Untersuchung der Atmosphärenmodelle bei MAGIC

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Universität Dortmund

Gliederung

I. Einleitung
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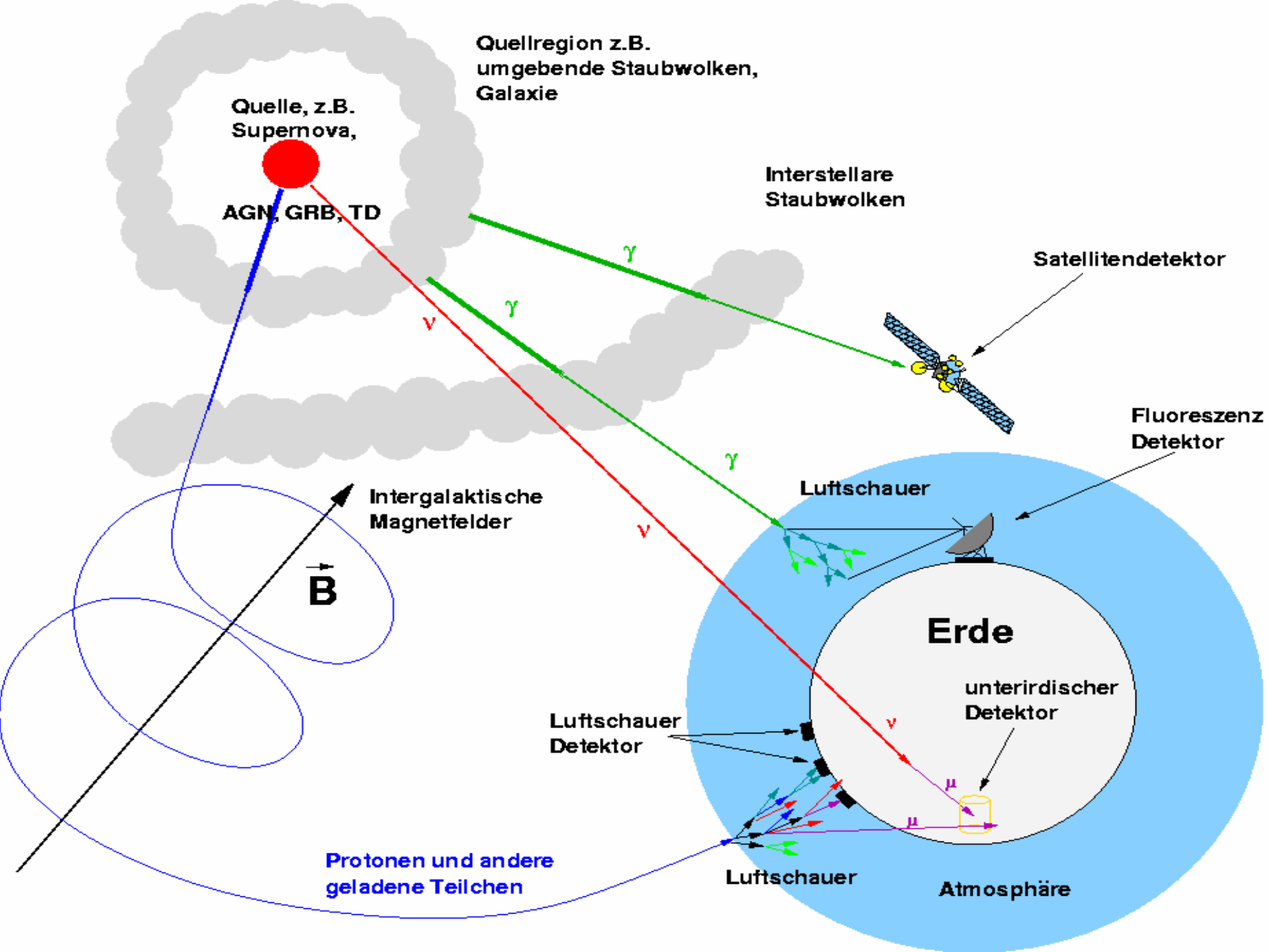
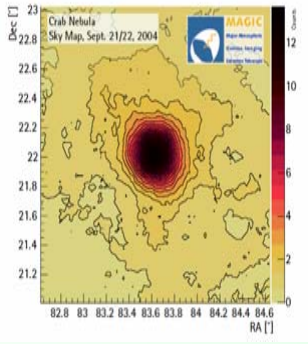
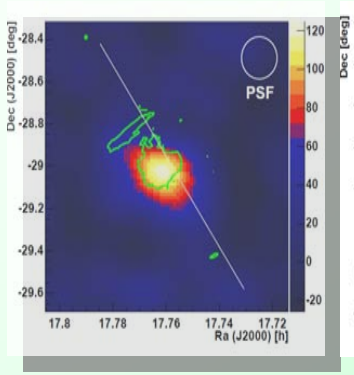

Quellregion z.B.
umgebende Staubwolken,
Galaxie
Quelle, z.B.
Supernova,
AGN, GRB, TD
Interstellare
Staubwolken
γ
γ
γ
ν
Satellitendetektor
Fluoreszenz
Detektor
Luftschauer
Intergalaktische
Magnetfelder
B
ν
Erde
unterirdischer
Detektor
Luftschauer
Detektor
ν
μ
μ
Protonen und andere
geladene Teilchen
Luftschauer
Atmosphäre

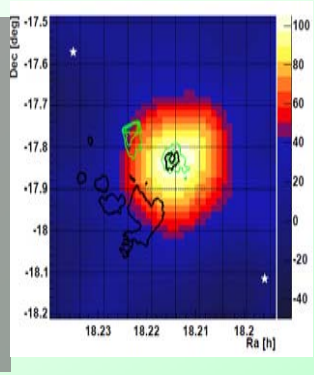
MAGIC Highlights of the First Year (Folie: M.Teshima)



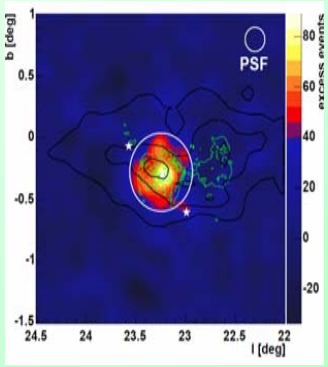
Crab Nebular
SZA & LZA



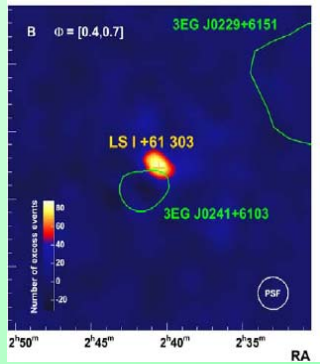
Galactic Center



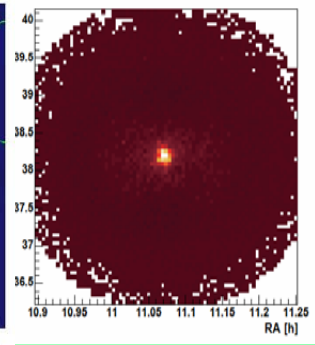
HESS J1813



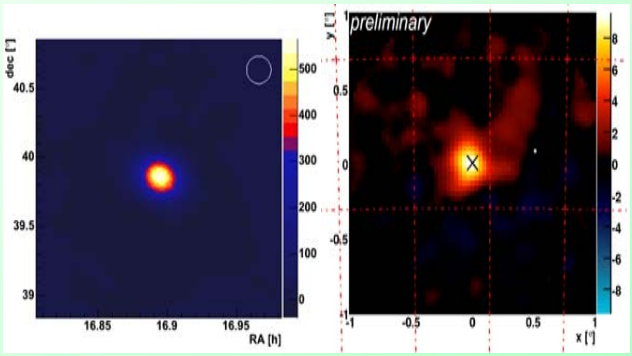
HESS J1834
^{13}CO cloud



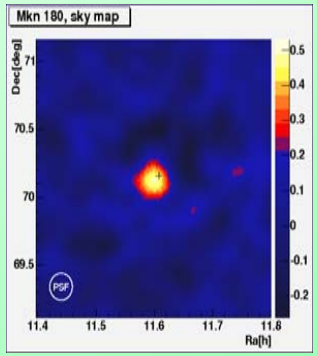
LSI+61 303
Micro-Quasar
New Source



Mrk421 (0.031)

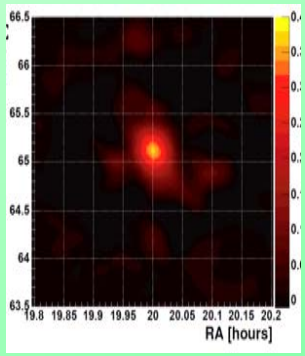


Mrk501 (z=0.034)

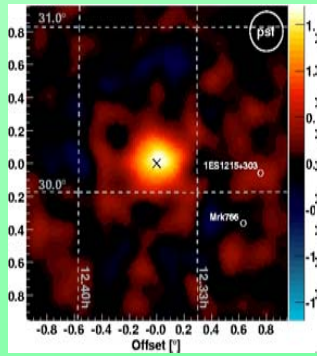


1ES2344 (z=0.044)

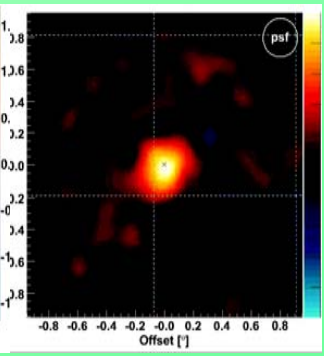
Mrk180 (0.045)
New source



1ES1959 (0.047)



1ES1218 (z=0.18)
New Source



PG 1553 (Z>0.25)
New source

I. Einleitung

MAGIC

- breite Analyse Software
- u.a. zur Generation von Monte Carlos
- zur Generation von Luftschauern:

CORSIKA

- verwendet Atmosphärenmodelle in der Schauer-Simulation

Ziel Diplomarbeit:
=> Verbesserung der Atmosphärenmodelle
und Untersuchung ihrer Auswirkungen

```
RUNNR   420
PRMPAR  1                  particle type
ERANGE  30.    300.          energy range
EVTNR   1                  number of first shower event
NSHOW   1                    number of showers to generate
ESLOPE  -2.6               slope of primary energy spectrum
THETAP  20.  20.             range of zenith angle (degree)
PHIP    0.   0.            range of azimuth angle (degree)
VIEWCONE  0. 0.
DIRECT  results/                                  data directory managed
by daemon
SEED    1    0    0     seed values managed by daemon
SEED    2    0    0     seed values managed by daemon
SEED    3    0    0     seed values managed by daemon
OBSLEV  2200.E2            observation level (in cm)
RADNKG  200.E2             outer radius for NKG lat.dens.determ.
ARRANG  0.                 rotation of array to north
FIXCHI  0.                starting altitude (g/cm**2)
MAGNET  29.5  23.0          magnetic field at LaPalma
HADFLG  0  0  0  0  0  0   flags for hadr. interaction
ECUTS   0.3  0.3  0.02  0.02   e.cuts: had, mu, elec y fot
MUMULT  T                  muon multiple scattering angle
LONGI   T  10.  T   F       longit.distr. & step size & fit
MAXPRT  1                  max. number of printed events
ECTMAP  1.E4               cut on gamma factor for printout
STEPFC  0.1                mult. scattering step length fact.
DEBUG   F  6  F  1000000      debug flag and log.unit for out
CWAVLG  290.  600.          Cherenkov wavelength band
CSCAT   1     0.     20000.     scatter Cherenkov events
CERSIZ  1.                 bunch size Cherenkov photons
USER    haffke
CERFIL  T                  Cherenkov output to extra file
DATBAS  T                  write .dbase file
CERTEL  1
        0. 0. 0. 0. 0. 2000. 1700.    Location and size of each CT
USER    haffke             user
atmosphere   0 F
```

- COsm
- Simu
- Bedie
- Atmo
- Quell

⇒ berec

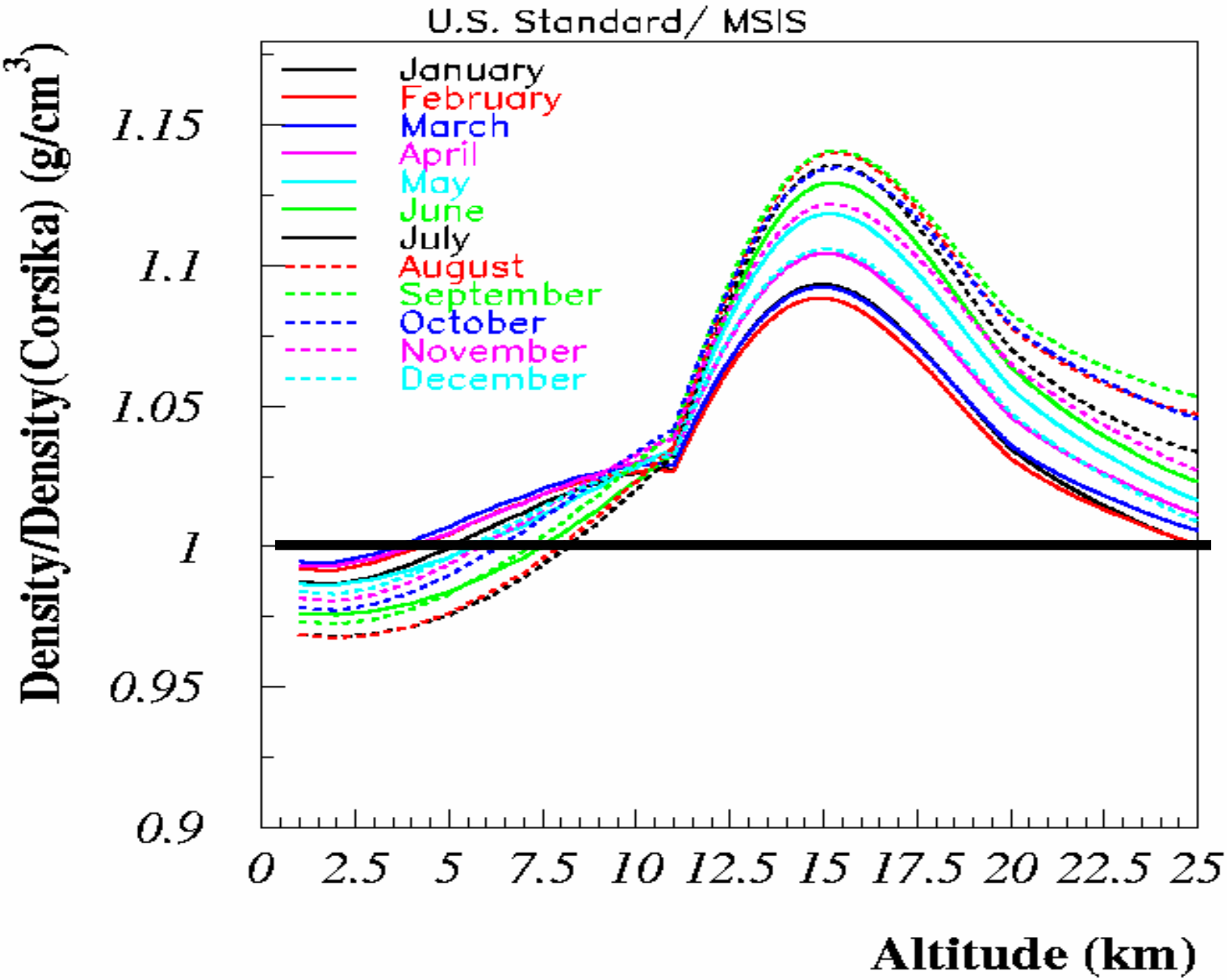
⇒ geeig

II. Atmosphärenmodelle

MSIS

NASA

- empirische Atmosphärenmodelle
- basierend auf Daten von Satelliten und Raketen
- liefert: Temperatur und Dichte
- Bedienung: Variationsmöglichkeiten in Längen-, Breitengrad und in der Zeit
- Quellcode: Fortran


U.S. Standard/ MSIS
January
February
March
April
May
June
July
August
September
October
November
December
Density/Density(Corsika) (g/cm^3)
1.15
1.1
1.05
1
0.95
0.9
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
Altitude (km)

```
RUNNR   420
PRMPAR  1                    particle type
ERANGE  30.     300.              energy range
EVTNR   1                   number of first shower event
NSHOW   1                     number of showers to generate
ESLOPE  -2.6                  slope of primary energy spectrum
THETAP   20.  20.               range of zenith angle (degree)
PHIP     0.   0.               range of azimuth angle (degree)
VIEWCONE  0. 0.
DIRECT   results/                                  data directory managed
by daemon
SEED      1       0       0     seed values managed by daemon
SEED      2       0       0     seed values managed by daemon
SEED      3       0       0     seed values managed by daemon
OBSLEV  2200.E2                observation level (in cm)
RADNKG  200.E2                 outer radius for NKG lat.dens.determ.
ARRANG  0.                    rotation of array to north
FIXCHI  0.                  starting altitude (g/cm**2)
MAGNET  29.5  23.0              magnetic field at LaPalma
HADFLG  0  0  0  0  0  0       flags for hadr. interaction
ECUTS   0.3  0.3  0.02  0.02     e.cuts: had, mu, elec y fot
MUMULT  T                     muon multiple scattering angle
LONGI    T  10.  T   F          longit.distr. & step size & fit
MAXPRT   1                     max. number of printed events
ECTMAP  1.E4                   cut on gamma factor for printout
STEPFC   0.1                  mult. scattering step length fact.
DEBUG   F  6  F  1000000          debug flag and log.unit for out
CWAVLG  290.  600.             Cherenkov wavelength band
CSCAT   1      0.      20000.       scatter Cherenkov events
CERSIZ  1.                   bunch size Cherenkov photons
USER    haffke
CERFIL  T                    Cherenkov output to extra file
DATBAS  T                     write .dbase file
CERTEL  1
        0. 0. 0. 0. 0. 2000. 1700.    Location and size of each CT
USER    haffke                 user
atmosphere   0 F
```

- Wie b … gen in CORS…
- => e…

Atmospheric Model 6 (U.S. Standard)

# Alt [km]	rho [g/cm^3]	thick [g/cm^2]	n-1
			8232E-03
			5634E-03
2.000	0.10054E-02	0.81286E+03	0.23214E-03
3.000	0.90839E-03	0.71725E+03	0.20975E-03
4.000	0.81888E-03	0.63097E+03	0.18904E-03
5.000	0.73643E-03	0.55328E+03	0.16994E-03
6.000	0.66012E-03	0.48352E+03	0.15235E-03
7.000	0.59048E-03	0.42105E+03	0.13620E-03
8.000	0.52609E-03	0.36529E+03	0.12136E-03
9.000	0.46741E-03	0.31567E+03	0.10782E-03
10.000	0.41370E-03	0.27167E+03	0.95426E-04
11.000	0.36499E-03	0.23278E+03	0.84194E-04
12.000	0.31209E-03	0.19900E+03	0.71987E-04
13.000	0.26674E-03	0.17012E+03	0.61523E-04
14.000	0.22792E-03	0.14543E+03	0.52581E-04
15.000	0.19479E-03	0.12434E+03	0.44937E-04
16.000	0.16651E-03	0.10631E+03	0.38406E-04
17.000	0.14236E-03	0.90902E+02	0.32840E-04
18.000	0.12168E-03	0.77727E+02	0.28071E-04
19.000	0.10403E-03	0.66465E+02	0.23997E-04
20.000	0.88928E-04	0.56837E+02	0.20516E-04
21.000	0.75750E-04	0.48620E+02	0.17475E-04
22.000	0.64544E-04	0.41621E+02	0.14887E-04
23.000	0.55021E-04	0.35655E+02	0.12695E-04
24.000	0.46965E-04	0.30566E+02	0.10833E-04
25.000	0.40097E-04	0.26222E+02	0.92494E-05
27.500	0.27126E-04	0.17925E+02	0.62570E-05
30.000	0.18420E-04	0.12302E+02	0.42495E-05
32.500	0.12139E-04	0.85361E+01	0.28004E-05

Brechungsindex

Höhe **Dichte** **Thickness**

```
PRMPAR  1                    particle type
ERANGE  30.     300.              energy range
EVTNR   1                  number of first shower event
NSHOW   1                    number of showers to generate
ESLOPE  -2.6                 slope of primary energy spectrum
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DIRECT   results/                                  data directory managed
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ARRANG  0.                   rotation of array to north
FIXCHI  0.                 starting altitude (g/cm**2)
MAGNET  29.5  23.0             magnetic field at LaPalma
HADFLG  0  0  0  0  0  0       flags for hadr. interaction
ECUTS   0.3  0.3  0.02  0.02     e.cuts: had, mu, elec y fot
MUMULT  T                    muon multiple scattering angle
LONGI    T  10.  T   F         longit.distr. & step size & fit
MAXPRT   1                   max. number of printed events
ECTMAP  1.E4                 cut on gamma factor for printout
STEPFC   0.1                 mult. scattering step length fact.
DEBUG   F  6  F  1000000         debug flag and log.unit for out
CWAVLG  290.  600.             Cherenkov wavelength band
CSCAT   1     0.      20000.       scatter Cherenkov events
CERSIZ  1.                   bunch size Cherenkov photons
USER    haffke
CERFIL  T                    Cherenkov output to extra file
DATBAS  T                    write .dbase file
CERTEL  1
      0. 0. 0. 0. 0. 2000. 1700.    Location and size of each CT
USER    haffke                 user
atmosphere   11 T
EXIT                       terminates input
```
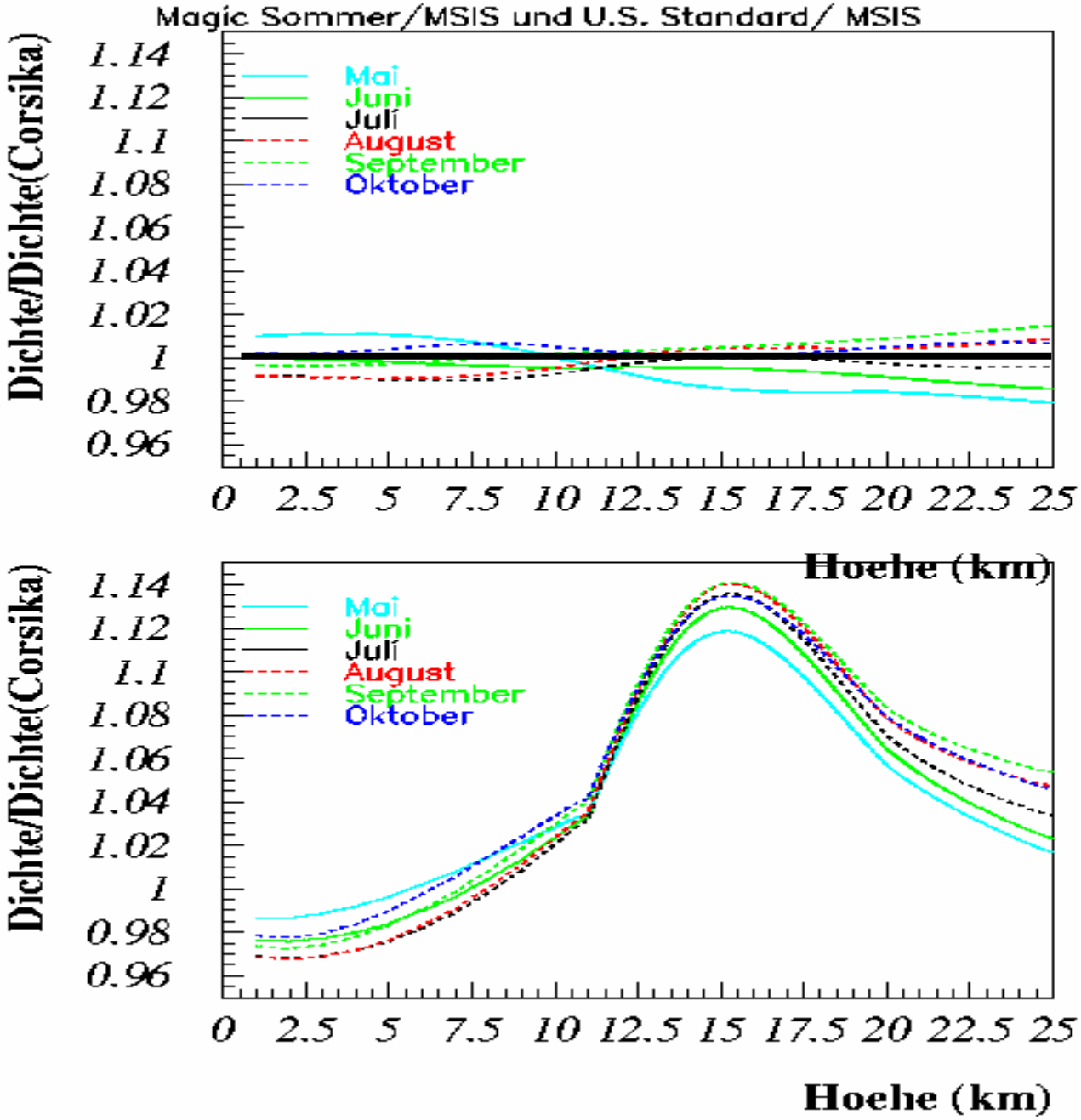
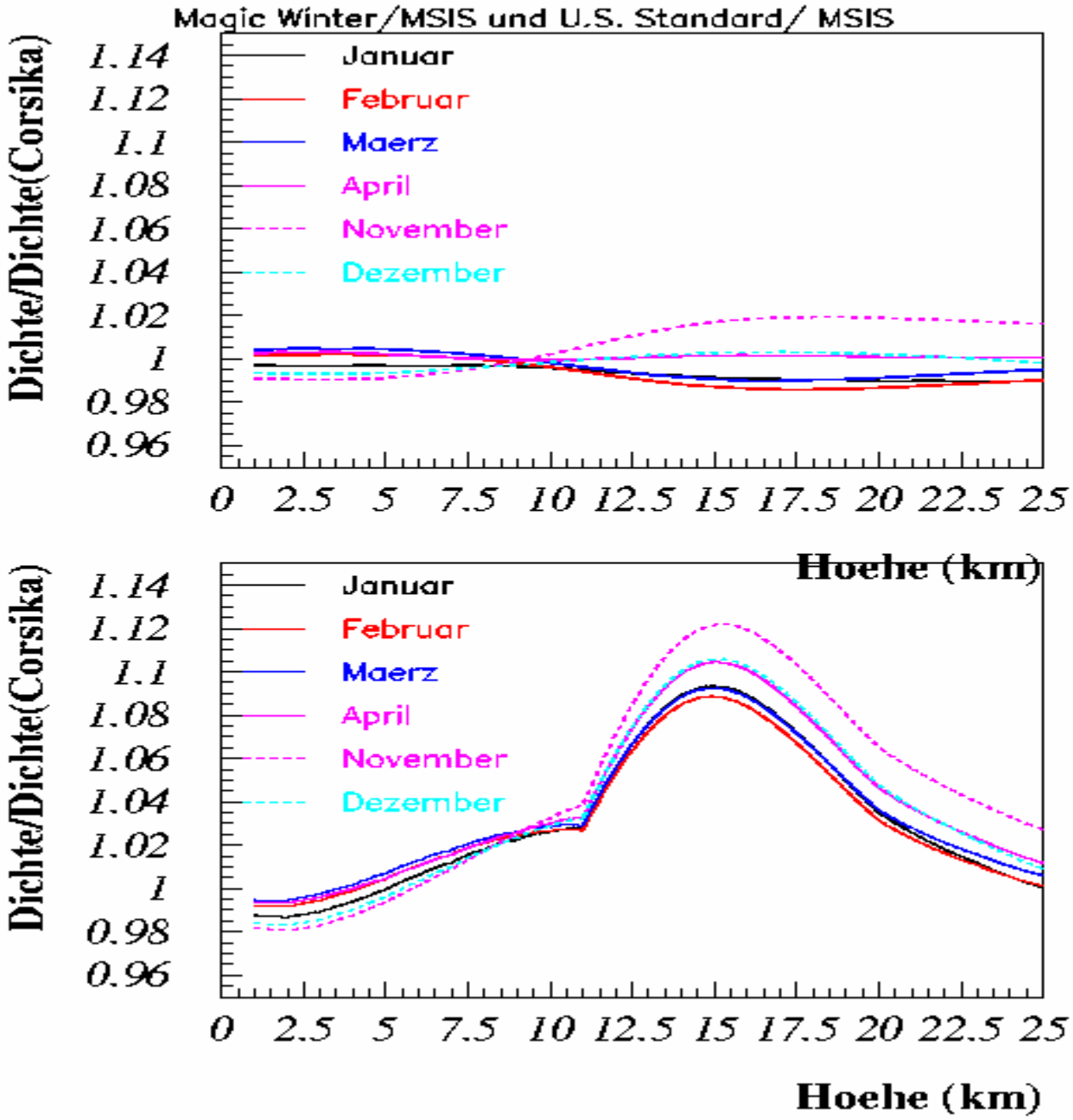


Magic Sommer/MSIS und U.S. Standard/ MSIS
Dichte/Dichte(Corsika)
1.14
1.12
1.1
1.08
1.06
1.04
1.02
1
0.98
0.96
Mai
Juni
Juli
August
September
Oktober
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
Hoehe (km)
Dichte/Dichte(Corsika)
Mai
Juni
Juli
August
September
Oktober
Hoehe (km)


Magic Winter/MSIS und U.S. Standard/ MSIS
Dichte/Dichte(Corsika)
1.14
1.12
1.1
1.08
1.06
1.04
1.02
1
0.98
0.96
Januar
Februar
Maerz
April
November
Dezember
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
25
Hoehe (km)
Dichte/Dichte(Corsika)
Januar
Februar
Maerz
April
November
Dezember
Hoehe (km)

II. Atmosphärenmodelle

Eigene Atmosphärenmodelle

- Atmosphärenmodelle im CORSIKA-Paket:

- 2 Atmosphärenmodelle

  - MagicWinter: November – April (atmprof11.dat)
  - MagicSommer: Mai – Oktober (atmprof12.dat)

=> nur noch 2% Abweichung

III. Monte Carlo

Unterschiede in der Höhe der 1. WW:

U.S. Standard Atmosphäre: 17664,5 m

MagicWinter: 17928,3 m

MagicSommer: 18038,5 m

IV. Ausblick

- Analyse mit Mars:
  - Erkennbare Unterschiede oder nicht
- Wenn ja:
  - Reanalyse von bekannter Quelle mit Sommer- und Winteratmosphäre

Zusammenfassung

- MAGIC: Tscherenkov-Teleskop
- Software: CORSIKA
- Vergleich Atmosphärenmodelle CORSIKA mit MSIS
- Atmosphärendichte unterliegt jahreszeitlichen Schwankungen
- MagicWinter- und MagicSommer-Atmosphäre
- Reduktion der Abweichung um 2%

Quellen

- Kosmische Spurensuche, Johannes Blümer
- CORSIKA Manual
- MSIS Homepage
- How to Camera, Abelardo Moralejo
- M. Teshima