T 12: Gamma Astronomy I

Time: Monday 16:30–18:00 Location: POT/0151

T 12.1 Mon 16:30 POT/0151

Generation of IACT images using generative models — •Christian Elflein, Jonas Glombitza, and Stefan Funk for the H.E.S.S.-Collaboration — Erlangen Centre for Astroparticle Physics, Erlangen, Germany

The development of precise, fast, and computationally efficient simulations is a central challenge of modern physics. With the advent of deep learning, new methods are emerging from the field of generative models. Recent applications to the generation of calorimeter images showed promising results, which motivates the application in astroparticle physics. In this contribution, we introduce a deep-learning-based model for the generation of camera images of Imaging Air Cherenkov Telescopes (IACTs).

In our case study, we use simulations of the High Energy Stereoscopic System (H.E.S.S.) to train a Wasserstein generative adversarial network (WGAN) for the generation of IACT images. We examine basic image properties of the generated samples, discuss their physical properties, and outline possibilities for stereoscopic image generation.

T 12.2 Mon 16:45 POT/0151

A template-based air shower reconstruction method for SWGO — •Franziska Leitl, Vikas Joshi, and Stefan Funk for the SWGO-Collaboration — Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen Centre for Astroparticle Physics, Nikolaus-Fiebiger-Str. 2, D-91058 Erlangen, Germany

The Southern Wide-field Gamma-ray Observatory (SWGO) is a future ground-based gamma-ray detector that will be built in South America, extending current generation instruments to the Southern Hemisphere. Primarily, water Cherenkov detectors will be utilized to detect particles in an energy range from 100s of GeV to 100s of TeV. The instrument will possess a close to 100% duty cycle and an order steradian field-of-view. The detection area will consist mainly of a densely packed inner array of water Cherenkov detectors for detecting low energy events, while a large, sparse outer array of detectors is used mainly for higher energy showers. In this contribution, the current status of air shower reconstruction for SWGO with a template-based reconstruction method will be presented.

T 12.3 Mon 17:00 POT/0151

Event classification in Compton-Pair telescopes using Convolutional Neural Networks — •Jan Lommler and Uwe Oberlack — Institut für Physik und Exzellenzcluster Prisma+ Johannes Gutenberg-Universität Mainz

Low to medium energy gamma rays are shielded by the Earth's atmosphere and cannot be measured with on-ground facilities. Satellite based gamma-ray astronomy relies on photo absorption, Compton scatter and Pair creation as measurement channels. Among the biggest challenges are the poor signal to background ratio due to low signal fluxes from cosmic sources and the high background rates even in the comparatively moderate environment of Low Earth Orbits. An efficient event tagging reduces signal losses by preventing type-mismatching applications of reconstruction algorithms (e.g. performing a Compton reconstruction on a Pair event) and signal pollution (distinguishing events originating from background sources). We explore the feasibility of Deep Convolutional Neural Networks in the context of event classification for Compton-Pair telescopes on the example of the e-ASTROGAM design proposal and show improvements possible when using publicly available analysis tools.

T 12.4 Mon 17:15 POT/0151

eep-learning-based gamma/hadron separation for IACTs — •Jonas Glombitza, Vikas Joshi, Benedetta Bruno, and Stefan Funk for the H.E.S.S.-Collaboration — Erlangen Centre for Astroparticle Physics, Erlangen, Germany

Ground-based gamma-ray observatories have opened in the last decades a new window to the non-thermal universe by studying air showers initiated by cosmic particles. Imaging Air Cherenkov Telescopes (IACTs), like the High Energy Stereoscopic System (H.E.S.S.), are utilized to image the distribution of Cherenkov light emitted during the development of air showers. For the rejection of the hadronic background, many algorithms rely on a high-level parameterization of these IACT images and exploit their correlation. Recently, deep-learning-based approaches showed promising results by explolting the full images, which overcomes the limitation of the elliptical modeling.

In this contribution, we present a new approach to reconstruct IACT images using deep learning. We model the images as a collection of triggered sensors that can be described by a graph and analyzed using graph convolutional neural networks. We describe our new algorithm, trained using H.E.S.S. simulations, examine its performance, and compare it to various classification algorithms.

T 12.5 Mon 17:30 POT/0151

Characterization of the Response of large-area PMTs for SWGO. — •Frederik Wohlleben, Fabian Haist, Hazal Göksu, and Felix Werner for the SWGO-Collaboration — Max-Planck-Institut für Kernphysik, P.O. Box 103980, D 69029 Heidelberg, Germany

The SWGO collaboration aims at building a ground-based gamma-ray detector in the southern hemisphere. A promising approach to build a low-cost water Cherenkov detector with muon-tagging abilities is to deploy a two-chamber bladder containing two PMTs into an open body of water. This talk will give a short overview over the research done on large-area PMTs operated with a custom electronics chain which will be used in prototype SWGO detectors.

T 12.6 Mon 17:45 POT/0151

Actuators for the Medium-Sized Telescopes of the Cherenkov Telescope Array — •Heiko Salzmann for the CTA MST-Collaboration — Sand 1, 72076 Tübingen, Germany

The Cherenkov Telescope Array (CTA) is a future ground-based observatory for gamma-ray astronomy offering unparalleled sensitivity in the energy range from 20 GeV up to 300 TeV. One array will be located in the northern hemisphere (La Palma, Canary Islands), one in the southern hemisphere (Atacama, Chile). Three different telescope types are foreseen. The Medium-Sized Telescope (MST) is covering the core energy range from 100 GeV up to 10 TeV and is currently the only type foreseen for both CTA sites in the Alpha configuration. It has a reflector with a diameter of 12 m and a tessellated mirror design of 86 mirror facets. Each mirror facet is mounted on the mirror support structure with two actuators that are adjustable in length to align the mirrors, and a freely rotating fixpoint. Image resolution and pointing accuracy constraints impose limits on the backlash and deformation of the actuators and the fixpoint under various weight and wind loads. After a short introduction into the MST mirror alignment procedure, this contribution will cover the mechanical design of the actuators, the limits on the positioning accuracy of the actuators and fixpoints as well as the verification thereof.