Deployment of a Pair of 3M telescopes in Utah

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Abstract. Two 3m telescopes are being installed in Grantsville Utah. They are intended for the testing of various approaches to the implementation of intensity interferometry using Cherenkov Telescopes in large arrays as receivers as well as for the testing of novel technology cameras and electronics for ground based gamma-ray astronomy.

Keywords: Intensity Interferometry, Star Base Utah, Gamma-Ray Astronomy
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INTRODUCTION

Star Base Utah[1] consists of two 3m telescopes [Figure 1], previously used in an array of seven gamma-ray detectors at the Dugway Proving Grounds in Utah[1]. They have 19 mirror facets and have an f number of f/1. The telescopes are now located in Grantsville, Utah at the Sea Base diving resort[2], only forty miles away from Salt Lake City. The main purpose of the two telescopes is to test new technology. The telescopes are equipped with mirrors in a Davies-Cotton configuration. The telescopes will be in operation in the beginning of 2009, and will be initially testing intensity interferometry electronics equipment. They will also be available for testing new cameras and electronics for Cherenkov telescopes.

FIGURE 1. One of the two Star Base Telescopes

INTENSITY INTERFEROMETRY

In the 1950's Robert Hanbury Brown and Richard Twiss developed the ideas of Intensity Interferometry (I.I.) [2]. I.I. can be used for high resolution imaging. I.I. was first used with radio telescopes and then later developed with optical telescopes. Brown and Twiss installed two telescopes in Narrabri in the 1960's [Figure 3]. The telescopes first used by Brown and Twiss were very similar to those used today by gamma-ray experiments. I.I. is different from the Michelson interferometer, which relies on the visibility of interferometric fringes to provide a measurement of the mutual degree of coherence between different telescopes. On the contrary, I.I. relies on the correlations between the intensity fluctuations to provide a measurement of the mutual degree of coherence of the light at the two telescopes [Figure 2][3]. The development of faster electronic and next generation Imaging Atmospheric Cherenkov Telescope (IACT) Arrays, such as CTA and AGIS, offers an interesting opportunity to revisit I.I.. Unused time on IACTs could be used for interferometric stellar observation with unprecedented numbers of baselines[4]. A working group was just created on I.I. within the IAU commision 54.

1 www.physics.utah.edu/starbase
2 www.seabase.net

CP1085, *High Energy Gamma-Ray Astronomy, 4th International Meeting on High Energy Gamma-Ray Astronomy*, edited by F. A. Aharonian, W. Hofmann, and F. M. Rieger

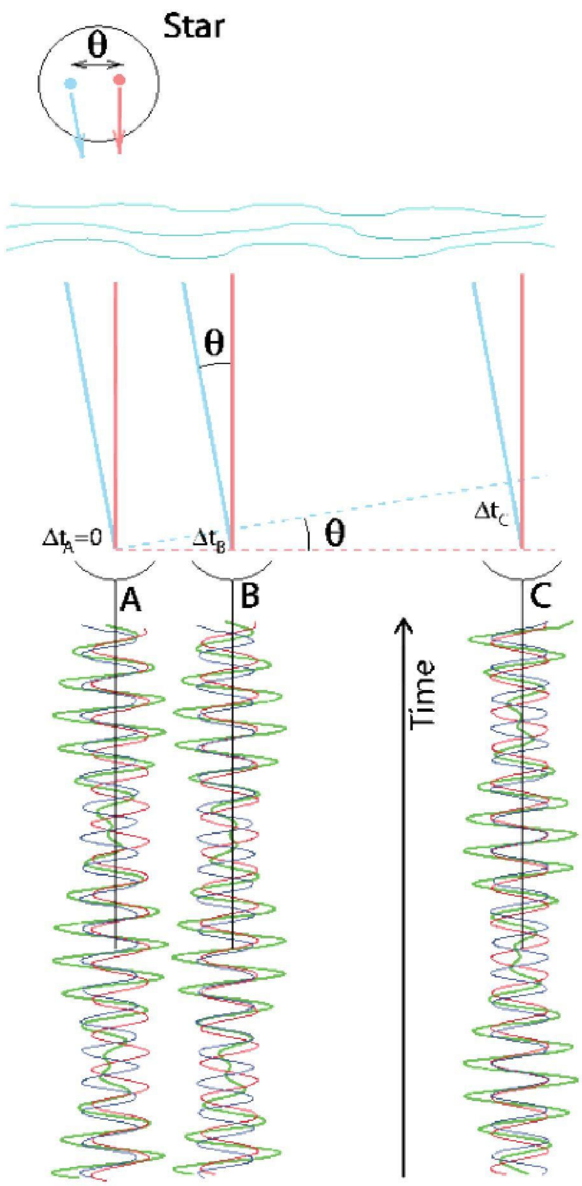

FIGURE 2. Two points of a star are emitting light with slightly different frequencies (blue and red) and produce beating at each telescope (green). The two waves shift in time with respect to on another according to the telescope position and affecting the relative phase of the beating at the different telescopes. Telescopes A and B being close together, the beatings they record are in phase and the correlation is high while for A and C the beatings are in phase quadrature and the correlation is small.

VERY HIGH ENERGY GAMMA-RAY ASTRONOMY

As the field of Very High Energy (VHE) Gamma-Ray Astronomy is continuously growing, it is important to test how novel photodetectors and electronics will operate in the field. The sensitivity of the IACTs is directly related to the quantum efficiency of the photomultiplier tubes (PMT). As new PMTs become available such as Silicon, Multi-Anode, and High Efficient PMTs, they will need to be tested to understand if a greater sensitivity can be reached. Testing new PMTs on large IACTs such as HESS, MAGIC and VERITAS is not practical. The two telescopes of Star Base Utah will facilitate much of the testing required for new technologies and technical solutions for the future of gamma-ray astronomy.

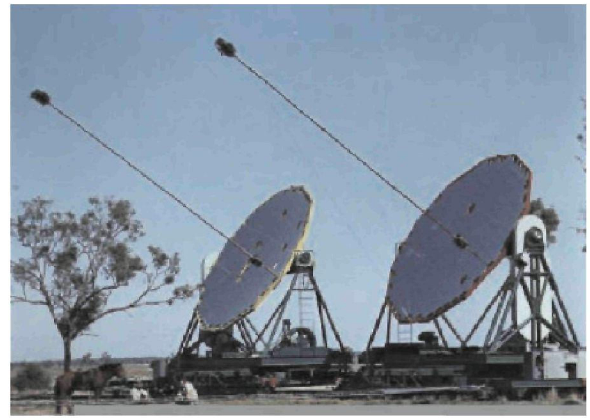

FIGURE 3. The two telescopes of the Intensity Interferometer in operation in Narrabri Australia until 1971.

An array of 3m telescopes, like those at Star Base Utah, could have a threshold of 1TeV (Colin & LeBohec 2008 in preparation of Astroparticle Physics) and given their relatively modest price, very large arrays could be constructed to extend the coverage to 100TeV. In this energy range it is expected to be easier to distinguish between electron and hadron processes responsible for the gamma ray emission.

PRESENT STATUS

Currently one of the telescopes is fully assembled and the other is being prepared to have the optical support structure attached. The telescope mount controls are being setup inside a central control building and safety measures are being setup to prevent the telescope from going past limits beyond which the driving system or cables might be damaged. The nineteen mirrors on the fully assembled telescope have all been aligned.

CONCLUSION

Two 3m Telescopes are being implemented in Grantsville, Utah under a project called Star Base Utah. The telescopes will be used to test new electronics for intensity interferometry and for VHE gamma-ray astronomy as well. Intensity interferometry with the use of IACTs will allow us to image stellar objects with high resolution. Testing of new electronics for gamma-ray science will also be facilitated at Star Base Utah. We invite anyone who has interest for the utilization of Star Base telescopes for prototyping to contact the authors[3].

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4. S. LeBohec and J. Holder, *ApJ, 649, 399-405, (2006)*.

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