Juno at Perijove-9: I. Global map and preview of PJ-10

John Rogers (BAA), 2017 Nov.

Summary: This perijove on 2017 Oct.24 took place only 2 days before Jupiter's solar conjunction, so there were no useful ground-based observations for nearly 4 weeks up to that time. But JunoCam's inbound and outbound images provided a good global map. This revealed an important change: a new South Tropical Disturbance had appeared, suggesting the possibility of further major changes in the South Tropical and Temperate domains in the coming year.

Figure 1 is a compilation of ground-based images in September, including the last useful ones covering the GRS and oval BA before solar conjunction; they are mostly by Clyde Foster, plus two by Isao Miyazaki. Note the prominent S.Tropical Band and shaded STropZ in this sector.

Figure 2 is a global map made from the inbound images (northern hemisphere) and outbound images (southern hemisphere), as map-projected by Gerald Eichstädt. He achieved remarkably good map projections in spite of the crescent phase of the planet, now that perijove is over the sunlit side rather than the terminator. The spacecraft orientation was different from PJ8, so the inbound images were more complete this time, but they were still restricted by the narrow crescent phase – which will only get worse at subsequent perijoves.

The map shows major changes in the southern hemisphere: most importantly and unexpectedly, a new South Tropical Disturbance (STropD), i.e. a recirculation across the S. Tropical Zone. Although it was not recognised till now, amateur images and JUPOS analysis show that it was initiated in early August when dark streaks, modestly retrograding in the northern STropZ, merged and recirculated into the mid-STropZ alongside the p. end of the STB Spectre. [We will show the data in a forthcoming report.] Early stages are visible in Fig.1. The STropD is prograding towards the GRS.

I think this enhances the likelihood of a SEB Fade developing within the coming year. In recent decades, S.Tropical Disturbances have tended to appear in association with SEB Fades (notably in 1993 and 2007*). The SEB will probably not fade immediately because the map also shows some small-scale rifting (white convective streaks) in the SEB alongside the STropD, and also at remote longitudes in the remains of the mid-SEB outbreak (also see close-ups in Part II). We will have to see how this plays out over the coming months, but I suspect that the rifts will soon die out and a SEB Fade may then develop in the first half of 2018.

There are also signs of possible disturbance in the S. Temperate domain. This domain has been in an anomalous state with no dark belt for a few years, and may be ripe for a revival of the now-absent STB, as last happened in 1993*. In the PJ9 map we can see:
--disturbance apparently prograding on the STBn jet from the new STropD towards the GRS;
--various small dark spots in the domain p. the GRS (in the 2016/17 apparition, this sector showed various shadings or blue colour as oval BA then the STB Ghost prograded along it);
--the STB Ghost is still pale, but there is the (short) orange recirculation loop Sf. it; and it is approaching the dark spot f. oval BA, so I expect a vigorous interaction when they collide in 2018 [now expected for 2018 April, +/- several months], and the STB Ghost will become dark;
--the orange recirculation loop Sf. the STB Spectre now appears to be ~50 deg long.
So in 2018 we could see a repeat of the events of 1993 with revivals of the STB and SEB.*

In the NEB, unusual large-scale wave structure – which was developing during 2017, and conspicuous in methane images -- is now prominent even in visible light at all longitudes. Various long-lived anticyclonic ovals (AWOs and LRSs) are labelled on the map (Figure 2). In the S2 domain, the large FFR is now tens of degrees f. A5, and there is a new small AWO just p. AWO A5a. The long-lived AWOs are all still present: A1 and A2 have not merged, but have rebounded so they are now a safe 13º apart. A6 has moved p., leaving only A7, A8, A1 & A2 in a closely spaced chain.

Figure 3 is a predictive map for perijove-10 (2017 Dec.16), made by 'rolling forward' the S. and S.S.Temperate domains, and the GRS, according to their recent drift rates.
Juno will again fly over the p. end of the STB Ghost, as at PJ8; it's worth imaging again because this region may undergo drastic changes next year. These images might also catch a small AWO merging with the growing SS-AWO A5a.
The NEB, with its impressive internal waves, is worth imaging again, to continue the series of images obtained during and after the recent expansion event. Otherwise, no well-known features are expected to be in view, so I have not adjusted the map in the northern hemisphere. It may be a good idea to sacrifice widespread imaging in favour of a top-quality image of the EZ, in the hope of catching mesoscale waves.
It is also very desirable to maintain maximal outbound coverage at PJ10 and subsequently, as at PJ9, to monitor both the circumpolar cyclones, and the anticipated changes in the South Tropical and Temperate regions.

*Reports on the 1993 and 2007 events:

Our full report on 1993, unfortunately, has never yet been finalised for publication, but a summary was given in: Rogers J (1993) 'Exciting events on Jupiter.' JBAA 103, 157-159. https://britastro.org/node/8241

The S. Temperate events are described in:
Rogers JH (2016) 'Jupiter's South Temperate domain: Evolution 1991-1999 and dynamics of cyclonic structured sectors as seen in Hubble maps.' https://www.britastro.org/node/7230

The S. Tropical events (STropDs and SEB Fade/Revival) have been described by:
Sanchez-Lavega A, Gomez JM, Lecacheux J, Colas F, Miyazaki I, Parker D & Guarro J (1996) 'The South Equatorial Belt of Jupiter, II: The onset and development of the 1993 disturbance.' Icarus 121, 18-29.

Our full report on 2007 is: Rogers J & Mettig H-J (2008), 'Jupiter in 2007: Final Numerical Report.' http://www.britastro.org/jupiter/2007report20.htm

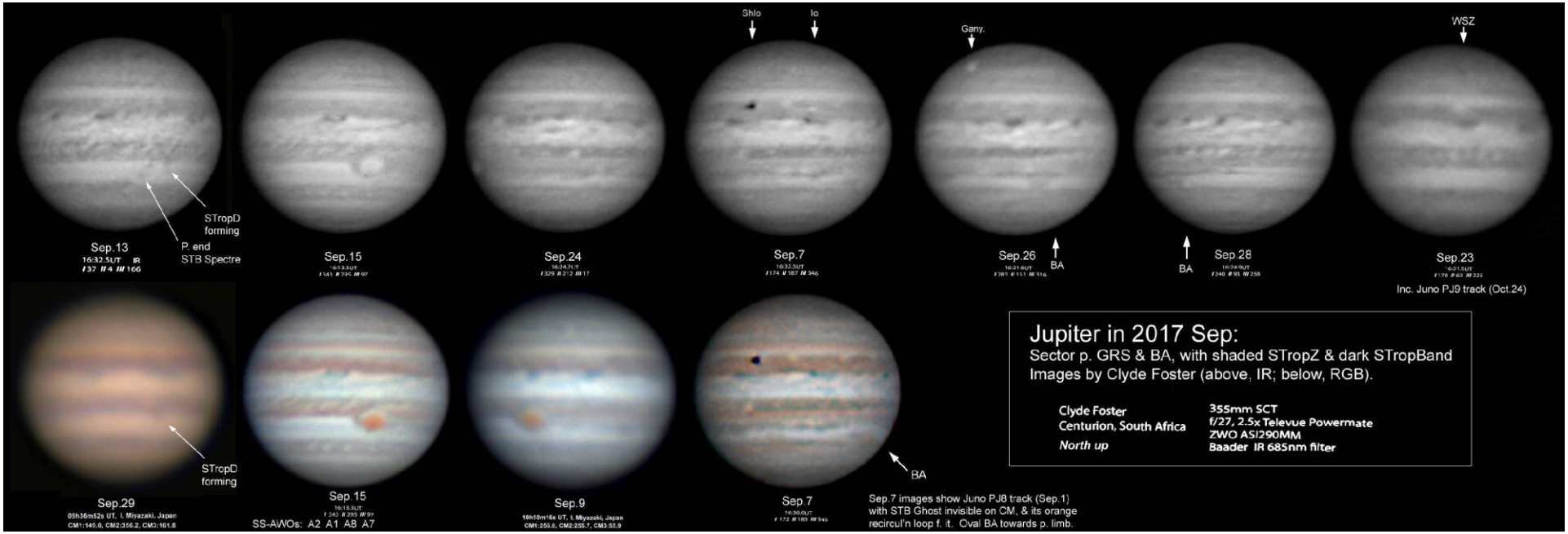
Shlo
Io
Gany.
WSZ
STropD forming
P. end STB Spectre
Sep.13
16:32.5UT IR
I 37 R 4 IR 166
Sep.15
Sep.24
Sep.7
Sep.26
16:21.6UT
BA
BA
Sep.28
Sep.23
Inc. Juno PJ9 track (Oct.24)
Jupiter in 2017 Sep:
Sector p. GRS & BA, with shaded STropZ & dark STropBand
Images by Clyde Foster (above, IR; below, RGB).
Clyde Foster
Centurion, South Africa
North up
355mm SCT
f/27, 2.5x Televue Powermate
ZWO ASI290MM
Baader IR 685nm filter
STropD forming
Sep.29
05h36m52s UT, I. Miyazaki. Japan
CM1:146.0, CM2:356.2, CM3:161.8
Sep.15
SS-AWOs: A2 A1 A8 A7
Sep.9
10h10m16s UT, I. Miyazaki, Japan
CM1:255.6, CM2:255.7, CM3:55.9
Sep.7
BA
Sep.7 images show Juno PJ8 track (Sep.1)
with STB Ghost invisible on CM, & its orange
recircul'n loop f. it. Oval BA towards p. limb.

Fig.1

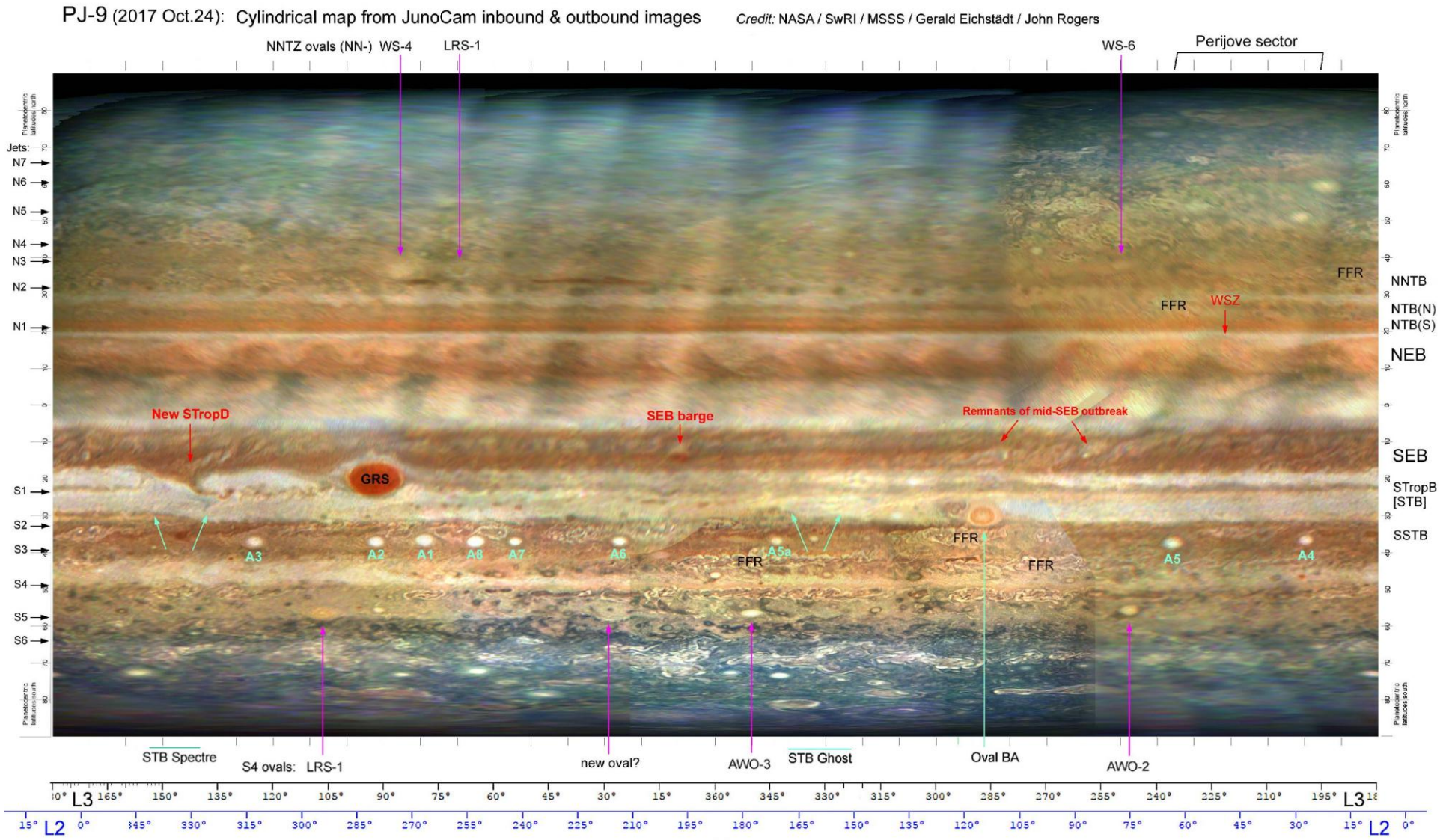
PJ-9 (2017 Oct.24): Cylindrical map from JunoCam inbound & outbound images
Credit: NASA / SwRI / MSSS / Gerald Eichstädt / John Rogers
NNTZ ovals (NN-)
WS-4
LRS-1
WS-6
Perijove sector
Jets:
N7
N6
N5
N4
N3
N2
N1
S1
S2
S3
S4
S5
S6
FFR
NNTB
FFR
WSZ
NTB(N)
NTB(S)
NEB
New STropD
SEB barge
Remnants of mid-SEB outbreak
SEB
GRS
STropB
[STB]
SSTB
A3
A2
A1
A8
A7
A6
FFR
A5a
FFR
FFR
A5
A4
STB Spectre
S4 ovals: LRS-1
new oval?
AWO-3
STB Ghost
Oval BA
AWO-2
L3
L2

Fig.2

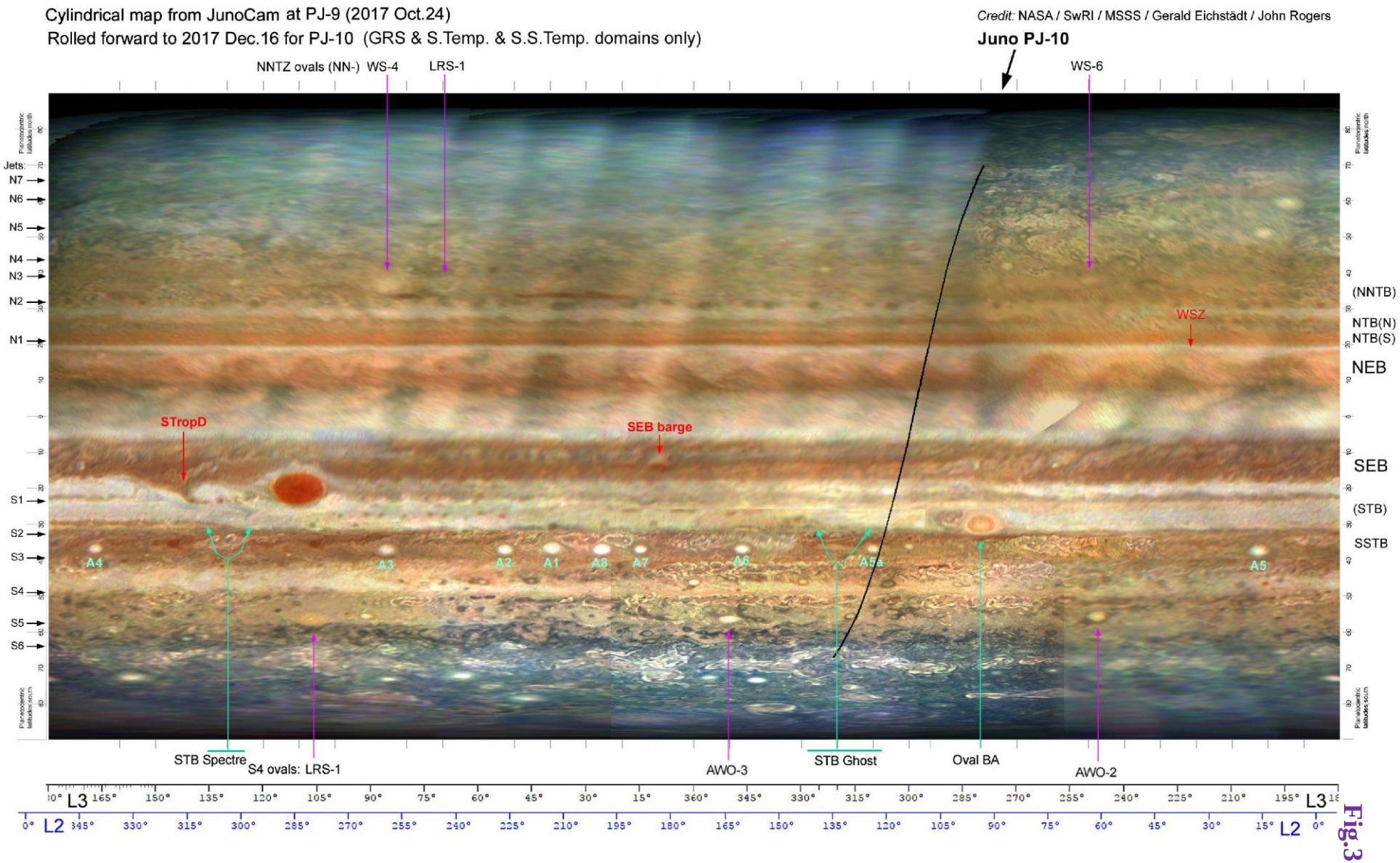
Cylindrical map from JunoCam at PJ-9 (2017 Oct.24)
Rolled forward to 2017 Dec.16 for PJ-10 (GRS & S.Temp. & S.S.Temp. domains only)
Credit: NASA / SwRI / MSSS / Gerald Eichstädt / John Rogers
Juno PJ-10
NNTZ ovals (NN-)
WS-4
LRS-1
WS-6
Jets:
N7
N6
N5
N4
N3
N2
N1
S1
S2
S3
S4
S5
S6
(NNTB)
NTB(N)
NTB(S)
NEB
SEB
(STB)
SSTB
WSZ
STropD
SEB barge
A4
A3
A2
A1
A8
A7
A6
A5a
A5
STB Spectre
S4 ovals: LRS-1
AWO-3
STB Ghost
Oval BA
AWO-2
L3
L2

Fig.3