Status of CORSIKA 7

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Outline

- **Introduction**
- **Release 7.74**
  - Model update
  - New features
  - Bug-fixes
- **Future developments**

CORSIKA 7 benefit from the tests done for CORSIKA 8. CORSIKA 7 still updated until CORSIKA 8 is fully operational.

Introduction

Origin

30+ years of development …

- Reminder : COsmic Ray SImulations for KASCADE

- 1989 : original design optimized for vertical showers on a flat array detector using monte-carlo technique
- 1994< : extension to different type of experiments
  - Cherenkov, fluorescence light, inclined showers, ...
- 2010< : extension to new type of simulations
  - cascade equations, parallelization, different media ...

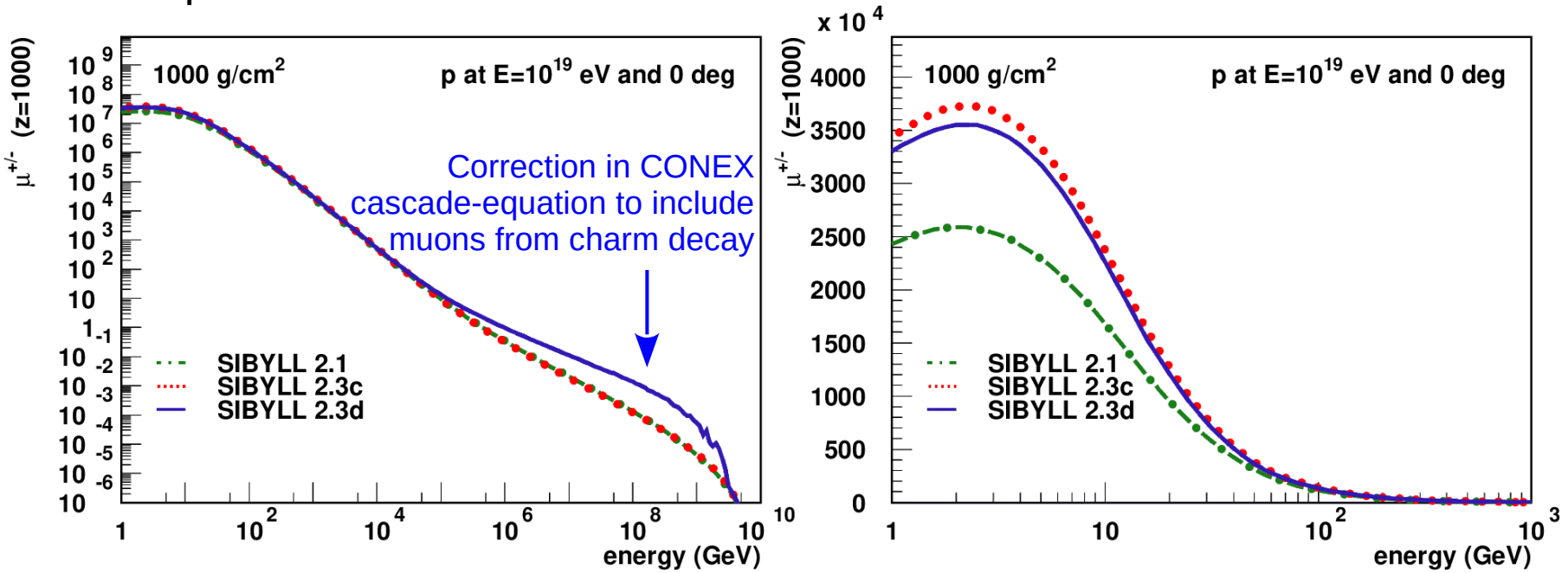
Technicalities

- **source code :**
  - ~ 83 200 lines (without external programs) ~ 300 routines
  - optional code : ~ 50 preprocessor options to be chosen during installation with ./coconut
  - program language (portability) : Fortran 77 / 90 + some few C-routines
- **steering input :**
  - free format with key words + parameters
    - ~ 100 key words
- **documentation:**
  - physics: FZKA 6019 (1998)
  - Webpage (documentations) : <https://www.ikp.kit.edu/corsika/>
- **availability:**
  - download from web : <https://web.ikp.kit.edu/corsika/download/>
  - Access by registration to our new mailing list (by email)
  - Last release : v7.7400 (27.05.2020)

Release v7.7400

Model Updates

- **Sibyll 2.3d** (see talk by F. Riehn)
  - New version with updated π^0 production (~5% less muons)
  - Updated Kaon cross-section



- **Update interface (compilation) with FLUKA 2020**
- **Other models**
  - Update to come for EPOS (3) … may be for QGSJETII (III) ?
  - Included in CORSIKA 7

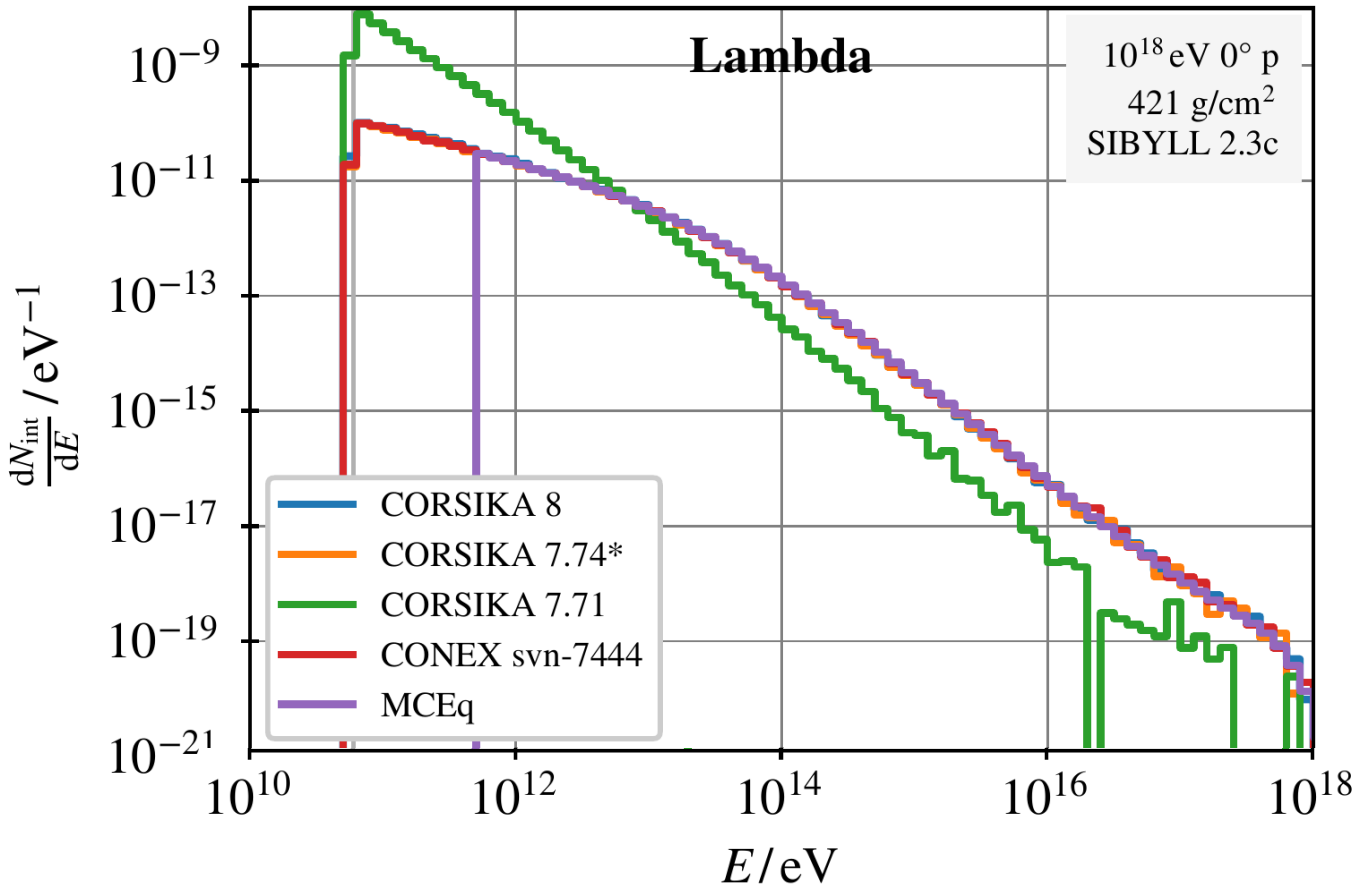
New Features

- **Technical improvements**
  - Add MWEIC keyword to select one of the weight in MULTITHIN with COASTUSERLIB and possibly keep a normal (unthinned) output.
    - Thinned shower for radio but unthinned for particles
  - Make the extended mass range for CONEX+EPOS optional to save memory
    - Primary mass up to 250 nucleons but RAM>2GB
  - Improve compatibility between MPI and MULTITHIN
    - Use a different random number sequence for all thinning definitions on the different cores

- **External updates**
  - Update of Bernlöhr package to version 1.61
  - New monthly South Pole atmosphere parameters for IceTop added

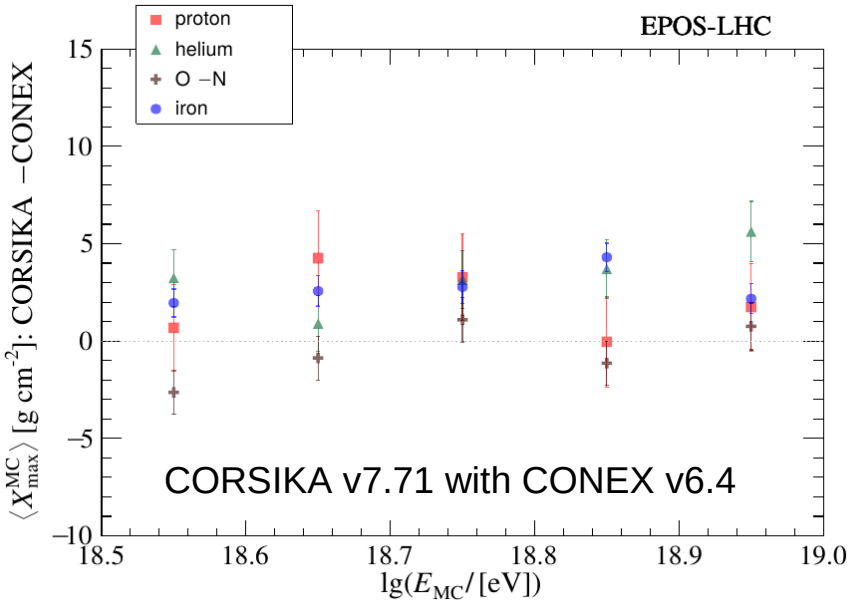
Bug-fixes

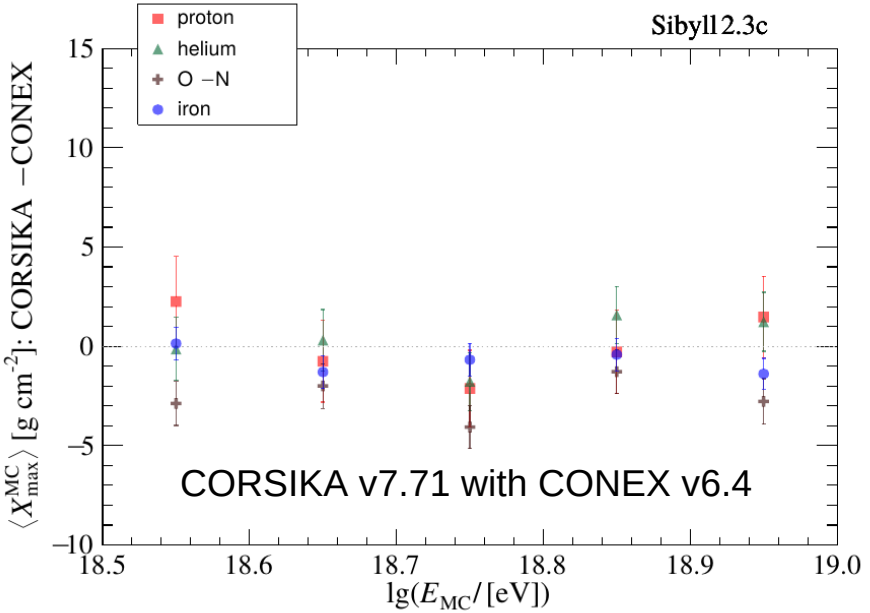
- **Comparing CORSIKA 8 with CORSIKA 7 and CONEX**
  - for EPOS and SIBYLL the decay length of strange baryons was not calculated
    - Only interactions on no decay for strange baryons !



Bug-fixes

- **Comparing CORSIKA 7 and CONEX**
  - ➔ Update CONEX to version 7.5 with improved compatibility with CORSIKA
    - same lambda treatment in QGSJETII (no interaction)
    - same target nucleus selection than in CORSIKA for SIBYLL
    - bug correction for φ direction in Preshower interface
    - consistent version of Sibyll2.3x in CONEX and CORSIKA !

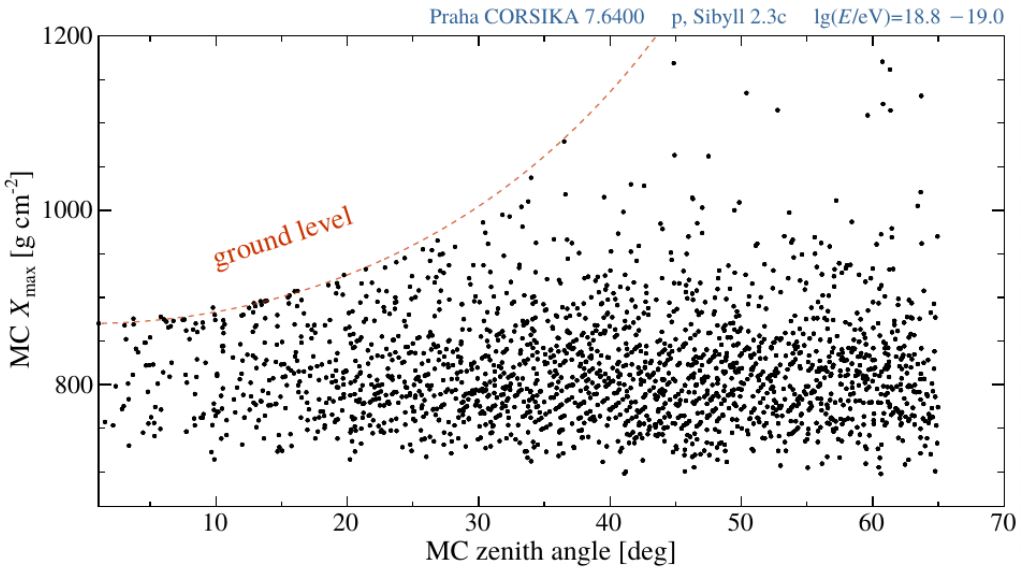




Plots by E. Santos and A. Yushkov for the Pierre Auger Collaboration

Bug-fixes

- **Extensive tests by other groups**
  - Bugs in SLANT for the binning of the longitudinal profiles (all) and in counting of neutral (only) particles for upward (only) going showers



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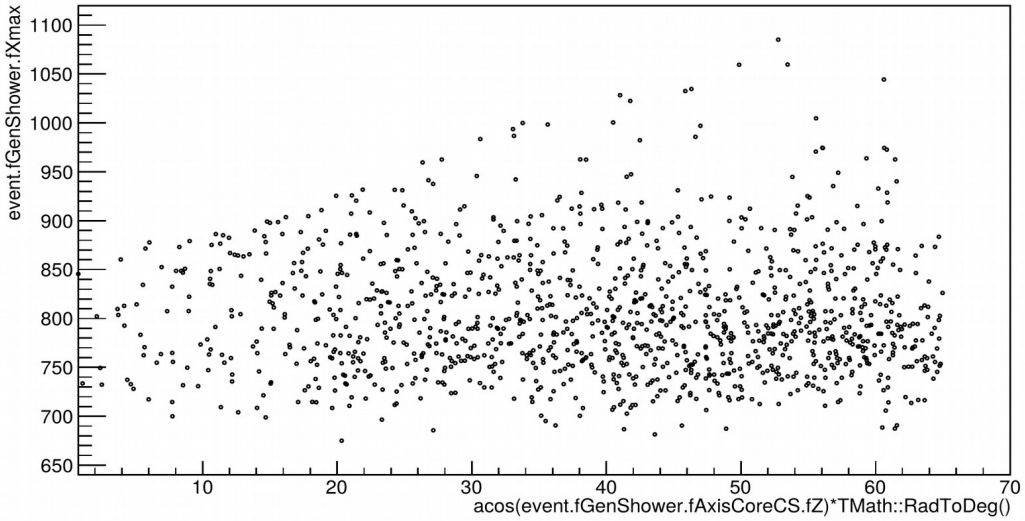


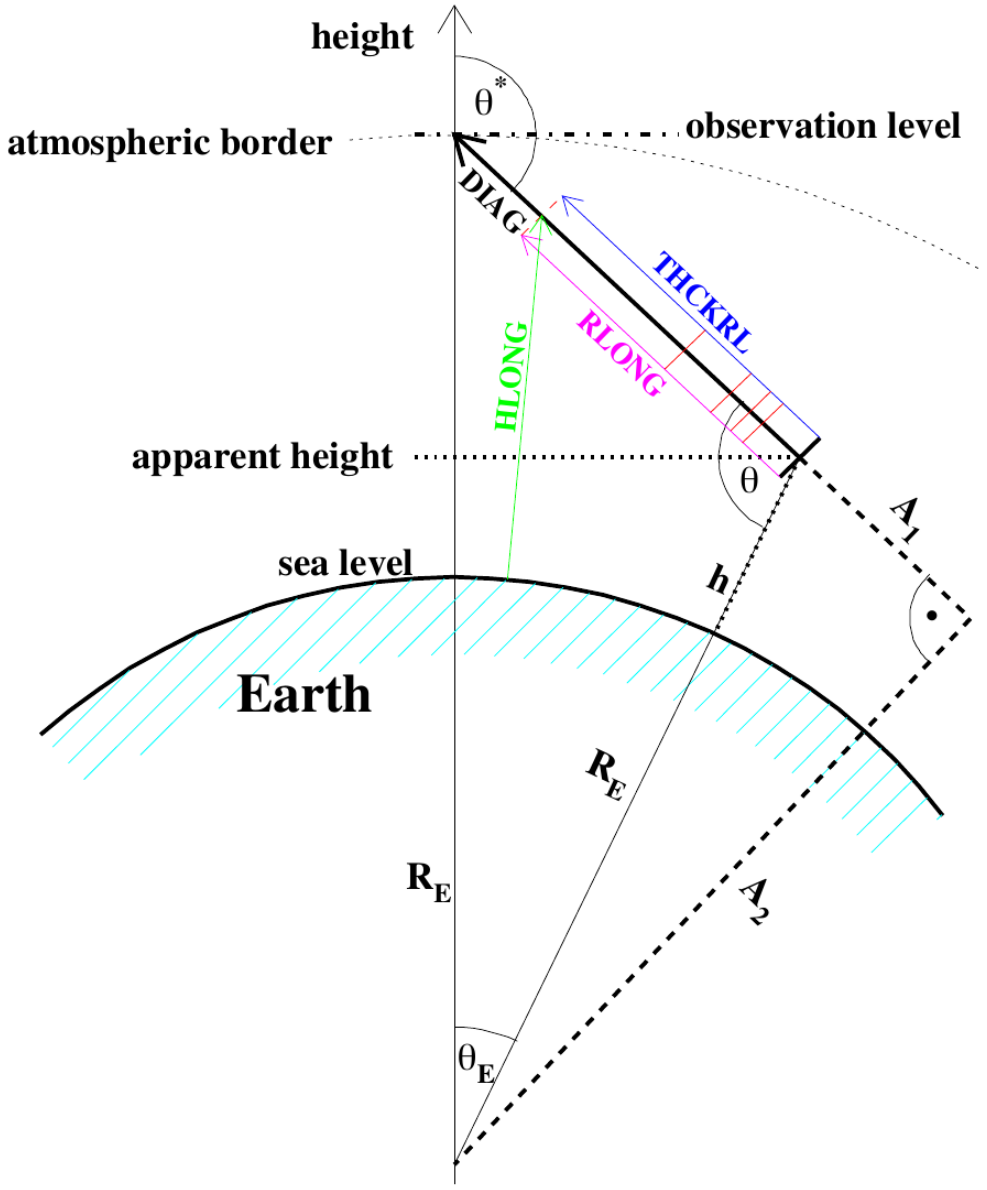
  - Corrections to optimize MPI usage with CoREAS
  - Change format for longitudinal energy deposit in vertical option to get correct depth values in the longitudinal profile.
    - This may give problems in connection with some long-file reader

Future developments

Upward going showers

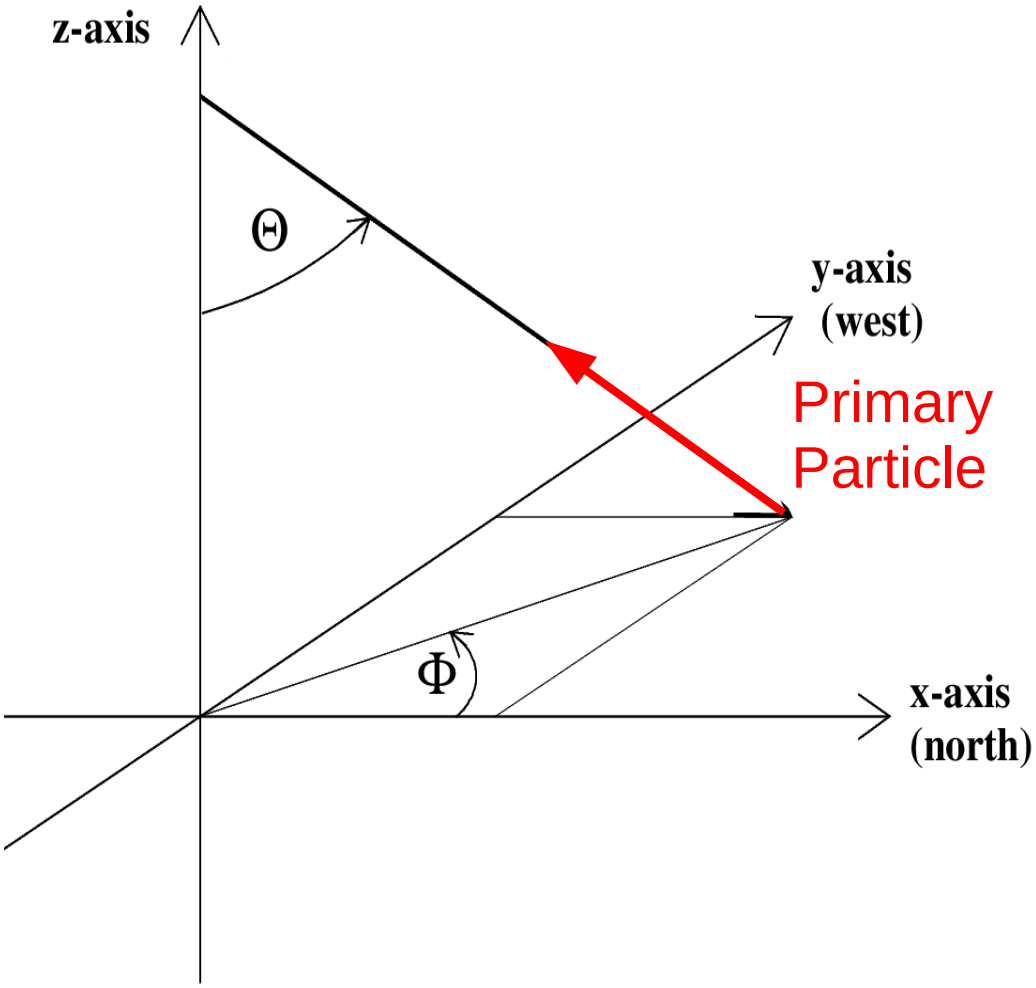
- **Original design**
  - Longitudinal profile only
  - Usual CORSIKA geometry used
- **Problem**
  - Observation level at the top of the atmosphere
  - No particle can be recorded at observation level

    (even with COAST)



Upward going showers

- **Original design**
  - Longitudinal profile only
  - Usual CORSIKA geometry used
- **Problem**
  - Observation level at the top of the atmosphere
  - No particle can be recorded at observation level
- **Solution**
  - Use geometry of downward going showers but put the primary at a different point with reversed momentum
  - Under development ...



Summary

- **CORSIKA 7 is still alive and take advantage of CORSIKA 8 development**
  - CORSIKA 7 will be maintained until CORSIKA 8 will become the new standard
  - Important corrections released in 7.74
- **But no major change expected except**
  - New hadronic models to come (EPOS 3, ...)
  - Upward going showers fully functional (particles at ground)
- **Tests from the community always useful and welcome !**

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