Results of planet tracking testing during the week of 2007Aug19-24

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Description

There are 2 implementations of planet tracking in the executor:

1. "old-style". This is a implementation which relies on an internal ephemeris within the executor. When an OBSERVE file with //PM cards is run through *obs2script*, that program will then take the right steps to call the necessary methods within the executor (using PlanetInterferometerModel as the model). This has been available within the executor for at least several months.
2. "new-style". This is an implementation which allows the user to specify, by calling certain methods from the EVLA script, the position and rate of the body in RA and DEC explicitly. This is not implemented within *obs2script*, and so the script has to be hand-modified (to make calls to PolynomialInterferometerModel). This has really only been available for testing for about the past week.

The "old-style" tracking had been tested once in real scientific observing, with project AB1254. In that observation, it was clear that the planet was tracked, but there was an offset in the image. Since that time, Barry has worked on this tracking method fairly extensively, so we needed tests of both techniques as they are implemented now.

Tests this week

I've done 4 tests of substance this week:

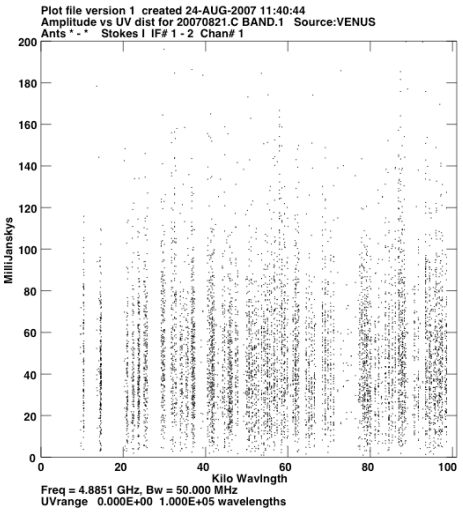
Run	Body	Band	UTC Date	LST range
1	Venus	C	2007Aug21	61054/0730-0800
2	Mars	C	2007Aug23	61056/0000-0100
3	Mars	C	2007Aug23	61056/0700-0800
4	Mars	C	2007Aug24	61056/2300-2400

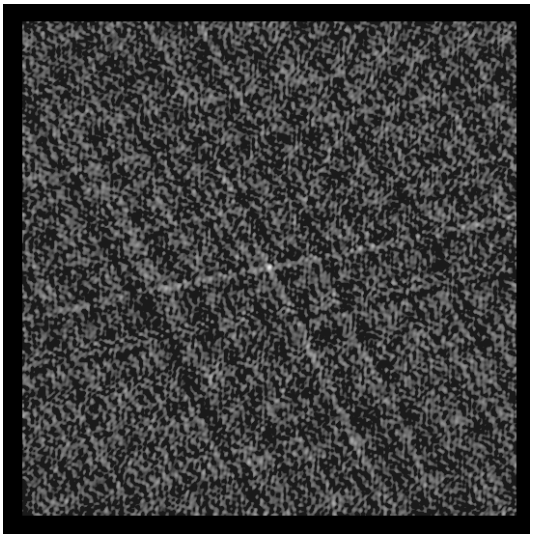
In all of these tests, I have a set of old-style scans followed by a set of new-style scans (3 each, varying length based on the entire observation length), interleaved with calibrator scans. No attempt is made to do flux density scale setting – these tests are just for testing the tracking.

Run 1

Venus is big – around 58" diameter at the time, and we're in A configuration. So we're way out in the visibility function, but simulations showed that we should still see around 500 mJy of flux density on short spacings (zero-spacing flux density at C-band was around 31 Jy).

Old-style





There is no correlated flux density apparent in the visibilities, and in the image, Venus is totally absent. There is, however, a "fake" source at the phase center. The magnitude of this source is ~4 mJy.

New-style

Basically the same as the old-style, but no source at the phase center.

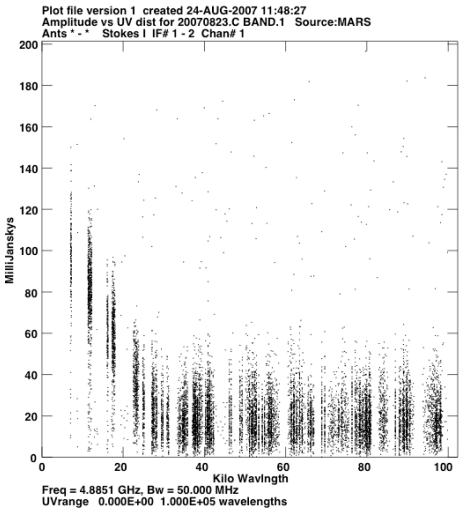
Comments

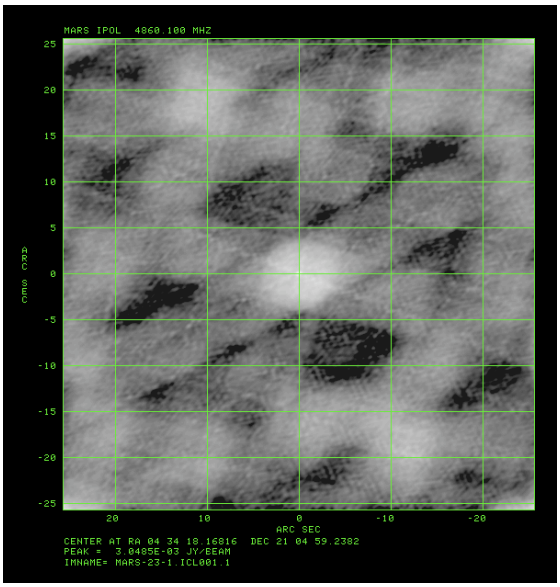
Unclear if planet tracking worked because of the size of Venus – might just be totally resolved out. It is also unclear what the cause of the "fake source" at the phase center is.

Run 2

Mars is much more reasonable than Venus, but still relatively large to A configuration even at C-band – around 7.7" in diameter. Expected flux density is around 160 mJy, though, and we do get some samples at the shortest spacings that are in the first lobe of the Bessel function.

Old-style





There is clearly correlated flux density in the visibilities. The image also looks very good – you can clearly see the planet, with a sharp limb, and it is well-centered. However, that pesky fake source at the phase center is there again. The level of the source above the background planet flux density is ~1.5 mJy.

New-style

I made an error when calculating the positions and putting them into the script by hand (factor of 2 too small), so we didn't have useful data for the new-style tracking from this run.

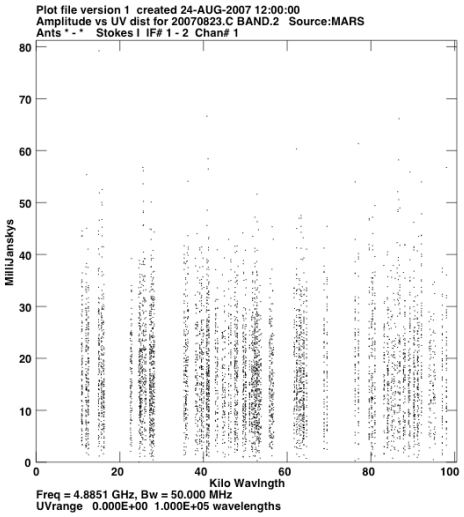
Comments

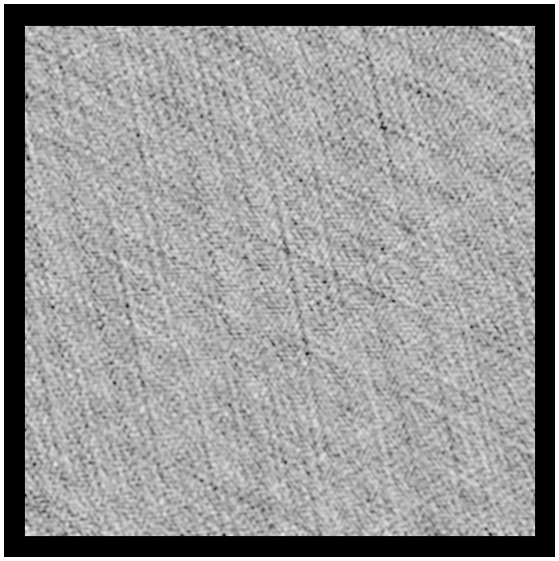
It seemed at this point that at least the old-style tracking had been fixed up. However, there was this poorly understood problem with "fake sources" at the phase center, which occurred in both of the old-style tests.

Run 3

Simply a repeat of Run 2, but with the new-style tracking bug of mine fixed.

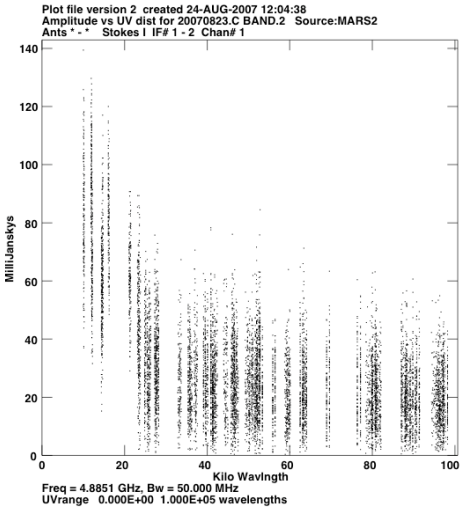
Old-style

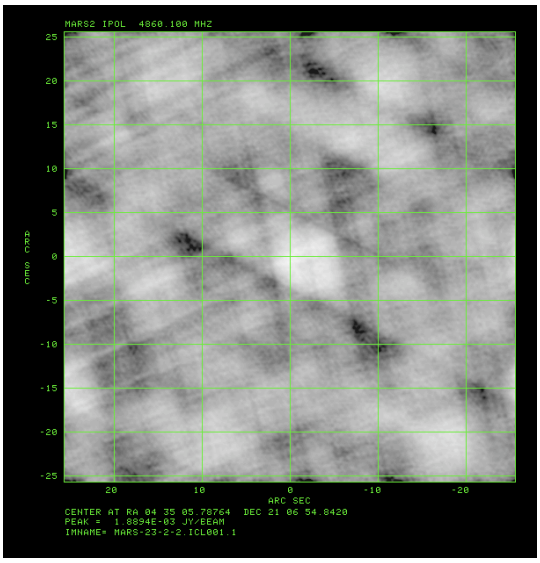




No flux density apparent in the visibilities and nothing in the map.

New-style





Flux density is apparent in the visibilities, and the planet is in the image, albeit fairly noisy. The planet is offset from the phase center by about 2” in RA (west) and 0.1” in DEC (south).

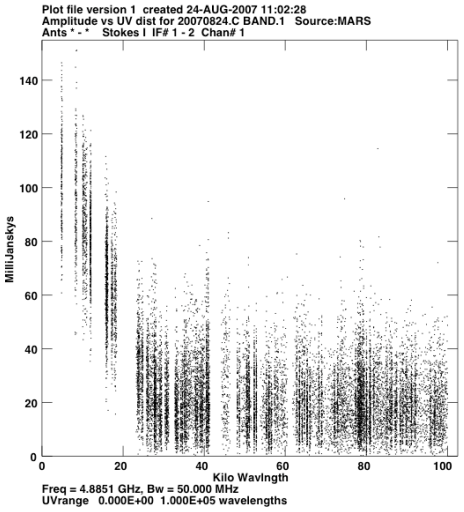
Comments

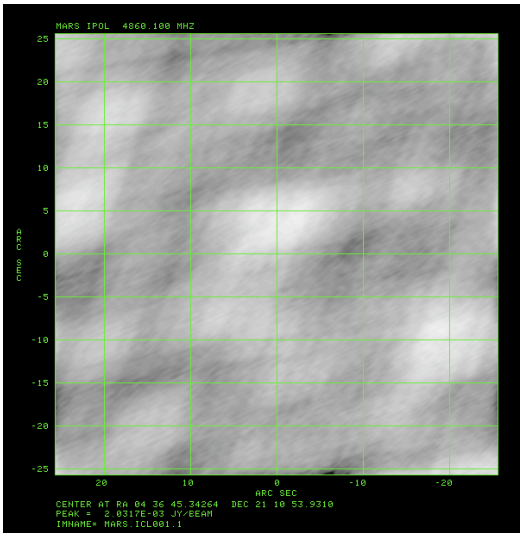
This was the first real test of the new-style tracking, and it seemed to work fairly well, aside from the offset. I was now quite confused about the state of the old-style tracking, however, as it clearly failed here.

Run 4

Another repeat, since I was confused about how things were working.

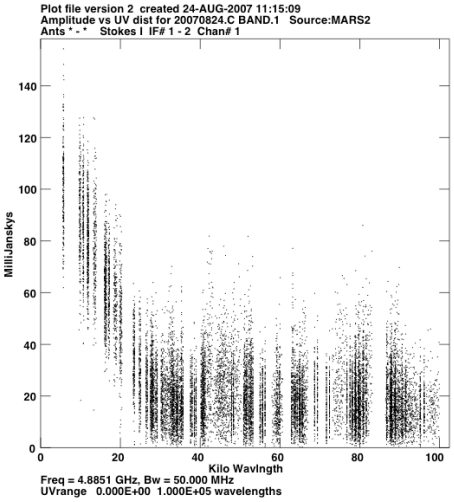
Old-style

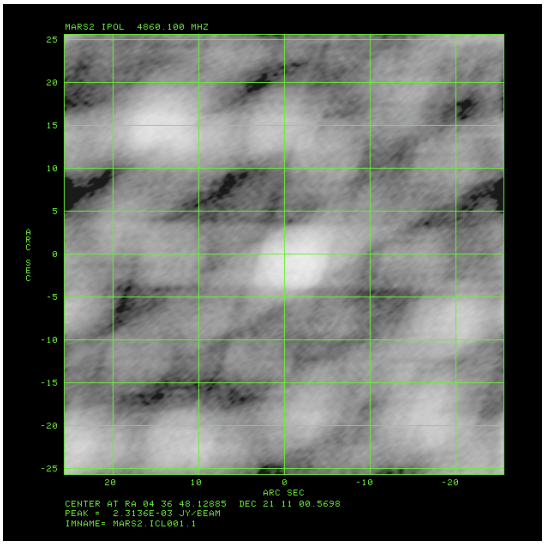




There is clearly correlated flux density in the visibilities, but the dirty image is very odd – quite diffuse and the “main” blob seems to be around 5” north of the phase center. This might just be due to phase fluctuations, and a weak distributed source in A configuration, but the calibration looks good, as does an image of the calibrator from this part of the data.

New-style





Once again, clearly correlated flux density in the u-v data, and the dirty image now looks much better – relatively sharp limb, etc. It is, however, offset from the phase center, by roughly 1.5” in RA (west) and 0.5” in DEC (south).

Comments

The new-style result seems consistent with the previous one – the planet was tracked reasonably, with an offset (which is consistent between the two observations, one of which is with source rising, the other setting). I am still now confused about the state of the old-style tracking. Perhaps the results from Run 3 were a fluke, and those from Run 4 can be written off as phase fluctuations, but I’m concerned.