Towards a four technique GGOS site: VLBI - DORIS compatibility tests at Wettzell

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Introduction

Within the framework of a Global Geodetic Observing System (GGOS), co-location sites are of special importance for the evaluation and mutual control of the individual geodetic space techniques. At the Geodetic Observatory Wettzell a DORIS (Doppler Orbitography and Radio-positioning Integrated by Satellite) beacon could complete the geodetic instrumentation consisting of three Very Long Baseline Interferometry (VLBI) telescopes, two Laser Ranging systems and a number of multi-Global Navigation Satellite System (GNSS) stations. We chose 3 options as possible sites for a DORIS beacon.

The EMC problem

The common operation of VLBI and DORIS at one site generates problems with Electromagnetic Compatibility (EMC). While the VLBI system is designed to receive extreme weak signals down to –110 dBm, the DORIS beacon emits a 2036 MHz frequency of +40 dBm. There is a high risk of coupling DORIS signals into the VLBI S-band receiver generating spurious signal and, in the worst case, overloading the Low Noise Amplifier (LNA) and risking its damage.

Test 1: Low power setup

A first test at low transmitting power using a simple signal generator and a DORIS antenna was performed to get an idea how sensitive the VLBI receiving systems of the 20 m telescope (RTW) and one of the 13 m TWIN telescopes (TTW-1) respond to the 2036 MHz frequency and to evaluate different possible DORIS sites.

Test 2: Real conditions

In a second test an original DORIS beacon at site A3/B4 was used under full transmitting power (10 W) to see if the power level at the LNA input is in the linear range (below –50 dBm) at all telescope positions.

Test 3: Effect of RF absorbers

These tests were carried out to check the effectiveness of microwave absorber plates (type COMTEST MT65, size 120 x 60 x 10 cm). In the first setup the effect of a barrier was compared to the direct line of sight at site C1. In a second setup a ring of absorber plates was mounted around the DORIS antenna at site A3/B4.

Conclusions

• In direct line of sight, the received power at the VLBI system may exceed the LNA saturation point everywhere on the station. A LNA destruction can be excluded (DORIS antenna below 0° elevation).

• RF barriers like absorber plates or obstacles like buildings or the hills reduce the received power up to 20 dB, however, at dedicated orientations (telescope pointing in direction of the beacon, or at high elevations) the power is still at the upper limit.

• The following principles for any site layout have been drawn up:
  - Installation of the DORIS antenna on the observatory ground (good for local ties and shield erection, low installation costs, atomic clock option)
  - No direct visibility between DORIS and any VLBI antenna (using local topography or RF blockers)
  - Consider height difference between both antennas (DORIS emission is lower at low elevation)
  - Maximum distance between DORIS and VLBI (ideally more than 300-400 m)

• In practice a compromise has to be found to minimize the constraints for both systems.

Correlation results

The correlation of dedicated VLBI sessions (IN315-278, IN316-081, R1732) showed no degradation on long baselines due to the DORIS beacon operation.

DORIS signal reception

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