

GrOptics User's Guide

Version 2.2

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Abstract

GrOptics is a detailed simulation program for ray-tracing Cherenkov photons through large arrays of atmospheric Cherenkov telescopes. Shower packages, such as GrISU [2] and CORSIKA [3], provide Cherenkov photons after conversion to GrISU format. The output to a ROOT file records individual photons striking the camera surface. The package models both VERITAS Davies-Cotton and Schwarzschild-Coudee telescopes with all telescope parameters taken from input files. There is no limit to the number or type of array telescopes. Adding new telescope types, input and output formats, etc. is straightforward using standard C++ coding techniques with existing base classes. Reference [1] gives the code download site.

1 Introduction

GrOptics is a detailed C++ Monte Carlo ray-tracing program to study the passage of atmospheric Cherenkov photons through telescopes designed to study atmospheric Cherenkov air showers. Photons produced by standard air shower codes enter the telescope; the output ROOT file contains tree records of the photons that strike the telescope cameras. GrOptics provides the input to the CARE telescope electronics code [4].

There are no intrinsic limits to the number or type of telescopes placed in the air Cherenkov telescope (ACT) array. Currently, the code contains two concrete telescope classes: for VERITAS Davies-Cotton telescopes and for Schwarzschild-Coudee telescopes. All array and telescope parameters are placed in input pilot or configuration files.

1.1 Installation

1. GrOptics relies heavily on ROOT [5]. I use the following installation method:

- Download the ROOT source package [5]
 - Follow package instructions to configure and to make
 - Setup ROOT environmental variables by sourcing *thisroot.sh* or *thisroot.csh* in `<rootDirectory>/bin`
2. The Schwarzschild-Coudee telescope class uses the ROBAST package [6]. ROBAST (ROot BAsed Simulator for ray Tracing) is a non-sequential ray tracing program which utilizes the 3D geometry library in ROOT. Its function is very simple compared to Geant4 Optical, but much easier to use. The ROBAST package is automatically downloaded by *make* when producing the GrOptics executable.

1.2 QuickStart

2 Code Overview

3 Input Files

3.1 Array Configuration

3.2 Standard Telescopes

3.2.1 Davies-Cotton Telescopes

3.2.2 Schwarzschild-Coudee Telescopes

4 Data Files

4.1 Input Data Files

4.2 Output Data Files

5 Graphical Output Options

References

- [1] GrOptics git repository (read only)
git clone <http://gtlib.gatech.edu/pub/IAC/GrOptics.git>
- [2] GrISU download site
<http://www.physics.utah.edu/gammaray/GrISU/>
- [3] CORSIKA: A Monte Carlo Code to Simulate Extensive Air Showers
D. Heck, J. Knapp, J.N. Capdevielle, G. Schatz, T. Thouw
Forschungszentrum Karlsruhe Report FZKA 6019 (1998)

- [4] CARE git repository (read only)
git clone <http://gtlib.gatech.edu/pub/IACT/CARE.git>
- [5] Rene Brun and Fons Rademakers,
ROOT - An Object Oriented Data Analysis Framework,
Proceedings AIHENP'96 Workshop, Lausanne, Sep. 1996,
Nucl. Inst. & Meth. in Phys. Res. A 389 (1997) 81-86.
See also <http://root.cern.ch/drupal/>
- [6] Development of Non-sequential Ray-tracing Software for Cosmic-ray Telescopes Authors: Akira Okumura, Masaaki Hayashida, Hideaki Katagiri, Takayuki Saito, Vladimir Vassiliev. <http://arxiv.org/abs/1110.4448> Download site <http://sourceforge.net/projects/robast/>