26 ans d'observations décamétriques de Jupiter à Nançay : une base de données, des résultats

26 years of decameter observations of Jupiter in Nançay : database and results

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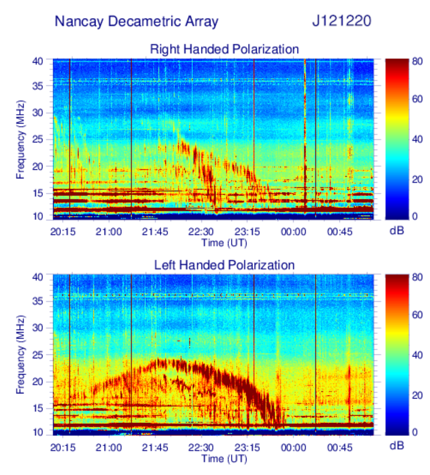
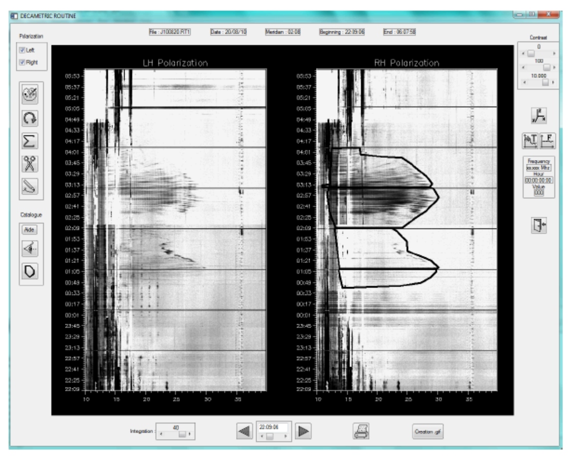
Building the database

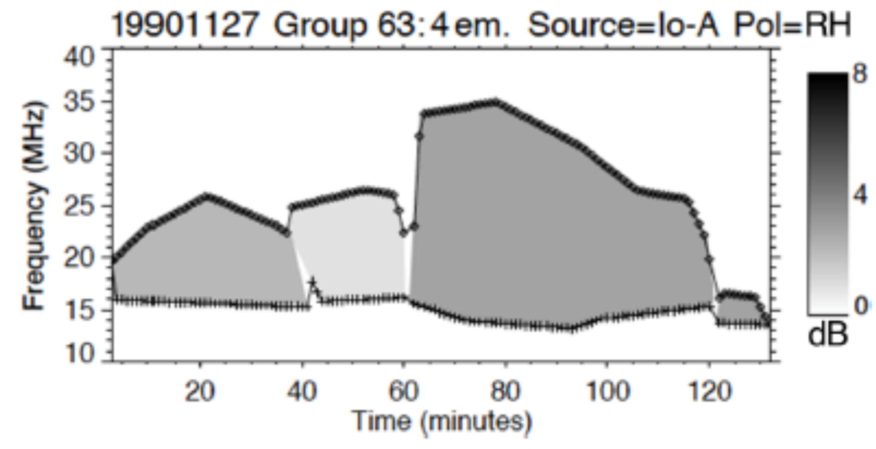
- Daily dynamic spectra at the Nançay Decameter Array (NDA)
- >8100 observations studied over 26 years → >6200 emissions catalogued, according to careful criteria (6 months in front of the screen !)
- emission parameters (polar, type, intensity, f_{min} & $f_{max}(t)$ at 1-min. resolution)
- ephemeris of observer and satellites computed over 26 years at 1-min. resolution → database



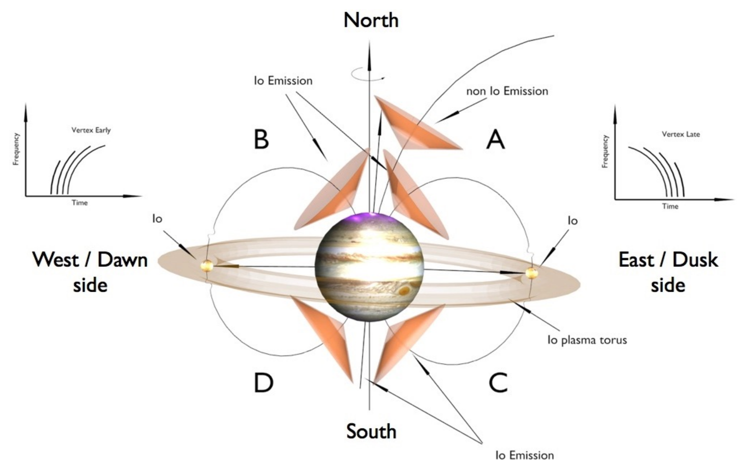
Routine dynamic spectra from NDA



Computer-Aided selection of emissions + type selection



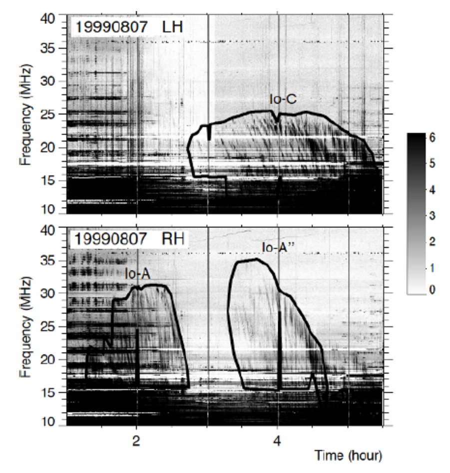
Post-processing of emissions regions: polar, intensity, f_{min} & $f_{max}(t)$ at 1-min. res.



Emission types and radio arc vertex

Table 1. Criteria adopted in this work for cataloguing each emission type.

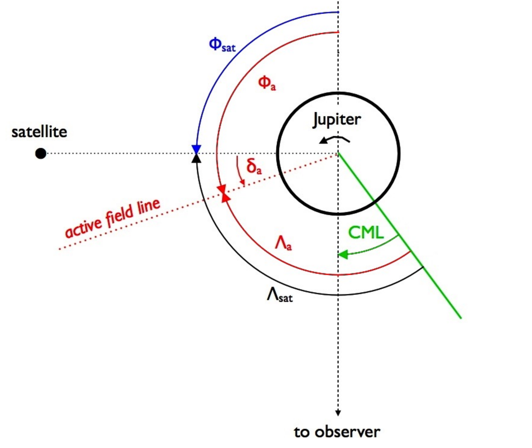
Emission type	Arc curvature (vertex)	Dominant circular polarization	Maximum frequency (MHz)
Io-A	late	RH	38
Io-A′	late	RH	28
Io-B	early	RH	40
Io-C	late	LH	30
Io-D	early	LH	30
non-Io-A	late	RH	38
non-Io-B	early	RH	38
non-Io-C	late	LH	32
non-Io-D	early	LH	29



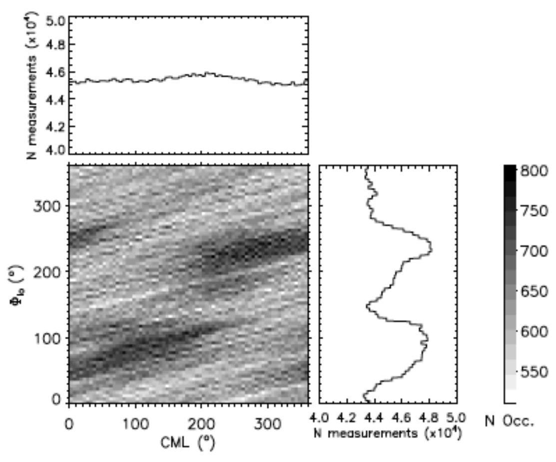
Emission contours and types on dynamic spectra

First results

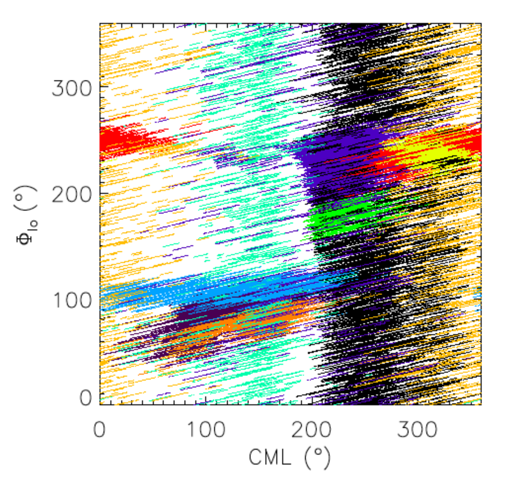
- CML-Φ_{Io} distribution of emissions, component per component
- Statistics on emission Intensity, Duration, Maximum frequency, Circular polarization



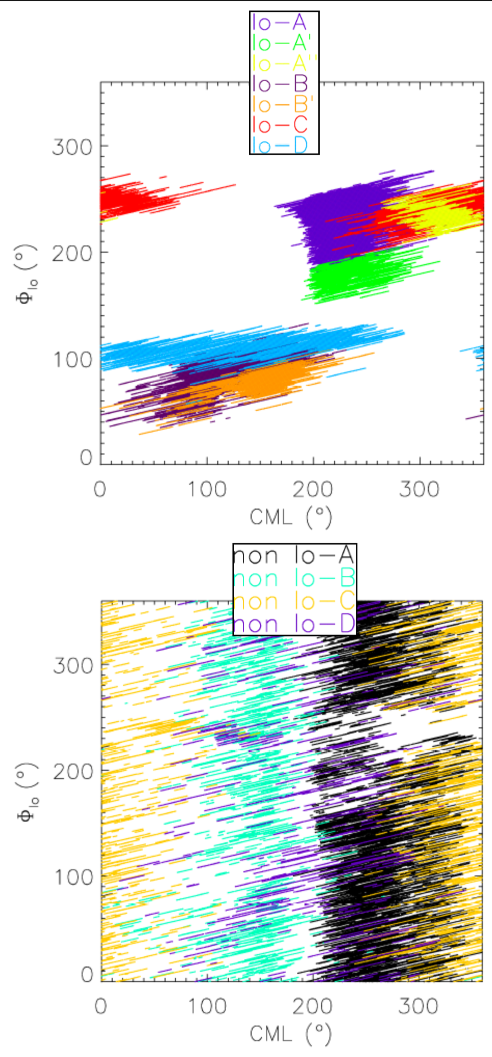
Geometry of satellite-Jupiter interaction



Coverage of the CML-Φlo plane with observations



All catalogues emissions …



… identified per type

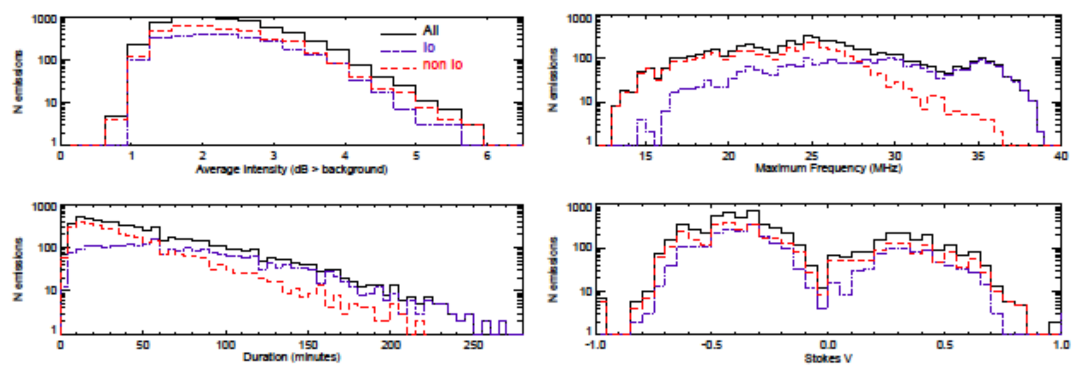


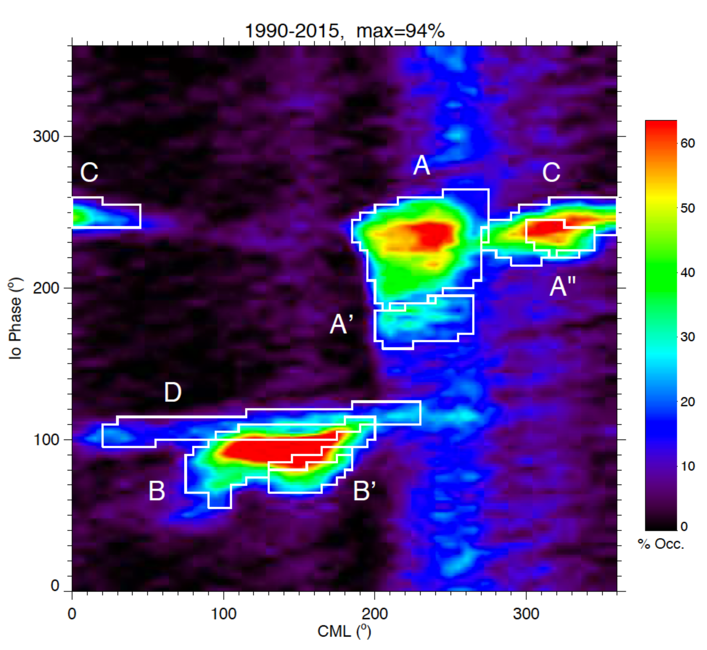
Table 2. Statistics of emission parameters for all, Io and non-Io, northern and southern, and dawn and dusk emission events.

Type		Number of events	Total duration [hours]	Occurrence probability [%]	Intensity [dB] Avg.(Med.)±σ	Duration [min.] Avg.(Med.)±σ Max.	Max. frequency [MHz] Avg.(Med.)±σ Max.	Circular polar. (Stokes V) Avg.(Med.)±σ
All events		6204	5744	10.5	2.28(2.19) ± 0.79	55(42) ± 44 300.	25.1(25.0) ± 5.3 38.9	–0.20(–0.33) ± 0.37
Io	All	2591	3234	5.9	2.32(2.21) ± 0.81	74(64) ± 49 300.	28.1(28.2) ± 5.3 38.9	–0.20(–0.33) ± 0.36
	NH	1958	2271	4.1	2.22(2.19) ± 0.77	69(59) ± 46 300.	30.1(29.8) ± 4.2 38.9	–0.36(–0.38) ± 0.20
	SH	633	963	1.8	2.64(2.54) ± 0.84	90(81) ± 54 282.	21.9(22.0) ± 2.8 29.4	0.32(0.33) ± 0.21
	Dawn	1053	1409	2.6	2.38(2.26) ± 0.87	79(68) ± 52 300.	28.8(29.4) ± 6.1 38.9	–0.17(–0.32) ± 0.35
	Dusk	1538	1824	3.3	2.29(2.19) ± 0.77	70(60) ± 47 282.	27.6(27.9) ± 4.6 38.6	–0.21(–0.33) ± 0.36
non-Io	All	3613	2511	4.6	2.23(2.19) ± 0.78	41(30) ± 34 222.	23.0(23.5) ± 4.1 37.4	–0.21(–0.33) ± 0.38
	NH	2677	1847	3.4	2.21(2.18) ± 0.78	40(30) ± 35 222.	24.2(24.6) ± 3.6 37.4	–0.39(–0.42) ± 0.21
	SH	936	664	1.2	2.26(2.19) ± 0.75	42(31) ± 34 208.	19.1(18.7) ± 3.0 28.5	0.31(0.33) ± 0.21
	Dawn	954	593	1.1	2.07(1.87) ± 0.78	36(29) ± 29 208.	23.0(23.1) ± 4.6 37.4	–0.18(–0.33) ± 0.40
	Dusk	2659	1918	3.5	2.28(2.19) ± 0.77	42(31) ± 36 222.	22.9(23.5) ± 3.9 35.9	–0.22(–0.33) ± 0.36

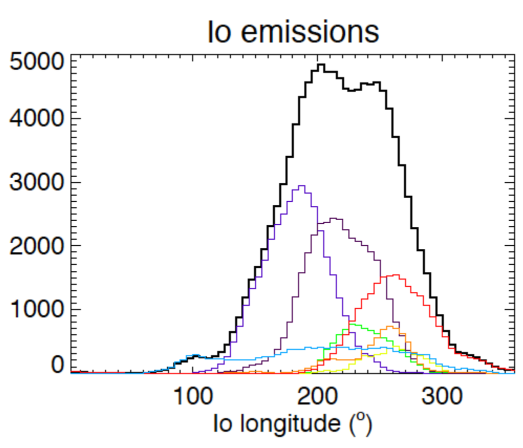
Emission parameter statistics

Io-Jupiter interaction and magnetic field models

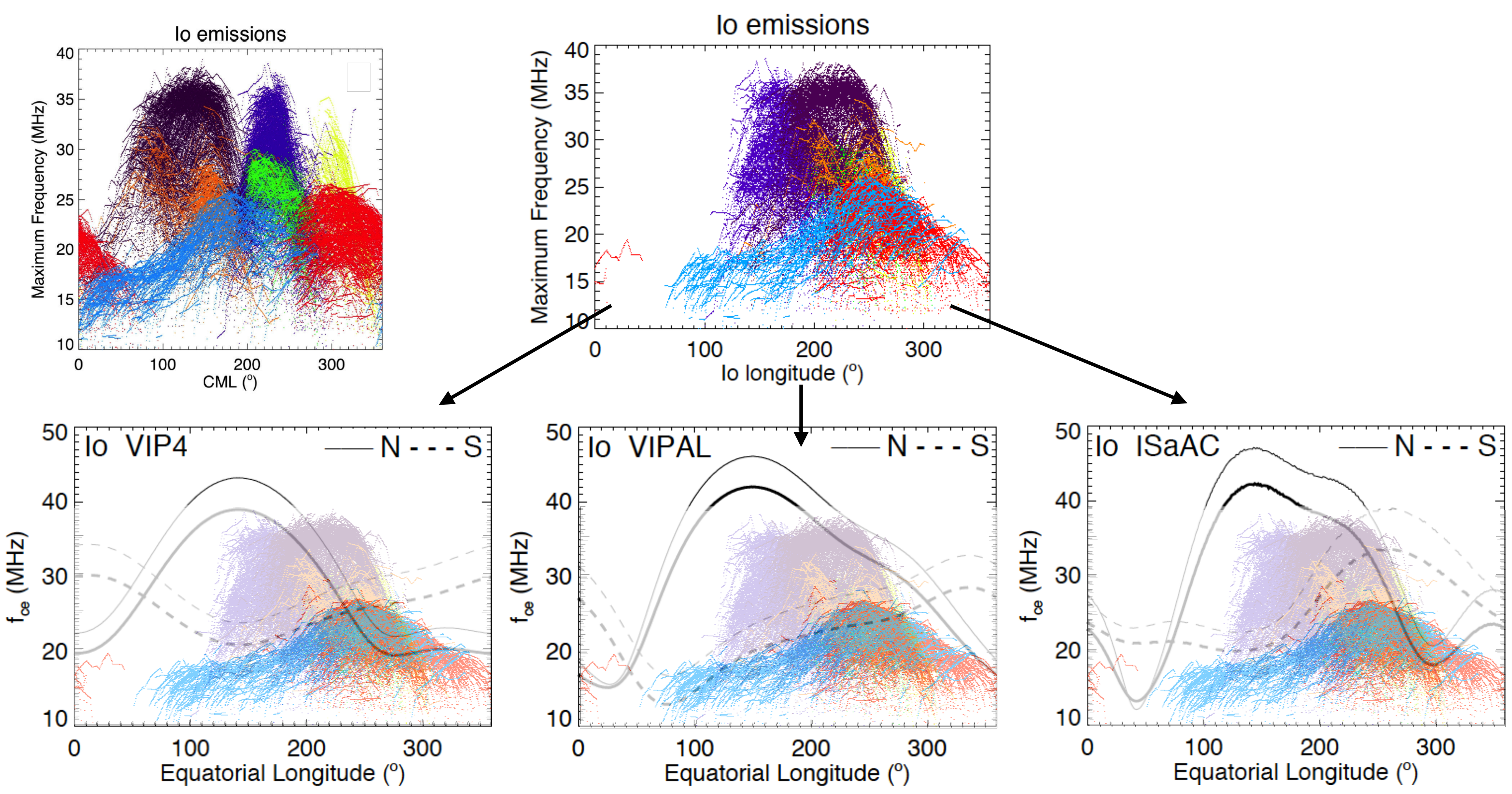
- Occurrence probability
- fmax(Λ)
- Comparison to magnetic field models



Io-Jupiter and non-Io long-term occurrence probability



Distribution of Io emissions vs Io's longitude

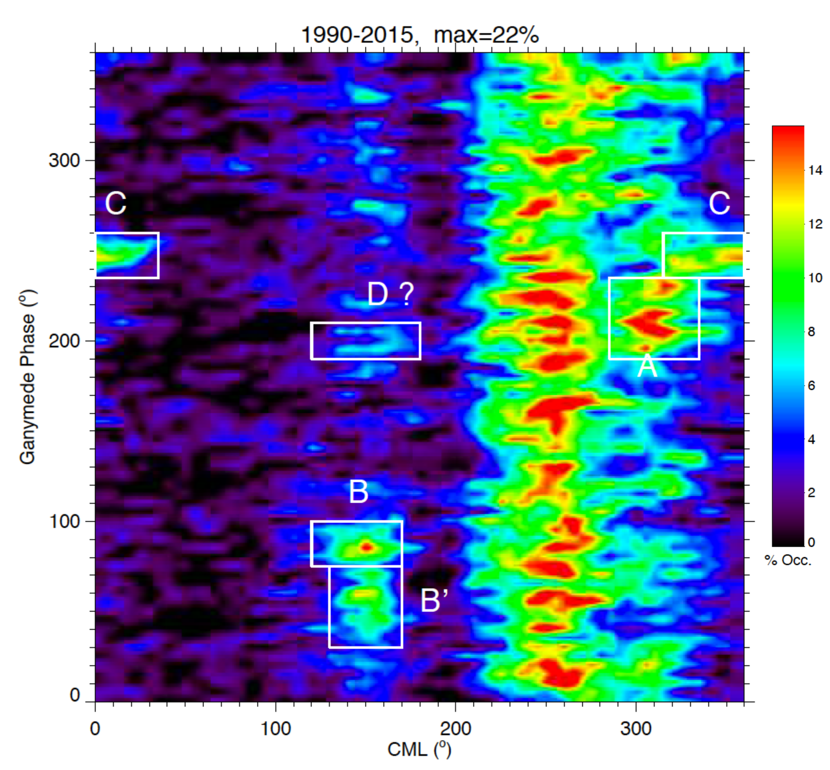


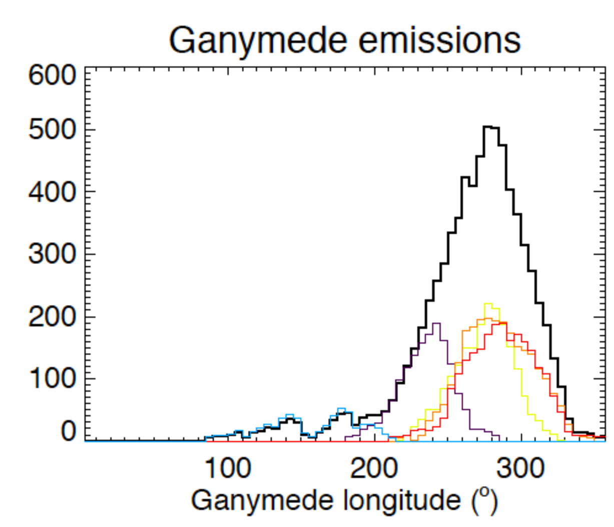
Distribution of Io emissions' f_{max} and comparison to magnetic field model predictions

Ganymede-Jupiter interaction

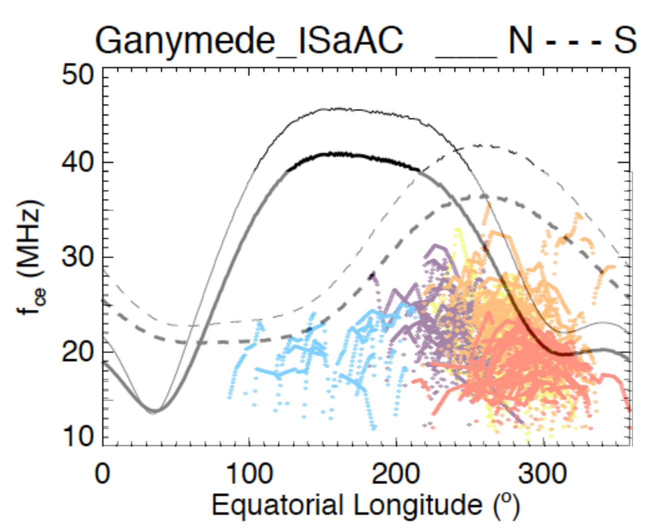
- Demonstrated and quantified
- Energetics
- Comparison to magnetic field models

Ganymede-induced radio emissions clearly identified





Distribution of Ganymede emissions vs Ganymede's longitude



Distribution of Ganymede emissions' f_{max} and comparison to magnetic field model predictions

Future work : automatic identification of emissions (machine learning …), database extension via archive data digitization …

References : Marques et al., Astron. Astrophys., 604, A17, 2017 ; Zarka et al., in "Planetary Radio Emissions VIII", Fischer et al. eds., Austrian Acad. Sci. Press, Vienna, 2017