Flaring stars & space environment

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Decameter regime
10 - 80 MHz (~1.2 - 2 R☉)

- 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

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Sun experience

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

**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)

**Flare or CME-related emissions**

**Faint drifting emissions**

Independent of large flare/CME

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

**Emissions not related to flare**

Still faint emissions at « low » frequencies
Continuum - < 120MHz
Follow Flare-Related Emission
low polarization

Electron maser cyclotron ?
Diag. of B field direction ?
Polarization: a key to determine the physical processes at play

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

CME related emissions
- Fund. : <5% circular polarization
- 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
- Red Dwarfs

**Shocks**
- Binary Stars

Young stars interaction with the proto-planetary disk

one key pb: detection of B

Fully convective stars
- Magnetic field generated and leads to magnetic reconnection

High Mass stars
- Strong stellar winds
- Produce shocks (X-ray and synchrotron)

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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


~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 \( \rightarrow \) region of launch of active phenomena

Active stars

- Still a lot to do!  
  ADS: Star / Flare / Radio / Decameter \( \rightarrow \) 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!