Chapter 7 status: cosmic ray physics, multiplicities, correlations and spectra

Tanguy Pierog

Karlsruhe Institute of Technology, Institut für KernPhysik,
Karlsruhe, Germany

QCD and Forward Physics at LHC, Trento, Italy

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Chapter 7

- **Measurements of particular interest to improve hadronic models used for air shower simulations**
  - no direct test of cosmic ray property
  - but fundamental to reduce uncertainty in air shower measurements (mass composition analysis)
- **Min bias type of analysis**
  - high cross section processes (~mb)
  - need low luminosity and low pile-up (each event is relevant)
- **All experiments were contacted and replied**
  - LHCf wants to update some plots
  - plots from LHCb ?
  - Only TOTEM didn't send any contribution
- **Chapter completed since end of July** (24 pages, incl ref.)

Chapter 7 Outline

- **1.Introduction** (R. Engel)
  - ➔ motivations from CR physics
    - spectral feature
    - mass composition

- **2.LHC and air showers** (D. Berge, R. Engel, T. Pierog, D. Salek and R. Ulrich)
    - 2.1.LHC data and hadronic interaction models
  - ➔ comparison old-new models for pseudorapidity
    - 2.2.Hadronic interaction models and air showers
  - ➔ Xmax and Nmu
    - 2.3.Need for measuring p-O interactions
  - ➔ comparison p-p and p-O and effect of extrapolation

Chapter 7 Outline (2)

- **3.Energy Flow** (T. Martin, R. Ulrich, D. Volyanskyy)
  - 3.1.Past measurements of energy flow
  - ➔ ATLAS, CMS, LHCb
  - 3.2.Future measurements of energy flow
  - ➔ ATLAS, CMS, LHCb common fiducial definition for energy flow
- **4.Particle Multiplicities** (T. Martin, D. Volyanskyy)
  - 4.1.Past measurements of particle multiplicities
  - ➔ ATLAS, LHCb
  - 4.2.Future measurements of particle multiplicities
  - ➔ ATLAS

Chapter 7 Outline (3)

- **5.Spectra** (D. Chinellato, T. Sako, R. Ulrich)
  - 5.1.Neutral particle spectra
  - ➔ past and future: LHCf
  - 5.2.Heavy flavor particle spectra
  - ➔ open charm CMS
  - 5.3.Identified particle spectra according to multiplicity
  - ➔ ALICE

- **6.Beam** (T. Martin, T. Pierog, T. Sako)
  - 6.1.Proton-proton collisions
  - 6.2.Light ion Collisions
  - ➔ fixed target (LHCb) and beam

Summary

contact : tanguy.pierog@kit.edu

	Exp	σ^{-1} (nb^{-1})	Pile-up	$\mathscr{L}$ ($cm^{-2}s^{-1}$)	β* (m)	N_b	N_p/b	bunch spacing (ns)
√	LHCf	5-20	<1	$6x10^{28}$	19	40	10^{10}	
	TOTEM	100	<1	10^{30}	90	<156	10^{11}	
√	ATLAS	1	<1					200
√	LHCb	10	<1					>50
√	CR	1	<1					