Searching for the Missing Baryon Fraction with SPTpol and the Dark Energy Survey

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Statement of contribution:

This is to certify that:

- This thesis entitled "Studying weakly lensed galaxies with velocity maps" comprises only my original work except where indicated otherwise.
- Due acknowledgement has been made in the text to all other material used.
- The thesis is no longer than 50 pages in length, inclusive of tables, figures, bibliographies and appendices.

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Mitchell de Zylva

Acknowledgements:

You put all the people you want to thanks here :)

You need a statement of contribution, which you will sign before you submit.

Abstract

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Contents

Chapter 1

Introduction

1.1 Motivation

The Cosmic Microwave Background (CMB) provides the most accurate and detailed measures of the primary cosmological parameters to date. For a Λ CDM universe, there are six independant paramters which descirbe the evolution and behaviour of the universe, the physical baryon density $\Omega_b h^2$, the physical dark matter density $\Omega_c h^2$, the age of the universe t_0 (or its reciprocal, the Hubble constant H_0), the scalar spectral index n_s, the curvature fluctuation amplitude Δ_R^2, and the reionisation optical depth τ.

Currently, the highest precision measures of these features from the CMB come from Planck Collaboration et al. (2018), which details that baryonic matter only comprises $\approx 5\%$ of the universe's energy density. In principle, this component of the universe should be directly measurable. At just three minutes after the Big Bang, deuterium can be used as a tracer for this abundance (Steigman, 2007), and at redshift $z \geqslant 2$, the baryon fraction can be found in the absorption lines of quasars passing through the diffuse, photo-ionised intergalactic medium, known as the Lyman-α forest (Weinberg et al., 1997). However as the universe evolved, this gas became sparser as it became more ionised. This makes searching for the entirety of the baryon fraction at low redshift difficult. When this fraction is calculated directly from observations, it shows only one tenth of the baryonic content shown in high redshift measurements is contained in galactic structures (Persic & Salucci, 1992). Some revised estimates considered that the limitations of observations were primarily to blame for this discrepency, and not inherent new physics (Bristow & Phillipps, 1994; Fukugita et al., 1998)

The baryon content has been confirmed to a very high accuracy with recent CMB experiments, first with the *Wilkinson Microwave Anisotropy Probe* (WMAP) (Spergel et al., 2007), and then with the *Planck* Satellite (Planck Collaboration et al., 2018). When we quote quantities, we take values from the latest *Planck* paper

Parameter	Value	Error
$\Omega_c h^2$	0.120	±0.001
$\Omega_b h^2$	0.0224	±0.0001
n_s	0.965	±0.004
τ	0.054	±0.007
$100\Theta_\star$	1.0411	±0.0003
H_0 (km s^{-1} Mpc^{-1})	67.4	±0.5

1.1.1 Optical Searches for Baryons

1.1.2 Warm-Hot Intergalactic Medium

1.2 Sunayev-Zeldovich Effect

Chapter 2

Results

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Chapter 3

Conclusion

All your Concluding.

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