

# Southern African Large Telescope Spectroscopy of BL Lacs for the CTA project

## Executive Summary

### Background

The aim of the Southern African Large Telescope (SALT) blazar redshift programme is to measure redshifts of BL Lacertae objects (BL Lacs - highly variable [active galactic nuclei](#) (AGN)) to create a sample of such objects that would likely be observed with the Cherenkov Telescope Array observatory (CTAO).

Blazars are a class of AGN, whose collimated plasma beams referred to as jets, are closely aligned with the line of sight to Earth, three quarters of which are classified as high-frequency peaked BL Lacs. It is this class of BL Lacs that we are interested in measuring the redshifts of.

This SALT blazar redshift programme is an important support arm for the CTA science objectives and goals, as the measured redshifts will enable uniform population studies of BL Lacs and an in-depth investigation of their cosmic evolution, in-depth studies of the [extragalactic background light](#) (EBL) density and also help constrain photon-axion coupling theories. These all form part of the important questions in the motivation for developing the CTA.

### Importance of spectroscopic redshifts and high-quality spectra

True spectroscopic redshifts of BL Lacs will bring us a step closer to fulfilling a significant part of the CTA's science goals and objectives. The measured redshifts will guide our theoretical understanding of very high energy blazar physics through tests of existing non-standard model physics predictions such as existence of axion like particles and their oscillations with gamma-ray photons, and through measurements of the EBL energy spectrum with further tests of the postulated EBL absorption of VHE blazar flux.

### SALT BL Lac redshift measurement capabilities and results

SALT has proven itself capable to obtain redshifts that are needed to achieve the above-stated science goals. The SALT BL Lac redshift program accomplishes its objectives by taking high quality (high signal-to-noise) spectra of BL Lac candidates. From November 2019 to June 2021, the program has taken spectra for more than 20 BL Lacs and has thus far successfully measured redshifts for eight of these. The analyses for some of these observations is yet to be concluded.

### Summary and next steps

Spectroscopic redshift measurements of BL Lacs, performed in this program and others, are seen as a necessary support undertaking for the CTA key science project (KSP) on Active Galactic Nuclei. High quality CTA spectra and true spectroscopic redshifts of BL Lacs are both crucial to the objectives and goals of this KSP. To that end, the SALT blazar redshift program is ongoing, and the current proposal runs until the end of 2022, by which a total of about 35 BL Lacs are planned to have been observed.