Applying UVOT data to finding new OB stars in the Small Magellanic Cloud

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OB stars are the most massive and hottest stars, and are important for understanding cosmic reionization sources, stellar and intermediate mass black holes and gravitational wave sources. They are of particular interest in the SMC due to its lower metallicity, which is reminiscent of the early Universe and the Epoch of Reionization.

In this work, we combine ultraviolet data from the Swift/UVOT satellite with optical and infrared catalog data. After data pre-selection, we create spectral energy distributions, and then fit model stellar atmospheres to obtain good estimates of effective temperature. OB stars emit the majority of their radiation in the ultraviolet part of the spectrum, so the addition of this data helps to constrain these temperature estimates. By comparing the fitted temperatures to literature values of previously known objects, we aim to identify new candidate OB stars.

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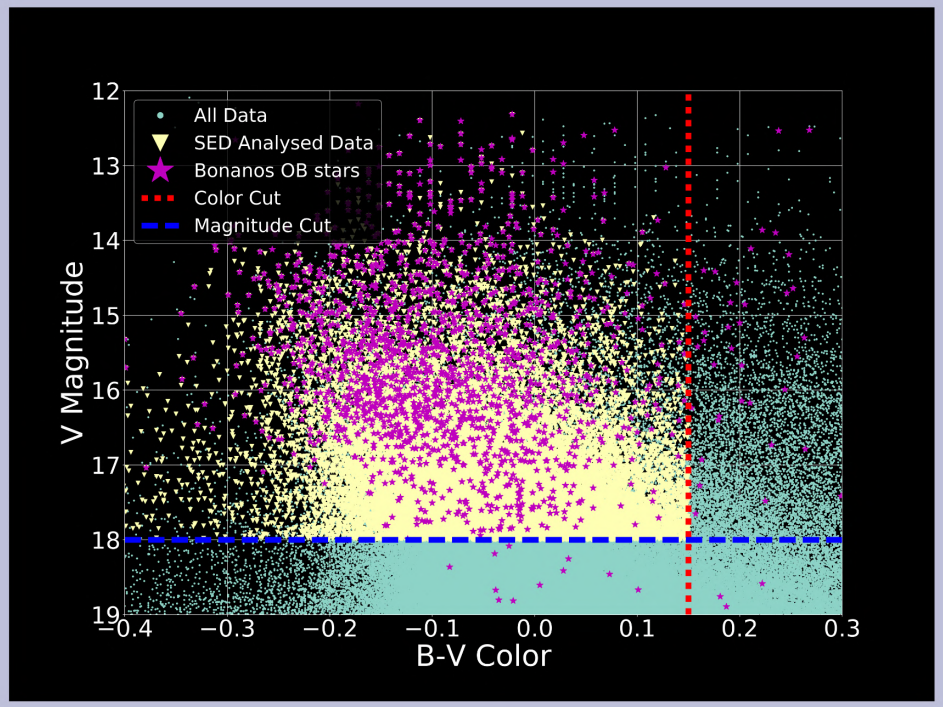
Armagh Observatory & Planetarium

university of groningen / faculty of science and engineering / kapteyn astronomical institute

Background Images: SMC, NASA/Swift/S. Immler (Goddard) and M. Siegel (Penn State)

Data Preselection

- We combine data from the SuMAC (ultraviolet), MCPS (optical) and IRSF (infrared) surveys
- We eliminate objects with $\sigma \geq 0.1$ mag in any band to ensure good quality data
- We cut at $V \leq 18$ to exclude white dwarfs and low-mass stars
- We cut at B-V = +0.15, the color of an A0V star adjusted for SMC extinction



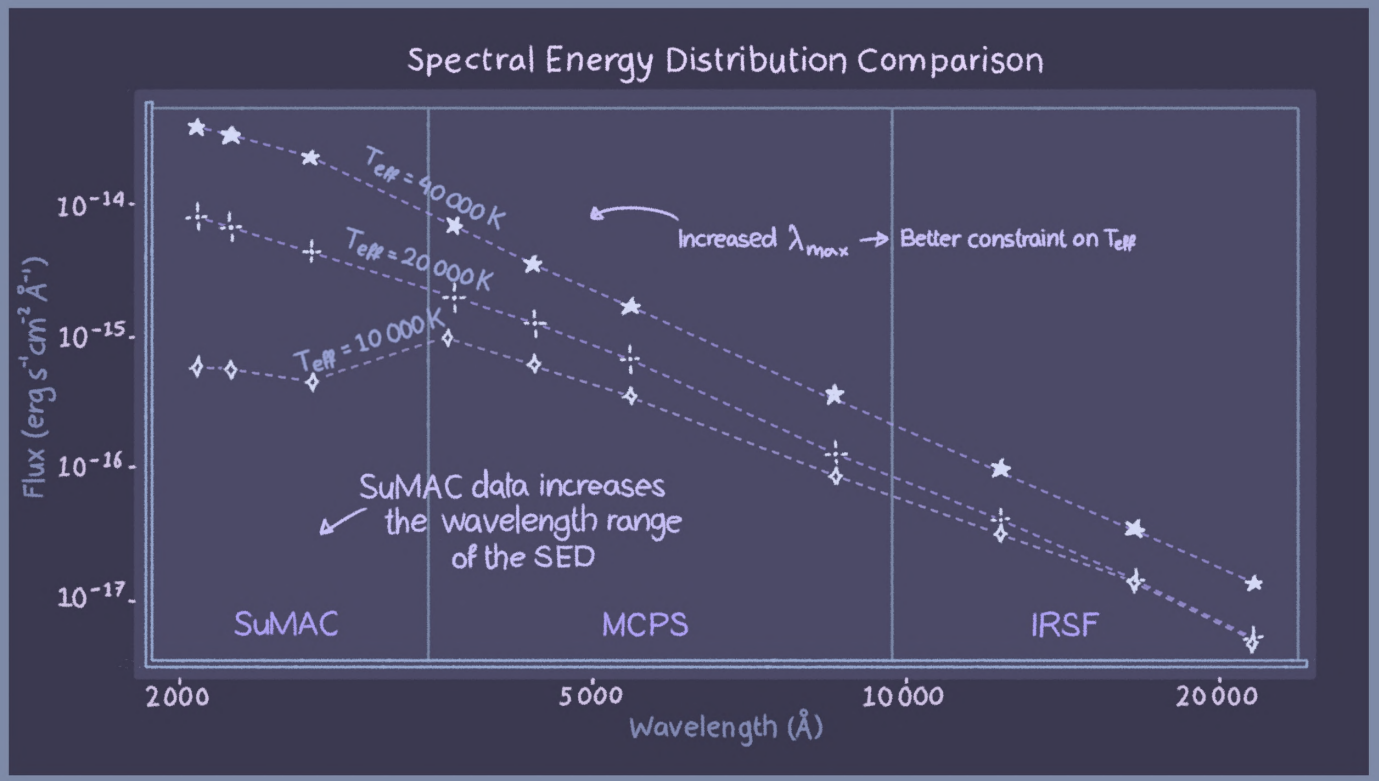
SMC Color-Magnitude Diagram

- Here is the resulting color-magnitude diagram of the SMC
- We have overlaid the OB stars in the Bonanos et al 2010 catalog that are in the area covered by UVOT, which is our spatial limiting factor
- This pre-selection is made to limit the number of SED fits needed
- For all objects satisfying our magnitude, color and quality conditions, we then create an SED and fit model stellar atmospheres

SuMAC - Swift Ultraviolet Survey of the Magellanic Clouds, Hagen et al. 2017
MCPS - Magellanic Clouds Photometric Survey, Zaritsky et al. 2001
IRSF - InfraRed Survey Facility survey, Kato et al. 2007

SEDs and Model Fitting

A Spectral Energy Distribution (SED) is a plot of flux vs wavelength. By constructing an SED for a star, and fitting a model stellar atmosphere to this SED, we can obtain a good estimate of its effective temperature.
Using these values, we can estimate its spectral type.



SED Comparison

- We use the VOSA tool from the SVO to fit model atmospheres to tens of thousands of stars at once, giving us good estimates for T_{eff}, L_{bol} and log g for each star
- We use a combination of the Kurucz ATLAS9 and TLUSTY model atmospheres
- The SuMAC UV data significantly improves the quality of the atmosphere fitting by better constraining the peak of a star's SED

VOSA - Virtual Observatory SED Analyser, Bayo et al. 2008
ATLAS9 - Castelli et al. 1997
TLUSTY - Lanz & Hubeny 2003, 2007

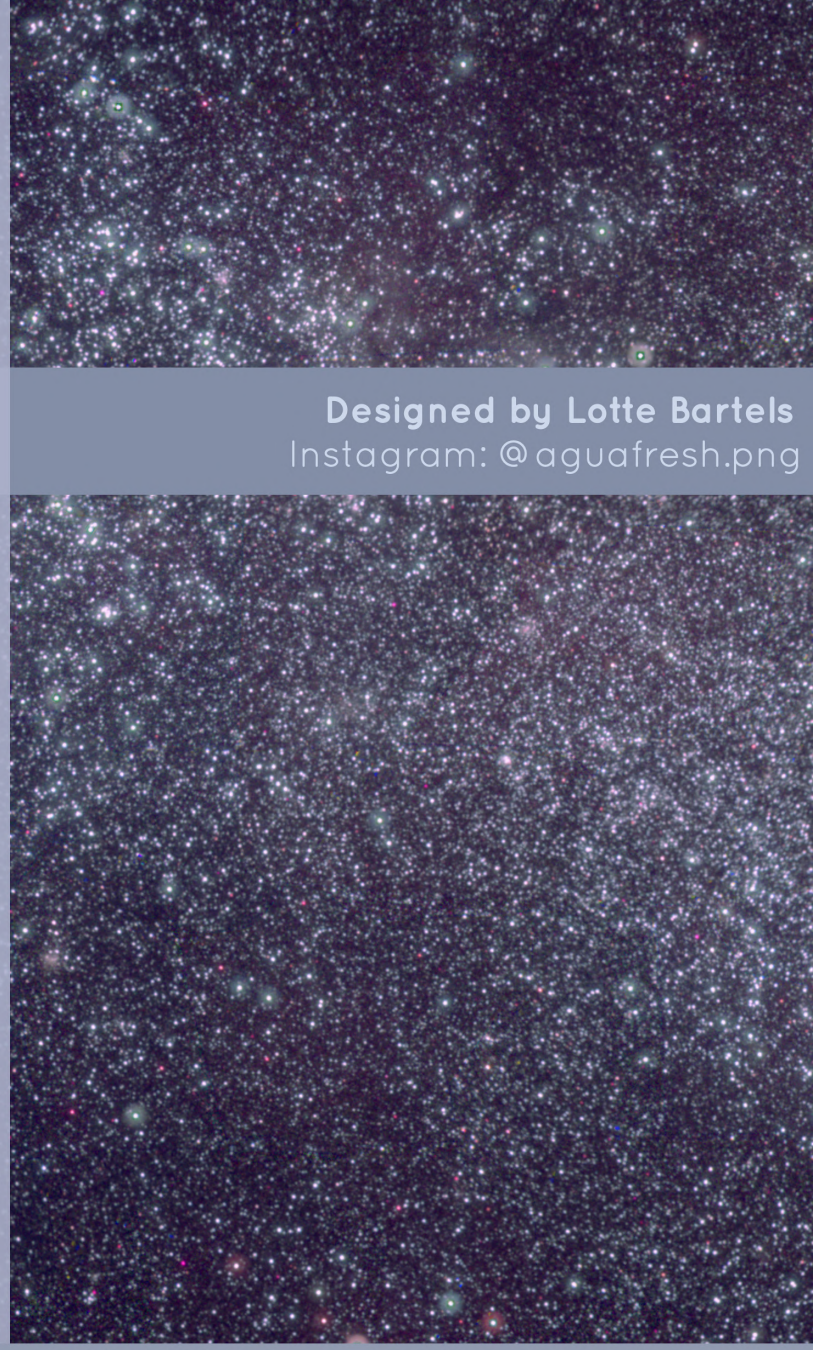
Current Progress

- ★ We have good magnitude and color cutoffs
- ★ We have data quality conditions that are giving good results
- ★ Currently working on optimal model fitting to SEDs
- ★ Aim is to confirm new OB candidates in the SMC soon!

Any Questions?

Tweet me @LarkinCormac
Or email me - larkin@astro.rug.nl

Side note - I'm finishing up BSc degrees in Astronomy and Physics soon, and currently looking at postgrad opportunities!



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