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**Studies of Fluorescence Profile
Reconstruction Systematics at the
Pierre Auger Observatory**

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For the degree of Master of Philosophy

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Max Malacari

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Abstract

In the fluorescence technique employed at the Pierre Auger Observatory, Nitrogen fluorescence at UV wavelengths, due to excitation of atmospheric molecules by charged air shower particles, is used to estimate the energy of incoming cosmic rays. However, due to the relativistic nature of the charged particles in the cascade, direct and scattered Cherenkov light contaminates the isotropically emitted fluorescence light. These ‘extra’ photons, if not accurately accounted for, will affect the assumed fluorescence emission, thereby altering reconstructed shower energies.

Assuming an isotropic distribution of cosmic ray arrival directions, there should be no preferential arrival direction in which a given fluorescence detector observes an event. However, a misrepresentation of the number of Cherenkov photons assumed to be arriving at the telescope aperture would cause an excess or deficit of events directed towards the telescope above some fixed energy, as these events are highly Cherenkov contaminated. Using Monte Carlo simulations of extensive air showers in the atmosphere mimicking the observed power law energy spectrum, effects on the distribution of arrival directions with respect to the fluorescence telescopes due to changes in the assumed Cherenkov normalisation can be explored. This thesis aims to put a limit on the possible deviation from the currently accepted Cherenkov model based on the current level of statistics at the Pierre Auger Observatory.

An accurate description of Cherenkov light production in extensive air showers is essential for improving our confidence in the energy assignments of the observatory and also serves to further our understanding of cosmic ray air shower physics.

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Contents

1	Ultra High Energy Cosmic Rays	1
1.1	A brief history	1
1.2	Energy spectrum	2
1.3	Mass composition	4
1.4	Acceleration mechanisms and propagation	6
1.4.1	Stochastic acceleration of charged particles	6
1.5	Anisotropy	9
2	Extensive Air Showers	11
2.1	The Heitler Model	12
2.2	Hadron initiated showers	14
3	EAS Detection Methods	17
3.1	Surface arrays	17
3.2	Fluorescence detectors	18
3.3	Hybrid detectors	20
3.4	Geometry and energy reconstruction	20
3.4.1	Surface arrays	20
3.4.2	Fluorescence detectors	21
3.4.3	Hybrid detectors	23
3.5	Experiments	24

4	Pierre Auger Observatory	25
4.1	Surface detector	26
4.1.1	SD triggering conditions	27
4.2	Fluorescence detector	29
4.2.1	FD triggering conditions	29
4.3	Hybrid mode	30
5	Cherenkov Light in EAS	33
5.1	Cherenkov radiation	34
5.2	Analytical description of Cherenkov light production	35
5.3	Treatment of Cherenkov light in fluorescence profile reconstruction	38
6	Verifying the Cherenkov Normalisation	45
6.1	Rescaling the Cherenkov normalisation: a semi-analytical model	45
6.2	A new method for testing the Cherenkov normalisation	52
6.3	Telescope azimuth transformation	52
6.4	Method: distribution templates via direct energy rescaling	54
6.4.1	Method workflow	58
7	Obtaining Full Reconstruction Efficiency	63
7.1	Telescope azimuth transformation revisited	64
7.2	X_{\max} viewing efficiency	66
7.2.1	Toy Monte Carlo simulation	67
7.2.2	Simulation parameters	69
7.2.3	Aperture effects	70
7.2.4	Results	73
7.3	Cherenkov light triggering bias	74
7.4	Fluorescence telescope trigger efficiency	76

CONTENTS

7.5	Quality reconstruction efficiency	82
7.6	Choosing a fully efficient shower sample	84
7.7	What about HEAT?	87
8	Generating a Set of Hypotheses	91
8.1	Hypothetical transformed azimuth distributions via toy Monte Carlo	91
8.2	Generating a suitable set of Monte Carlo events	93
8.3	Creating the template distributions	95
8.3.1	Procedure	96
9	Application of Method	99
9.1	Toy Monte Carlo data	99
9.1.1	Method resolution	100
9.2	Full Monte Carlo data	105
9.3	Real hybrid data	109
9.4	Conclusions	111
A	Standard Shower Simulation Modules	113
B	Standard Hybrid Reconstruction Modules	117
C	Full efficiency plots	121
C.1	X_{\max} viewing efficiency	121
C.2	Combined X_{\max} viewing efficiency and PMT trigger efficiency	125
C.3	Full reconstruction efficiency	128