ETA Array Specification

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1 Introduction

This document serves as the specification for the Eight-meter-wavelength Transient Array (ETA), to be constructed on the campus of the Pisgah Astronomical Research Institute (PARI). This specification addresses the location and geometry of the array elements, the electronics hut, and connections between the elements and the electronics hut.

2 Site Description

The site designated for ETA is shown in Figure 1. "West Array Area" refers to the field west of PARI Buildings 12 and 17. "East Array Area" refers to the field east of the PARI 12-meter dish.

3 Equipment Hut

PARI Building 17 is indicated as the “ETA Electronics Building” in Figure 1, and shall serve as the “Equipment Hut” as described in the ETA NSF proposal.
Figure 2: Detail of Building 17 area showing approximate positions of antenna stands (indicated using “×”). Building 17 is the thin rectangular building close to the origin of the coordinate axes.

4 Antenna Stand Locations

4.1 Definition of Terms

ETA includes an array of 12 dual-polarization antennas. Each of these is mounted on an antenna “stand”; thus, there are 12 antenna stands. The details of the antennas themselves (including the stands) shall be specified in a separate document. This document specifies the locations of the antenna stands and how they are connected to Building 17.

The 12 ETA antenna stands are organized into the following groups:

- The “Core Array”, which consists of 10 stands in a circular geometry, in the West Array Area.
- The “North Outrigger”, which is a single stand located in the West Array Area.
- The “East Outrigger”, which is a single stand located in the East Array Area.

Figure 2 shows in greater detail the West Array Area, includig the stands of the Core Array and the North Outrigger.

4.2 Core Array Antenna Stands

The Core Array consists of a single central antenna stand, henceforth referred numbered “1”, surrounded by 9 stands in a circle of radius 8 m (ft), numbered “2” through “10” as indicated in Figure 3.
<table>
<thead>
<tr>
<th>Stand ID</th>
<th>$x$ (m)</th>
<th>$y$ (m)</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.00</td>
<td>0.00</td>
<td>±8 cm (3 in)</td>
</tr>
<tr>
<td>2</td>
<td>4.95</td>
<td>1.16</td>
<td>±8 cm (3 in)</td>
</tr>
<tr>
<td>3</td>
<td>1.12</td>
<td>6.37</td>
<td>±8 cm (3 in)</td>
</tr>
<tr>
<td>4</td>
<td>-3.23</td>
<td>5.60</td>
<td>±8 cm (3 in)</td>
</tr>
<tr>
<td>5</td>
<td>-6.08</td>
<td>2.21</td>
<td>±8 cm (3 in)</td>
</tr>
<tr>
<td>6</td>
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<td>-2.21</td>
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<tr>
<td>7</td>
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<tr>
<td>8</td>
<td>1.12</td>
<td>-6.37</td>
<td>±8 cm (3 in)</td>
</tr>
<tr>
<td>9</td>
<td>4.95</td>
<td>-4.16</td>
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</tr>
<tr>
<td>10</td>
<td>6.47</td>
<td>0.00</td>
<td>±8 cm (3 in)</td>
</tr>
</tbody>
</table>

Figure 3: Geometry of the Core Array antenna stands. “$x$” refers to location relative to Stand 1 along the East-West baseline, where $x > 0$ is East. “$y$” refers to location relative to Stand 1 along the North-South baseline, where $y > 0$ is North.

Stand 1 shall be located within 2.0 m (6.6 ft) of the following location: 18.3 m (60 ft) West, and 15.2 m (50 ft) South of the center of the West-facing wall of Building 17. (Note: This places the center of the Core Array roughly half-way between two prominent concrete slab-covered access holes in the West Array Area.)

4.3 North Outrigger
The North Outrigger stand be known as “Stand 11” and shall be located approximately 46 m (150 ft) North of the center of the West-facing wall of Building 17, approximately centered in the grassy strip West of the parking area. It is required that the location of this antenna stand be determined to within 8 cm (3 in) accuracy after installation.

4.4 East Outrigger
The East Outrigger stand shall be known as “Stand 12” and shall be located in the East Array Area. This stand shall be located as far East as possible, subject to the following constraints:

- The total cable length from Stand 12 to Building 17 shall be less than 152 m (500 ft).
- The stand shall be located approximately half-way between the Northern and Southern edges of the field.

It is required that the location of this antenna stand be determined to within 8 cm (3 in) accuracy after installation.

5 Signal Connections Between Stands and Building 17
5.1 Each stand shall be connected to Building 17 via 2 parallel runs of coaxial cable, corresponding to the two polarizations of the antennas mounted to the stand.

5.2 The cable path from the antenna stand to Building 17 shall follow the shortest practical route. There is no requirement for the cable length from stand to stand to be equal, or to be known exactly.

5.3 All cable should buried at least 30 cm under the surface of the ground.

5.4 All underground cable shall be contained within suitable waterproof conduit. Buried cable should at no point make direct contact with the soil or other natural material. The conduit shall be sufficiently large in diameter so as to facilitate the later removal and reinstallation of cable by pulling through.
5.5 RG223-type coaxial cable is preferred. RG58-type coaxial is an acceptable substitute under the condition that no more than two cables are allowed to run in parallel and within 10 cm over a length greater than 1 m.

5.6 All installed cable must be “fresh” (i.e., previously unused). There shall be no splices or connectors other than those required at Building 17 and the antenna stands.

5.7 The connectors at each end of the cables shall be of Type PL-259 (i.e., “UHF” male connectors). A sturdy heat shrink wrap shall be applied over the seam where the cable emerges from the connector sheath, for additional mechanical support and to discourage moisture penetration.

5.8 Each cable manufactured and installed shall be labeled sequentially, starting with the designation “W1” and continuing to “W2”, “W3”, “W4”, and so on. This identification shall be independent of any association with antenna stands; i.e., there is no requirement for W1 to be attached to stand 1. (These labels are analogous to serial numbers, and are used solely to identify cables. The purpose of the prefix “W” is to avoid confusion between numbers; e.g., “6” and “9”.)

5.9 Cable identification markers shall be permanently attached to both ends of any cables installed. The marker shall indicate the cable’s unique identification number (see above). The marker shall be printed electronically on sturdy UV-resistant heat & shrink wrap tubing, and applied between 6 in and 12 in from the end of the cable. A suitable cable tagging system is the Kroy K4100 or equivalent.

5.10 3 m of excess cable shall be provided at both ends. The purpose of this excess is to facilitate testing, maintenance, and minor routing changes.

5.11 Two additional cables (i.e., total of 4) shall be installed to the vicinity of Stand 1. This is to facilitate testing, maintenance, and bypassing of cables in the Core Array as needed after installation. These cables may either share the same conduit as the Stand 1 cables, or may be installed in separate conduit.

5.12 One additional cable (i.e., total of 3) shall be installed to each of the outriggers (Stands 11 and 12). The third cable in each case is to serve as a spare, testing, or for maintenance.

6 Power Connections Between Stands and Building 17

Each antenna stand may require as much as 2.5 A at 12 V DC power. Power will be generated at Building 17 and shall be distributed to antenna stands using cables.

6.1 Power cables shall consist of three parallel conductors of 12 AWG or larger diameter in a single PVC jacket, suitable for underground installation; Southwire Type UF-B or similar. (Three conductors facilitates independent control of power to two polarizations of the active balun, and further allows smaller gauge wire to be used.)

6.2 The voltage drop must not be greater than 6 V over 500 ft.

6.3 Power cable shall be routed in parallel with the coaxial cable to the same stand. Provisions 5.4,6,9, and 10 above apply equally to power cables. Exception: Power cable may be spliced.

6.4 Each power cable manufactured and installed shall be labeled sequentially, starting with the designation “P1” and continuing to “P2”, “P3”, “P4”, and so on. This identification shall be independent of any association with antenna stands; i.e., there is no requirement for P1 to be attached to stand 1. (These labels are analogous to serial numbers, and are used solely to identify wires. The purpose of the prefix “P” is to avoid confusion between numbers; e.g., “6” and “9”.)