

What is an N-Event



Jupiter Emission Types

- The Jupiter, Io system generates three types of emissions mainly in the form of S (Short) bursts, L (Long) bursts, and N (narrow band) events.
 - S-bursts are shorter than a few tenths of a second, generally lasting only a few tens of milliseconds and may occur in periodic succession at rates of between 10 and 40 per second.
 - L-bursts range from a few tenths of a second to a few seconds.
 - N-Events are typically in the 10's of seconds range, however, some can last for minutes. Their f-t slopes are small and random with the average bandwidth of these emissions in the vicinity of 200 kHz.

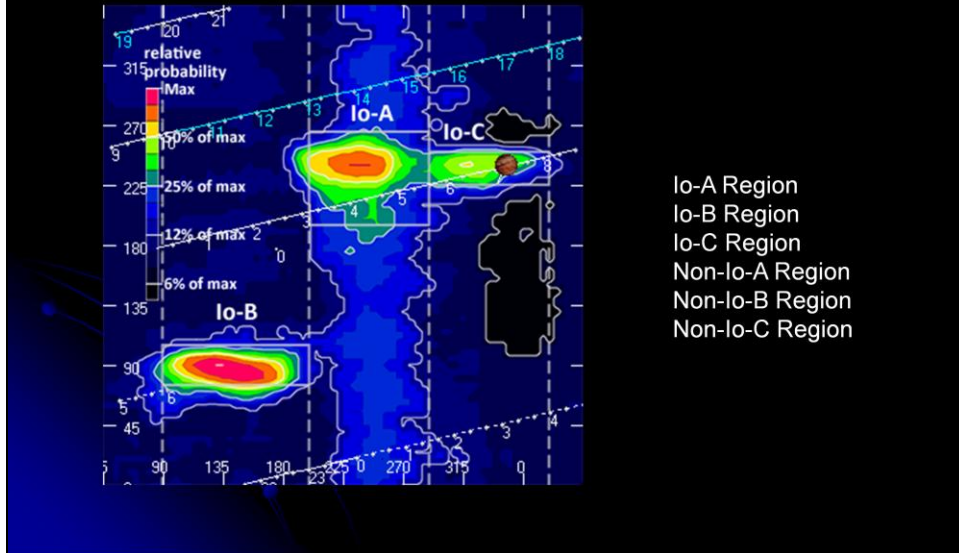
Sometimes called N-Bursts, conventionally now referred to as N-Events, they are an emission type that is not typical of other Jovian emissions.

N-Events

- N-events have been considered to belong to the category of the L-bursts although the N-event has a restricted frequency range showing an almost constant frequency and a narrow band width.
- There can be mixtures of both L and S bursts that make a definition challenging.

L-bursts range from a few tenths of a second to a few seconds. S-bursts are shorter than a few tenths of a second, generally lasting only a few tens of milliseconds and may occur in periodic succession at rates of between 10 and 40 per second.

The Emission Regions



Three major regions of longitude called simply, A, B, and C regions seem to have the most effect. Jupiter's magnetic field is tilted about 10 degrees in relation to the planet's rotational axis and thus appears to wobble from our perspective. The active regions are tied to this magnetic field. Jupiter's gaseous makeup provides us with no solid surface features to monitor its rotation. The clouds at different latitudes rotate at different rates. The rotation of the magnetic field has proven to be the best indicator and so a System III system of longitude was established for Jupiter. Systems I and II were based on cloud rotation at certain latitudes. The A, B, and C emission mode regions are based on System III central meridian longitude (CML III).

In the 1960's it was recognized that the position of Io also strongly affects the probability that a given region will produce emissions. This is probably related to Io's volcanic nature and its constant spewing of ionized particles along its orbit. The trail of ionized particles that lie along its orbital plane is referred to as the Io torus. A longitudinal band of electromagnetic activity extends from the magnetic poles of Jupiter to Io. This band, known as a flux tube, plays a role in the radio noise storms as electrons spiral back and forth along its path.

We measure Io's position in its orbit around Jupiter in relation to the way we see it from Earth. When Io is on the back side of Jupiter, 180 degrees from its closest Earthward position we say it is in Superior Geocentric Conjunction or SGC. The angular distance which Io has from SGC is called the Io Phase. Taken together Io Phase and CML III account for the major emission modes. The last major factor identified, the Jovicentric declination of the Earth is a long term variance in probability related to the the orbits of Jupiter and the Earth and is treated elsewhere in this document.

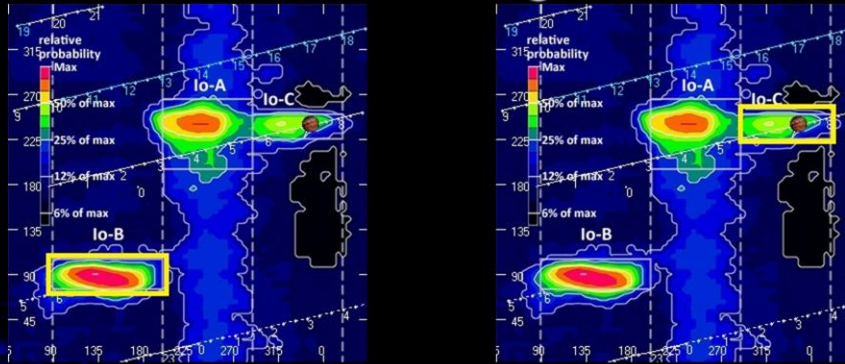
Radio Sky Publishing, <http://www.radiosky.com/jupmodes.html>

What Is Likely To Happen Where

	L Bursts	S Bursts	N Events
Io-A	X		
Io-B	X	X	X
Io-C	X	X	X
Non-Io-A	X		
Non-Io-B	X		
Non-Io-C	X		?

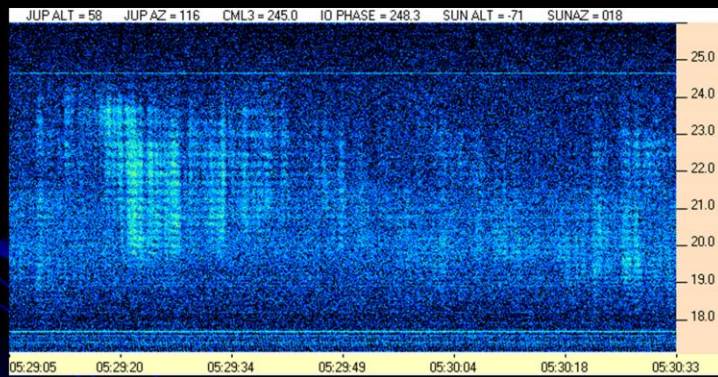
L-Bursts occur in each of the 6 emission regions. S-Bursts occur in only 2 of the emission regions, Io-B and Io-C. N-events occur in only 2 of the emission regions, Io-B and Io-C.

N-Event Regions



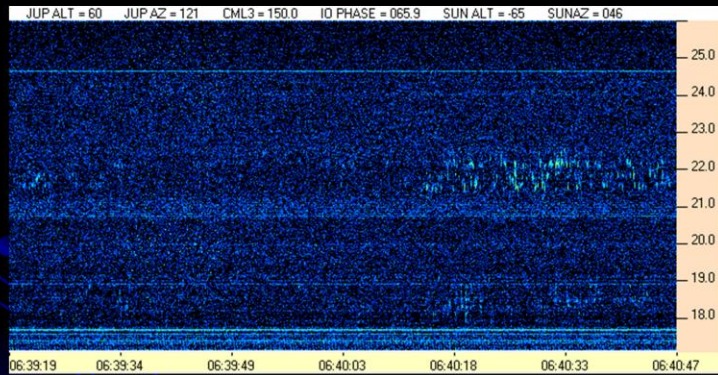
- From the previous slide, we see that N-Events are associated with the Io-B and Io-C regions. This is also where S-Bursts occur.

L-Bursts



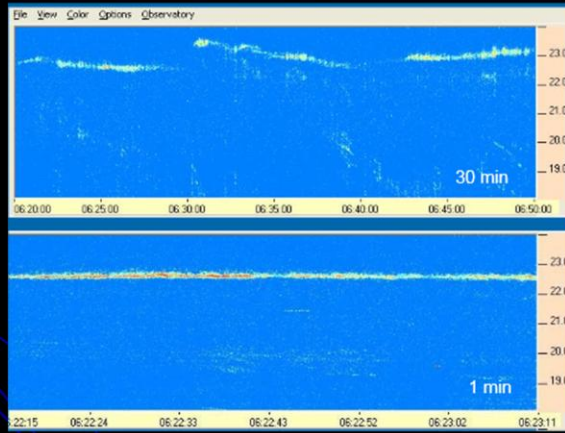
HNR AO

S-Bursts



HNRAO

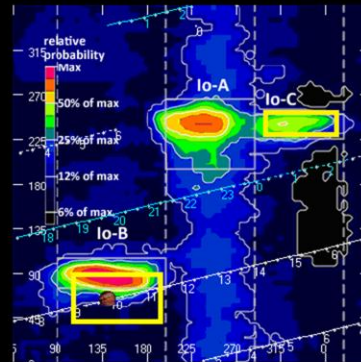
N-Event



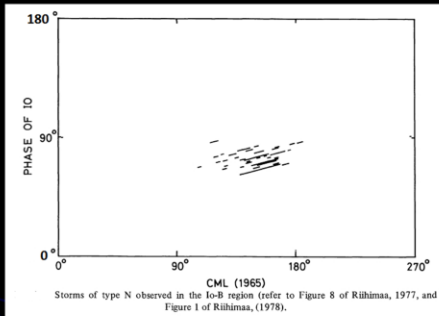
UFRO

Io-B & Io-C Regions

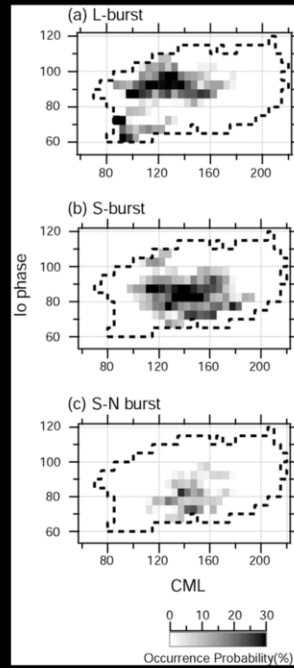
In the Io-B region when viewed on the CML plane, the areas of likely occurrence is in the range of 100-190 with the Io phase > 45 degrees and < 90 degrees and in the Io-C region. When associated with Io-B, (Riihimaa, 1985) they nearly never appear close to the center of Io-B.



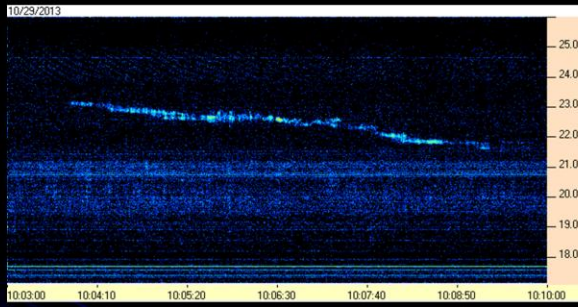
Io-B Region



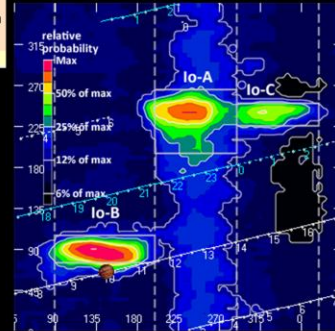
The occurrence probabilities of observed emissions in Io-B region. (a) L-burst. (b) S-burst. (c) S-N burst. The region surrounded by the dotted line shows the observed region. Oya_et_al, 2002.



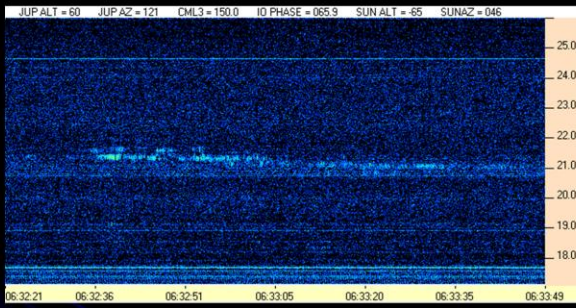
Io-B Event Oct. 29, 2013



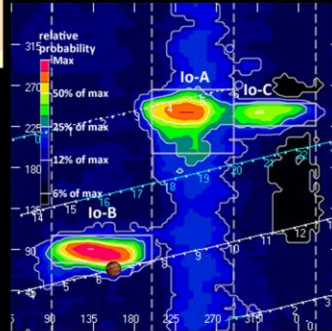
HNRAO



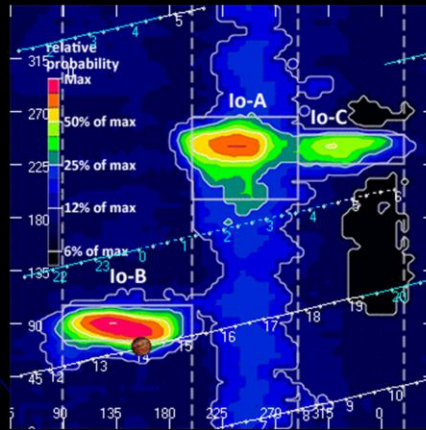
Io-B Event Nov. 30, 2013



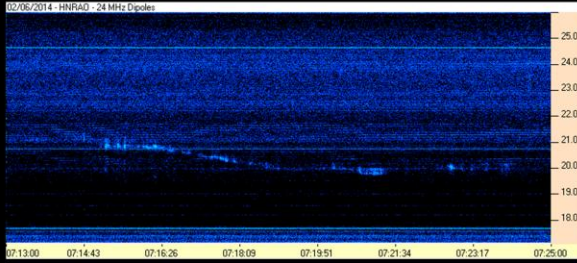
HNRAO



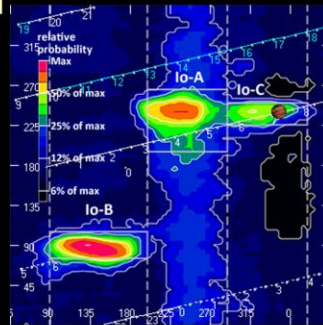
All Io-B Events for 2013/14 season



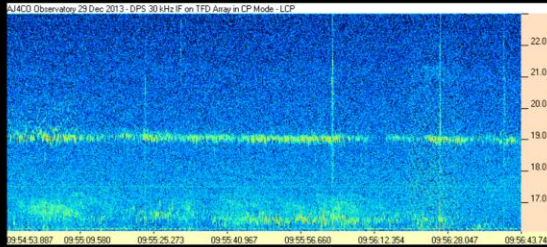
Io-C Event Feb. 6, 2014



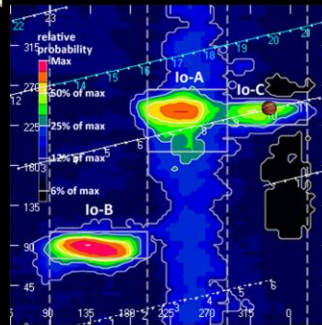
HNRAG



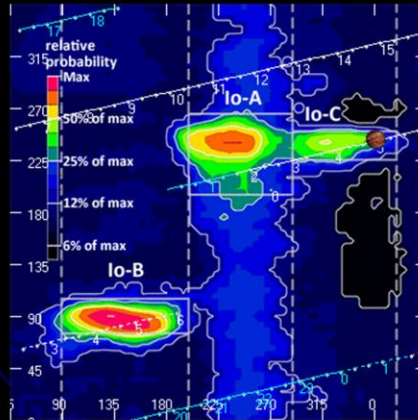
Io-C Event Dec. 29, 2013



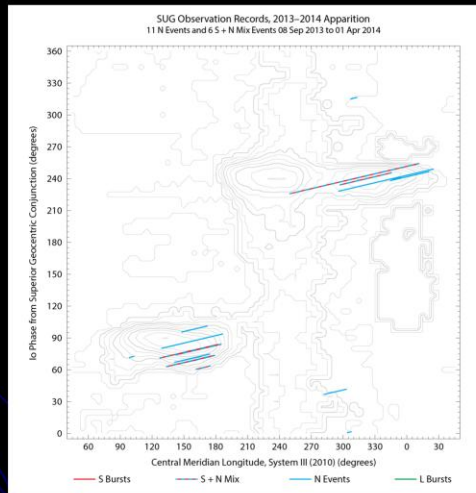
Dave Typinski



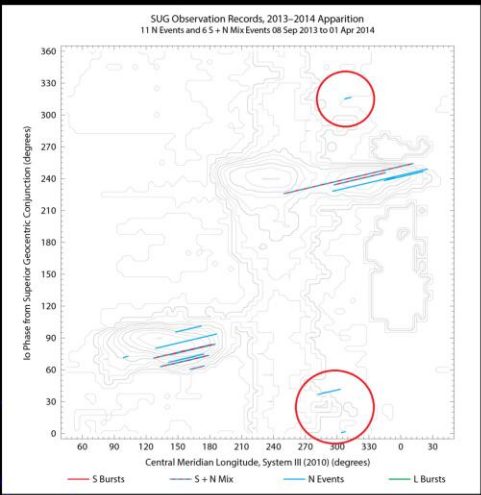
All Io-C Events for 2013/14 season



What SUG saw



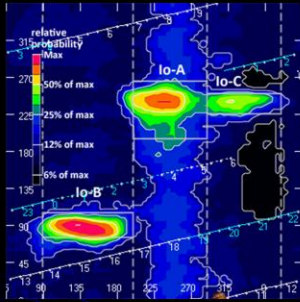
What's Here?



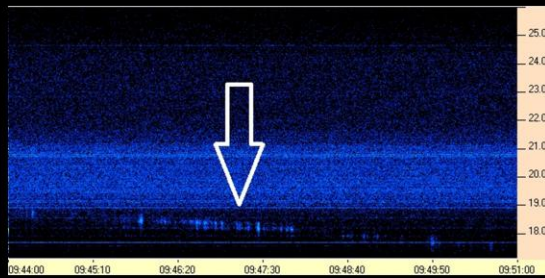
What Happens Where

	L Bursts	S Bursts	N Events
Io-A	X		
Io-B	X	X	X
Io-C	X	X	X
Non-Io-A	X		
Non-Io-B	X		
Non-Io-C	X		?

N-Event (ish)

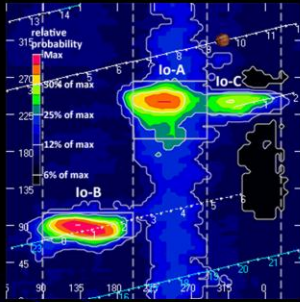


Here's an event that falls outside the conventional areas of traditional N-events. It appears too wide band to be a classic N-event. What is it?

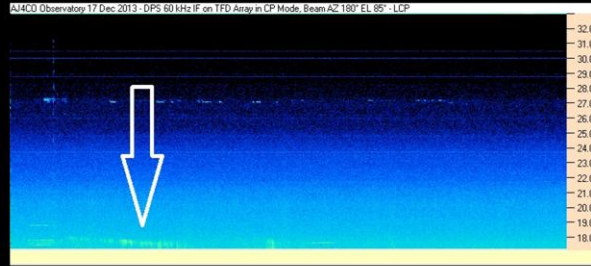


HNRAO

N-Event (ish)



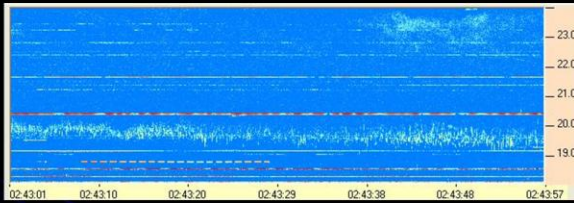
Here's another event that falls outside the conventional areas of traditional N-events. It also appears too wide band to be a classic N-event. What is it?



Dave Typinski

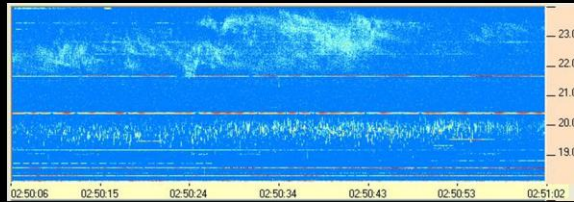
S-Trains are Not An N-Event

- S-Trains were talked about by Riihimaa as early as 1971.



March 25, 2004, Io-C,
0243:30 UTC,
CML=320.9, Io
phase=243.7, S-Burst
train, UFRO

March 25, 2004, Io-C,
0250:30 UTC,
CML=325.2, Io
phase=244.7, L-bursts
above 22 MHz, S-Burst
train near 20 MHz.,
UFRO

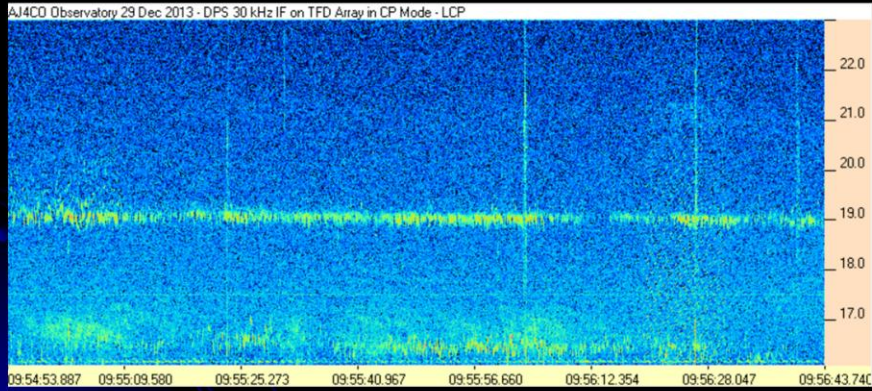


Resolution

- It comes down to the resolution of the observing equipment.
- Resolution of the FSX spectrograph, while better than some equipment in the past, lacks the high speed A/D ability to see fine details in the events.
- Does the wide band receiver and fast A/D converter help?

At 19 MHz N-Event? or S-Train ?

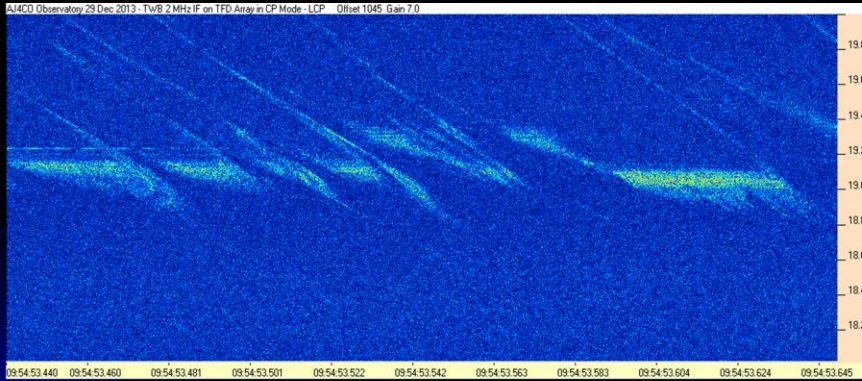
Is this L-Burst broken up with scintillation, or closely spaced S-Bursts?



Dave Typinski

200 ms

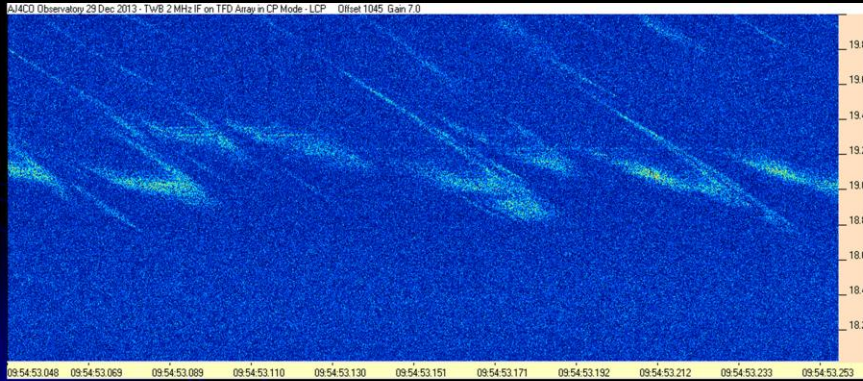
Sort of S so what do we call it?



Dave Typinski

200 ms

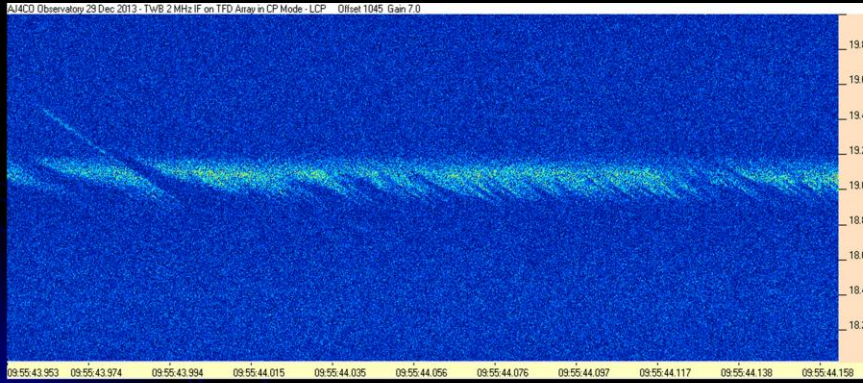
Mostly S so what do we call it?



Dave Typinski

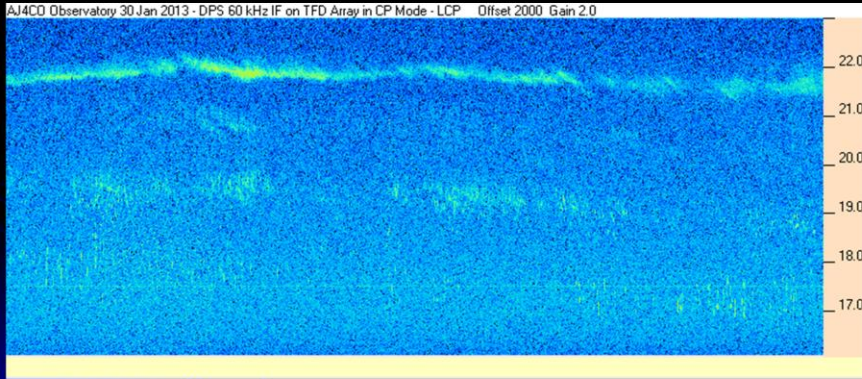
200 ms

Sort of L, sort of S so what do we call it?



Dave Typinski

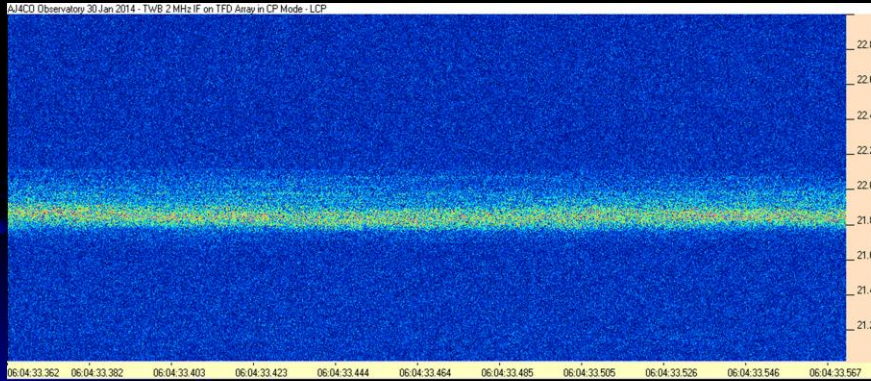
Event Jan. 30, 2014



Dave Typinski

200 ms

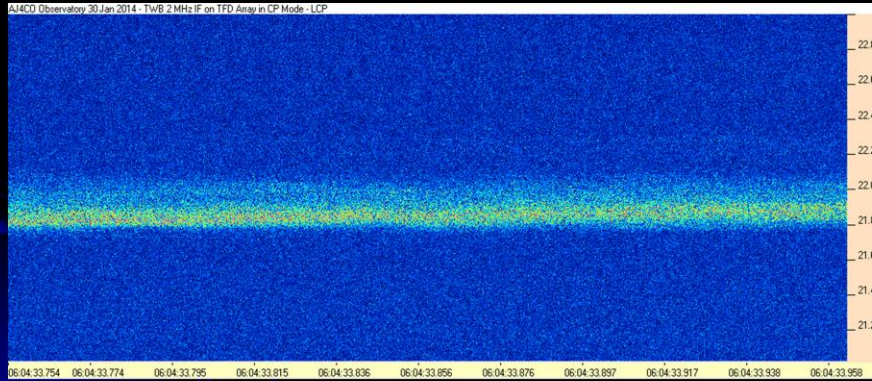
Pure L-Burst



Dave Typinski

200 ms

Pure L-Burst



Dave Typinski

So,
What Is An N-Event



More Study

- The definitions have begun to blur as technology has improved. Early spectrographs were low resolution compared to today's instruments.
- The mechanism by which these events are generated is not known, or at least fully understood.
- Continued observations by multiple spaced spectrographs may shed more light on the phenomena.
- Increased resolution as technology improves will help in defining these events.



That's all Folks!

Jim Brown, HNRAO
Industry, PA

Thanks to
Dick Flagg and Dave Typinski

References

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http://www.astro.ufl.edu/events/frontiers/presentations11/reyes_frontiers11.pdf
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