Atmospheric Phase Monitoring Interferometer for the NOEMA Observatory

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Abstract—**IRAM is currently adapting, in collaboration with the Smithsonian Astrophysical Observatory (SAO), an atmospheric phase monitoring system as was developed for the Submillimeter Array (SMA) to be possibly used for the NOEMA interferometer.**

I. Introduction

In this paper, we present the proof-of-concept of the atmospheric phase monitoring system and show the first results obtained so far. The final goal of this project is to provide a permanent monitoring system of the observing conditions for the NOEMA interferometer, located on the plateau de Bure, at 2500m above sea level in the French Alps. Indeed, this system would make observations more efficient, by being able to choose the correct observing band right away and/or anticipate on whether to start or stop observing.

After initial tests carried out on the roof of the IRAM Grenoble headquarters, the system was moved to the plateau to make first onsite data acquisition at the end of October 2018.

II. System Description

The atmospheric phase monitoring system demonstrator is based on a dual off- axis aluminium satellite dishes (Fuba DDA 110: 1090 x 991 mm^2) interferometer, that receive a broadband white noise-like Ku Band (~11.85 GHz) signal from a geostationary satellite and focus it to the center of the feed signal source.

The Low Noise Blocks (LNB) that down convert this signal to the Intermediate Frequency (IF) one (~1.2 GHz) have been modified to be fed with a common Local Oscillator.

The IF signals are then amplified, filtered and transported through optical fibers down to the building where they are processed by a commercial analog correlator (IQ demodulation card) that produces the phase delays between pairs (only one so far) of antennas from the I & Q signals.

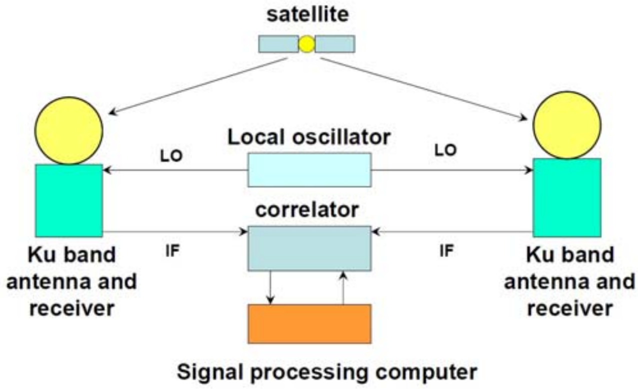

Fig. 1. Phase Monitoring System Principle.

The data are then further processed by a LINUX pc that runs software, which amongst other parameters, works out the atmospheric RMS phase over different time intervals. This real-time statistical data measured in the direction of the satellite provides an estimate of the phase front distortion experienced at the same time by the NOEMA interferometer.

III. System Implementation

During the development phase at the IRAM headquarters, some optimizations were implemented in order to achieve the best possible results. Despite these efforts, we were still facing, at the end, electromagnetic pollution and environmental limitation and decided to move the atmospheric phase interferometer to the plateau de Bure for a short data collection campaign. The first trials on the plateau, in parallel with the NOEMA interferometer are encouraging as there is good agreement between the two systems.

IV. Conclusion

This paper has briefly described the phase monitoring system work that has been ongoing for the past two years at IRAM. More detailed description of the system will be provided during the conference, together with test results.

References

[1] Robert S. Kimberk & All "A Multi-Baseline 12 GHz Atmospheric Phase Interferometer with One Micron Path Length Sensitivity", May. 2012.

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