Workshop on the tuning of hadronic interaction models

Report of Contributions

https://indico.uni-wuppertal.de/e/hadintmod

Contribution ID: **2** Type: **Presentation**

Air shower predictions of QGSJET-III and model uncertainties for Xmax

Tuesday, 23 January 2024 09:00 (20 minutes)

I shall discuss new theoretical approaches implemented in the QGSJET-III Monte Carlo generator and present selected model results regarding secondary hadron production in hadron-proton and hadron-nucleus collisions. The predictions of the model for basic characteristics of proton-induced extensive air showers (EAS) will be compared to the ones of QGSJET-II and of other cosmic ray interaction models. In the second part of my talk, I shall concentrate on potential model uncertainties regarding predictions for EAS maximum depth.

Primary author: OSTAPCHENKO, Sergey (Hamburg University, II Institute for Theoretical Physics)

Presenter: OSTAPCHENKO, Sergey (Hamburg University, II Institute for Theoretical Physics)

Session Classification: Generators & Theory

Contribution ID: **3** Type: **Presentation**

Strangeness enhancements and the muon excess in extensive air showers

Tuesday, 23 January 2024 16:55 (20 minutes)

Several high-energy cosmic-ray experiments have observed an excess of muons compared to theoretical expectations from air shower simulations based on standard hadronic interaction models. We investigate the potential of producing states of dense quark-gluon matter (so-called fireballs) to resolve the excess of muons on the ground for a given depth of the shower maximum. Adopting a phenomenological fireball model, we find that the inelasticity enhancement associated with the formation of a plasma state is in tension with data on the electromagnetic longitudinal shower development. We then restrict the fireball model to only enhance the strangeness produced in Standard Model hadronic interactions, and dub this model the strangeball model. Comparing with air shower measurements we find strangeball parameters that resolve the muon puzzle. Constraints from data on shower-to-shower fluctuations of the muon number require strangeness enhancements already at energies accessible to current-generation collider experiments. The strangeball hypothesis leads to a 5–9% increase of the average fraction of energy retained in the hadronic cascade compared to predictions from current hadronic interaction models. A comparison with relevant measurements of the LHCf and LHCb detectors does not directly exclude this scenario, though the obtained tension with LHCb suggests a stringent test at 14 TeV.

Based mainly on Manshanden, Sigl and Garzelli, JCAP02 (2023) 017.

Primary authors: MANSHANDEN, Julien; GARZELLI, Maria Vittoria (II Institut fuer Theoretische Physik, Universitaet Hamburg); SIGL, Guenter (Universität Hamburg); OSTAPCHENKO, Sergey (Hamburg University, II Institute for Theoretical Physics)

Presenter: SIGL, Guenter (Universität Hamburg)

Session Classification: Particle transport in matter

Contribution ID: **4** Type: **Presentation**

Hadronic interactions in Angantyr

Monday, 22 January 2024 17:30 (20 minutes)

In recent times, the Pythia event generator has been extended to feature simulations of generic hadron-nucleon interactions. In this talk, I present a further extension to hadron-ion interactions, which are of particular relevance for air showers where hadronic cascades interact with nuclei in the air.

The model has been validated against NA61/SHINE data. The model also has applications to the vector-meson dominance component of photo-induced processes, and in this context has been found to give a good description of HERA and ATLAS data.

Primary author: UTHEIM, Marius

Presenter: UTHEIM, Marius

Session Classification: Generators & Theory

Contribution ID: **6** Type: **Presentation**

A RIVETing journey: Analysis Preservation and Generator Tuning in High Energy Physics

Wednesday, 24 January 2024 09:50 (20 minutes)

A RIVETing journey: Analysis Preservation and Generator Tuning in High Energy Physics

Primary author: KOLK, Lars (TU Dortmund)

Co-author: DEMBINSKI, Hans (TU Dortmund)

Presenter: KOLK, Lars (TU Dortmund)

Session Classification: Tuning of event generators

Contribution ID: **7** Type: **Presentation**

EPOS4 overview

Tuesday, 23 January 2024 09:25 (20 minutes)

EPOS4 overview

Primary author: WERNER, Klaus (SUBATECH)

Presenter: WERNER, Klaus (SUBATECH)

Session Classification: Generators & Theory

Contribution ID: **8** Type: **Presentation**

Results and prospects of LHCf (cancelled)

LHCf is an LHC experiment designed to study high energy hadronic interaction for understanding cosmic-ray-induced air-shower development. LHCf measures the differential production cross-sections of neutral particles (photons, pi0, and neutrons) at the very forward region of collisions. In this talk, I will review LHCf results and discuss the prospects of ongoing analyses and future operation of pO collisions.

Primary author: MENJO, Hiroaki (ISEE, Nagoya University, Japan)

Presenter: MENJO, Hiroaki (ISEE, Nagoya University, Japan)

Session Classification: Accelerator input

Contribution ID: **9** Type: **Presentation**

Radio Detection and its relevance for studying air shower physics

Wednesday, 24 January 2024 14:25 (20 minutes)

Radio Detection and its relevance for studying air shower physics

Primary author: HUEGE, Tim (Karlsruher Institut für Technologie)

Presenter: HUEGE, Tim (Karlsruher Institut für Technologie)

Session Classification: Astroparticle input

Contribution ID: **10** Type: **Presentation**

Pythia 8 Overview

Monday, 22 January 2024 16:30 (30 minutes)

Pythia 8 Overview

Primary author: SJÖSTRAND, Torbjörn (Lund University)

Presenter: SJÖSTRAND, Torbjörn (Lund University)

Session Classification: Generators & Theory

Contribution ID: **11** Type: **Presentation**

Measurements of Relevance for Cosmic-Ray Physics with NA61/SHINE

Monday, 22 January 2024 15:25 (20 minutes)

Measurements of Relevance for Cosmic-Ray Physics with NA61/SHINE

Primary author: UNGER, Michael

Presenter: UNGER, Michael

Session Classification: Accelerator input

Contribution ID: **12** Type: **Presentation**

atmospheric flux calculations and LHC input

Tuesday, 23 January 2024 11:50 (20 minutes)

I discuss the calculations of atmospheric fluxes (prompt and conventional)
and LHC input useful for it.

Primary author: GARZELLI, Maria Vittoria (II Institut fuer Theoretische Physik, Universitaet Hamburg)

Presenter: GARZELLI, Maria Vittoria (II Institut fuer Theoretische Physik, Universitaet Hamburg)

Session Classification: Particle transport in matter

Contribution ID: **13** Type: **Presentation**

Models and Measurements of Antiproton Production for Cosmic-Ray Studies

Wednesday, 24 January 2024 09:25 (20 minutes)

Models and Measurements of Antiproton Production for Cosmic-Ray Studies

Primary author: PÖSCHL, Thomas (CERN)

Presenter: PÖSCHL, Thomas (CERN)

Session Classification: Accelerator input

Contribution ID: **14** Type: **Presentation**

Relevance of hybrid data to the tuning of hadronic interaction models

Wednesday, 24 January 2024 14:00 (20 minutes)

Relevance of hybrid data to the tuning of hadronic interaction models

Primary author: VÍCHA, Jakub (FZU - Institute of Physics of Czech Academy of Sciences)

Presenter: VÍCHA, Jakub (FZU - Institute of Physics of Czech Academy of Sciences)

Session Classification: Astroparticle input

Contribution ID: **15** Type: **Presentation**

MCPLOTS : MC validation resource based on volunteer computing

Wednesday, 24 January 2024 11:00 (20 minutes)

We present the MCPLOTS online resource for MC event-generator validations. The project is based on the RIVET analysis library and harnesses volunteer computing to generate high-statistics MC comparisons to data. Users interact with the resource via a simple web site, mcplots.cern.ch, where run cards, histogram points, etc, are all made easily available for download. The project has been structured to enable community-driven developments, and we discuss the computational back end, the web front end, and possibilities for further extensions and collaboration.

Primary authors: KARNEYEU, Anton (INR RAS); KORNEEVA, Natalia (Monash University); SKANDS, Peter (Monash University)

Presenter: KORNEEVA, Natalia (Monash University)

Session Classification: Tuning of event generators

Contribution ID: **16** Type: **Presentation**

CRPropa: overview and embedded hadronic interactions

Tuesday, 23 January 2024 17:20 (20 minutes)

CRPropa 3.2, released recently, is the latest update in a continued effort to maintain and extend this open-source code well known in the cosmic-ray community. Originally aimed at simulating the ballistic propagation and interactions of Ultra-High Energy Cosmic Rays, today it can handle diffusive propagation of cosmic rays in a variety of magnetic fields, deal with stochastic cosmic ray acceleration, model electromagnetic cascades for gamma ray emission and transport, among other capabilities. Of special interest is the introduction of hadronic interactions to facilitate the treatment of cosmic ray interactions in the galaxy and within the sources. This talk provides an up-to-date overview of the code and details the recently implemented hadronic interactions.

Primary author: MOREJON, Leonel (BUW)

Presenter: MOREJON, Leonel (BUW)

Session Classification: Particle transport in matter

Contribution ID: **17** Type: **Presentation**

Chromo: An event generator frontend for particle and astroparticle physics

Thursday, 25 January 2024 10:00 (20 minutes)

Chromo: An event generator frontend for particle and astroparticle physics

Primary authors: PROSEKIN, Anton (Institute of Physics, Academia Sinica, Taipei, Taiwan); DEMBINSKI, Hans (TU Dortmund); FEDYNITCH, Anatoli (Institute of Physics, Academia Sinica, Taipei, Taiwan)

Presenter: PROSEKIN, Anton (Institute of Physics, Academia Sinica, Taipei, Taiwan)

Session Classification: Generators & Theory

Contribution ID: **18** Type: **Presentation**

Status of nuclear-PDF analyses and prospects with light ions

Thursday, 25 January 2024 09:35 (20 minutes)

Status of nuclear-PDF analyses and prospects with light ions

Primary author: PAAKKINEN, Petja (University of Jyväskylä)

Presenter: PAAKKINEN, Petja (University of Jyväskylä)

Session Classification: Generators & Theory

Contribution ID: **19** Type: **Presentation**

Introduction and overview of the UrQMD model for p+A and A+A reactions

Wednesday, 24 January 2024 16:55 (20 minutes)

This talk provides an introduction into the Ultra-relativistic Quantum Molecular Dynamics model (UrQMD). UrQMD is a well established transport approach to simulate hadron-hadron, hadron+nucleus and nucleus+nucleus reactions at beam energies starting from 1 GeV to center-of-mass energies of a few hundred GeV. UrQMD has been well tested against a wide range of accelerator data for various collision systems and allows to obtain a full momentum distribution of all final state particles.

Primary author: Prof. BLEICHER, Marcus (Uni Frankfurt)

Presenter: Prof. BLEICHER, Marcus (Uni Frankfurt)

Session Classification: Generators & Theory

Contribution ID: **20** Type: **Presentation**

LHCb colliding-beam measurements for astroparticle physics

Monday, 22 January 2024 15:00 (20 minutes)

LHCb colliding-beam measurements for astroparticle physics

Primary author: SCHMELLING, Michael

Presenter: SCHMELLING, Michael

Session Classification: Accelerator input

Contribution ID: **21** Type: **Presentation**

Air shower genealogy

Tuesday, 23 January 2024 16:30 (20 minutes)

genealogical studies of EM and hadron/muon EAS component with CORSIKA 8 and comparisons with Heitler-Matthews model

Primary author: REININGHAUS, Maximilian

Co-authors: ENGEL, Ralph (Karlsruhe Institute of Technology (KIT)); PIEROG, Tanguy (KIT, IAP)

Presenter: REININGHAUS, Maximilian

Session Classification: Particle transport in matter

Contribution ID: **22** Type: **not specified**

Welcome

Monday, 22 January 2024 14:00 (10 minutes)

Presenter: KAMPERT, Karl-Heinz (Department of Physics)

Contribution ID: **23** Type: **not specified**

Tuning of event generators with accelerator and astroparticle experiments

Monday, 22 January 2024 14:20 (30 minutes)

Presenter: DEMBINSKI, Hans (TU Dortmund)

Contribution ID: **24** Type: **not specified**

Summary and final remarks on the workshop

Thursday, 25 January 2024 11:00 (10 minutes)

Presenters: DEMBINSKI, Hans (TU Dortmund); KAMPERT, Karl-Heinz (Department of Physics)

Contribution ID: **26** Type: **not specified**

Sibyll-2.3d and SIBYLL-STAR

Monday, 22 January 2024 17:05 (20 minutes)

Presenter: RIEHN, felix (igfae, usc, santiago de compostela)

Session Classification: Generators & Theory

Contribution ID: **27** Type: **Presentation**

EPOS-LHCR

Tuesday, 23 January 2024 09:50 (20 minutes)

Presenter: PIEROG, Tanguy (KIT, IAP)

Session Classification: Generators & Theory

Contribution ID: **28** Type: **not specified**

CORSIKA 8 overview

Tuesday, 23 January 2024 11:00 (20 minutes)

Presenter: SANDROCK, Alexander (Bergische Universität Wuppertal)

Session Classification: Particle transport in matter

Contribution ID: **29** Type: **not specified**

MCEq for atmospheric lepton flux calculation

Tuesday, 23 January 2024 11:25 (20 minutes)

Presenter: FEDYNITCH, Anatoli (Institute of Physics, Academia Sinica, Taipei, Taiwan)

Session Classification: Particle transport in matter

Contribution ID: **30** Type: **not specified**

Overview on UHECR interactions

Tuesday, 23 January 2024 14:00 (20 minutes)

Presenter: ENGEL, Ralph (Karlsruhe Institute of Technology (KIT))

Session Classification: Astroparticle input

Contribution ID: **31** Type: **not specified**

The role of direct muon measurements in Auger

Tuesday, 23 January 2024 14:25 (20 minutes)

Presenter: ROTH, Markus (KIT)

Session Classification: Astroparticle input

Contribution ID: **32** Type: **not specified**

KASCADE

Tuesday, 23 January 2024 14:50 (20 minutes)

Presenter: HAUNGS, Andreas (Baden)

Session Classification: Astroparticle input

Contribution ID: **33** Type: **not specified**

WHISP

Tuesday, 23 January 2024 15:15 (20 minutes)

Presenter: CAZON, Lorenzo (IGFAE - University of Santiago de Compostela)

Session Classification: Astroparticle input

Contribution ID: **34** Type: **not specified**

Fixed target experiments at the LHC: SMOG and SMOG2 at LHCb

Wednesday, 24 January 2024 09:00 (20 minutes)

Presenter: GRAZIANI, Giacomo (INFN, Sezione di Firenze)

Session Classification: Accelerator input

Contribution ID: **37** Type: **not specified**

Tuning in the far forward region for FASER

Wednesday, 24 January 2024 17:20 (20 minutes)

Presenter: FIEG, Max

Session Classification: Tuning of event generators

Contribution ID: **38** Type: **not specified**

Tuning of Pythia 8 for simulations of UHECR induced air showers

Wednesday, 24 January 2024 11:25 (20 minutes)

Presenter: GAUDU, Chloé (Bergische Universität Wuppertal)

Session Classification: Tuning of event generators

Contribution ID: **39** Type: **not specified**

Tuning with Bayesian methods

Wednesday, 24 January 2024 11:50 (20 minutes)

Presenter: WINDAU, Michael (TU Dortmund)

Session Classification: Tuning of event generators

Contribution ID: **40** Type: **not specified**

IceTop observables for tuning

Wednesday, 24 January 2024 14:50 (20 minutes)

Presenter: SOLDIN, Dennis

Session Classification: Astroparticle input

Contribution ID: **41** Type: **not specified**

IceCube observables for tuning

Wednesday, 24 January 2024 15:15 (20 minutes)

Presenter: HÜNNEFELD, Mirco (TU Dortmund University)

Session Classification: Astroparticle input

Contribution ID: **42** Type: **not specified**

Modified Hadronic Interactions in CORSIKA 7

Wednesday, 24 January 2024 16:30 (20 minutes)

Ulrich et al. have shown already in 2011 that changing the cross-section, elasticity and multiplicity of hadronic interactions at very high energies with respect to the standard hadronic interaction models has a direct impact on predicted depths of the shower maxima and numbers of muons at ground. We have expanded this work from the original 1D implementation in CONEX to full 3D simulations in CORSIKA, allowing us to quantify the effects of the modified interactions on other observables. We find that satisfying the latest constraints from the Pierre Auger Observatory on the number of muons at 1000 meters from the shower axis and depth of shower maximum simultaneously is challenging, but possible within a reasonable space of modifications.

Presenter: EBR, Jan (FZU - Institute of Physics of the Czech Academy of Sciences)

Session Classification: Astroparticle input

Contribution ID: **43** Type: **not specified**

ALICE measurements for tuning

Thursday, 25 January 2024 09:00 (30 minutes)

Presenter: MAIRE, Antonin (IPHC-CNRS IN2P3 (Strasbourg))

Session Classification: Accelerator input

Contribution ID: **46** Type: **not specified**

About train driver's strike

Tuesday, 23 January 2024 13:55 (5 minutes)

Presenter: DEMBINSKI, Hans (TU Dortmund)