

Astronomy with LOFAR

Search for Extra-terrestrial Intelligence (SETI)



Are we alone ?

The idea that intelligent life might exist elsewhere in our galaxy and elsewhere in the Universe is an old one, dating back to at least the 16th century...



"Innumerable suns exist; innumerable earths revolve around these suns in a manner similar to the way the seven planets revolve around our sun. Living beings inhabit these worlds."

- Giordano Bruno, Italian monk of the sixteenth century.

Giordano was burned at the stake for his beliefs but now 400 years later, new radio telescopes like LOFAR will reach a level of sensitivity and sophistication where we can begin a realistic search for radio signals from other civilisations.

$$N = R_{\text{star}} \times f_p \times n_e \times f_i \times f_c \times L$$

The Drake Equation

Scientists estimate that there may be anywhere between 1 and 50 million observable civilisations in our own galaxy, the Milky Way. Even for astronomers, the uncertainty in this number is quite large!

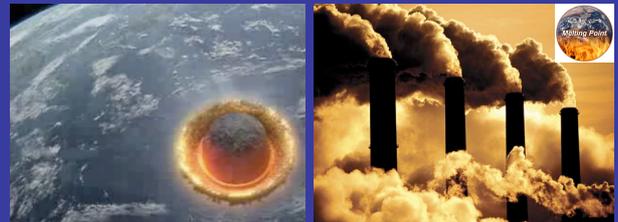
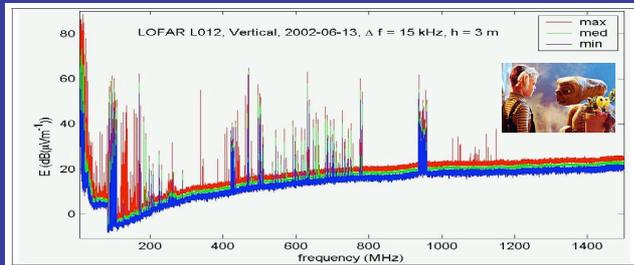
The famous Drake equation (see above) is used to estimate N, the number of observable civilisations, with the uncertainty in the other values increasing from left to right. The largest uncertainty is in "L", the average lifetime of a communicating civilisation. In the case of our own civilisation we have been observable to other civilisations since the dawn of Television broadcasts i.e. for about 50 years.

Below: Natural and man-made catastrophic events probably limit the typical lifetime of intelligent civilisations.

Detecting "leakage" radio signals from ET

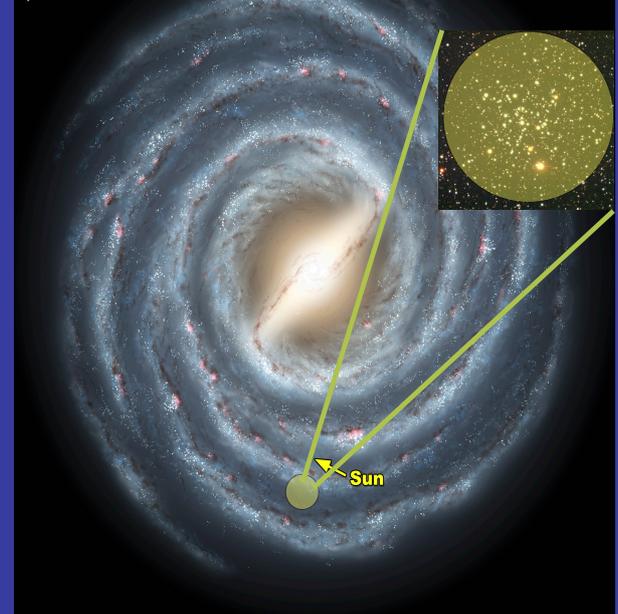
It seems likely that at least during some stage, all civilisations probably use radio waves to communicate. The most powerful radio transmitters on Earth include TV broadcasts, civil/military radar installations and ionospheric research facilities.

Left (below): A survey of man-made radio transmissions in the vicinity of the LOFAR telescope (courtesy Albert-Jan Boonstra - ASTRON). The most powerful man-made transmissions are made at relatively low-frequencies.



Intelligent life seems to have the property that it greatly modifies its environment, rather than adapts to it. Currently this is leading to large and perhaps irreversible changes to our planet's climate and given that we also now have the capability to destroy ourselves (via a global nuclear conflict) the value of L is considered very uncertain. Mass extinctions (due to, for example, asteroid impacts) are inevitable.

Below: LOFAR should be able to detect the most powerful military radars on Earth at a distance of ~ 300 light years; the volume probed would include about 100000 stars!



LOFAR

LOFAR has many qualities that may make it an excellent instrument with which to search for leakage radioation from other civilisations:

- (i) LOFAR operates at low-radio frequencies where (at least on Earth) artificial radio transmissions are most powerful
- (ii) LOFAR has a larger field-of-view than any other radio telescope, and can survey the many millions of stars that are required in order to have any reasonable chance of success,
- (iii) LOFAR is connected to one of the most powerful computers in the world - the IBM Blue-Gene - enabling thousands of narrow frequency channels to be surveyed simultaneously across a relatively wide frequency band.

