This is a subset of slides from the SPWG telecon to show the discussion of Attitude Adjustment planning

31 May 2017

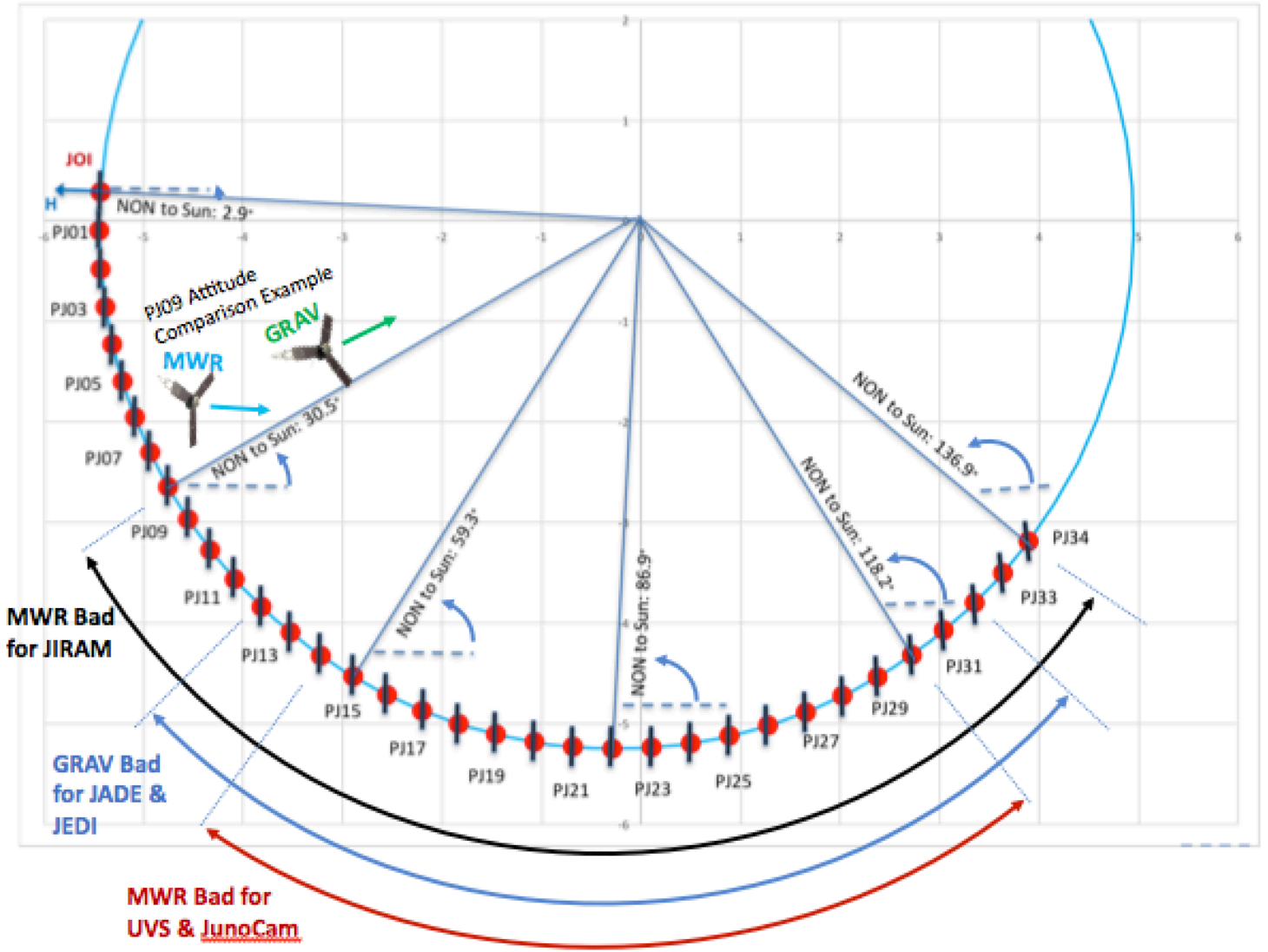
53-day orbit high-level Re-plan

The New Mission – recap from JST meeting

- PJ7 – PJ10:
  - The next uplink driven milestone is a mid-September (or earlier) decision on whether PJ9 is MWR tilt (current baseline) vs MWR nadir; no changes to PJ7-PJ8, which are MWR-nadir, GRAV, resp.; Decision: PJ9 will stay MWR tilt, PJ10 needs to be analyzed GRAV vs MWR (see "Attitude Analysis" slide)
  - GRS overflight trades will need to be finalized in August (after PJ7)
    - Gravity is happy with getting PJ21
    - No need to change current plan by swapping around longitudes
    - But final decision will be made after PJ7
- MWR xtrk orientation will be moved to PJ18 (from PJ12)
  - No impact to MWR science
  - PJ18 was viable possibility anyway wrt Gravity science
  - Allows better use of JADE, JEDI, UVS, JIRAM and JunoCam in PJ12 while geometry in nominal attitude is still OK (but which geometry – gravity or MWR?) Leave as open item for now – personnel concerns

Juno Orbit Geometry

#	Type	Time (UTC/SCET)	NON to Sun (°)	NON to Earth (°)
0	JOI	07/05/2016 02:47:32	2.9	12.0
1	PJ1	08/27/2016 12:50:44	2.9	2.8
2	Post-SM	10/19/2016 18:10:54	6.3	9.6
3	GRAV	12/11/2016 17:03:41	10.2	19.2
4	MWR	02/02/2017 12:57:09	14.3	23.0
5	MWR Tilt	03/27/2017 08:51:52	18.7	20.6
6	GRAV	05/19/2017 06:00:45	22.3	15.1
7	MWR	07/11/2017 01:54:51	26.4	16.0
8	GRAV	09/01/2017 21:08:57	30.5	23.6
9	MWR Tilt	10/24/2017 17:43:00	34.6	34.3
10	GRAV	12/16/2017 17:57:38	38.8	45.5
11	GRAV	02/07/2018 13:51:49	42.9	53.2
12	MWR XTk	04/01/2018 09:45:57	47.1	53.0
13	GRAV	05/24/2018 05:40:07	51.2	48.2
14	GRAV	07/16/2018 05:17:38	55.3	45.4
15	GRAV	09/07/2018 01:11:55	59.3	49.8
16	GRAV	10/29/2018 21:06:15	63.3	59.5
17	GRAV	12/21/2018 17:00:25	67.3	70.9
18	MWR XTk	02/12/2019 16:19:48	71.3	80.2
19	GRAV	04/06/2019 12:13:58	75.3	85.1
20	GRAV	05/29/2019 08:08:13	79.2	81.2
21	GRAV	07/21/2019 04:02:44	83.1	75.2
22	GRAV	09/12/2019 03:40:47	86.9	76.2
23	GRAV	11/03/2019 23:32:56	92.8	85.2
24	GRAV	12/26/2019 16:38:59	96.4	96.3
25	GRAV	02/17/2020 17:51:36	100.1	107.0
26	GRAV	04/10/2020 14:24:34	103.7	114.6
27	GRAV	06/02/2020 10:19:55	107.5	114.9
28	GRAV	07/25/2020 06:15:21	110.9	108.7
29	GRAV	09/16/2020 02:10:49	114.6	104.6
30	GRAV	11/08/2020 01:49:39	118.2	108.6
31	GRAV	12/30/2020 21:45:12	121.9	117.8
32	GRAV	02/21/2021 17:40:31	125.6	129.0
33	GRAV	04/15/2021 13:36:26	129.3	138.8
34	Extra	06/07/2021 09:32:03	133.1	143.8
35	Deorbit	07/30/2021 04:33:28	136.9	141.1



Updated charts shown in meeting will be emailed out separately

53-day orbit high-level Re-plan

The New Mission – recap from JST meeting

- Beyond PJ12 need to turn away from gravity orientation to restore JADE, JEDI, UVS, JIRAM and JunoCam viewing geometry
  - Need common terminology to describe offset angles – done, see previous slides
  - Mission planning team will supply c kernels for GRAV, MWR, MWR tilt, MWR cross-track, plus 30-deg and 60-deg off-Sun for specific orbits
- Gravity team feedback:
  - Want to keep PJ21 (GRS) and PJ23 (occultation)
  - Willing to give up PJ24 and PJ32 right now
  - Other pj's also a possibility but don't want to lose several in a row
- Ad hoc working group came up with first cut (next page)
- Power will be an important constraint – project is working on a new tool to estimate power as a function of angle off-sun – will see first results in June 21 SPWG telecon
- MWR would like consideration of another degree of freedom to tilt northward after orbit 18 due to orbit rotation southward – is this possible?

Orbit #	Current S/C Attitude	Orbits Gravity science is flexible	MWR tilts bad for JIRAM?	MWR tilts bad for UVS?	MWR tilts bad for Juno Cam?	Preliminary orbits scoped to support JADE/JEDI auroral observations
5	MWR					
6	Grav					
7	MWR-n					
8	Grav		Y*			
9	MWR-t		Y*			
10	Grav		Y*			X
11	Grav		Y*			
12	MWR-xtk		Y*			
13	Grav	X	Y*			X
14	Grav		Y	Y	Y	
15	Grav		Y	Y	Y	
16	Grav		Y	Y	Y	
17	Grav	X	Y	Y	Y	X
18	MWR-xtk		Y	Y	Y	
19	Grav		Y	Y	Y	
20	Grav	X	Y	Y	Y	X
21	Grav		Y	Y	Y	
22	Grav		Y	Y	Y	
23	Grav		Y	Y	Y	
24	Grav	X	Y	Y	Y	X
25	Grav		Y	Y	Y	
26	Grav		Y	Y	Y	
27	Grav		Y	Y	Y	
28	Grav	X	Y	Y	Y	X
29	Grav		Y	Y	Y	
30	Grav		Y	Y	Y	
31	Grav		Y			
32	Grav	X	Y			X
33	Grav		Y			

Attitude Analysis

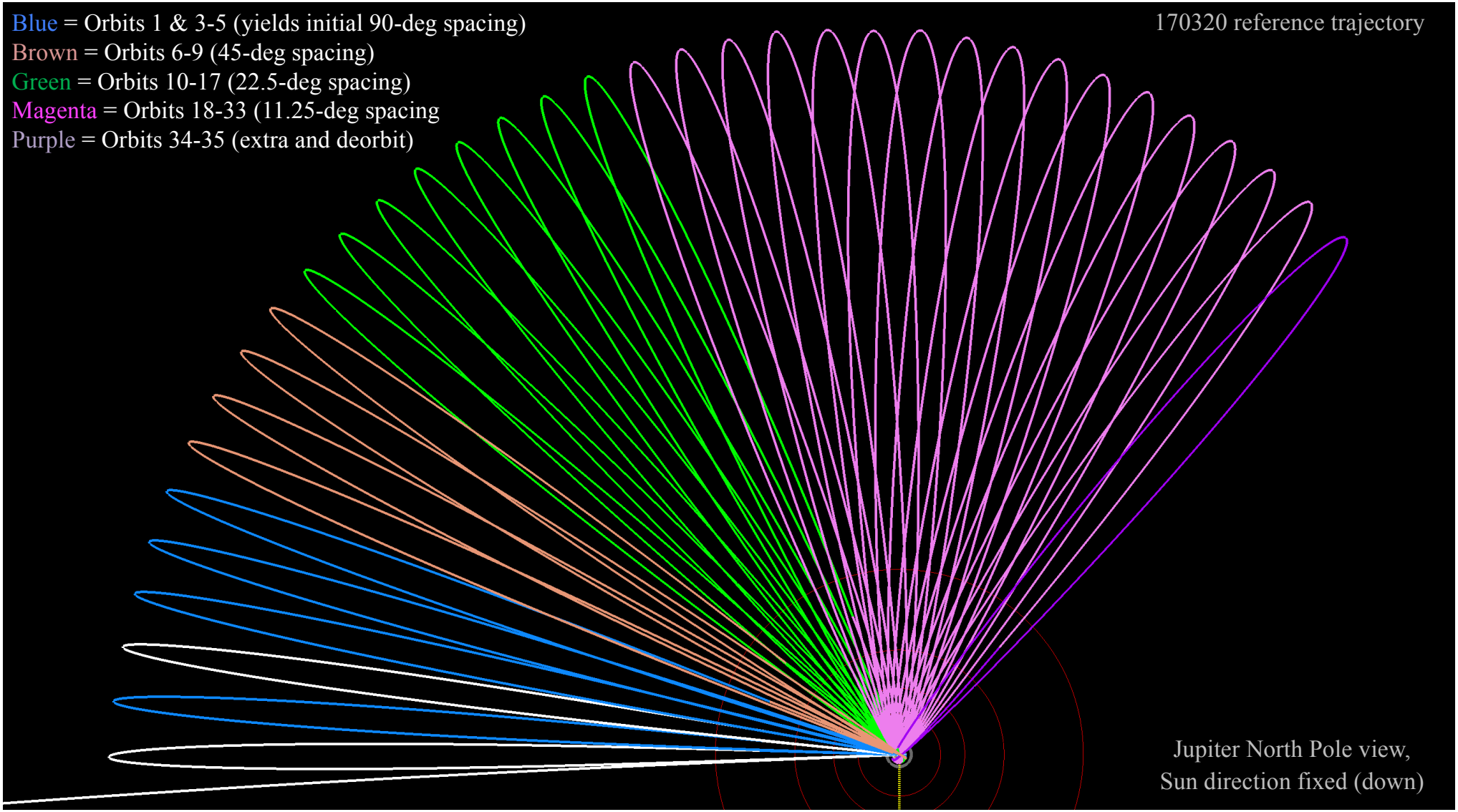
- JIRAM identified PJs with a (*) to denote that they have a higher preference to not do MWR orientation because of the expected radiation aging effects on their radiator paint (i.e., thermal issues)
- Highlighted rows represent the preliminary list of PJs to support a “MWR-like” tilt for the particle instruments. This was discussed with UVS, JIRAM, JADE and JEDI.
- Marty and Stuart will produce C-Kernels for the typical tilts (grav, mwr, xtrack, etc.) plus 30 and 60 degree off Sun cases for evaluation of these specific orbits
- Engineering data is still needed (e.g., duration of tilt, instrument keep out durations, when can we start the re-orientation, etc.).

New PJ Dates

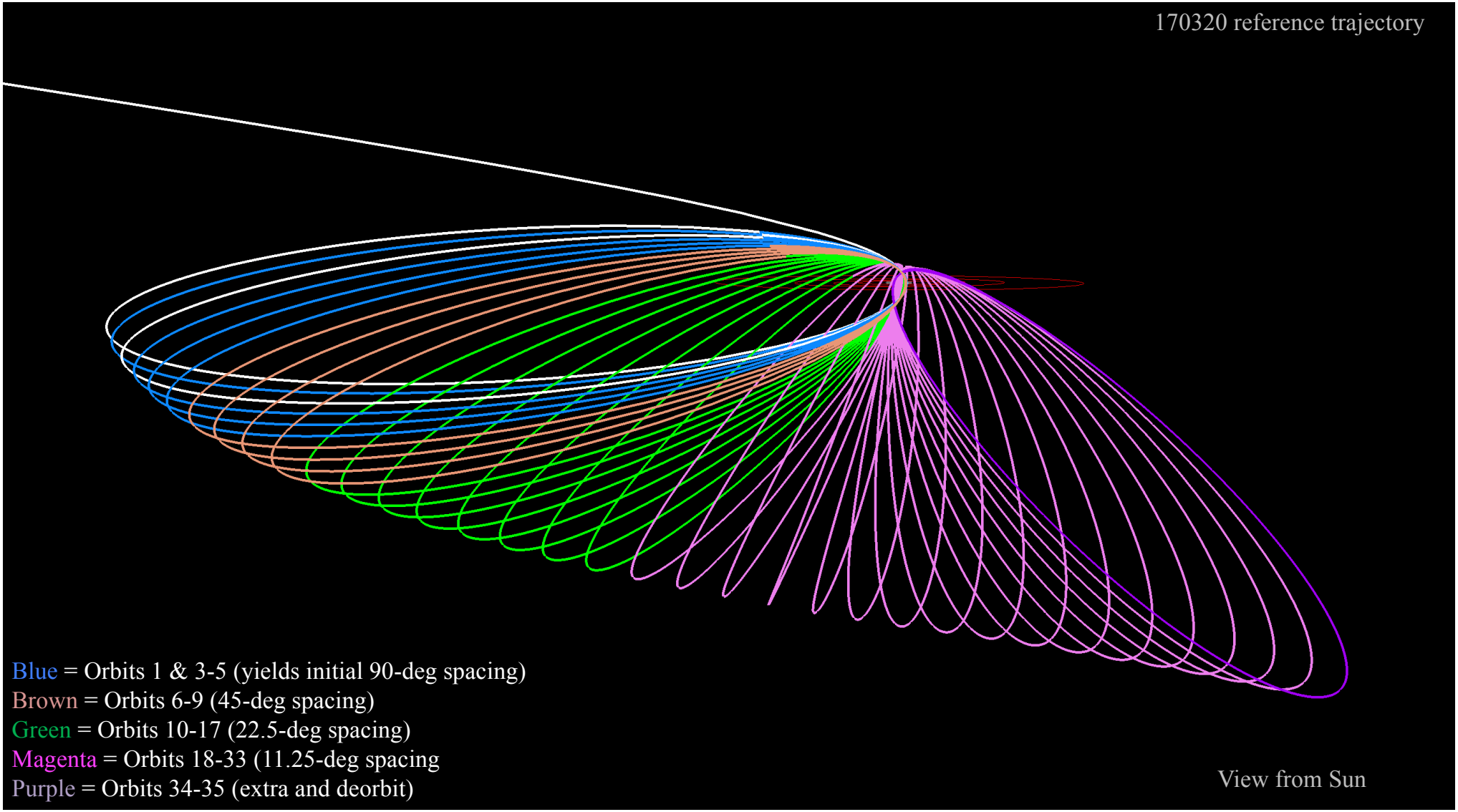
Dates for 53 day orbits, near-term

- PJ-02: Oct 19, 2016
- PJ-03: Dec 11, 2016
- PJ-04: Feb 2, 2017
- PJ-05: Mar 27, 2017
- PJ-06: May 19, 2017
- PJ-07: July 11, 2017
- PJ-08: Sept 1, 2017
- PJ-09: Oct 24, 2017 (conjunction on Oct 26, 2017)
- PJ-10: December 16

Trajectory plots [1/2]
View from North pole

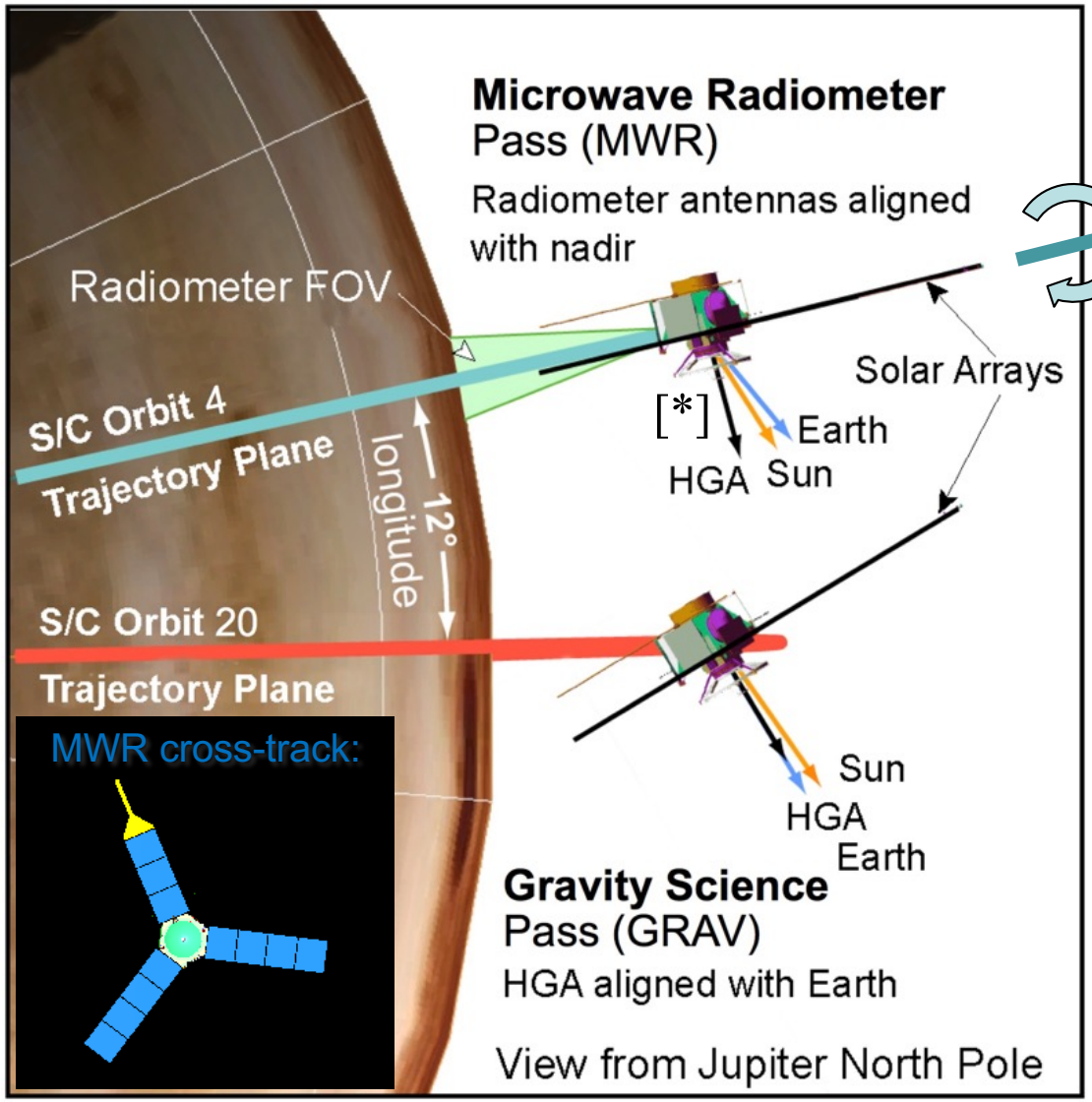


Trajectory plots [2/2]
View from Sun



Perijove attitudes: GRAV, MWR, MWR tilt, and MWR cross-track

- **GRAV** and **MWR** PJ attitudes are shown below, along with **MWR tilt** attitude:
  - The MWR tilt attitude would bring the head of the +Z S/C spin axis vector, the one pointing toward the HGA [*], up and out of the paper (negative 14º rotation about Jupiter-to-Juno vector, using the right-hand rule).
  - The MWR cross-track attitude would orient the +Z S/C spin axis parallel to the Jupiter N pole vector (with ~90-deg turns before/after, and putting solar arrays off-Sun, similar to main engine burn attitude).



MWR tilt:

–14º rotation about the ...

Jupiter-to-Juno vector

(–14º is clockwise if we look down on the pointy end of the arrow)