Sun, completely structured by the magnetic field.

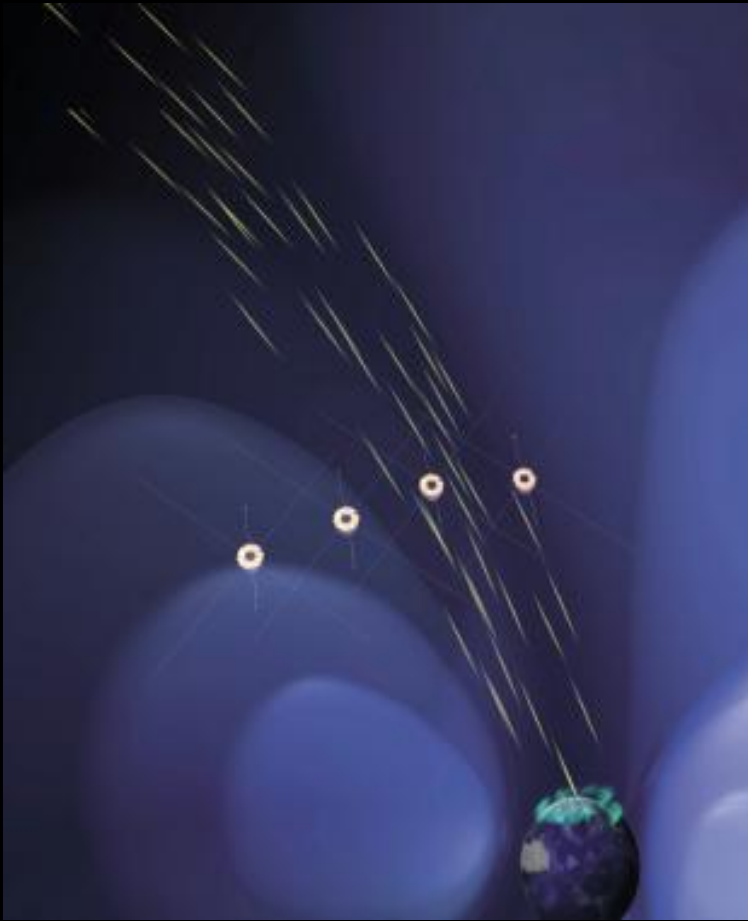
It is the seat of the solar wind and the source of Coronal Mass Ejection which expand and travel in interplanetary space



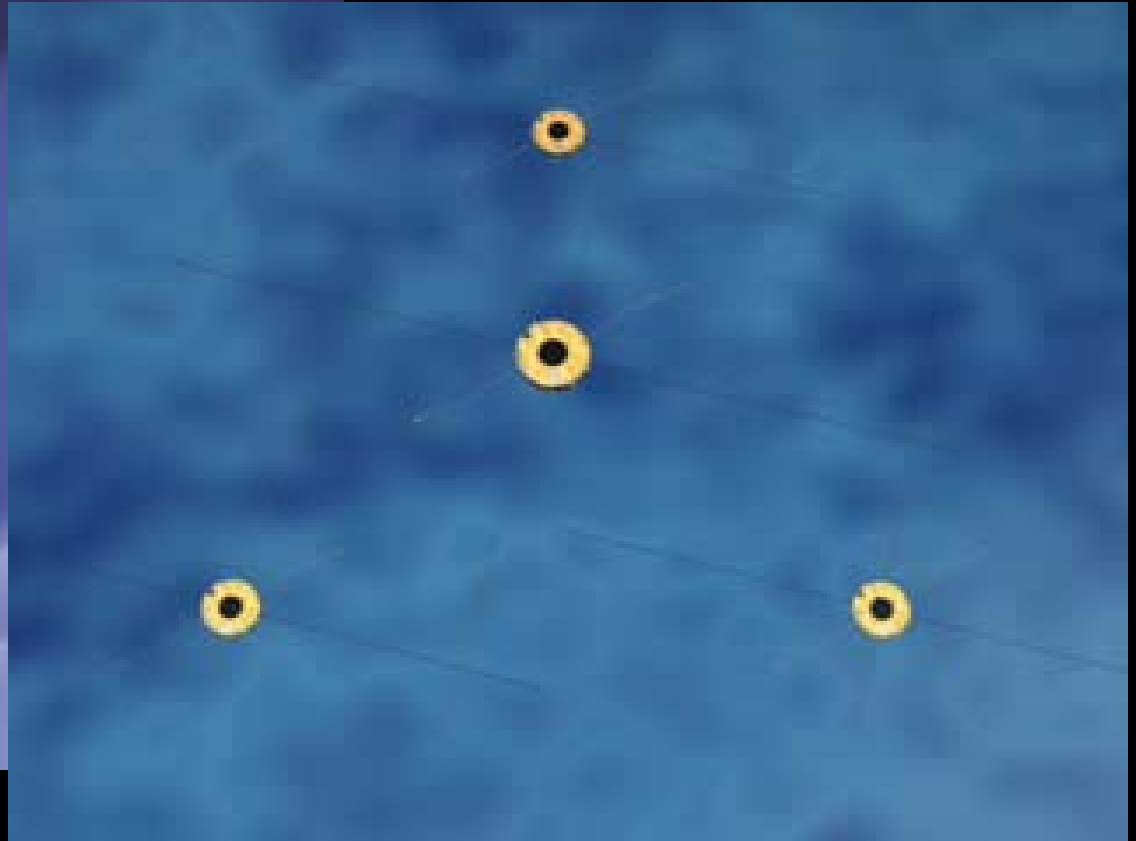
FIRST INTERFACE: THE MAGNETOSPHERE



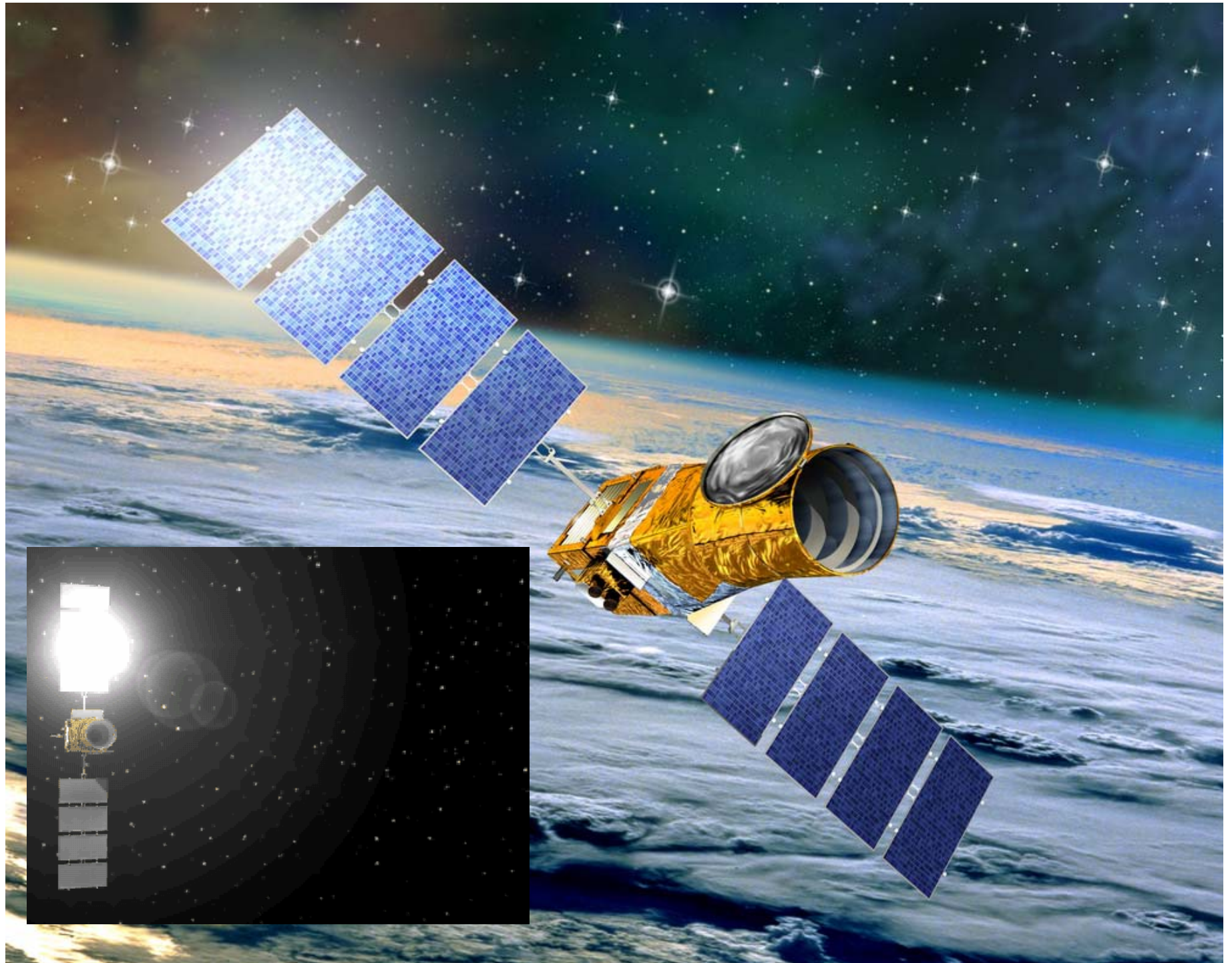
4 CLUSTER LOOK AT THE EARTH



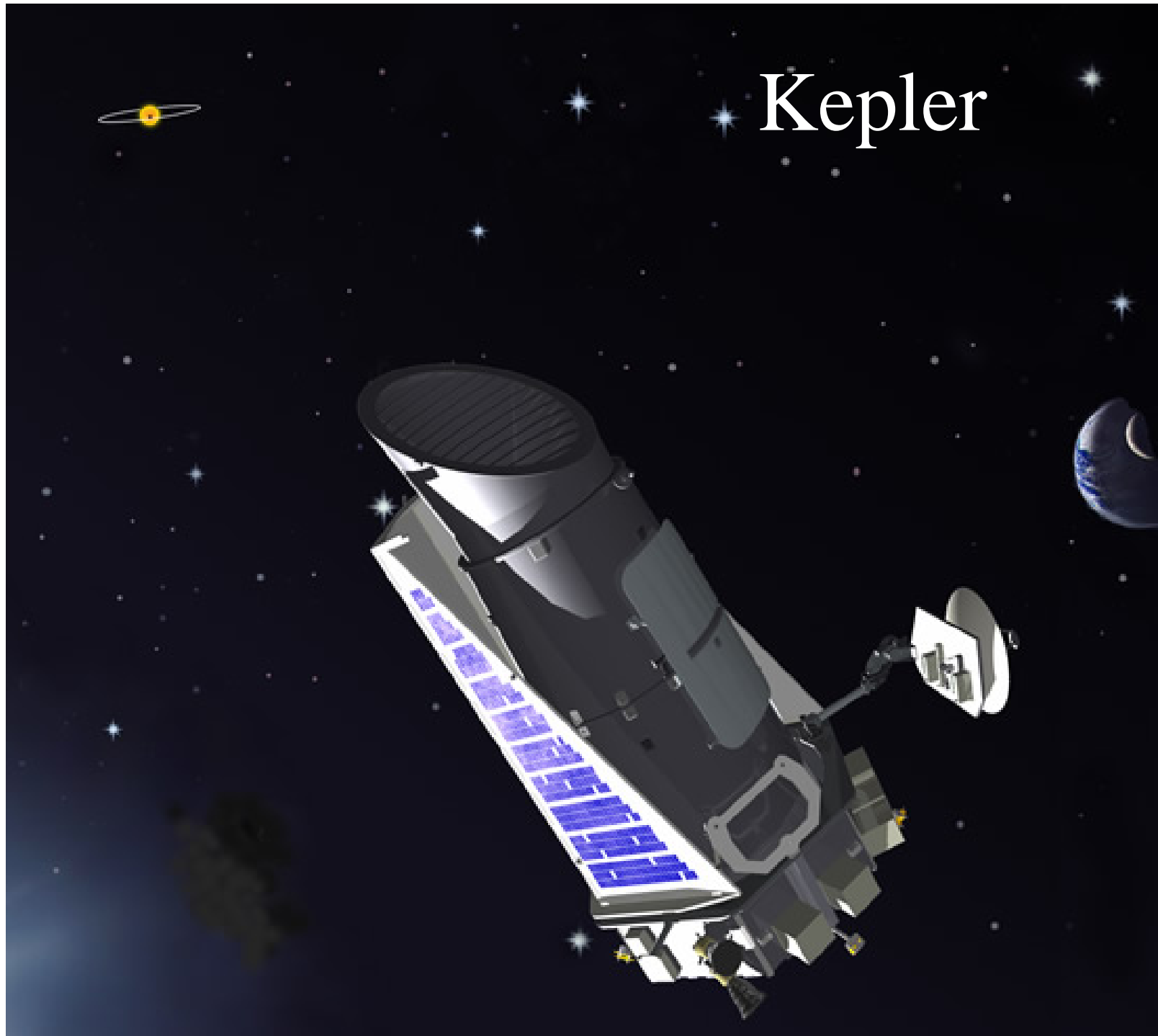
The 4 Cluster spacecraft were launched by ESA in 2000 to investigate the interaction of the solar wind and the Magnetosphere

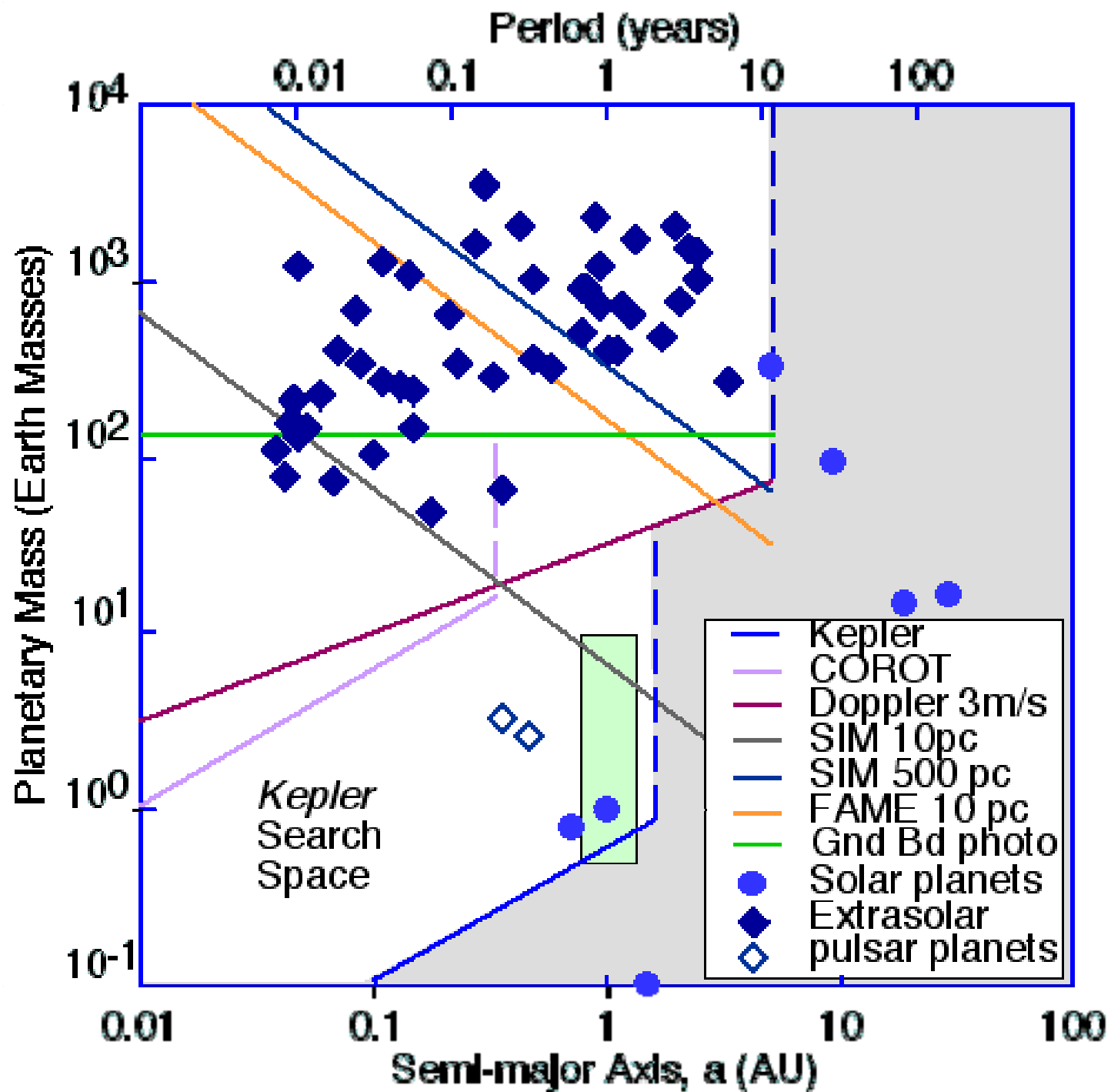


The wavy structure of the Magnetosphere



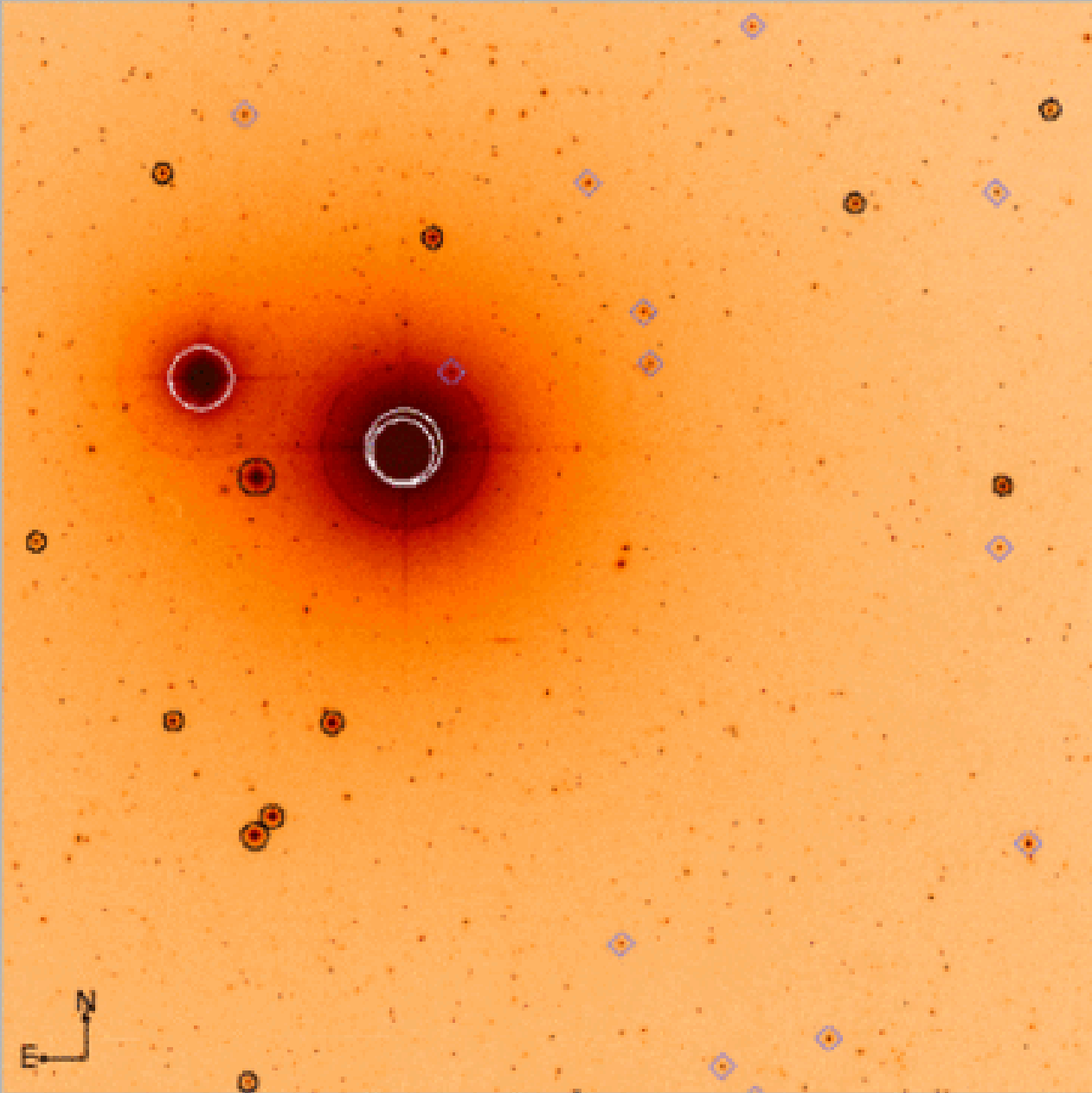
Kepler





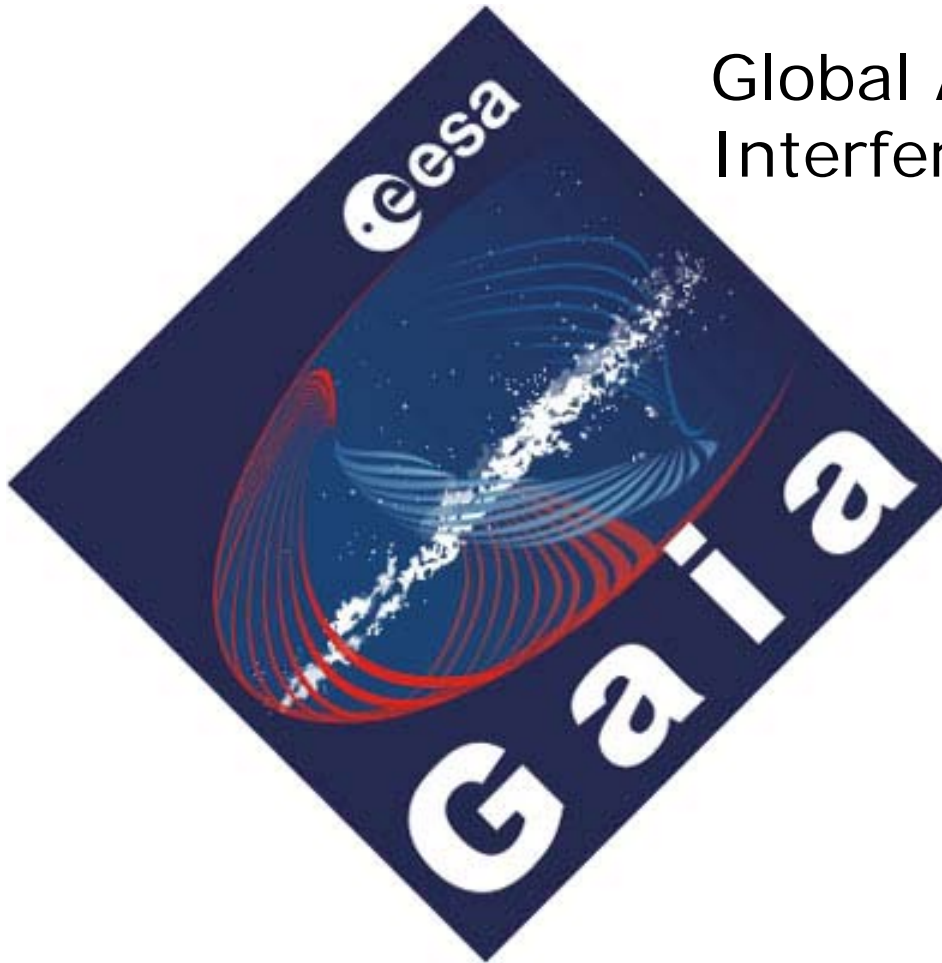


Hipparc



Hipparcos stars, Tycho stars, *new stars in Tycho-2*

Global Astrometric Interferometer for Astrophysics



ESA Space Science context

- Space astrometry (global astrometry): an established European specialty
- **Hipparcos**, launched in 1989: first astrometric satellite
120000 stars, accuracy: 1 mas
 - Feb 2006: > **3500 papers, among which > 1600 refereed**
 - Detailed 3-D study of the solar neighbourhood.
 - First to solve the discrepancy between the age of the oldest stars in the Galaxy and the expansion age of the Universe
- **Gaia**, much more ambitious: **one billion objects, 10-25 μ as** at V=15 + spectroscopy and multiband photometry
 - Included in Horizon 2000+ in 1994
 - Planned for launch in December 2011
 - Exactly in line with several themes selected for Cosmic Vision 2015-2025

Gaia: Design considerations

- **Optimized**

- to decipher the **history of our Galaxy**
- to spell out the origin and **evolution of stars** of all masses
- to make a complete **census** of the solar neighbourhood, down to exoplanets and brown dwarfs
- to quantify the **interactions** between our Galaxy and the Local Group galaxies

⇒ Systematic observation of **all objects down to $V=20$** (on-board detection)

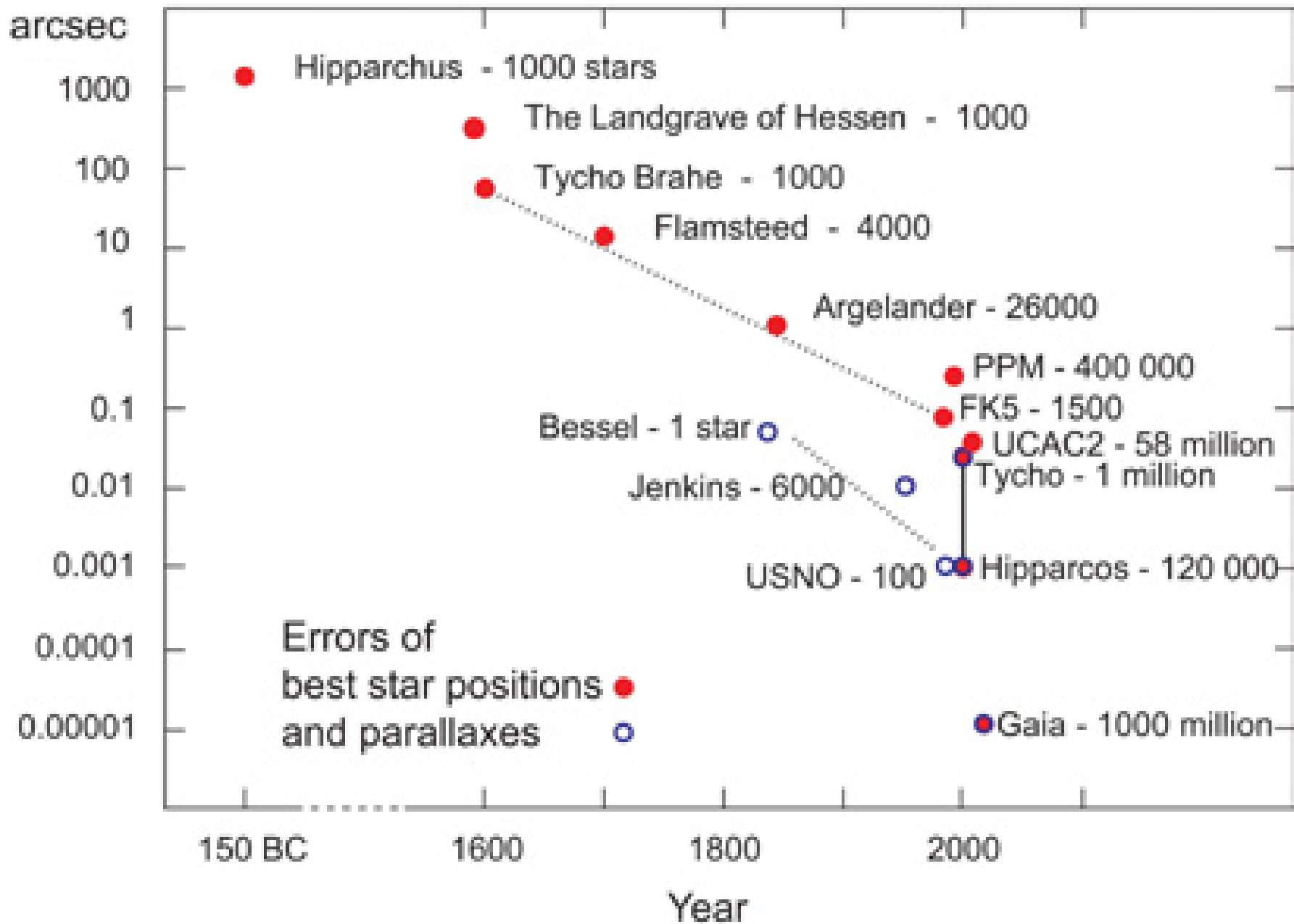
⇒ Determine **distances to 10 % up to a minimum of 10 kpc**

⇒ Determine **3-D velocities to a few km/s up to 20 kpc min**

- radial velocity from **on-board slitless spectrometer** (847-874 nm, Ca triplet)

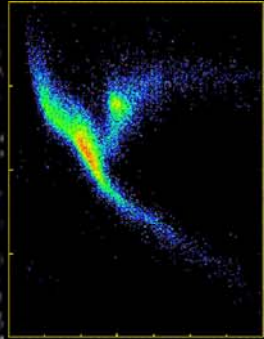
⇒ Observe **physical characteristics** of targets

- astrophysical diagnostics (T_{eff} , [Fe/H], extinction) from **on-board multi-epoch multi-colour photometry + spectrometer**



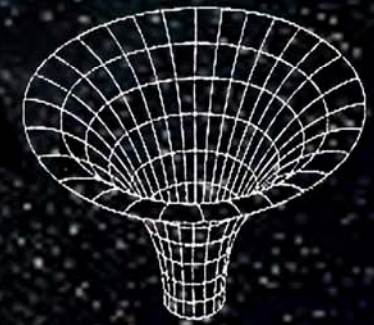
GAIA

Stellar
Astrophysics



Star Formation
History of the
Milky Way

Galactic
Structure

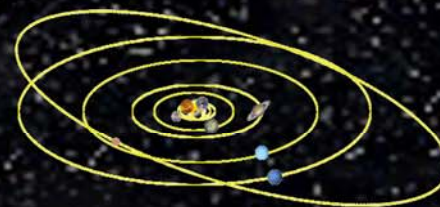


Fundamental
Physics

Binaries and
Brown Dwarfs

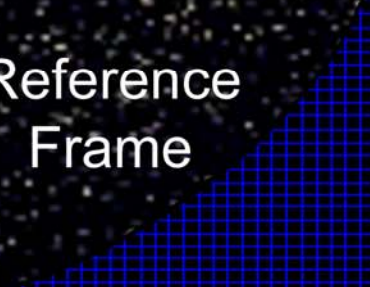


Extrasolar
Planets



Solar
System

Reference
Frame



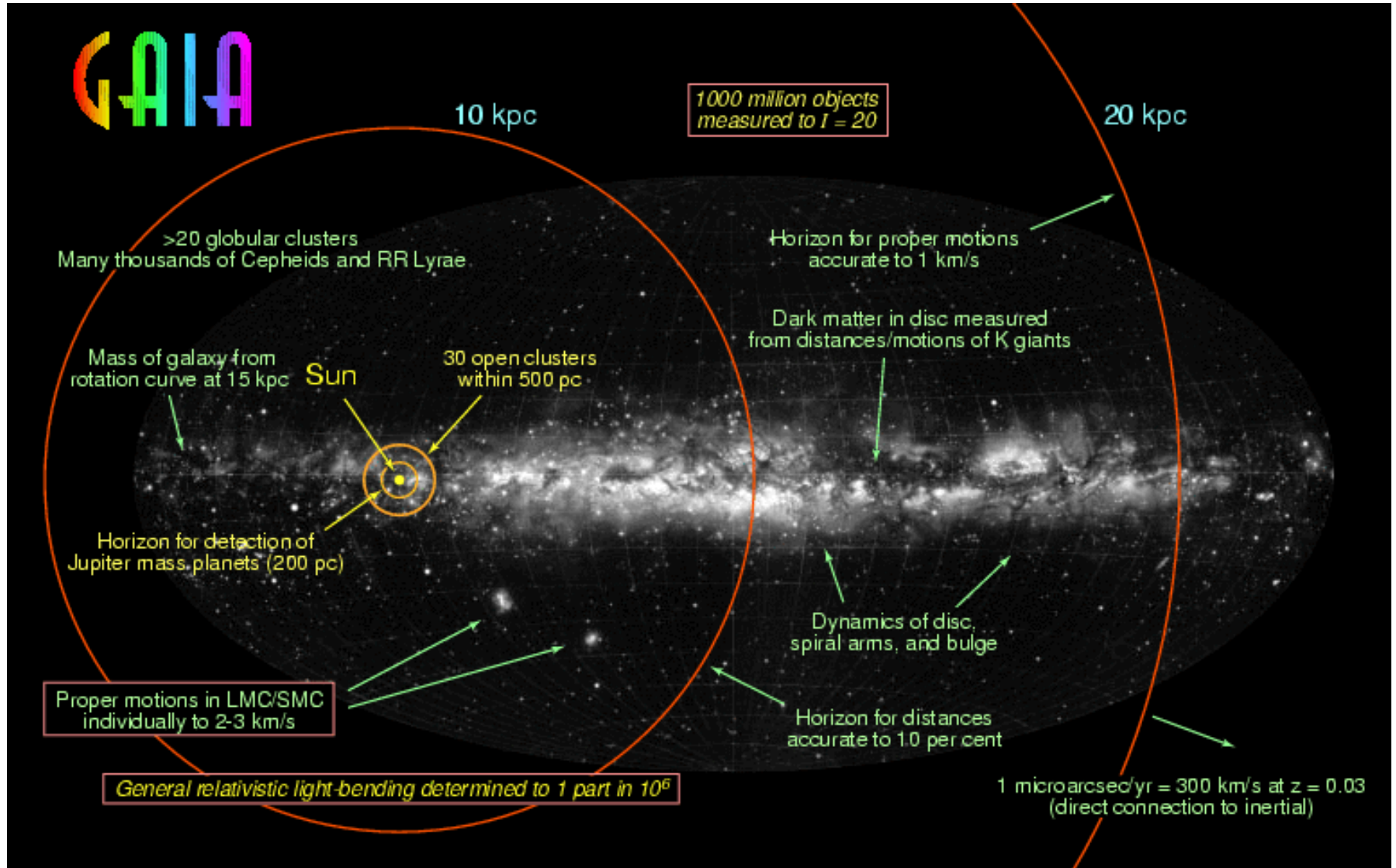
Light Bending in Solar System

Hipparcos $\rightarrow \gamma = 1 \pm 3 \cdot 10^{-3}$

Gaia $\rightarrow \sigma_{\gamma} = 10^{-6}$ to $5 \cdot 10^{-7}$



GAIA Accuracies and our Galaxy



10 μ as = 10% distances at 10 kpc

10 μ as/yr = 1 km/sec at 20 kpc

