Imperial College London

MAG Data Release Report 2012

24 February 2021 (report covers data release for 1-31 Dec)

Report Version	1	L2 ground processing software version:	1.15
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Data Summary

MAG was on for the whole period 1-31 December.

On the 27th of December, Solar Orbiter had the first flyby with Venus.

Spacecraft noise was observed particularly in IBS data for several periods (there was significant noise for a total of 75 hours during December). This noise is very clear in IBS, the source has not been identified. We can see evidence for it being there in OBS as well, and have not got algorithms to clean this from the data. The magnetic field data have been converted to NaNs when the noise in the data was particularly high. The full period of missing data is listed in the appendix of this report. If you have particular need for any data during these periods, please contact the MAG team and we see if the data maybe suitable for release for certain applications.

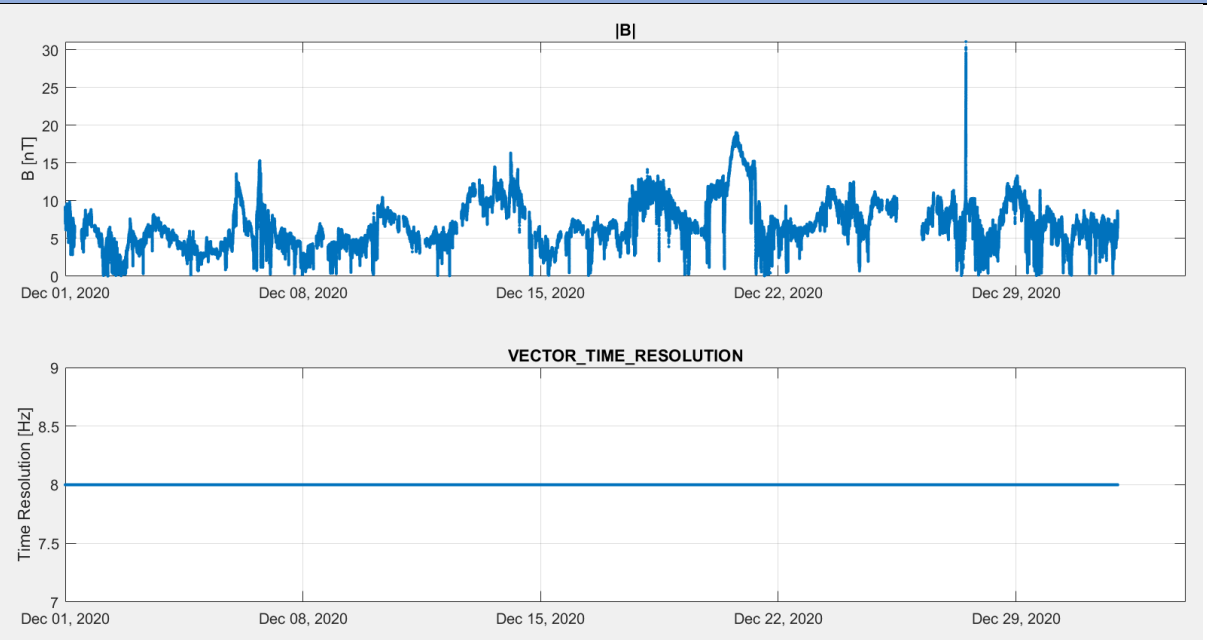
On **21 December**, there was a solar array current event which is not yet fully understood, but which caused a large step change in offset at the inboard sensor (~2nT in Y and Z axes) and a smaller change in the outboard sensor. More events were seen in January. MAG will continue to investigate.

Higher frequency (2-15Hz) interference from the MAG heater is observable in burst mode data throughout December: please, see the last section of this report for further details.

Before and during the flyby there were events such as the solar arrays and high gain antenna movements, which generated **offset changes** in the inboard and outboard sensors.

The spacecraft started December at 0.87AU and ended December at 0.70AU.

Normal Mode



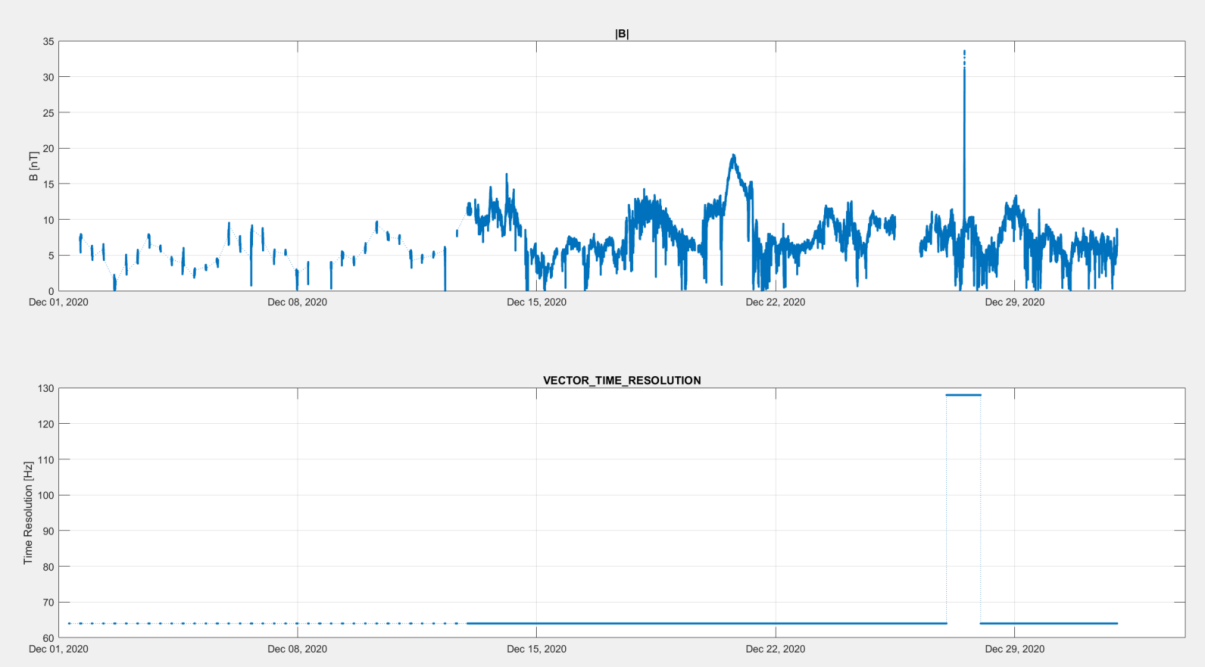
For whole month, MAG was on with 8Hz cadence normal mode data returned, for exceptions see below.

Operations	1-31 Dec	Cruise phase throughout period
Operational Events of Note	27 Dec	Venus flyby

Data Gaps greater than one minute:

NaNs periods have been introduced because the data was affected by high SC interference.
The total amount of NaNs in December is 75 hours.
Please, see Appendix A to visualise the complete list of the NaNs.

Burst Mode



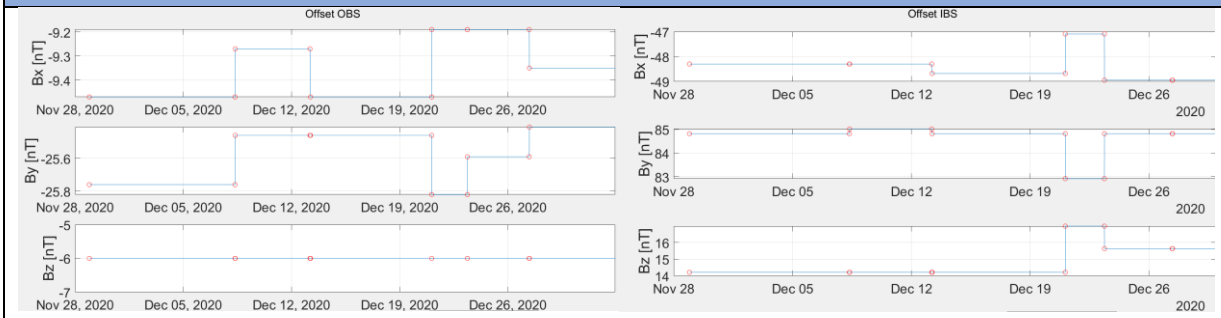
Coverage continuous. Data at 64 Hz and 128 Hz cadence.

	From	To	Coverage
Coverage	1/12	12/12	2 hours 64 Hz
	13/12	31/12 except 27/12	24 hours 64Hz
	27/12	27/12	24 hours 128 Hz

Quality bitmask

Quality bit mask events	
SC events which disturb the field	1. Thruster firings 2. Solar array lubrications (solar array is moved 15 degrees, then returned to original position) 3. Solar array movements (solar array angle is changed, and then remains at new angle due to sun-SC distance thermal constraints) 4. High gain antenna movements
SC related issues	- Solar array current event at 01:39 on 21/12/2020 - Solar arrays rotation from 30 to 56 degrees at 08:56 on 23/12/2020 - High gain antenna movement on 27/12/2020 08:57-09:17 - Solar arrays rotation from 56 to 60 degrees at 3:24 on 31/12/2020

Offset



1-31 Dec:
Both IBS and OBS offsets have been modified by the solar arrays movement and the high gain antenna movements. Two changes unrelated to any known SC events have been detected.
These offsets have been quantified and removed from the L2 data.

Offset	Date	OBSX	OBSY	OBSZ	IBSX	IBSY	IBSZ	
85	28/11/2020 22:15:01.000	-9.47	-25.76	-6	-48.3	84.82	14.21	Post SA lubrication
85	08/12/2020 08:25:00.000	-9.47	-25.76	-6	-48.3	84.82	14.21	Offset constant to here
86	08/12/2020 08:45:00.000	-9.27	-25.46	-6	-48.3	85.02	14.21	OBS and IBS offset change – cause unknown
86	13/12/2020 04:45:00.000	-9.27	-25.46	-6	-48.3	85.02	14.21	Offset constant to here
87	13/12/2020 05:30:00.000	-9.47	-25.46	-6	-48.68	84.82	14.21	OBS and IBS offset change – cause unknown
87	21/12/2020 01:39:23.000	-9.47	-25.46	-6	-48.68	84.82	14.21	Offset constant to here
82	21/12/2020 01:39:23.700	-9.19	-25.82	-6	-47.09	82.92	16.98	Post Solar arrays current event
82	23/12/2020 09:01:00.000	-9.19	-25.82	-6	-47.09	82.92	16.98	Offset constant to here
83	23/12/2020 09:05:00.000	-9.19	-25.59	-6	-48.95	84.82	15.63	Post Solar arrays movement from 30 to 56 degrees
83	27/12/2020 08:57:00.000	-9.19	-25.59	-6	-48.95	84.82	15.63	Offset constant to here
84	27/12/2020 09:17:00.000	-9.35	-25.41	-6	-48.95	84.82	15.63	Post HGA movement
84	20/02/2021 09:14:00.000	-9.35	-25.41	-6	-48.95	84.82	15.63	Final Offset

MAG Heater 3-15Hz interference

An interference signal is generated by the MAG heater. This is routinely modelled, and removed from the time series. However, during December, there was higher frequency noise (usually around 10Hz but at times in the range from 3 to 15Hz) associated with the times when the heater is operational. This is not cleaned from the burst mode data using the current technique. It has been filtered out of the NM data by the instrument low pass filters.

This interference is present throughout December: it always starts when the MAG heater is switched on and it stops when it is switched off. The heater is on for one minute, thus the observable signal lasts exactly one minute. The frequency characterising the signal is not fixed and such high variability has not been explained yet. The components of the field mostly affected by this signal is Bz (URF).

The flag called “MAGHEATERONFLAG” highlights the times at which the MAG heater was on, so it can be used to identify the periods in which the interference caused by the heater can be present.

The following spectrograms show the periodic signal as lighter vertical features emerging from the blue background. The duration of each single feature is one minute.

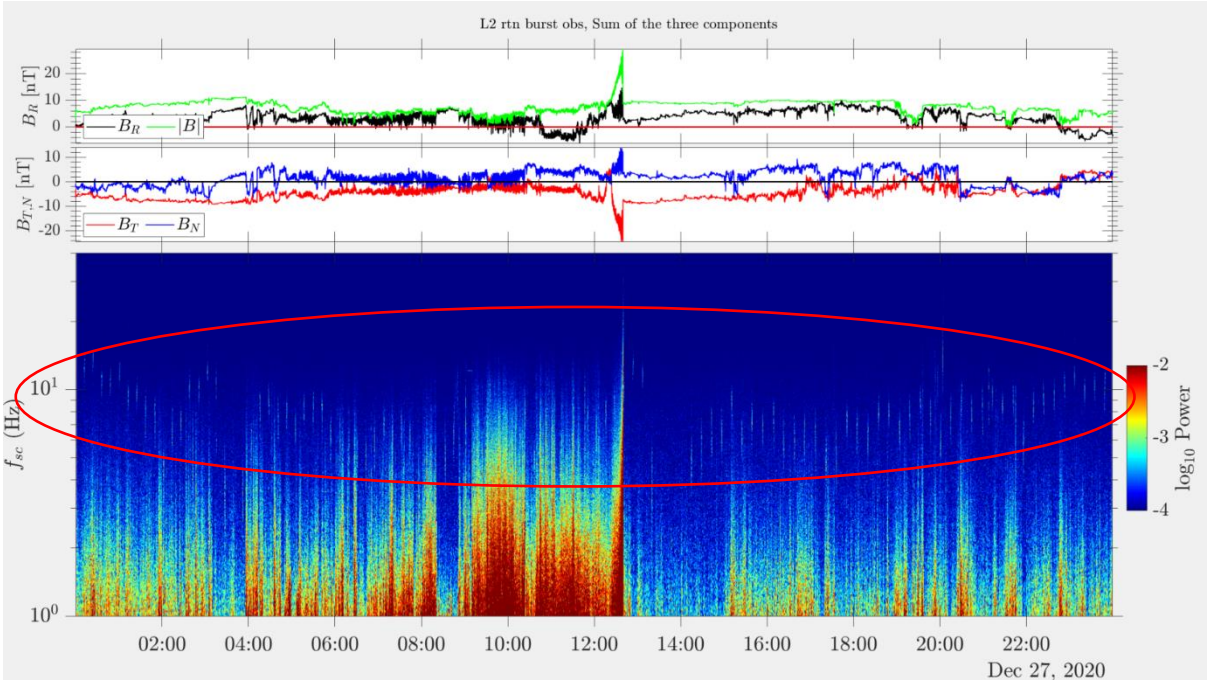


Figure 1: Spectrogram of OBS burst mode data (27th Dec 2020)

This signal is clearly correlated with the MAG heater, whose activations are represented in Figure 2 by red vertical lines. It is an artificial signal.

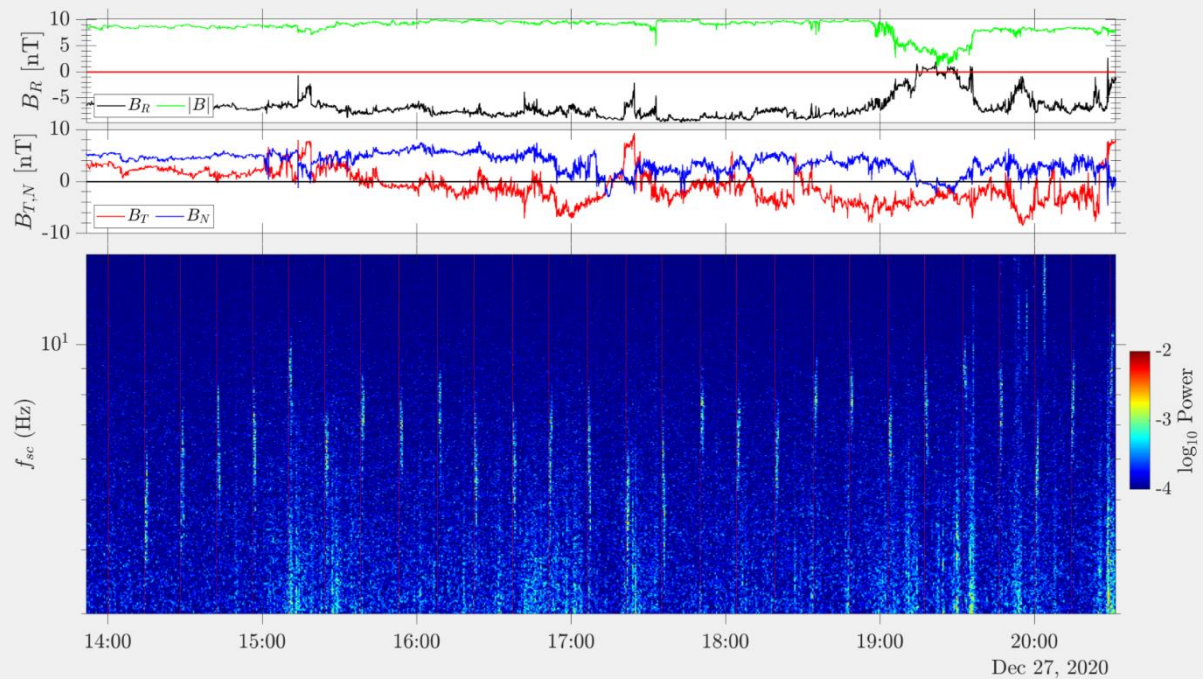


Figure 2: Spectrogram of OBS burst mode data (27th Dec 2020: from ~14:00 to ~20:30). The red vertical lines show the exact time at which the MAG heater was switched on.

Figure 3 shows the PSD of a period when the heater was on: Bz is the component of the field which is affected the most by the MAG heater interference.

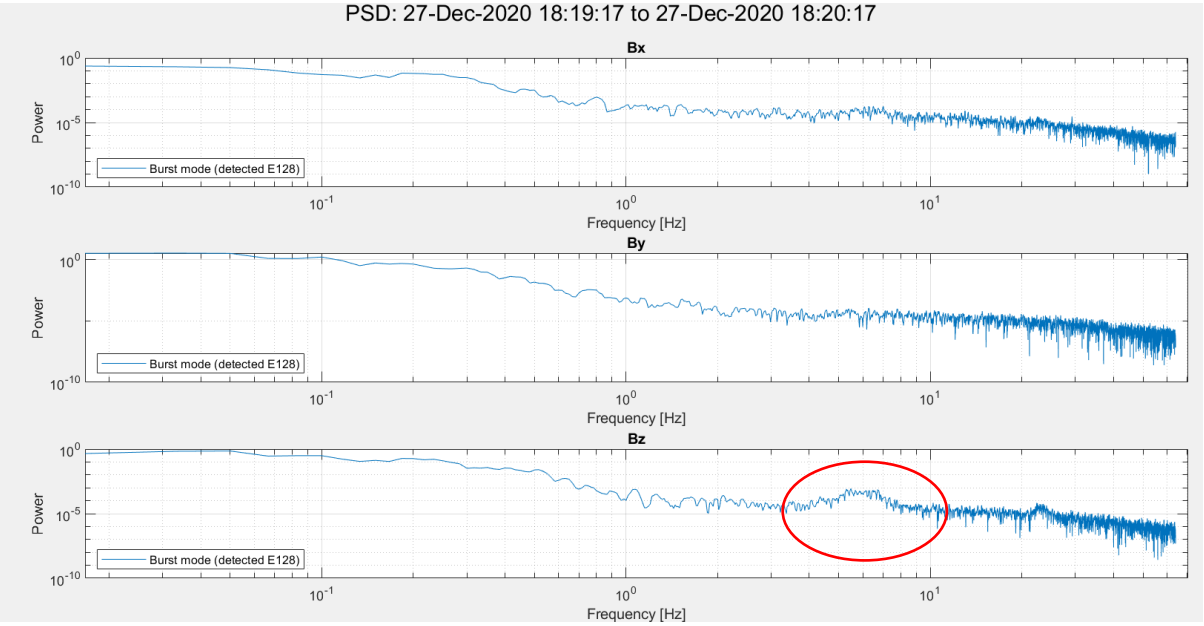


Figure 3: Power Spectral Density starting when the heater was switched on and ending when it was switched off. It represents OBS Bx By Bz in Sensor Reference Frame (URF). The PSD of the 3rd component shows a bump corresponding to the signal in the spectrogram.

Appendix

Appendix A: December NANs periods

This table shows the NaNs periods which have been introduced in the data due to SC interference.

GapType	GapStart	GapEnd	GapDuration
Nan	20201201T06:40:00.108	20201201T11:29:59.890	04:49:59
Nan	20201201T18:40:00.070	20201201T20:39:59.981	01:59:59
Nan	20201208T07:30:00.016	20201208T09:29:59.926	01:59:59
Nan	20201208T14:30:00.073	20201208T17:44:59.924	03:14:59
Nan	20201209T04:45:00.049	20201209T05:29:59.889	00:44:59
Nan	20201209T08:40:00.121	20201209T09:14:59.968	00:34:59
Nan	20201209T12:00:00.094	20201209T12:59:59.923	00:59:59
Nan	20201210T12:15:00.117	20201210T13:14:59.946	00:59:59
Nan	20201210T17:30:00.003	20201210T18:49:59.943	01:19:59
Nan	20201210T20:00:00.015	20201210T22:59:59.877	02:59:59
Nan	20201211T10:45:00.094	20201211T14:29:59.937	03:44:59
Nan	20201212T12:45:00.056	20201212T15:59:59.908	03:14:59
Nan	20201212T17:30:00.091	20201212T18:59:59.899	01:29:59
Nan	20201213T02:00:00.083	20201213T04:44:59.958	02:44:59
Nan	20201214T13:00:00.018	20201214T15:59:59.884	02:59:59
Nan	20201214T18:00:00.045	20201214T19:59:59.955	01:59:59
Nan	20201215T08:30:00.020	20201215T09:44:59.964	01:14:59
Nan	20201215T11:10:00.025	20201215T11:39:59.878	00:29:59
Nan	20201215T14:30:00.001	20201215T17:44:59.979	03:14:59
Nan	20201216T06:15:00.046	20201216T08:29:59.944	02:14:59
Nan	20201216T13:00:00.120	20201216T13:44:59.961	00:44:59
Nan	20201216T14:30:00.053	20201216T14:59:59.905	00:29:59
Nan	20201217T10:00:00.058	20201217T11:29:59.992	01:29:59
Nan	20201217T15:30:00.064	20201217T16:44:59.882	01:14:59
Nan	20201217T20:20:00.098	20201217T21:09:59.936	00:49:59
Nan	20201217T21:45:00.035	20201217T22:14:59.889	00:29:59
Nan	20201219T10:30:00.028	20201219T11:29:59.984	00:59:59
Nan	20201219T12:00:00.087	20201219T12:39:59.932	00:39:59
Nan	20201219T15:15:00.068	20201219T17:29:59.968	02:14:59
Nan	20201225T01:30:00.097	20201225T04:29:59.962	02:59:59
Nan	20201225T12:00:00.000	20201226T05:29:59.963	17:29:59
Nan	20201226T14:00:00.081	20201226T15:59:59.991	01:59:59