DATA RECORDING AT NATIONAL RADIO ASTRONOMY OBSERVATORY: The VLBA Recording System

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VLBA RECORDING SYSTEM

- Modified Metrum Model 96 Drive
- 2 Acquisition Drives Per Site
- 24 Playback Drives At Socorro Correlator
- 21 Hours Of Recording Without Tape Change at 128 Mbits/Secons With 2 Drives

TAPE MEDIUM

- 1” Wide Tape On 14” Reel
- 15 Microns Thick
- 18,000 feet of tape per reel
- Bit Density - 25 Mbits/Square Inch
- 5 Tera Bits/Tape

VLBA RECORDER HEADSTACK

- Manufactured by Metrum and Spin Physics
- Inductive Ferrite Heads
- 36 Heads
- Head Pitch = 698.5 Microns
- Track Width = 38 Microns
- Head Gap = 330 nm
- Read and Write With Same Heads

HEADSTACK MOVEMENT

- Inchworm Motor Moves The Headstack
- Head Moves With 1 Micron of Accuracy
- LVDT Measures Headstack Position
- Range Of Motion Is ~650 Microns, In Normal Recording
- Actual Range Is >2000 microns
- Headstack Can “Peak” on Track During Read

TRACK ARRANGEMENT

- Tracks Are Longitudinal
- 32 Tracks Are Written Each Pass
- A Different Headstack Position Is Used For Each Of 14 Passes
- 448 Tracks Are Written On The Tape
- Track Pitch Is 48 Microns
- Forward/Reverse Guardband is 62 Microns

ACQUISITION DRIVE CAPABILITIES

- Write 36 Tracks At One Time (32 Data Tracks + 4 System Tracks)
- 40, 80, And 160 ips Recording Speeds
- Read 2 Tracks At One Time (Can Cycle Through All 36 Tracks, 2 At A Time)
- Data Quality Can Be Check (Parity Errors, Resync Errors, No Sync Errors)

Playback Drive Capabilities

- All Tracks Can Be Read At One Time
- No Write Capability
- Data Quality Is Checked In Playback Interface (Interface Between Playback Drives And Correlator)
- 160 ips Playback Speed

VLBA FORMATTER

- Accepts 32 Digital Data Streams, Each At 32 MHZ
- Multiplexing/Demultiplexing Capabilities
- Provides Time Stamp For Data, Based On A Hydrogen Maser
- Barrel Roll Spreads Lost Data From A Dead Track Among All Tracks
- Performs Quality Analysis On Recorded Data

FORMAT OF VLBA DATA

- 22,680 Bits/Frame
- 9 Bit Bytes, With 9th Bit Parity
- NRZM Encoding Of Data
- Header Includes Sync Word, Time, CRCC Check Over Time Field, Track ID, Channel ID, Headstack Position, Station ID

SOCORRO OPERATIONS

- Tapes Are Shipped From VLBA Sites To Array Operations Center In Socorro, NM
- All Tapes Are Played Back At One Time
- Correlator Has 20 Inputs From 24 Playback Drives
- Speed Corrections Sent To Each Drive To Keep All Drives Synchronized
- Operator Monitors Playback Quality

PLAYBACK INTERFACE

- Deformats Data
- Gathers Data Quality Information
- Routes Data To Correlator

VLBA CORRELATOR

- Does FFT On Incoming Data
- Correlation Is Done By Pairwise Multiplication Of Station Spectra
- Output Is Stored On DAT For NRAO Archive - This Is Not Just Backup!
- Astronomer Receives Data On Dat or Exabyte

SCIENTIFIC RESULTS

- Astronomer Can Determine Size, Shape, Distance, Movement, Composition, And Other Properties Of Object Being Observed
- Results Often Displayed In Form Of Map
- Observing At More Wavelengths Gives More Information - Optical And Radio Astronomy Can Work Hand In Hand