HERA Memo 74
HERA Dish Surface Inspection and Some Proposed Metrics

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The HERA calibration strategy relies on repeatability between antennas. Though the overall specification for construction accuracy is 2cm, in practice there are places this level of accuracy is difficult to achieve. One obvious point of difficulty is the surface of the dish. Dish surface roughness can vary dramatically from dish to dish with deviations as large as 20cm but the effect of these deviations in the array performance is not currently known. In the recent IDR2.2 analysis several antennas were flagged due to their overall "lack of redundancy". Dish surface quality could be a potential cause of non-redundancy. We investigate this possibility by surveying dish surface quality and hypothesizing a causal relationship to redundancy. As a first step we perform a qualitative survey of a selection of antennas, using the following criteria, with the goal of developing a simple grading scheme which can be regularly evaluated by anyone on site[1].

1 PVC Quality

The radial pvc pieces that leave the hub should sit flush with the top of the pvc extending from the hub to ensure the correct dish shape. Many pvc radials have fallen or are sagging as they are often stepped on when raising feeds. See Figure 1 for an example of some bad pvc connections exiting the hub.

Figure 1: An example of PVC radials that have fallen from their desired position.

2 Mesh Overlap

The mesh pieces that make up the surface of the dish require a sufficient amount of overlap (several inches) between sections. Lack of sufficient overlap and ripples in the mesh material which prevent panels from being in contact are problematic.

[1]Thanks to Dave DeBoer for helping us come up with these criteria

3 Mesh Sag

Instead of being taut and flat, many mesh panels (pieces of mesh that rest between pvc radials) sag significantly. Most sag seen in antenna panels tend toward the panels adjacent to the door in the dish. But, some antennas also showed significant sag (a few to several cm) on panels far from the door. An example of a saggy panel can be seen in Figure 2.

Figure 2: Mesh panels between PCV radials, if not taut, can sag and form ripples in the mesh surface.

4 Mesh Ripples

Ripples on the mesh surface of the antenna are also common where panels sag and/or are not taut. Sufficient ripples can cause a differing antenna gain (see Ruzes equation). Some mesh ripples, which are difficult to capture in a photo, can be seen in Figure 2.

5 Door

The door should ideally be indistinguishable from the adjacent mesh panels, so doors that are improperly fastened or bent are potentially problematic.

6 Overall

The overall score (see Fig. 3) is weighted primarily by the ranking for PVC quality as this should most significantly affect the antenna beam. Antennas with a score of one should be inspected and improved. Antennas with a score of two should be inspected, but may not need much work to bring up to a score of three.

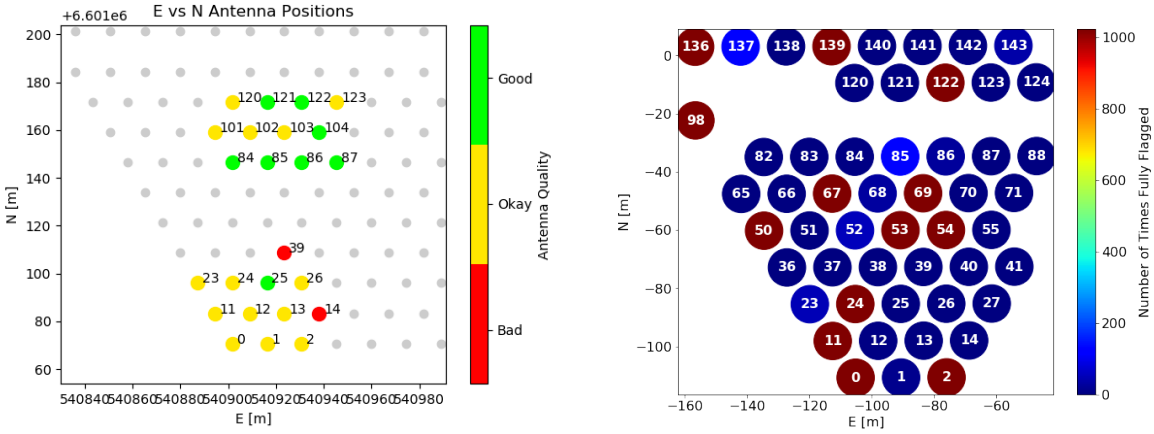

Figure 3: (Left) Overall scores for node 0 and node 9 antennas from tables 1 and 2, respectively. (Right) The number of times a given antenna has been flagged entirely in a dataset throughout all of IDR2.2 for comparison with antennas flagged as potentially non-redundant.

Table 1: Node 0 Antenna Scores

Ant	PVC	Mesh Overlap	Mesh Sag	Mesh Ripples	Door	Overall
0	1	2	3	2	3	2
1	1	3	3	2	3	2
2	1	3	3	2	3	2
11	3	3	2	2	1	2
12	1	3	3	2	3	2
13	3	3	2	2	1	2
14	1	2	2	2	3	1
23	3	3	2	2	1	2
24	2	2	1	2	2	2
25	3	2	3	3	3	3
26	3	2	2	2	2	2
39	2	3	2	2	0	1

Table 2: Node 9 Antenna Scores

Ant	PVC	Mesh Overlap	Mesh Sag	Mesh Ripples	Door	Overall
84	3	3	3	2	0	3
85	3	3	3	3	0	3
86	3	3	3	2	0	3
87	3	2	3	2	0	3
101	1	3	3	3	0	2
102	1	3	3	2	0	2
103	1	3	3	2	0	2
104	2	3	3	3	0	3
120	3	2	2	1	0	2
121	3	2	3	2	0	3
122	3	3	2	2	0	3
123	2	3	2	2	0	2