Flaring stars & space environment

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Decameter regime

10 - 80 MHZ (~1.2 - 2 $R_\odot$)

Flux measurements —> Tb >> thermal values

Emissions from non thermal origin

Plasma waves
Electron dynamics
(bump-on-tail, electron-maser cyclotron)

Polarization / Cyclotron emission —> B Norm

Ideally, Full B components at coronal level

Magnetic reconnection
Filaments disruption
data-driven models for space weather

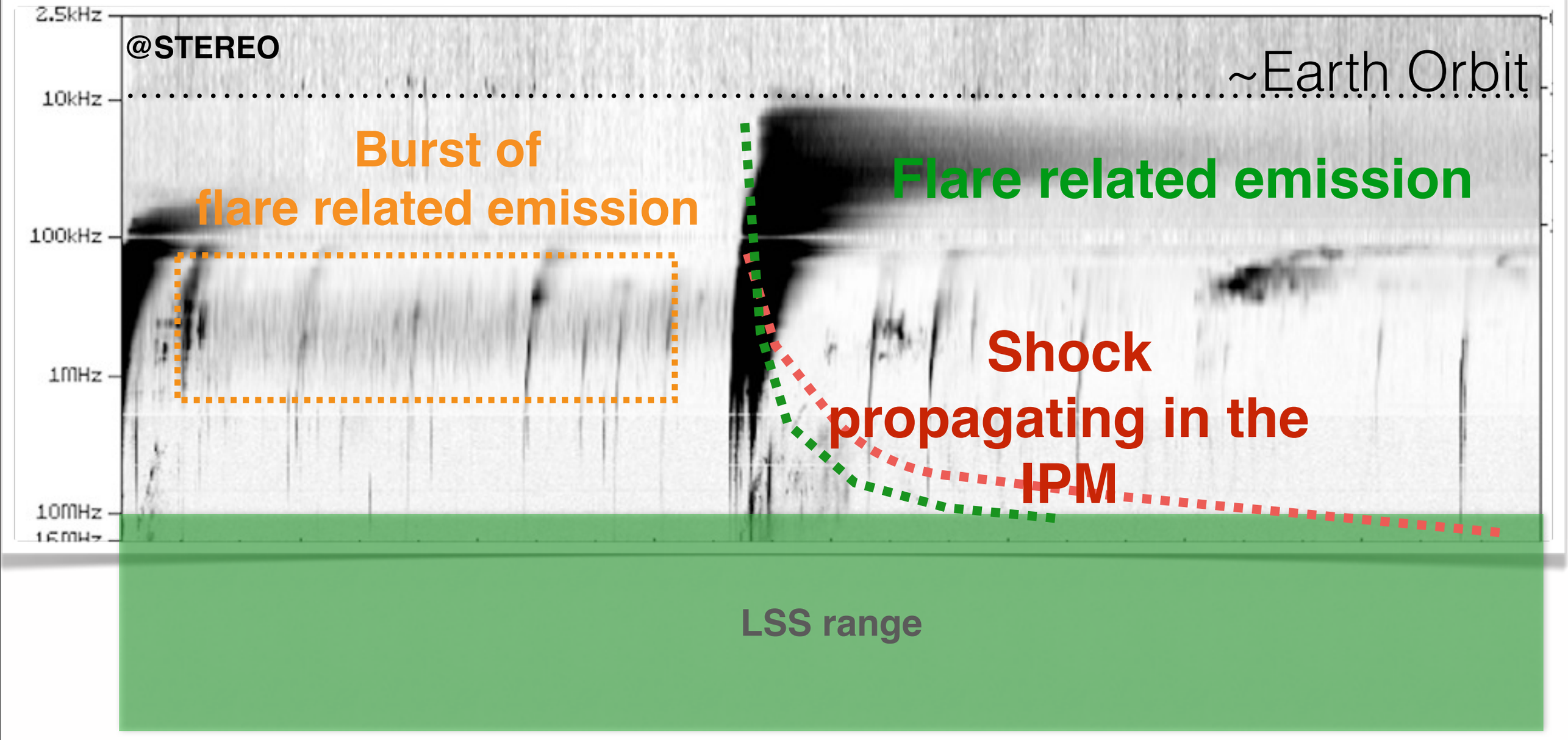
Time-Frequency Drift

Mass ejection
Shock propagation

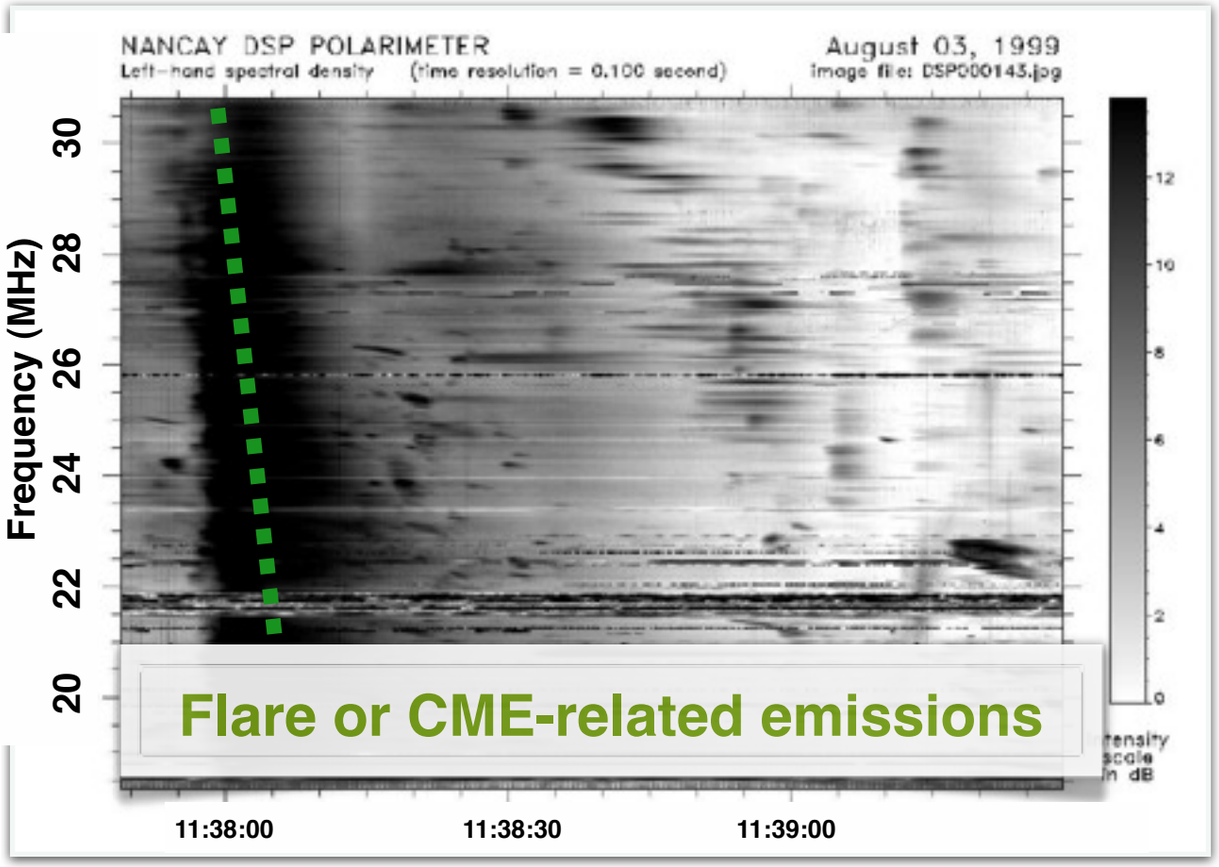
IPM dynamics around stars

Sun experience

Radio emissions witness energy release in the corona and IPM. Sometimes no counterpart in other wavelengths



Wealth of detail



Faint drifting emissions

Independent of large flare/CME

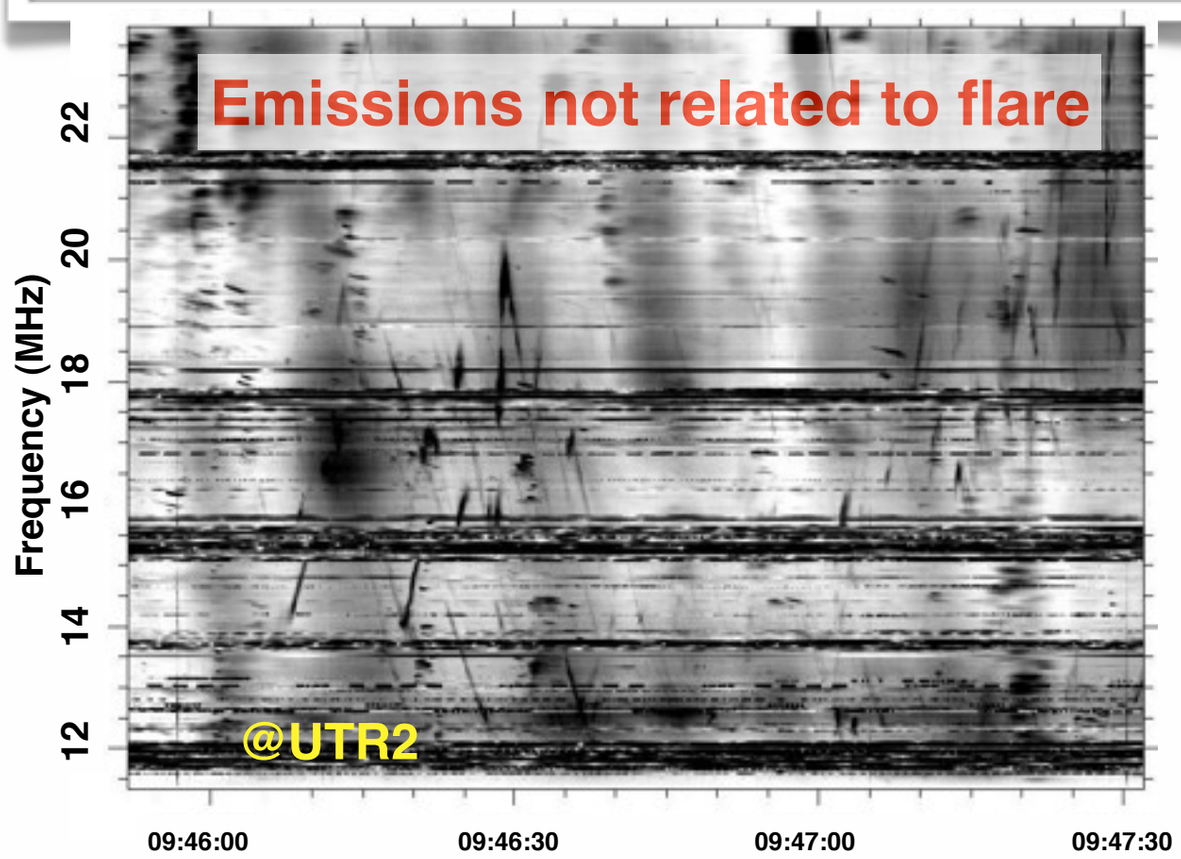
-> Local heating (Briand et al. 2007, 2008)

Emission drifts

-> *Sign*: Direction (inwards or outwards from the Sun) of electrons

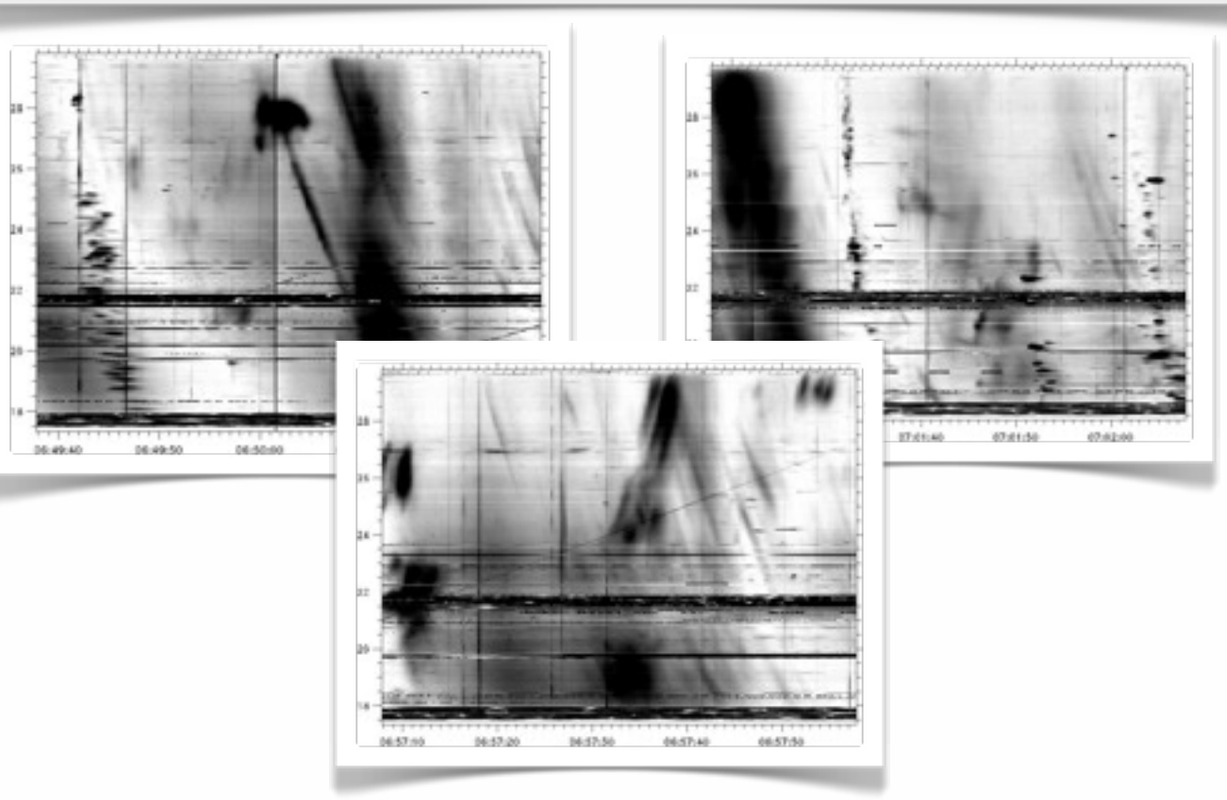
-> *Drift value*: Velocity of the electron beams (Briand et al. 2008)

-> *Change of sign*: Local fluctuations of T in the corona ? (Melnik et al. 2008, 2014)

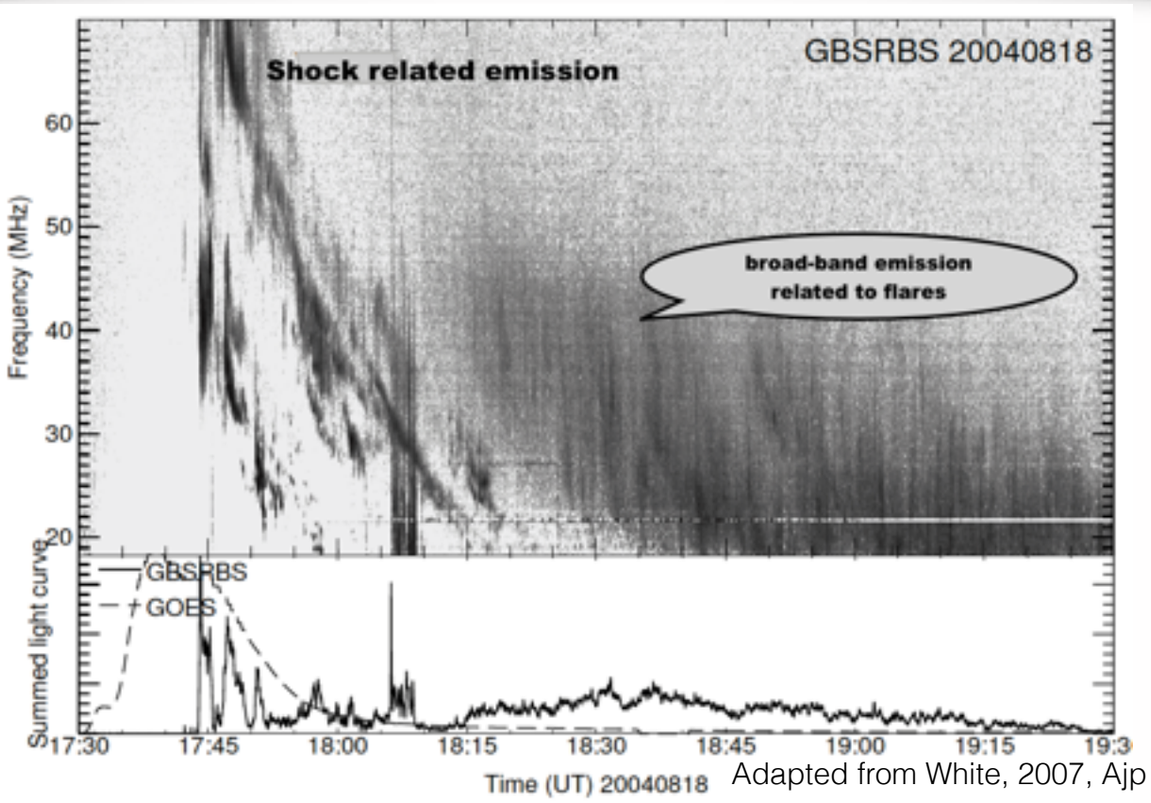


Still faint emissions at « low » frequencies

may narrow band emissions not understood



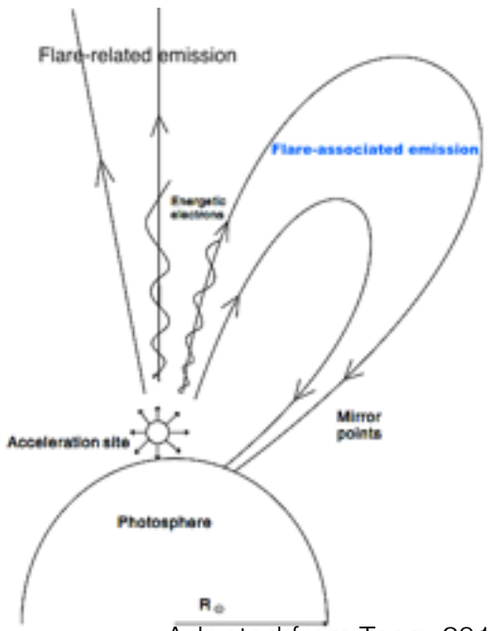
and also from continuum and broad band emissions



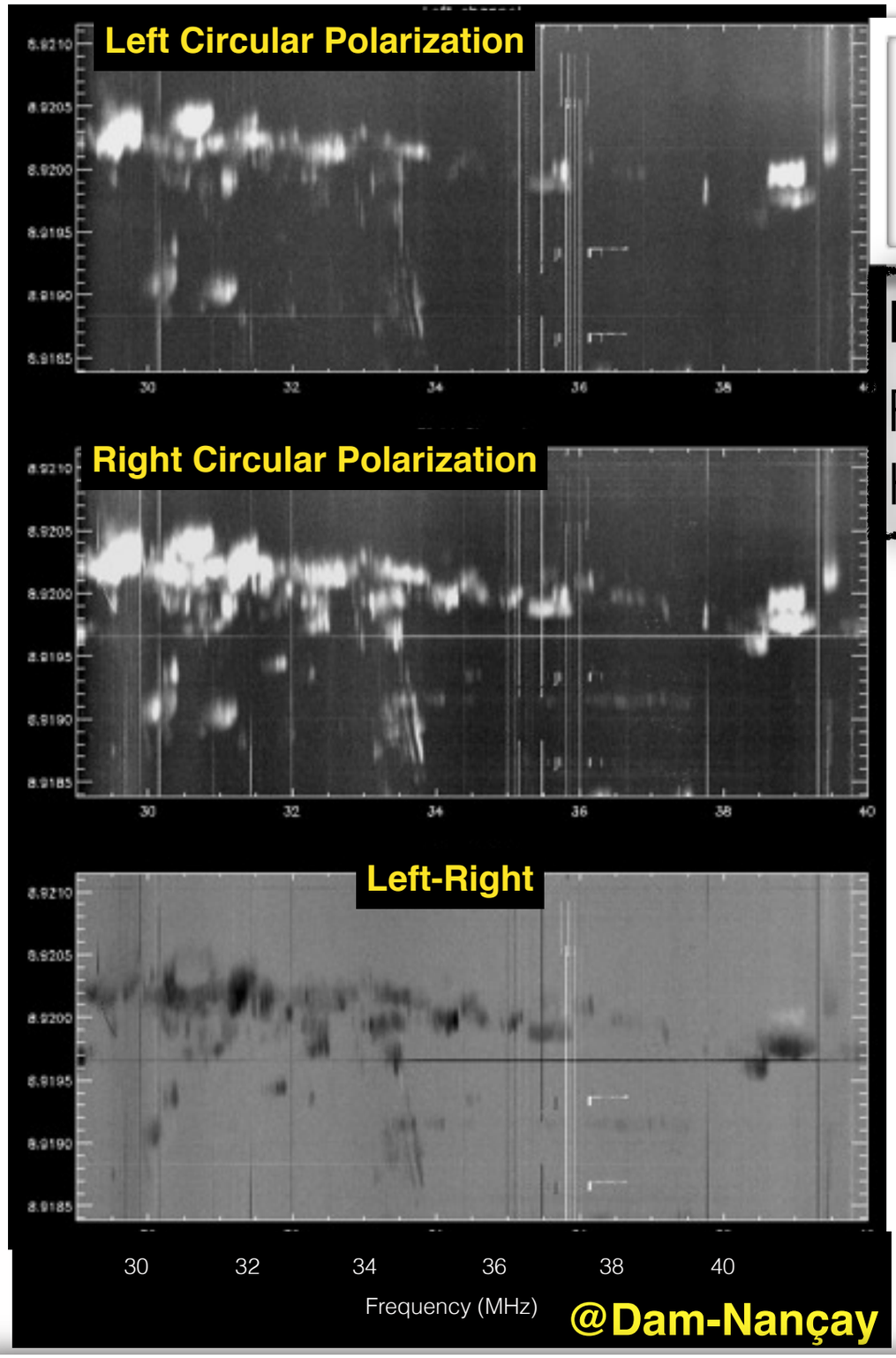
Adapted from White, 2007, Ajp

Continuum - < 120MHz
Follow Flare-Related Emission
low polarization

Electron maser cyclotron ?
Diag. of B field direction ?



Adapted from Tang, 2013, ApJ



Polarization: a key to determine the physical processes at play

Flare related emissions	CME related emissions
Fund. :~50% circular polarization	Fund. :<5% circular polarization
Harm.: <15%	Harm. < Fund.

Other narrow band / faint structures: from 0 to 100% circ. Polarization

ES ->EM mode conversion: polarization can reveal density gradient and/or B variation

Local electron maser cyclotron ?

High spatial, spectral and time resolution together with polarization measurements & high sensitivity

Stellar Activity (decameter range)

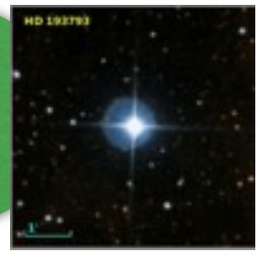
Flares

- **Herbig Ae T Tauri** → Young stars
  interaction with the proto-planetary disk

  one key pb: detection of B
- **Red Dwarfs** → Fully convective stars
  Magnetic field generated and leads to magnetic reconnection

Shocks

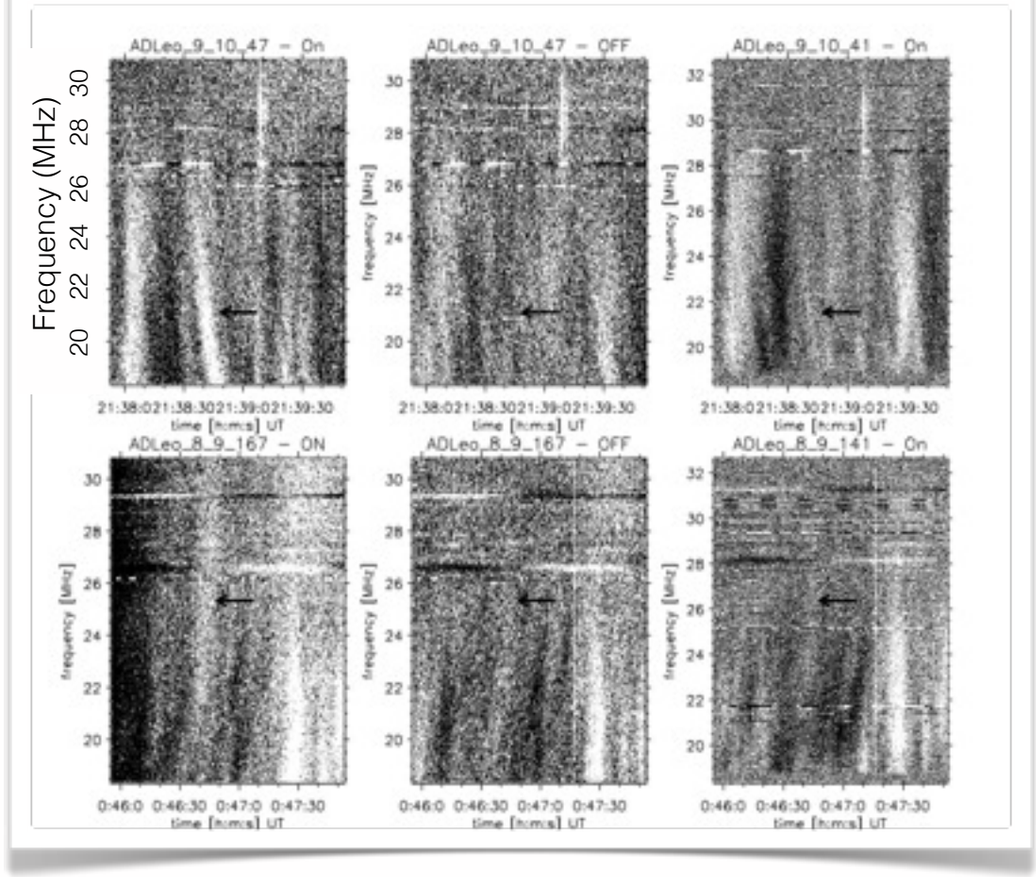
- **Binary Stars** → High Mass stars
  Strong stellar winds
  Produce shocks (X-ray and synchrotron)



Red Dwarf Stars

- Lower part of the Main sequence
- ~80 stars known (2012), half within 10pc
- Coll (Teff~3500k) and small (R< Rs), L~0.1Ls
- Archetype: UV Cet (Others : **AD Leo, EV Lac**)
- Represent 75% of the Milky Way stars !

- First observations in the decameter range 1985



Leitzinger et al. 2010, ‘Central Europe Astrophys. Bulletin

UTR-2 Ukranian RadioTelescope

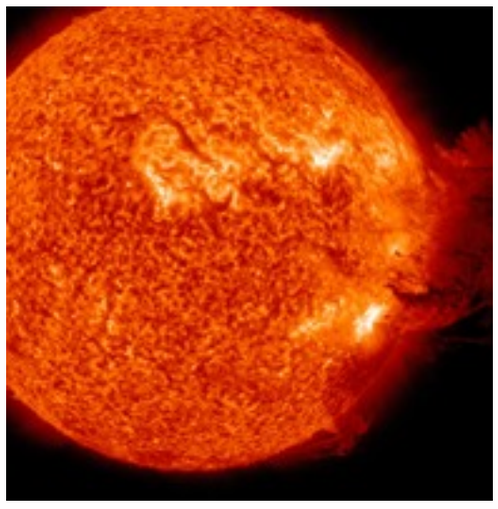
~1 flare / 2-3 hours
To be combined with higher frequency range observations
Circular Polarization: yes at higher freq.

Conclusions

Solar observations

- Require higher sensitivity together with polarimetric measurements

- Diagnostic of the density, magnetic field structure of the corona -> region of launch of active phenomena



Active stars

- Still a lot to do ! ADS : Star / Flare / Radio /Decameter —> 21 referred papers …

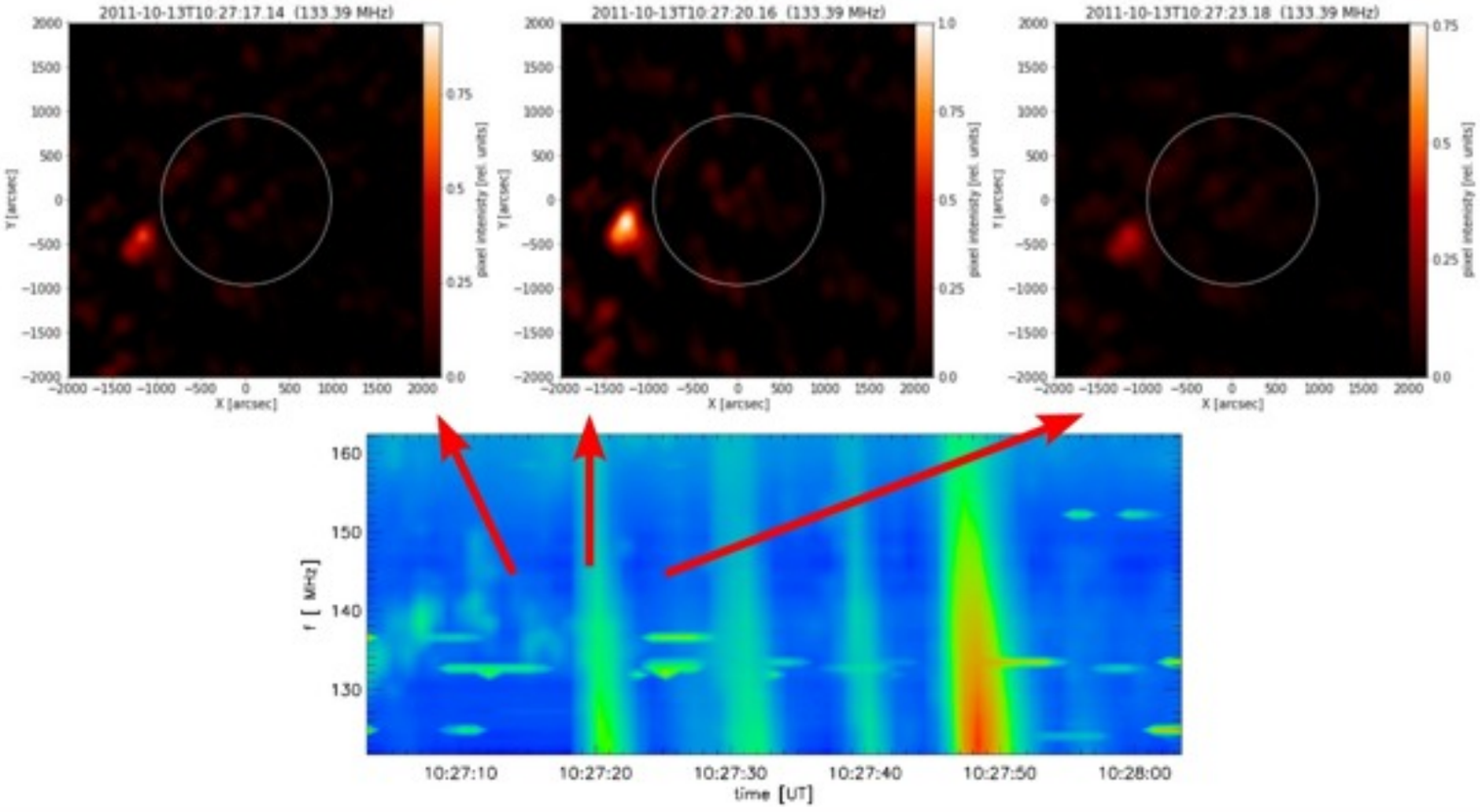
- Require high sensitivity + survey modes (few flares)

NEnuPHAR to push towards new simulations and laboratory experiments

- **Simulations of radio emissions**
  - Shock (Schmidt & Cairns 2013)
  - Flare related emission (Li & Cairns 2008-2013)

- **Laboratory experiments**
  - Laser -> better understand ES to EM conversion processes (Briand & Riconda, in prep.)
  - Electron gun to feed electromagnet -> electron-maser cyclotron (Bingham et al. 2013)

Images



Complementary diagnostic capabilities between f-t diagram and images

+ polarization measurements !