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URSI Commission J: Radio Astronomy

Solare Radiobursts:
Beobachtungen vom weltgrößten
Radioteleskop UTR-2 im Dekameter Wellenlängenbereich

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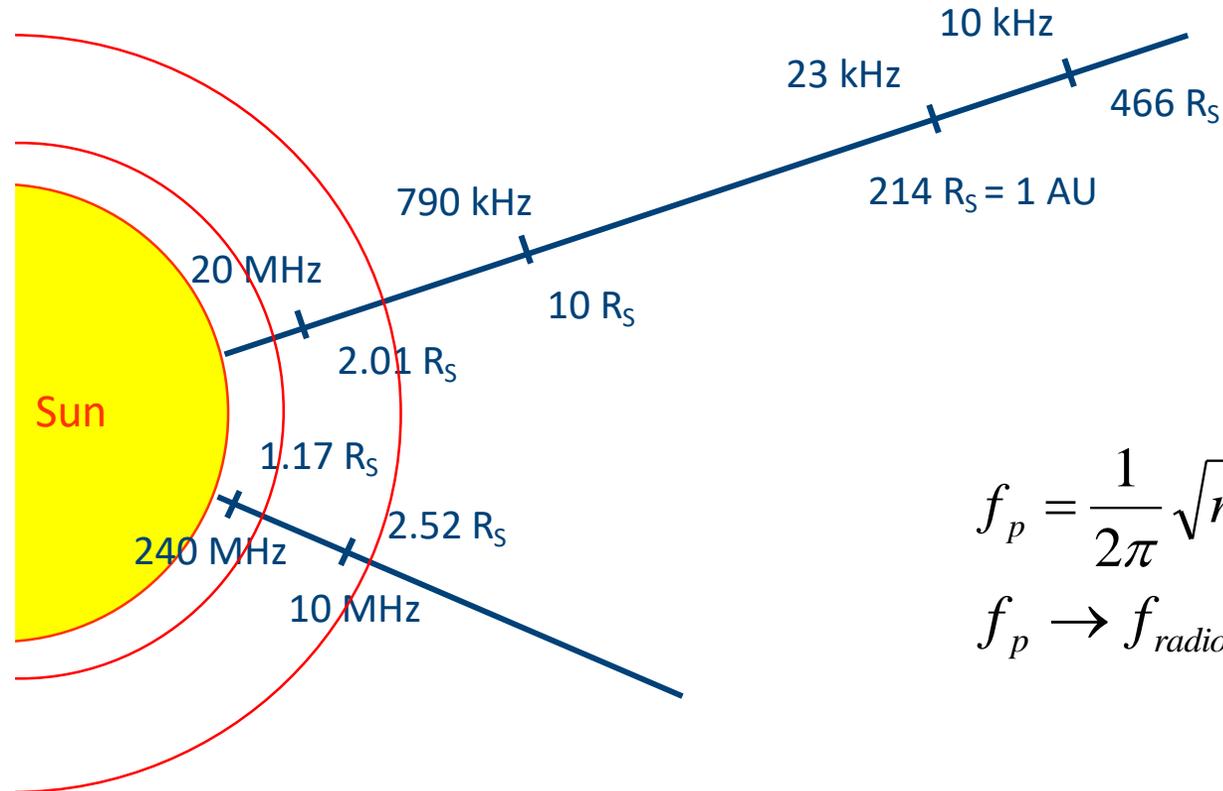


**The world's largest UTR-2 radio telescope (N-S arm, 1.9 km x 60 m)
Frequency range - 8... 32 MHz; number of elements - 2040;
effective area - 150,000 square meters.**

Low-frequency radio telescopes on the map of Ukraine



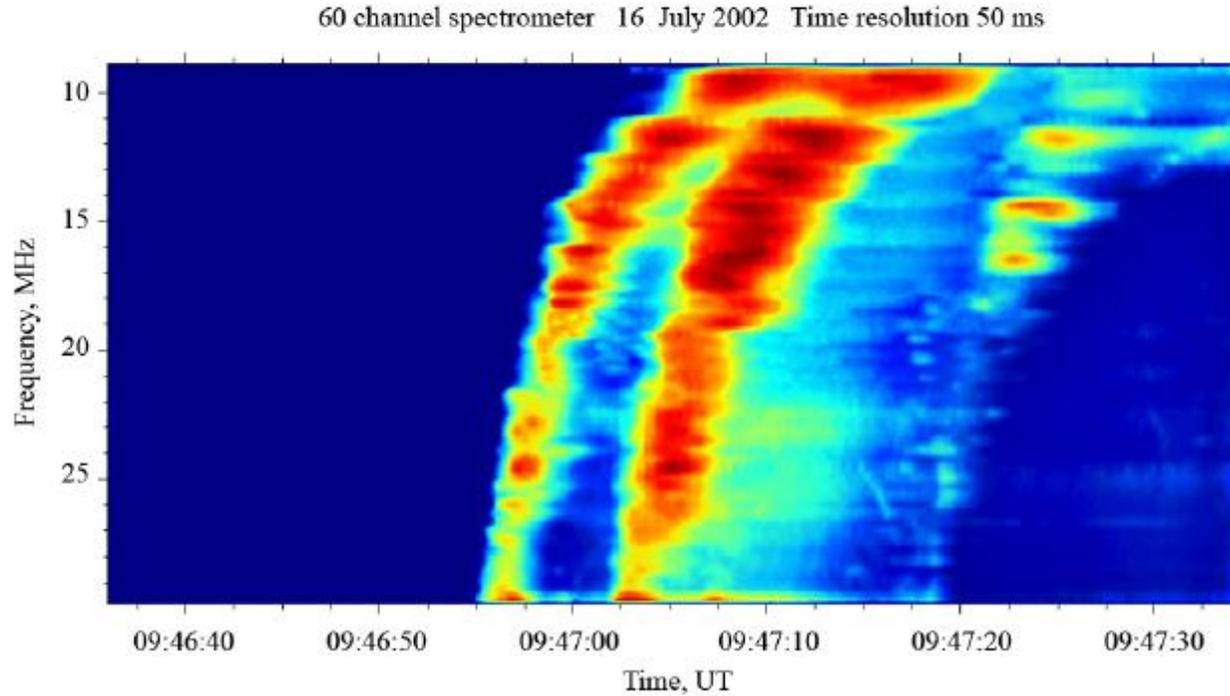
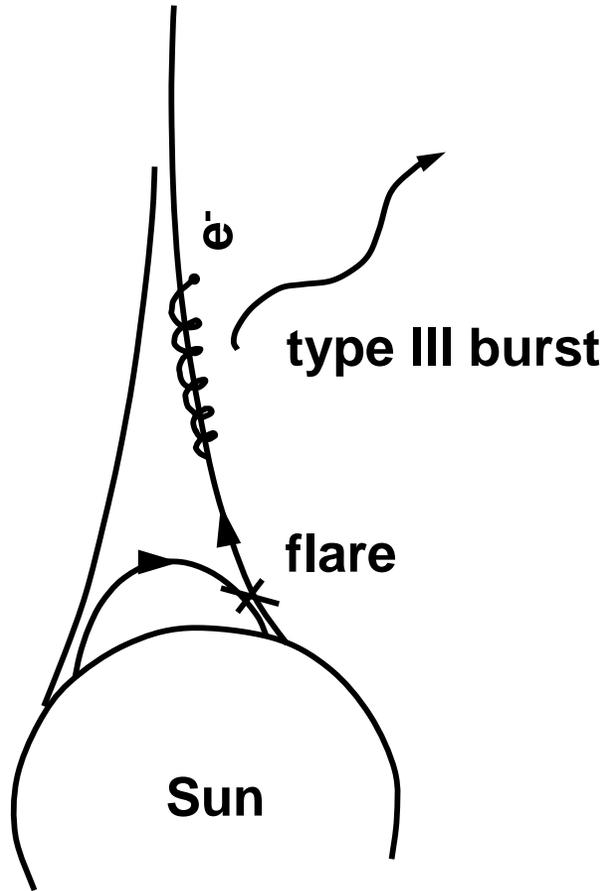
Coronal and Interplanetary Density Model



$$f_p = \frac{1}{2\pi} \sqrt{ne^2 / m\epsilon_0}$$

$$f_p \rightarrow f_{radio}$$

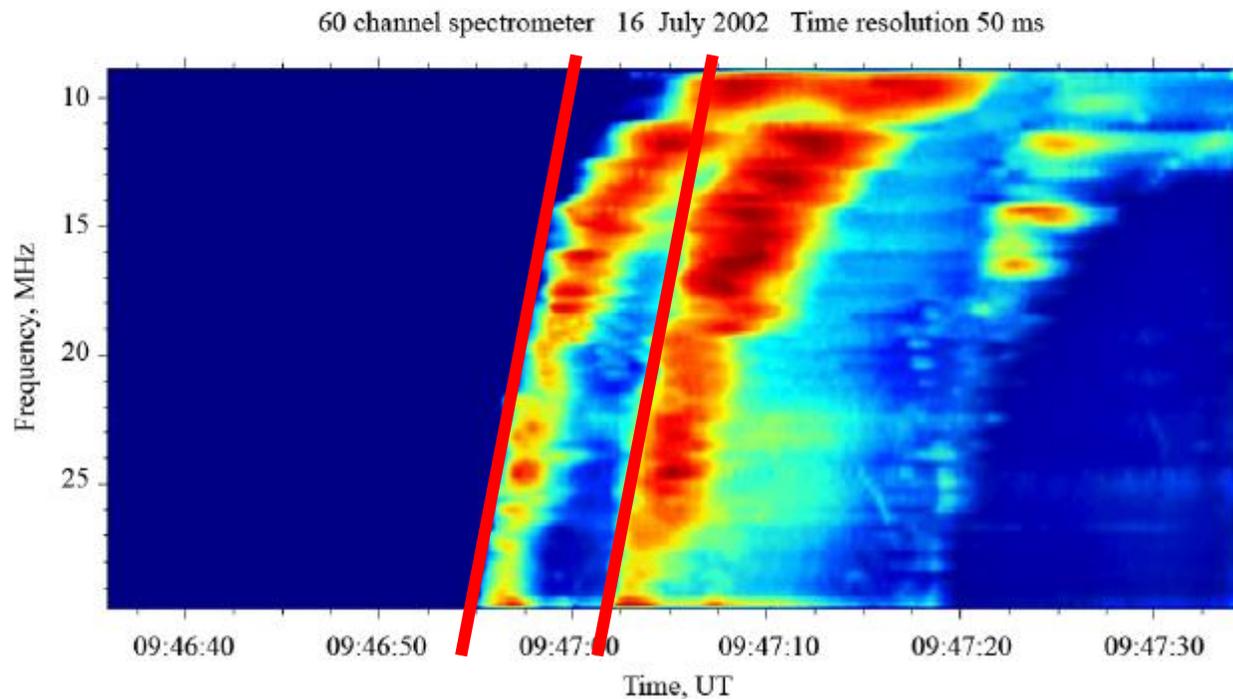
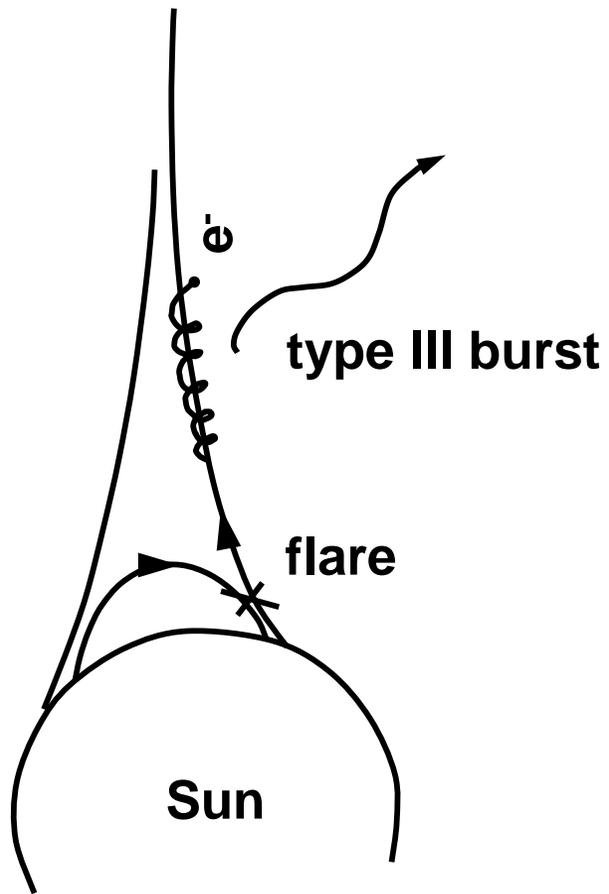
Type III bursts



Harmonic pair of two powerful Type III bursts observed on July 16, 2002.

Der Type III burst ist die Radio-Signatur eines Elektronenstrahles, welcher durch einen flare erzeugt wird. Die Propagierung erfolgt entlang von Magnetfeldlinien durch die Korona, Radiowellen werden emittiert.

Type III bursts

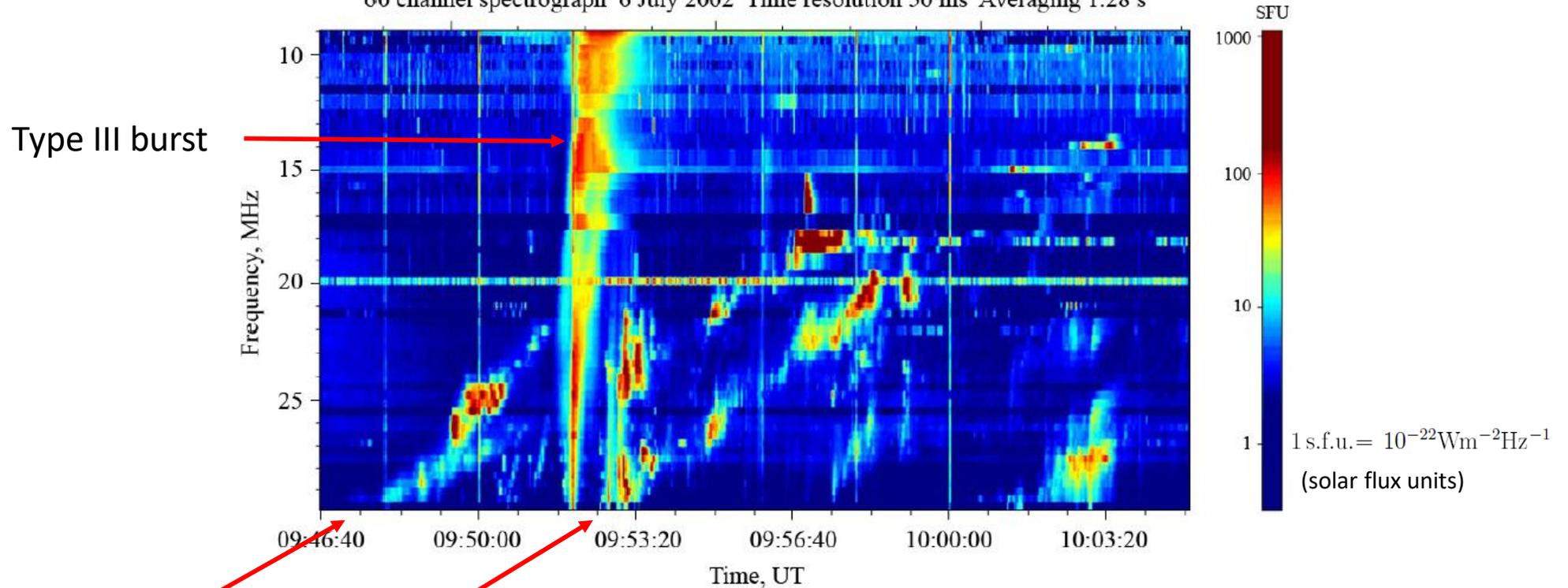


Harmonic pair of two powerful Type III bursts observed on July 16, 2002.

Drift rate: $D_f = \frac{df}{dt} = \frac{f}{2N} \frac{1}{dr} \frac{dN}{dr} V_{source} \longrightarrow V_{source} \sim 0,25 c$

Type II and Type III bursts

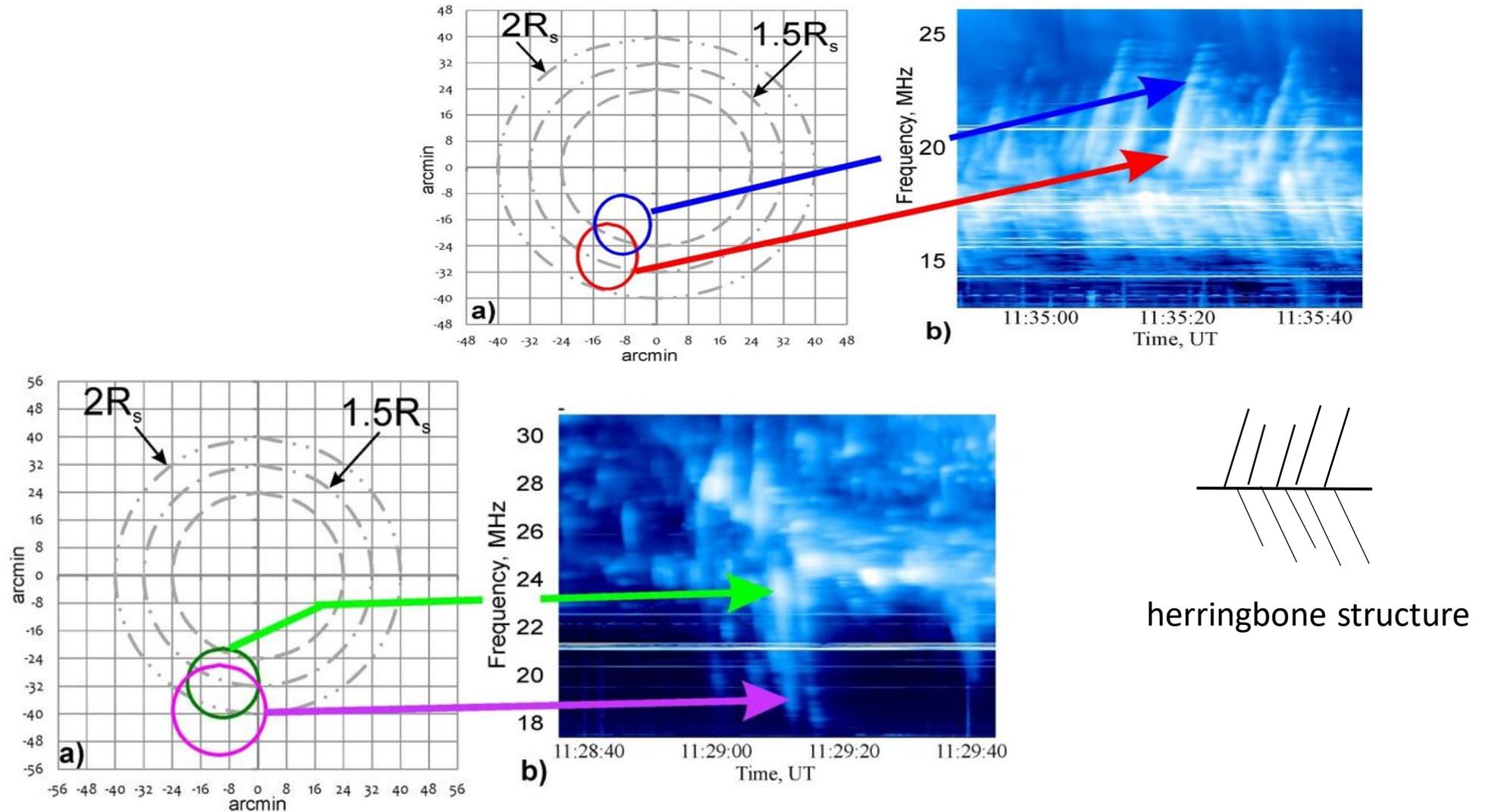
60 channel spectrograph 6 July 2002 Time resolution 50 ms Averaging 1.28 s



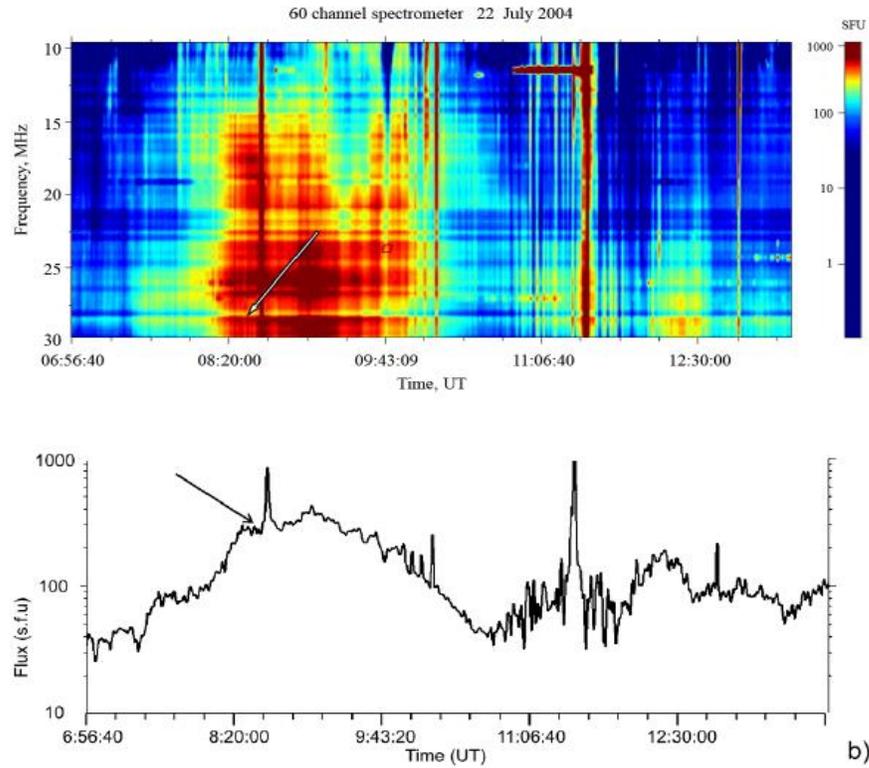
Type II burst with band splitting of fundamental and harmonic emission observed by the 60-channel spectrometer. At 09:52:00 UT a Type III burst is visible.

Flares und Coronal Mass Ejections (CMEs) verursachen Schockwellen in der Korona, in weiterer Folge werden Type II bursts erzeugt.

Interferometer observation of Type II burst with herringbone structure on 31 May 2013

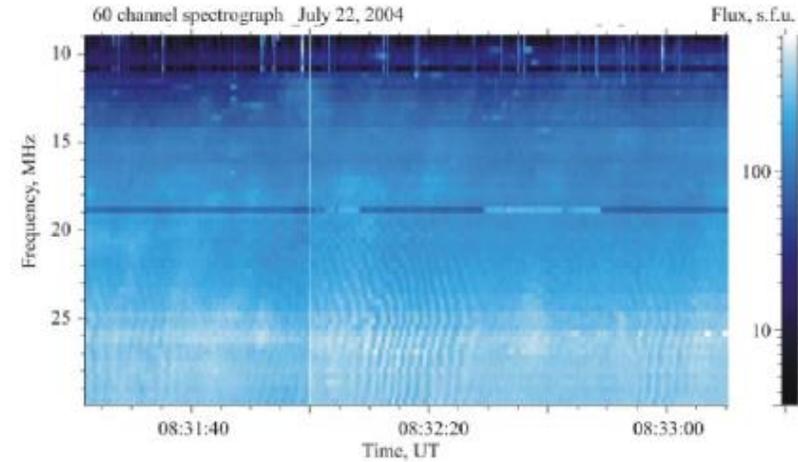


Type IV burst

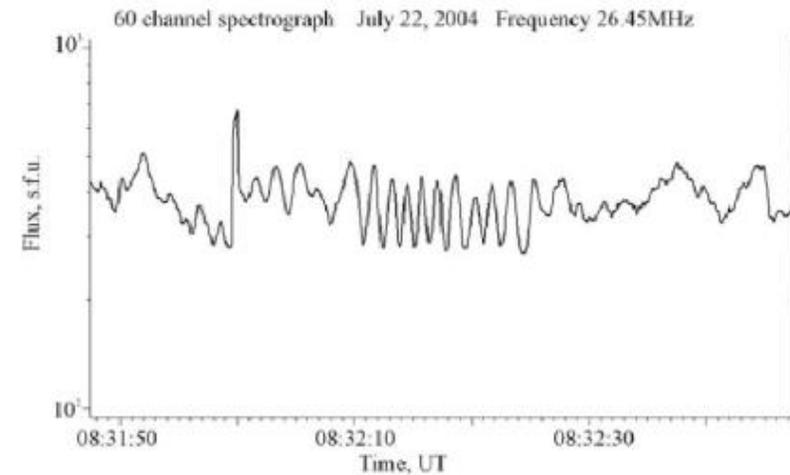


Dynamic spectrum of the Type IV burst on July 22, 2004, (top) and its time profile at 30 MHz (bottom). The time corresponding to the discussed ZP is marked with arrows.

Fingerprint fine structure („Zebra“ pattern)
(Zlotnik et al., Solar Phys., 2015)

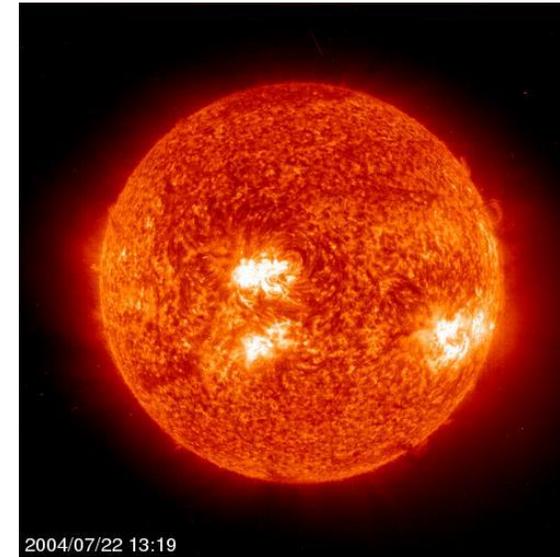
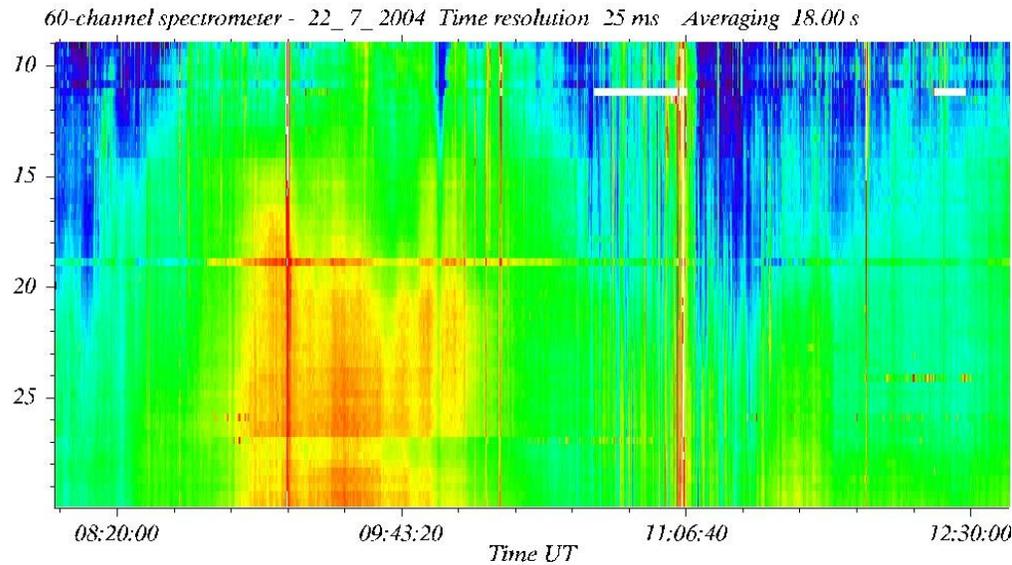


Three groups of zebra patterns.

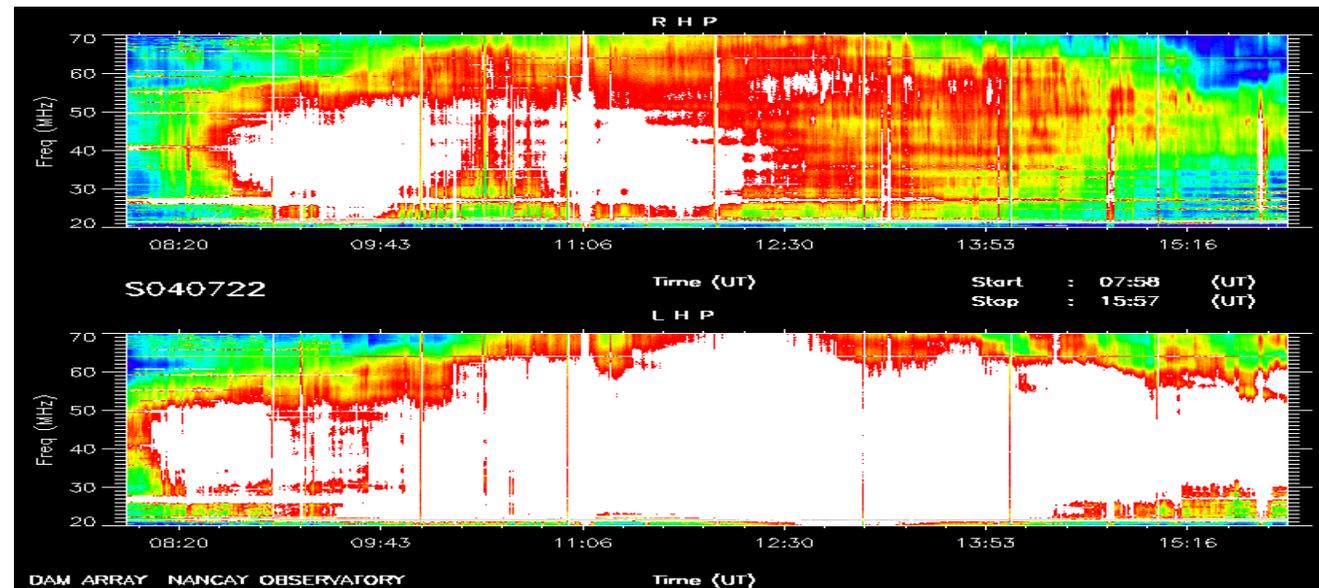


Type IV burst from the CME directed to the Earth

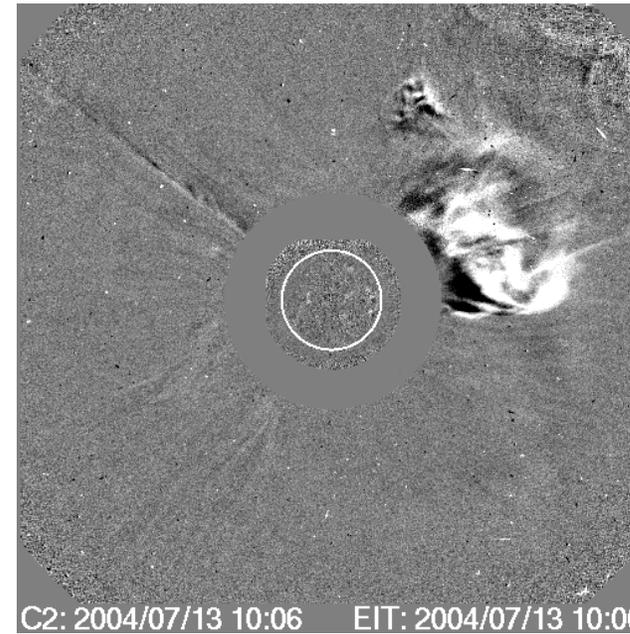
UTR-2 Kharkov
(Ukraine)



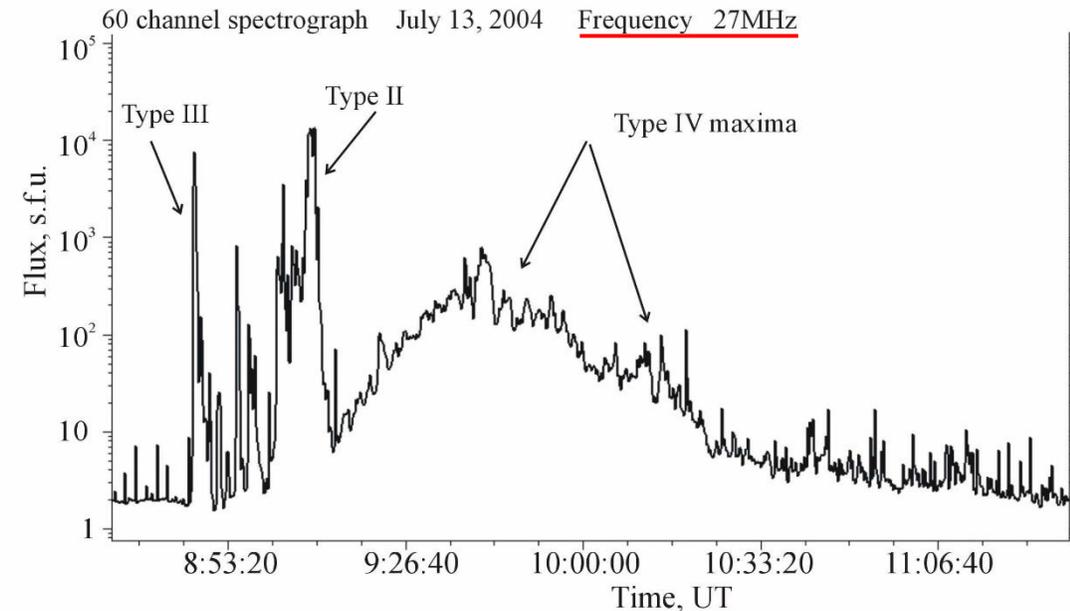
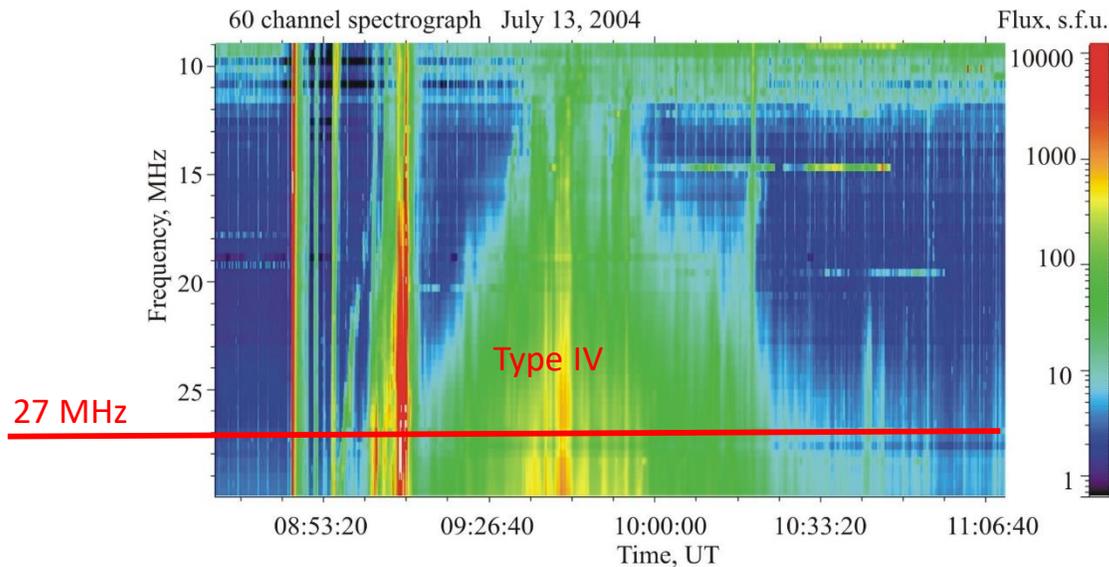
Nancay DAM Array
(Frankreich)



Quell-Region
(source region)
des Type IV bursts
im „core“-Bereich
des CME



EIT:
SOHO Extreme
Ultraviolet Imaging
Telescope



- **Solare Radiostrahlung wird aus der solaren Korona emittiert.**
- **Die nichtthermische Radiostrahlung wird durch energetische “electron beams” generiert, die während solarer flares gebildet werden.**
- **Energiereiche Elektronen werden in magnetischen “reconnection”-Regionen und an Schockwellen (z.B. an der Front von CMEs) bzw. im Kerngebiet von CMEs erzeugt.**
- **Plasma-Oszillationen mit der Plasmafrequenz werden transformiert in (EM-)Radiowellen**
- **„Solar bursts“ treten in verschiedenen Erscheinungsformen auf: Type-II, -III, -IV, -V**