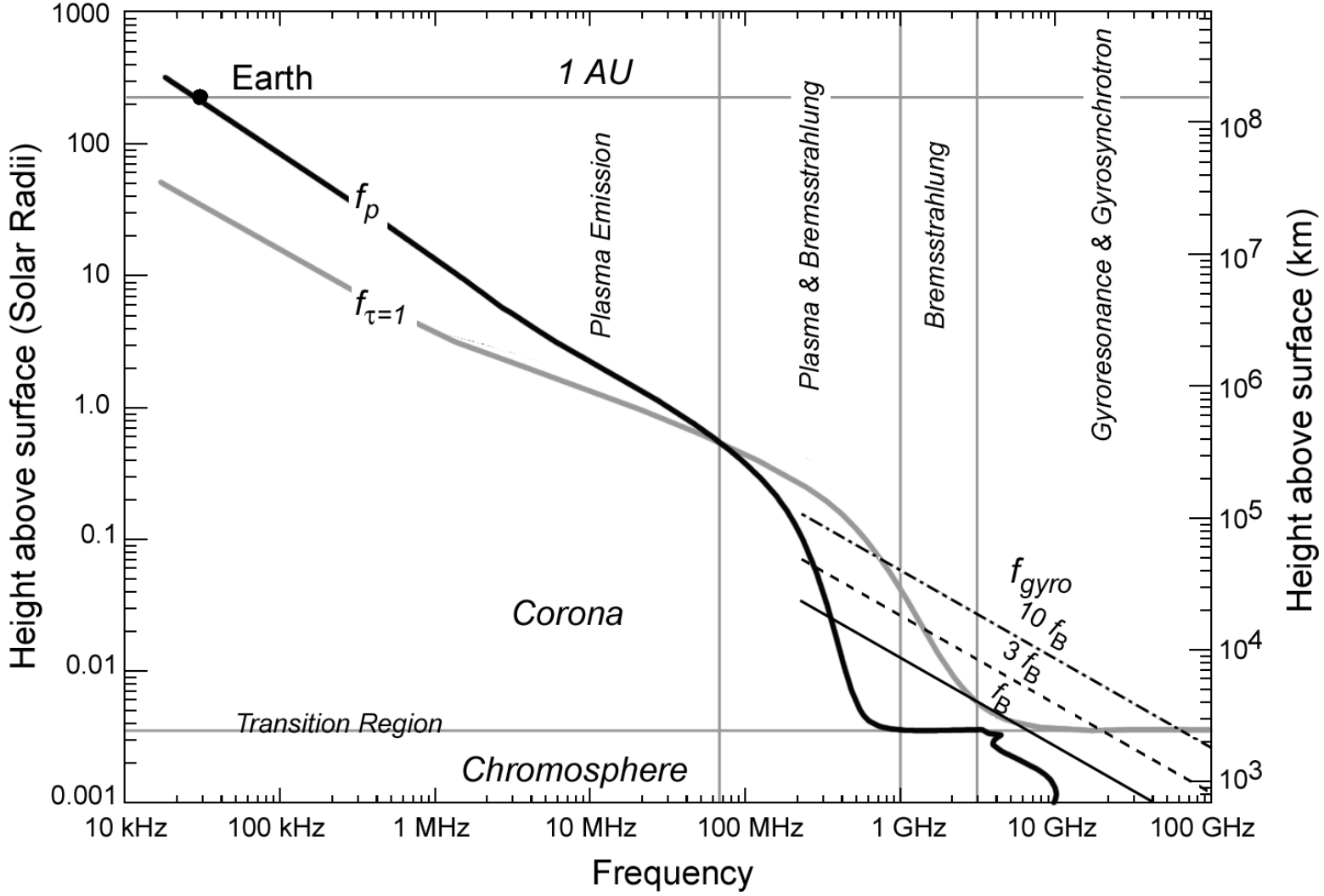
Elements of Solar Radio Astronomy

Radiospectrographs and Radioheliographs

The Solar Corona Height-Frequency Plot



1. Lower Frequencies correspond to layers further from the solar surface
2. A multi frequency radio observation provides an in depth picture of the Solar Atmosphere (from Radio-spectrograph).
3. For 2D, images are obtained by interferometry (Radio-heliograph)

The ARTEMIS IV Solar Radiospectrograph

ARTEMIS IV is a Franco-Hellenic solar radiospectrograph operated by the University of Athens at Thermopylae

Frequency range of 20 to 650 MHz

Two receivers operating in parallel:
1. Global Spectral Analyser (ASG), a sweep frequency receiver
2. Acousto-Optic Spectrograph (SAO), a multichannel acousto-optical receiver.

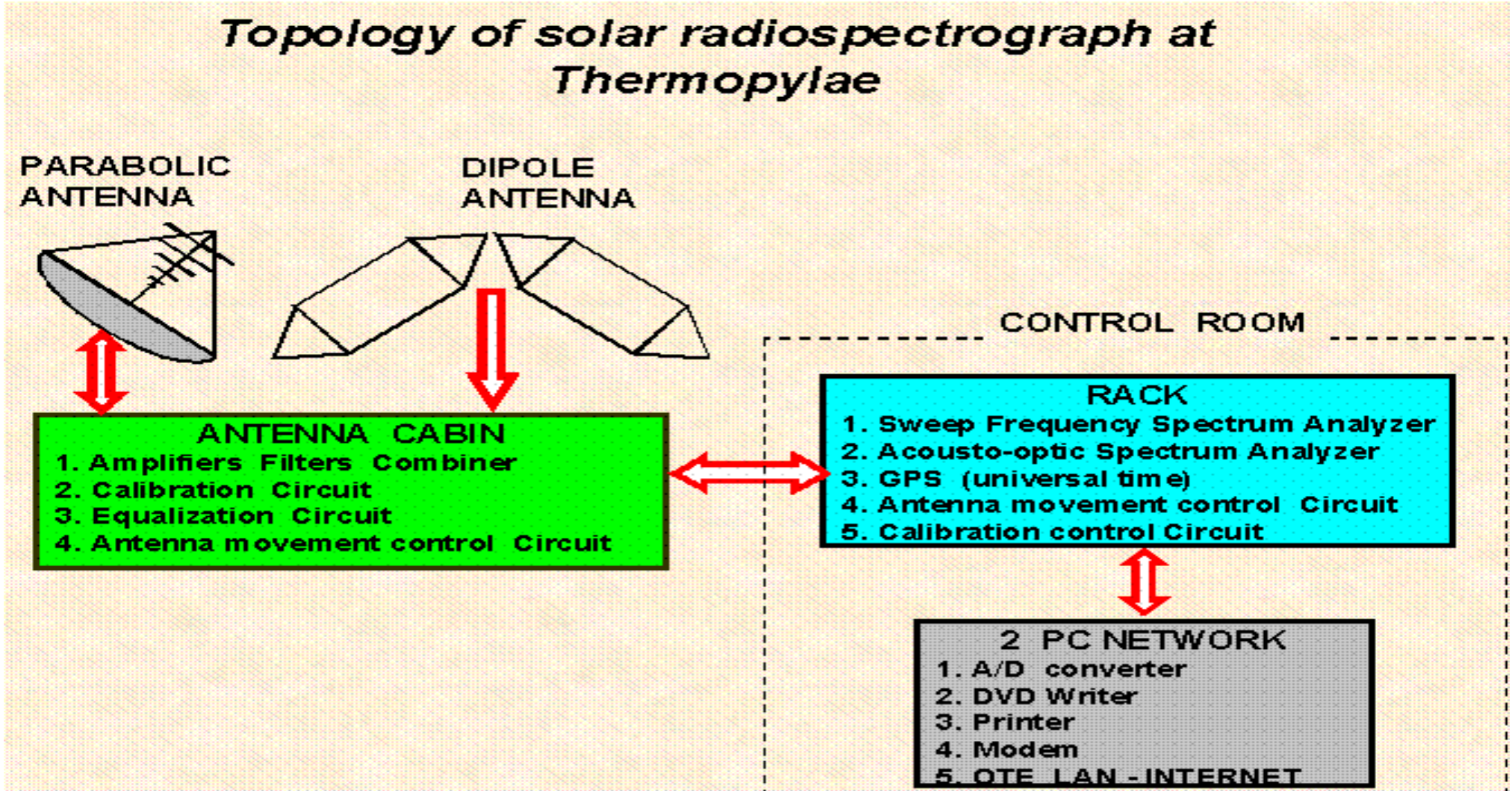
The sweep frequency analyser (ASG) covers
the full frequency band with a time resolution of 10 spectra/s.

The high sensitivity multi-channel acousto-optical analyser covers
the 265-450 MHz range, with high frequency and time resolution (100 spectra/s)
its recordings are used, mostly, for the study of fine structures

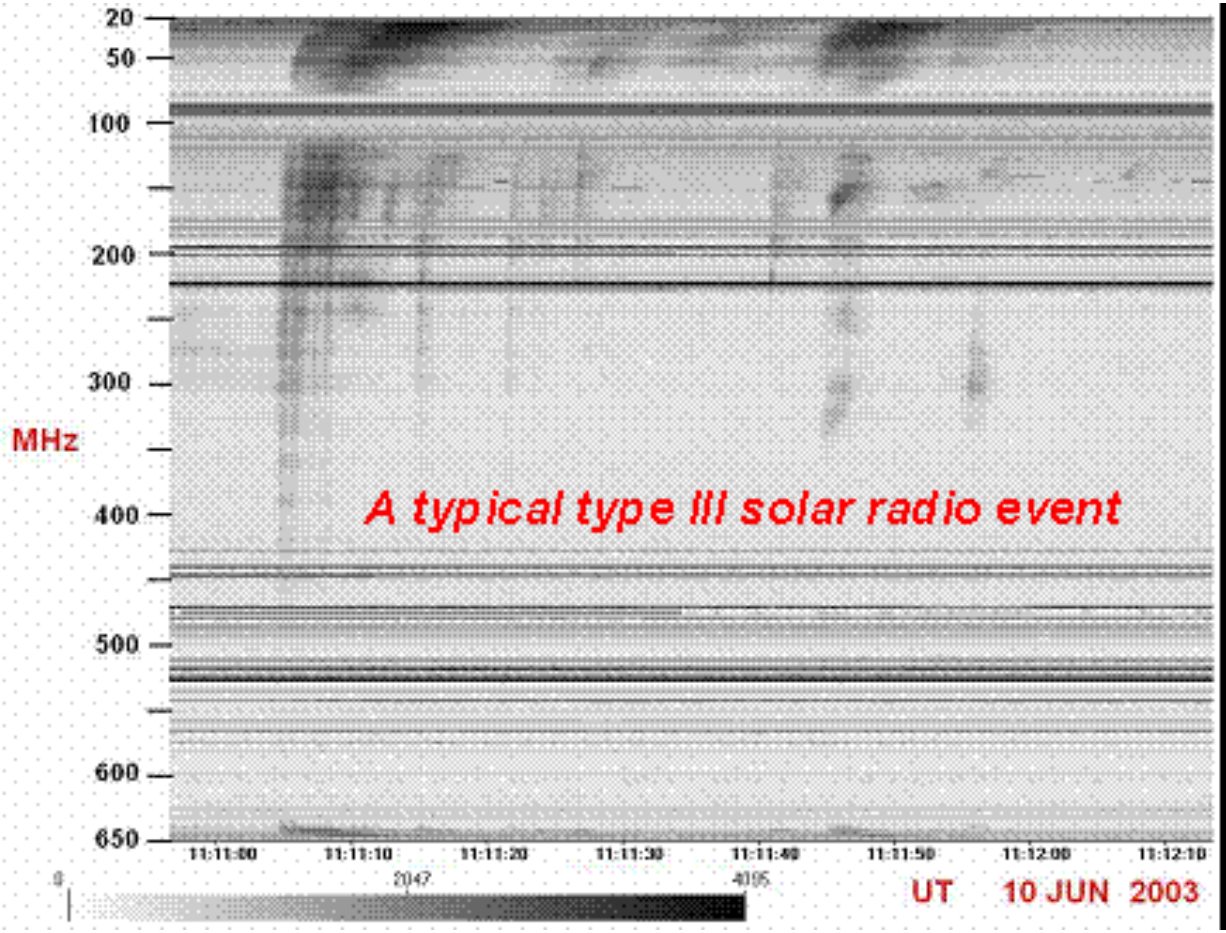
Data for storage **1.4 GB/day**

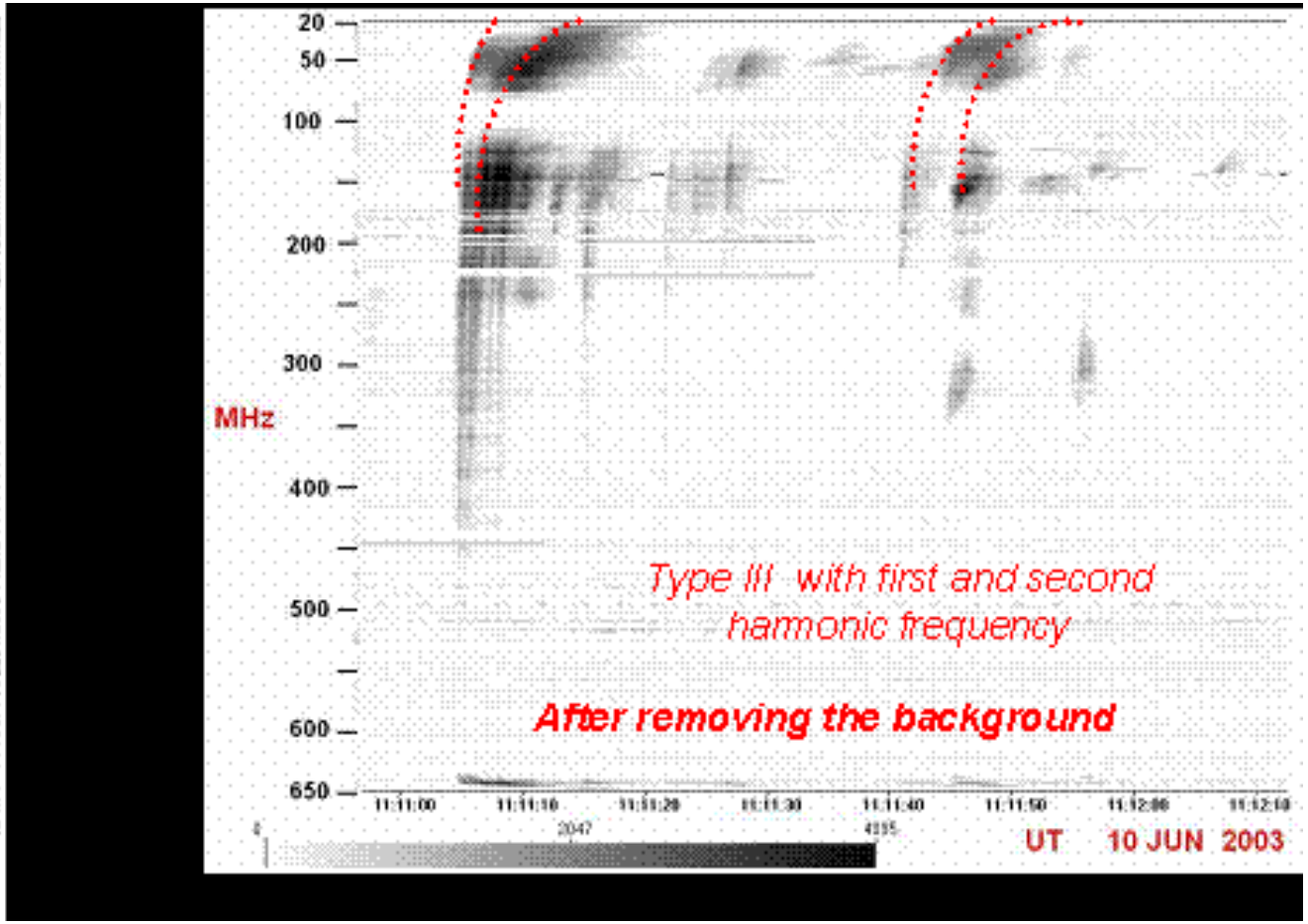
The two antennas at Thermopylae

The ARTEMIS IV Solar Radiospectrograph



Dynamic Spectrum





What is the Effect of the Ionosphere ????

A multi frequency radio observation provides an in depth picture of the Solar Atmosphere.

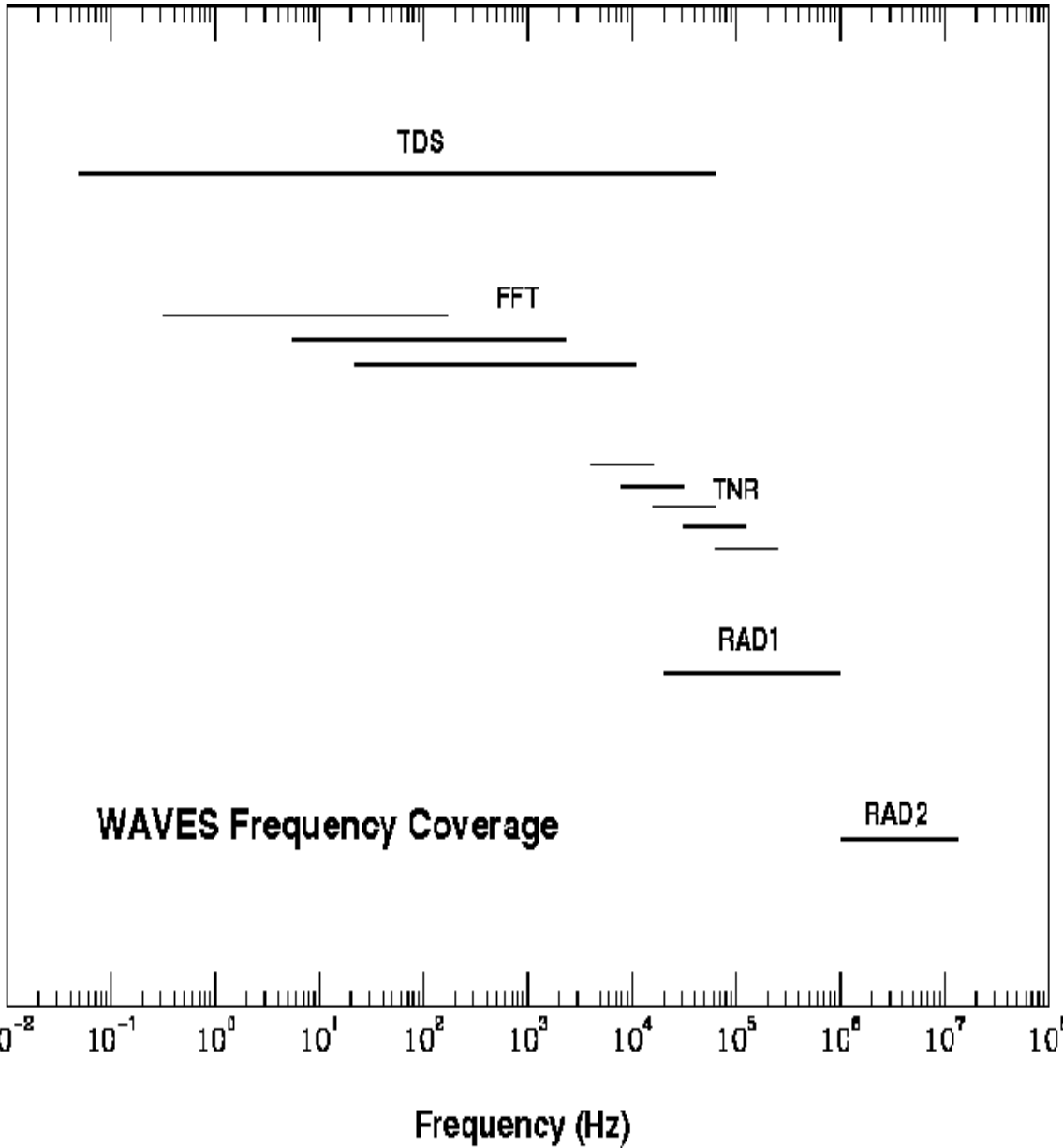
BUT

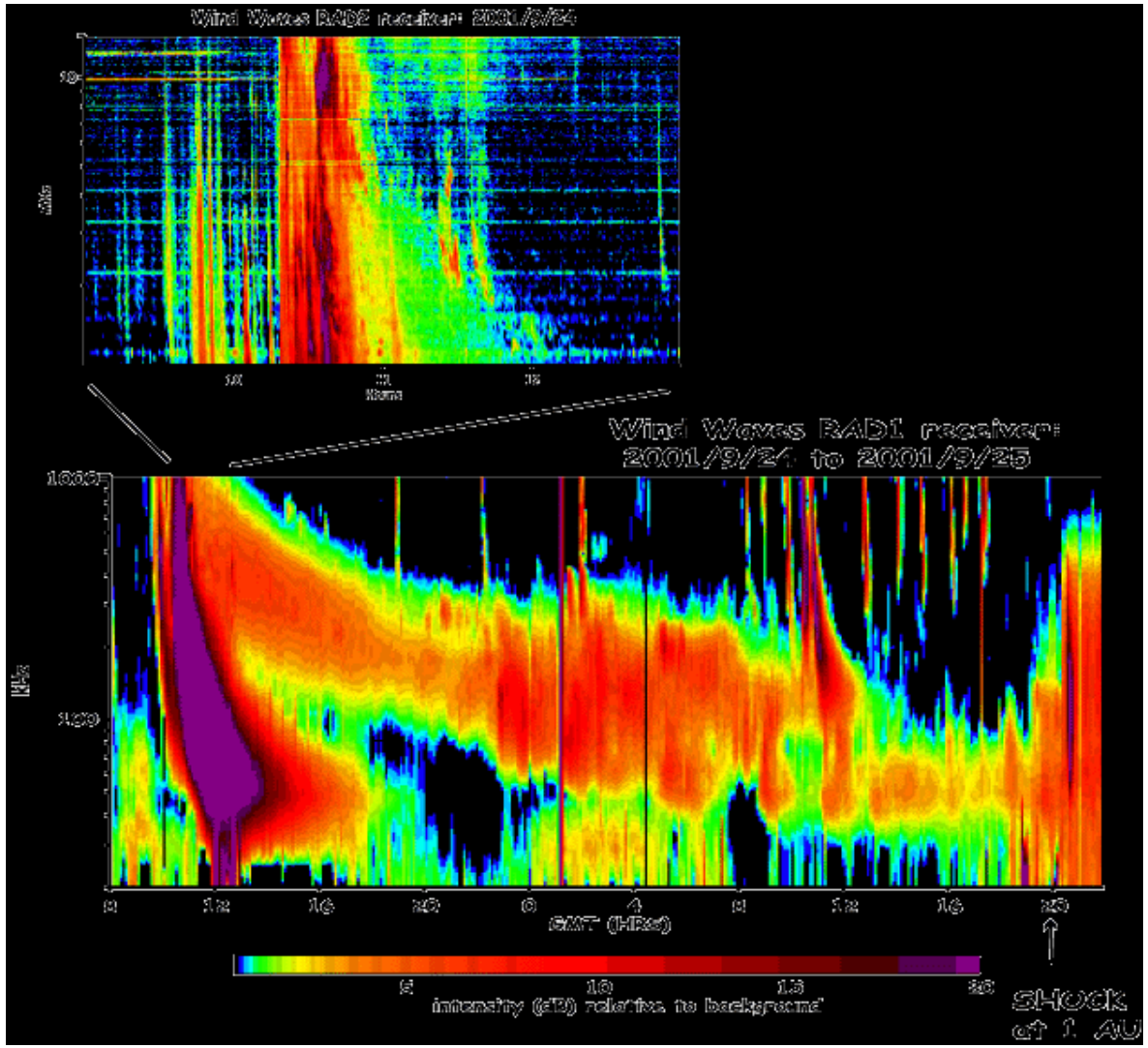
The lowest limit imposed by the Ionosphere is **~ 20** MHz

For lower frequencies is necessary!

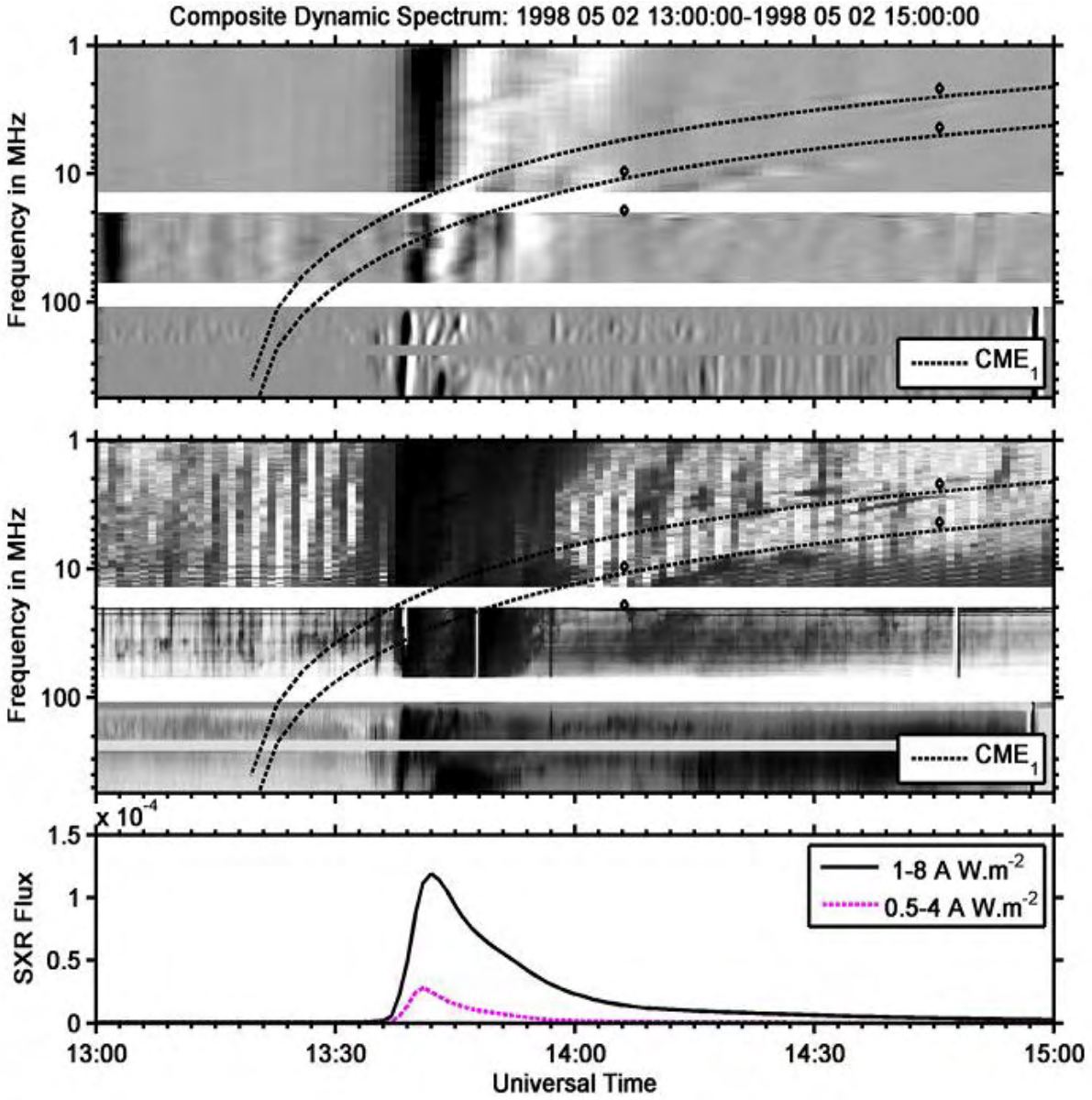
- Space Born Radiospectrograph

WIND-WAVES: The Radio and Plasma Wave Investigation on the WIND Spacecraft





Artemis/JLS and Wind/WAVES Composite Spectrum



02 May 1998 event. Top panel: Wind/WAVES and ARTEMIS-IV differential spectrum. Middle panel: dynamic spectrum. The associated CME trajectory overlaid on the spectra.

Bottom panel: the profiles of GOES SXR 1-8 Å (solid black line) and 0.5-4 Å

NRH Nançay Radioheliograph (NRH)

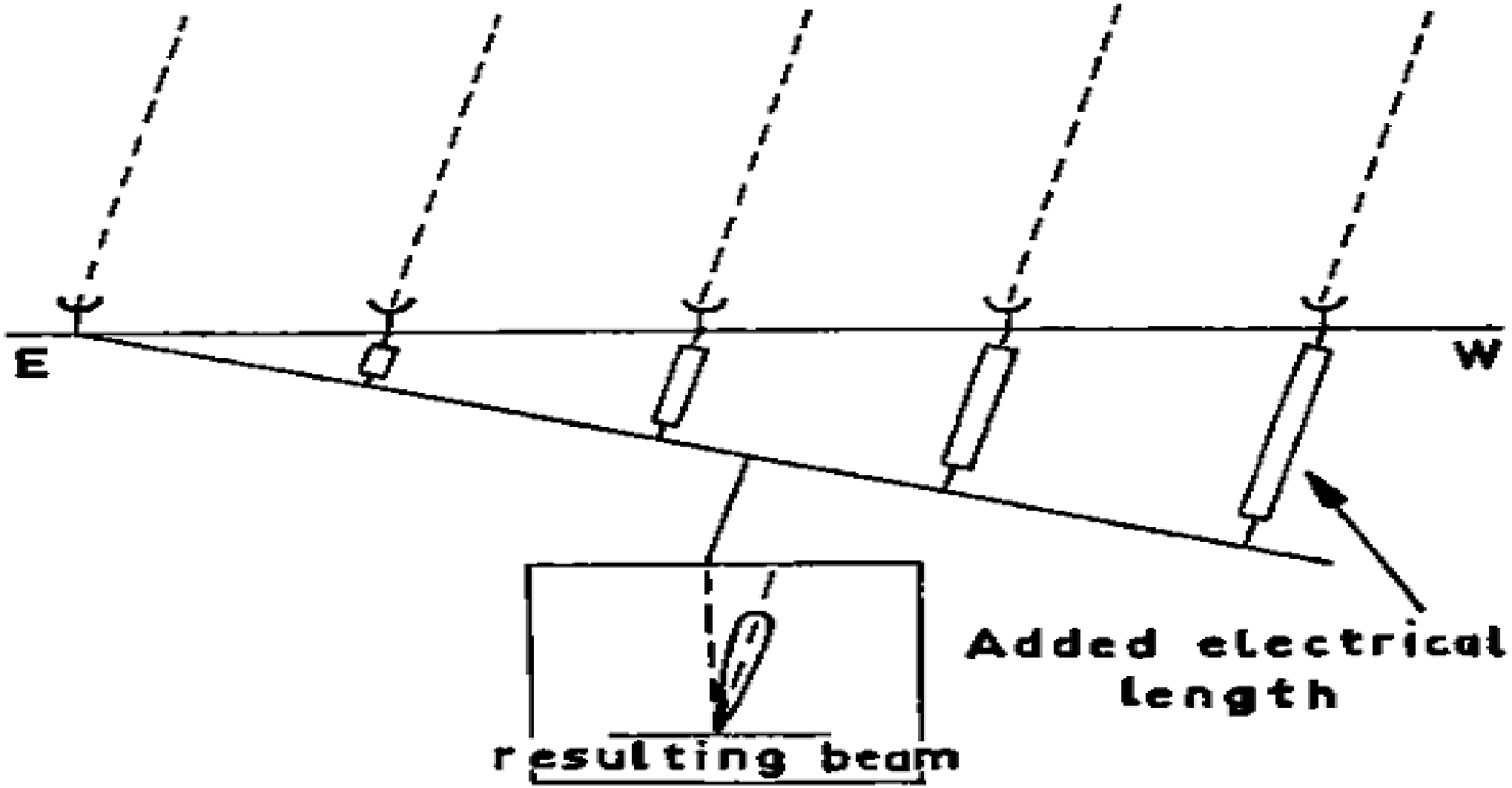
What is the Radioheliograph of the Nançay Radio Observatory?

The heliograph is an interferometer made up of equatorially mounted antennas of ~5 m diameter. 19 antennas are located on an east–west baseline 3.2 km long, 25 antennas are on a north-south baseline 2.5 km long. The instrument produces images of the corona in the **frequency range 150 MHz to 450 MHz** (wavelengths of 2 m to 0.67 m).

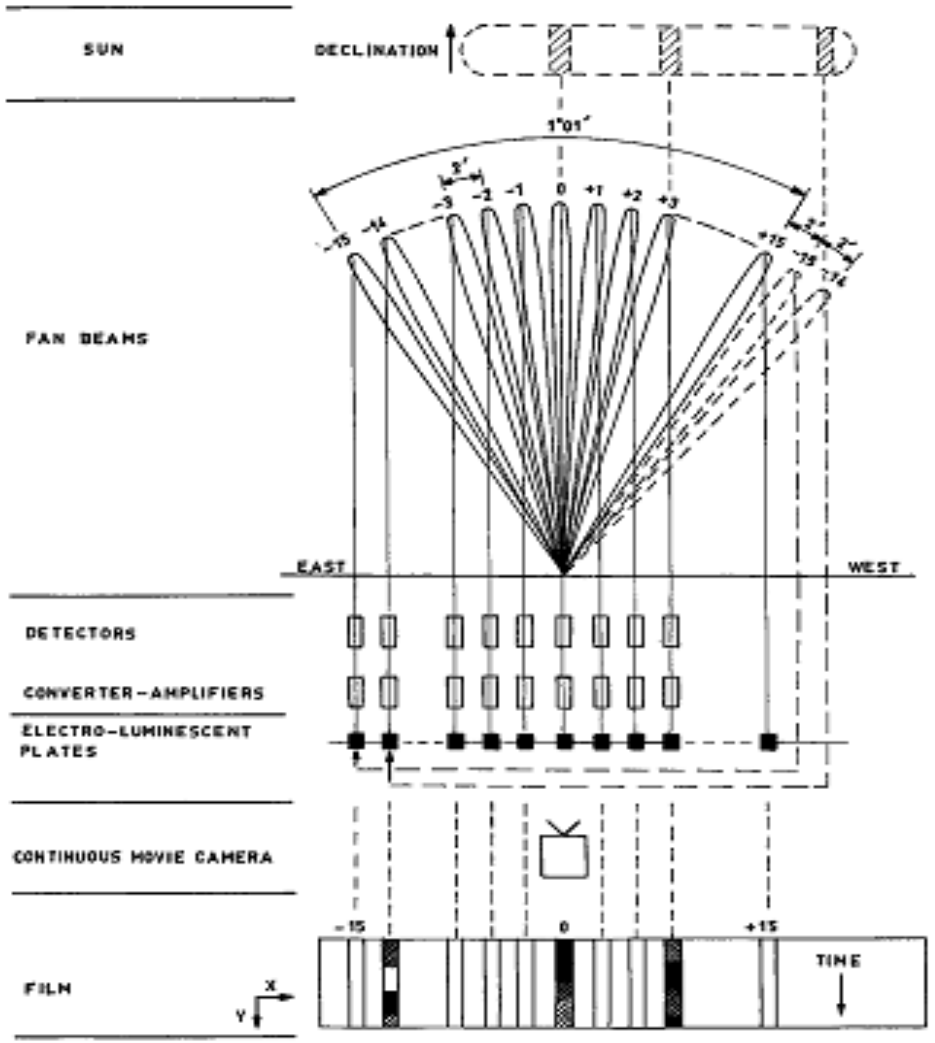
The angular resolution is then similar to that of the naked eye in visible light. Up to 200 images per second can be taken.

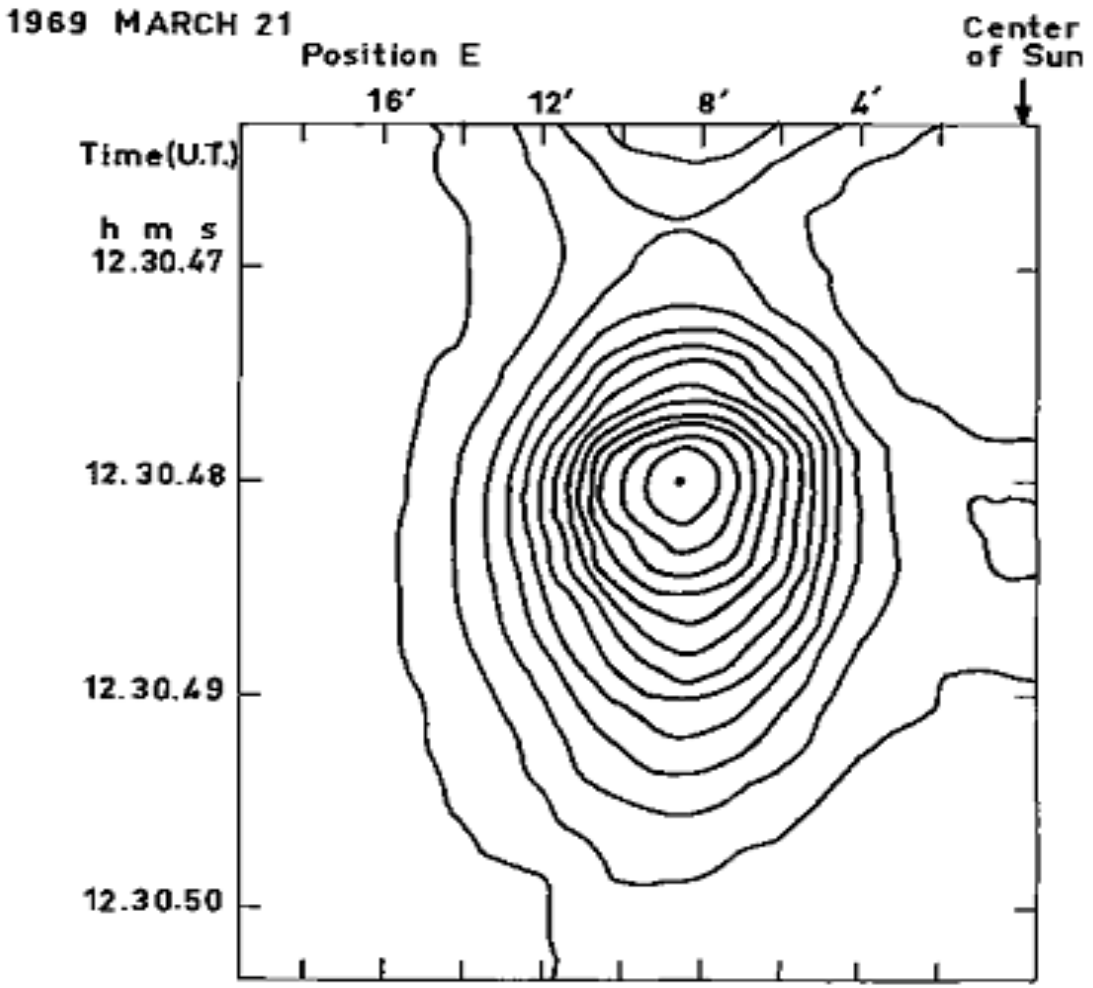
This allows the systematic study of the **quiet corona**, **solar flares** and **coronal mass ejections**

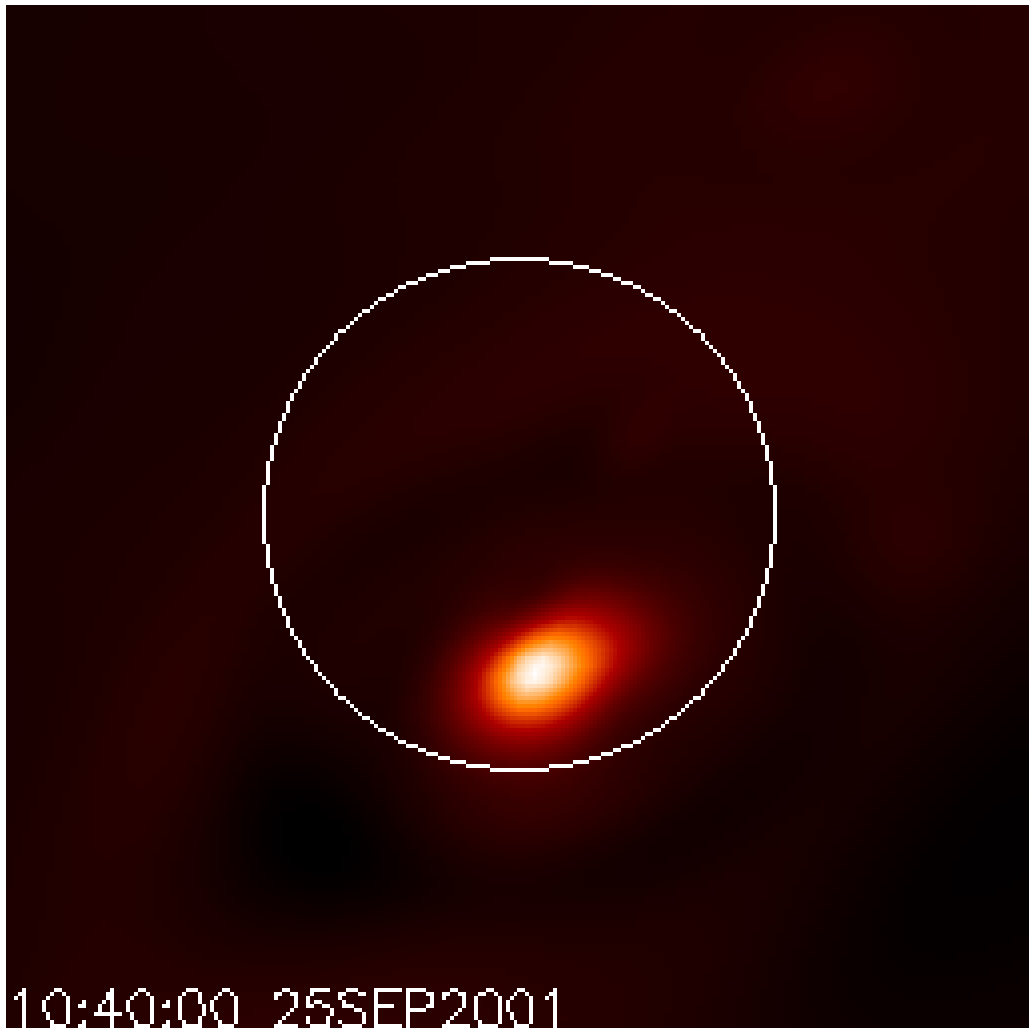
Principle of Pointing a Beam in a Desired Direction



Principle of the Radio Heliograph Operation

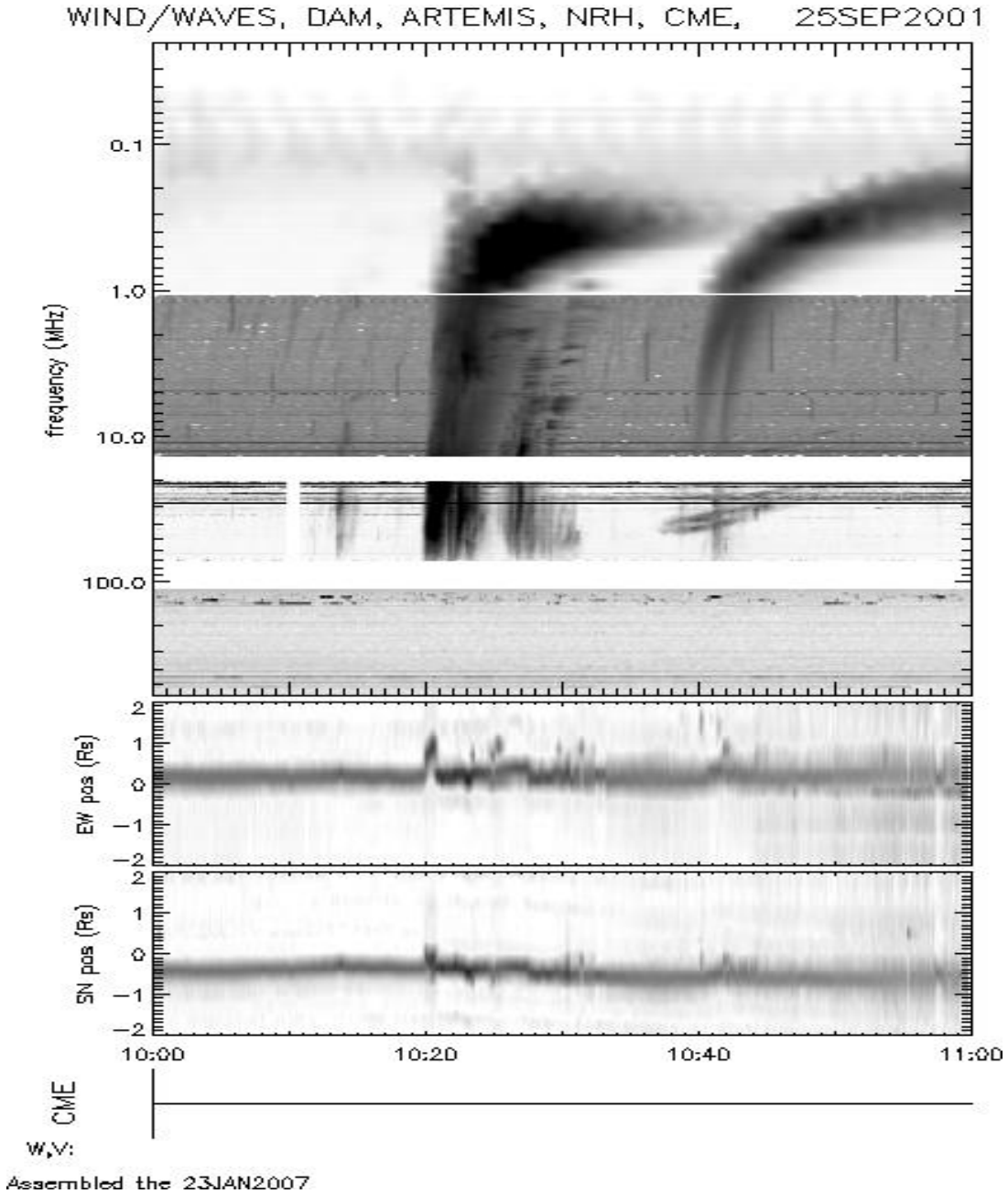


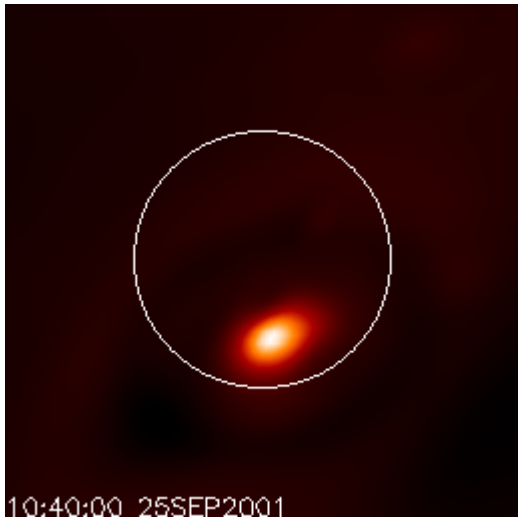


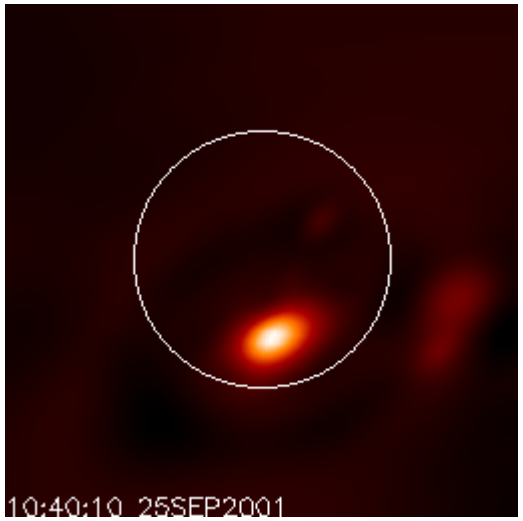


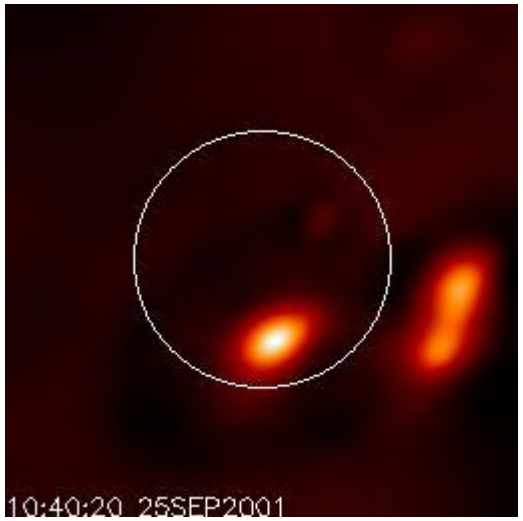
Combined Results in the East West-North South Direction

Combined Observations









Artemis-JLS (IV) spectra at 115--700 MHz at 13:33:30--13:53:30 UT. The lower panel shows the time derivative of the intensity. The Nançay imaging frequencies are marked on the left. A Number of Bursts are Marked (We will see these in detail in the Radio Bursts Class !!).