

The Bonn Astro/Geo Mark IV Correlator

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Abstract

The Bonn Mark IV VLBI correlator is operated jointly by the MPIfR and the GIUB in Bonn and the BKG in Frankfurt. In 2004 Gbit/s correlation and ftp-VLBI fringe tests were conducted successfully for the first time.

1. Introduction

The Bonn Mark IV correlator is hosted at the Max-Planck-Institut für Radioastronomie (MPIfR)¹, Bonn, Germany. It is operated jointly by the MPIfR and by the Bundesamt für Kartographie und Geodäsie (BKG)² in cooperation with the Geodätisches Institut der Universität Bonn (GIUB)³. It is a major correlator for geodetic observations and MPIfR's astronomical projects.

2. Present Status and Capabilities



Figure 1. Left: correlator surrounded by two Mark 5 playback units and two station units. Center: six rack-mounted Mark 5 playback units. Right: tape drive with station unit on top.

The Bonn correlator (Fig 1) is one of the four Mark IV VLBI data processors in the world. It has been operational since 2000. A summary of the Bonn correlator capabilities is presented in Table 1.

¹<http://www.mpifr-bonn.mpg.de/div/vlbicor/index.e.html>

²http://www.ifag.de/index_english.htm

³<http://www.gib.uni-bonn.de>

Table 1. Correlator Capabilities

Playback Units

Number available:	9 Mark IV tape drives, 8 Mark 5A systems (interchangeable)
Tape types:	Thick, thin
Playback speeds:	80 ips, 160 ips (thin tapes); 135 ips, 270 ips (thick tapes) up to 1024 Mbit/s (Mark 5A)
Formats:	Mark III/Mark IV/VLBA (Mark IV/VLBA w/wo barrel roll, data demod.)
Sampling:	One bit; two bit
Fan-out:	1:1 1:2 1:4
Fan-in:	Not supported
No. channels:	≤ 16 USB and/or LSB
Bandwidth/channel:	(2, 4, 8, 16) MHz
Signal:	Mono, dual frequency; dual polarization
Modes:	128-16-1 128-16-2 128-8-1 128-8-2 128-4-1 128-4-2 128-2-2 256-16-1 256-16-2 256-8-1 256-8-2 256-4-2 512-16-2 512-8-2 1024-16-2

Correlation

Geometric Model:	CALC 8
Number of boards:	16
Phase cal:	Single tone extraction at selectable frequency
Pre-average times:	0.2 s to 5 s
Lags per channel:	32 minimum, 2048 maximum; 1024 tested and used
Maximum output:	9 stations: 36 baselines, 16 channels, 32 lags with autocorrelation function (ACF) without circular polarization (CP); 8 stations: 28 baselines, 16 channels, 32 lags with ACF with CP
Fringe-fit:	Off-line FOURFIT run
Export:	Data base, MK4IN to AIPS

The correlator is controlled from a dedicated workstation. Correlation setup, data inspection, fringe-fitting, and data export are done with a separate workstation. Per year about 300 Gbyte to 400 Gbyte of correlated data are generated. The total disk space available for data handling at the correlator is 1000 Gbyte. Data security is guaranteed by using a file system with redundancy (RAID level 5) and by daily back-up of the data on a 120 Gbyte disk of a low-end Linux PC.

3. Staff

The people in the geodetic group at the Bonn correlator are

- Arno Müskens: group leader, overall experiment supervision, scheduling of T2, OHIG and EURO series.
- Alessandra Bertarini: experiment setup and evaluation of correlated data, media shipping.
- Alexandra Höfer: experiment setup and evaluation of correlated data, media shipping.
- 10 student operators for the night shifts and the weekends.

MPIfR staff supports IVS correlation with

- Walter Alef: correlator manager, correlator software maintenance and upgrades, and computer system administration.
- David Graham: technical development, consultant.
- Heinz Fuchs: correlator operator, responsible for the correlator operator schedule, daily operations, and tape shipping.
- Hermann Sturm: correlator operator, correlator support software, tape shipping.
- Michael Wunderlich: engineer, correlator and playback drive maintenance, Mark 5 support.
- Rolf Märtens: technician, playback drive maintenance, Mark 5 support.

4. Status

In 2004 the Bonn group correlated and released 50 geodetic experiments: 10 T2, 29 R1, four EURO, five OHIG, the NORD01 experiment and the VIEPR1 experiment (diploma thesis project).

To improve the monitoring of the Terrestrial Reference Frame (TRF), the IVS Observing Program Committee (OPC) decided to enlarge the T2 sessions to as many as 16 stations (for more details see the IVS Newsletter, Aug. 2004, p. 6).

The geodetic group tested ftp-VLBI between Kashima and TIGO. A piece of an IVS-T2026 scan was transferred to the Bonn FTP server from Kashima via Haystack and from TIGO, copied onto Mark 5 modules and was successfully correlated. Ftp-VLBI was used on subsequent occasion and fringes were always found.

The astronomical group correlated a 1 Gbit/s observation with eight stations simultaneously. The processing factor (PF, ratio between the correlation time and the observation time) for this 1 Gbit/s experiment was better than 1.5. It was a Mark 5 only observation with short scans.

5. Outlook for 2005

In spring we expect to have Gbit/s connectivity to BonnNet and into Géant (European Academic Network). We will be limited initially by the 100 Mbit/s router at MPIfR. This will be upgraded to higher bit rates depending on the demand. A proposal to participate in the German 10 Gbit/s optically-switched test network VIOLA⁴ has been submitted.

⁴(<http://www.dfn.de/content/entwicklungen/netztechnik/optischenetze/>)

MPIfR and BKG will upgrade the correlator to 12 stations with Mark 5B, including new computers and a software upgrade.

The tape drivers and station units will still be maintained for some time because not all IVS and VLBA stations have been upgraded to Mark 5, though the upgrade of the VLBA to Mark 5A has begun thanks to the Huygens mission.