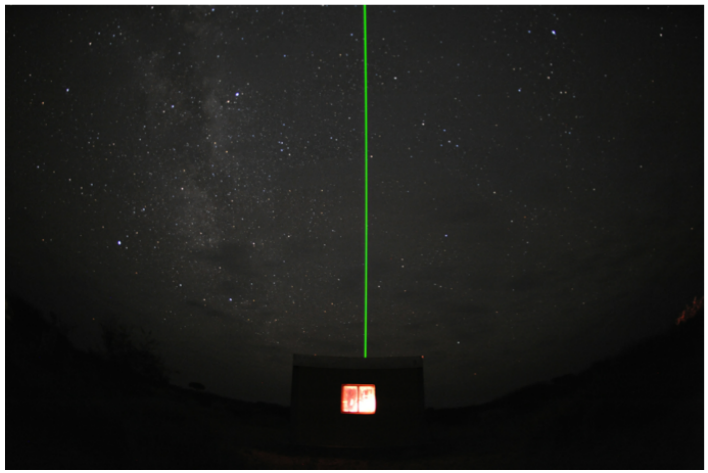

H.E.S.S. LIDAR
ANALYSIS STATUS

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IN2P3–LUPM

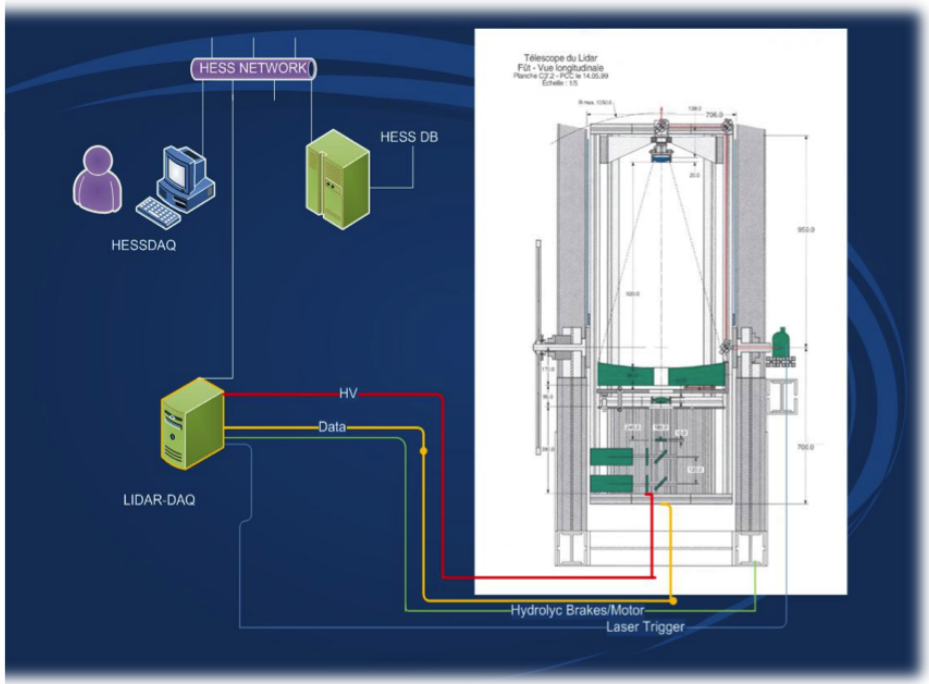
AtmoHEAD 2014, May 21$^{\mathrm{th}}$, 2014

Goals

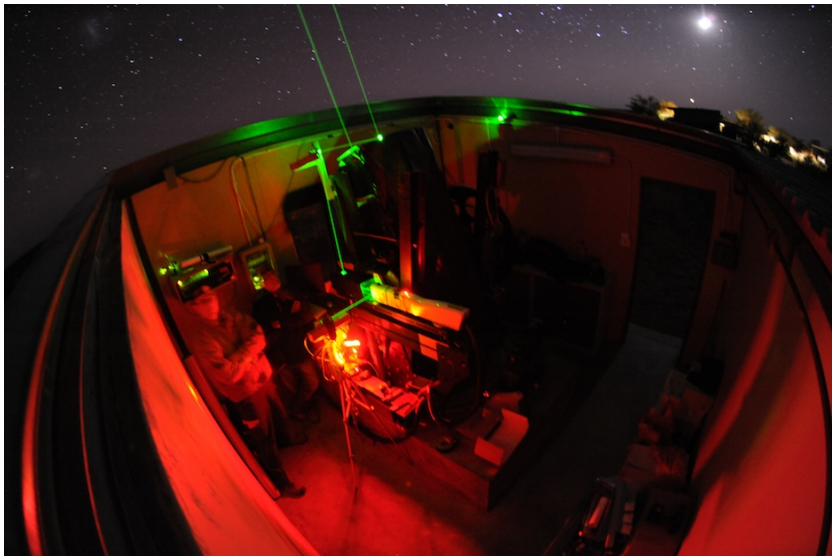
- Understand LIDAR data
  - define LIDAR data quality
  - systematic analysis within the H.E.S.S. software (`ParisAnalysis framework`)
  - extract atmospheric transmission profile and integrated opacity
- Use LIDAR data to improve high level science
  - state atmosphere quality
  - recover medium quality atmosphere data
  - minimize systematics uncertainties due to atmosphere quality

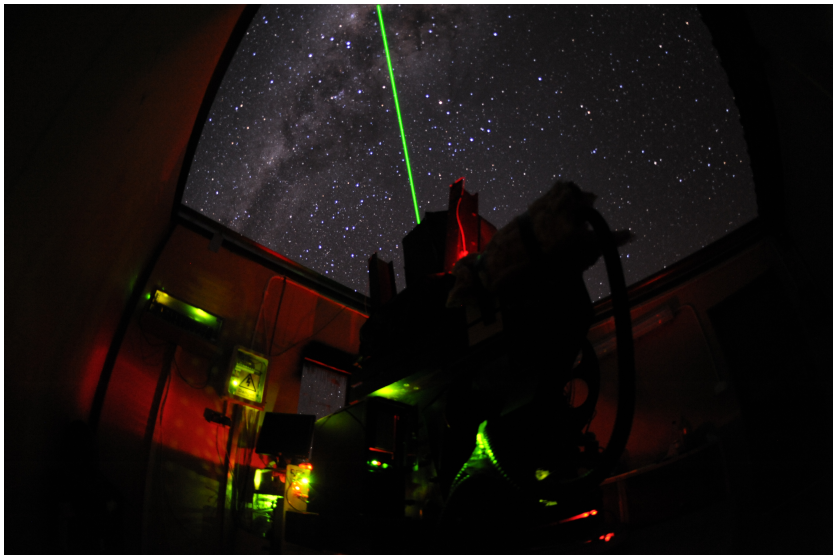
LIDAR specifications

- Elastic Lidar
- Biaxial/Coaxial configuration
- Quantel Brillant 30 laser
  - 532nm
  - 355nm
  - 10 Hz repetition rate
  - 3.4 W
- 60 cm mirror
- Cassegrain type telescope (f/1.2)
- Fully automated



LIDAR operations





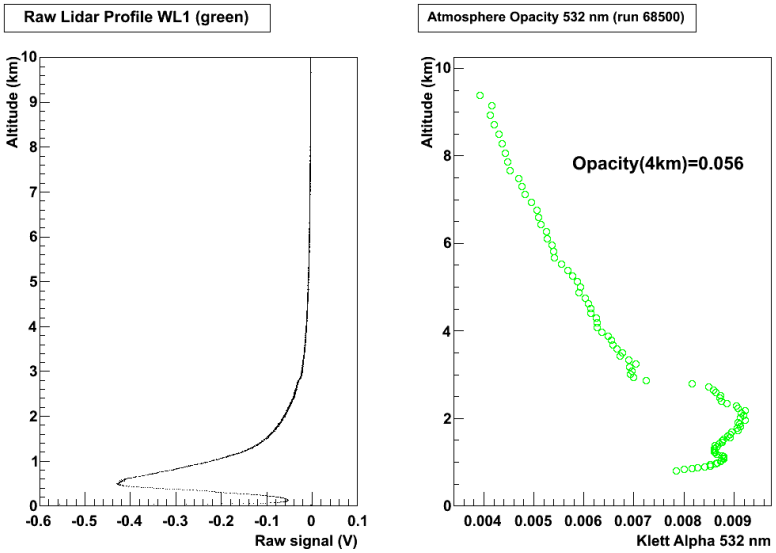
- Typical operation of the H.E.S.S.S lidar on either bi-axial or coaxial mode

H.E.S.S. DATA INTEGRATION

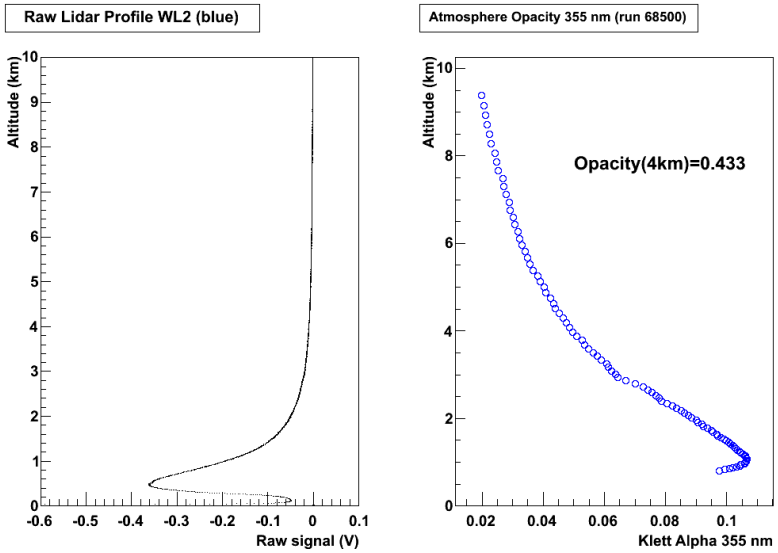
- Implement two independent Klett inversion algorithm
  - Standalone running package
  - `ParisRunQuality` package
- HESS Lidar data analysis now available for 1600 runs, covering 2 years of data
- Output availble for further analysis
  - raw signal profiles, reduced power profiles, atmosphere extinction profiles
  - integrated atmosphere opacity from 800 m to 4 km

Typical atmospheric profile

Run 69500 at 532 nm

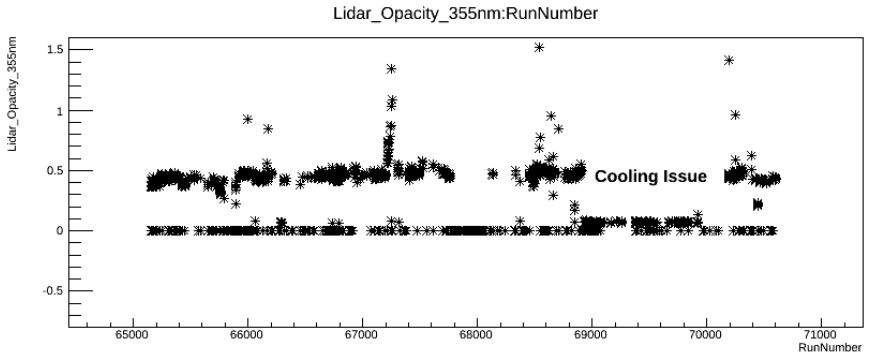


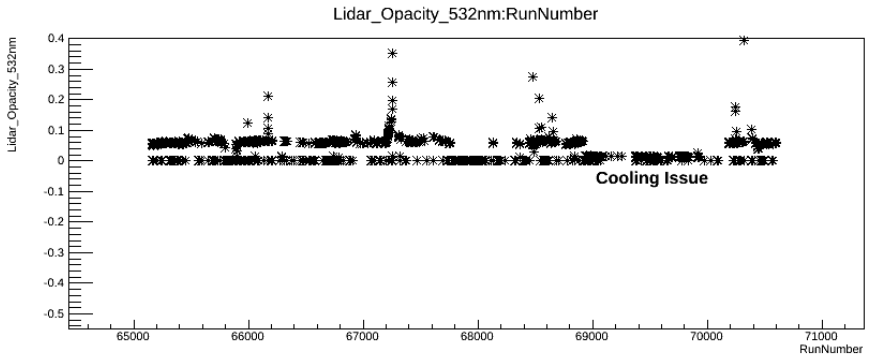
Run 69500 at 355 nm

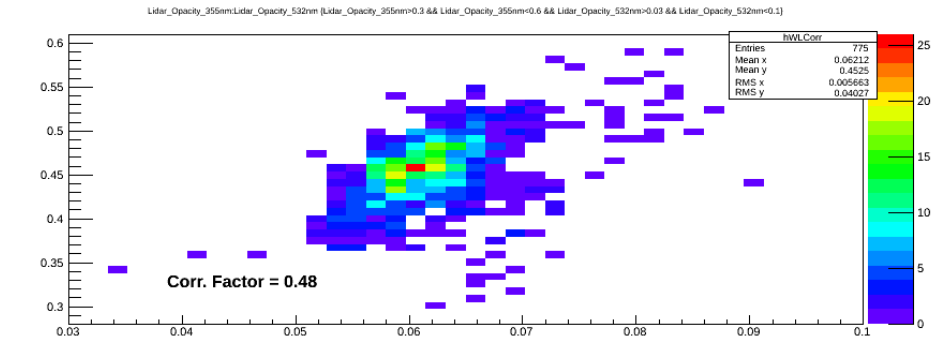


- Data are available in the `runquality` root files
- Every profile 1200 laser shots
- Green and blue wavelength are sensitive to different effects

Overview

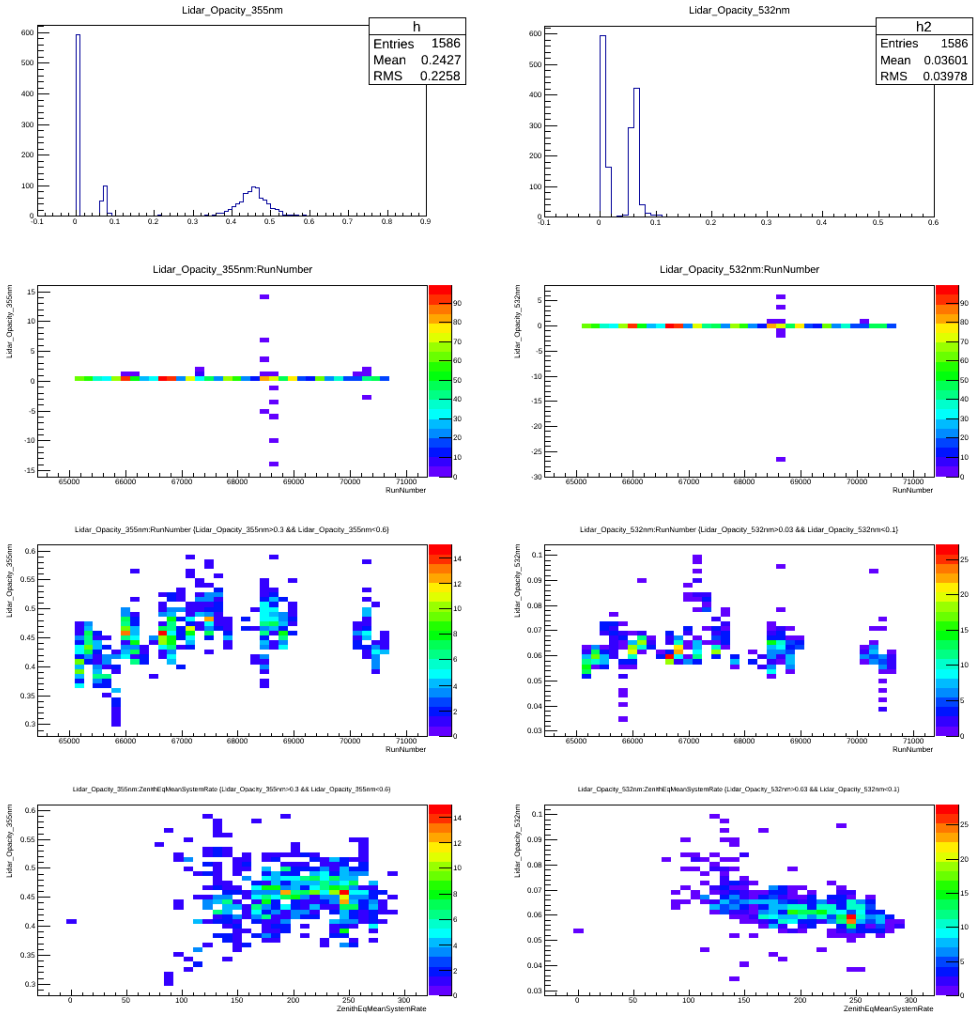






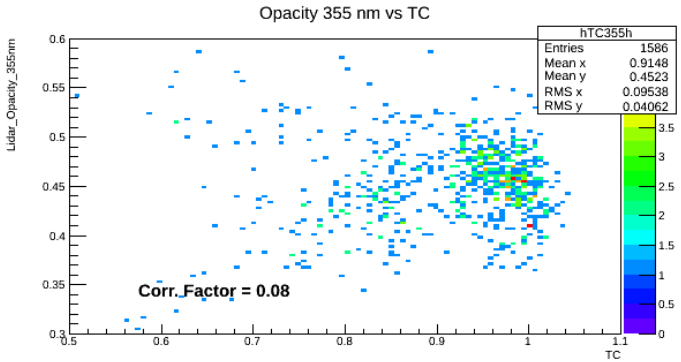
- 1288 "good" runs out of 1986 runs at 532 nm: (30/06/2011) to (01/012/2013)

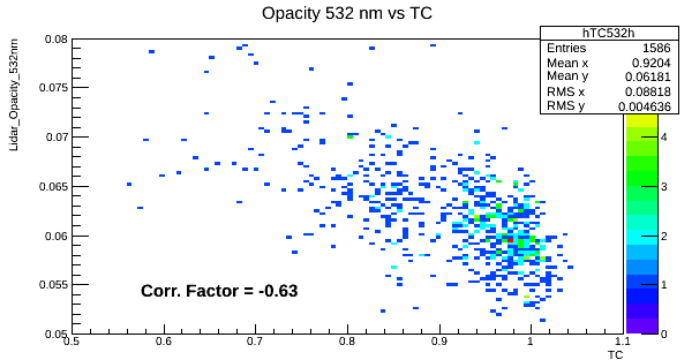
Quality

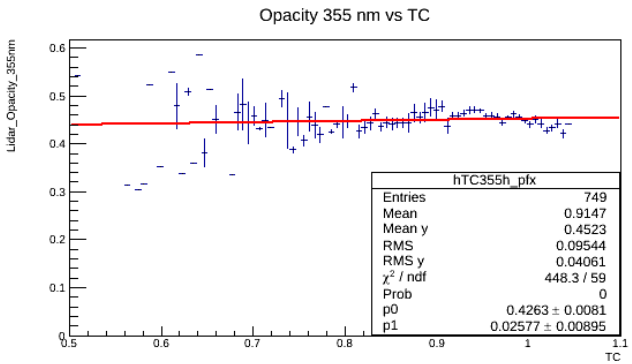


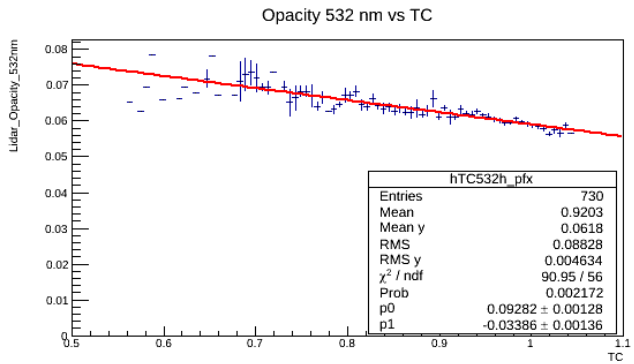
- once the zeroes and bad data are removed, data seem to be reasonably homogeneous

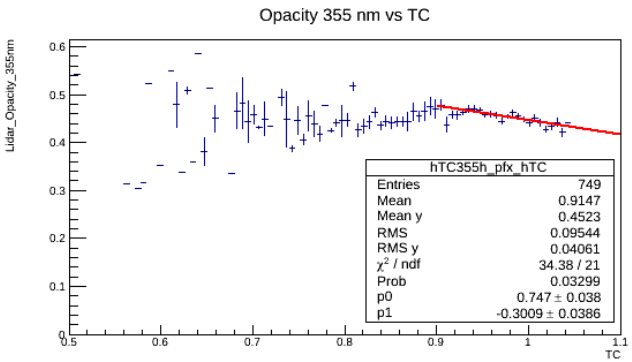
Correlation with Transparency Coefficient

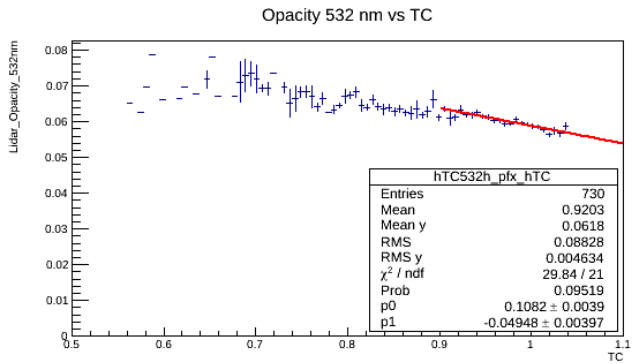








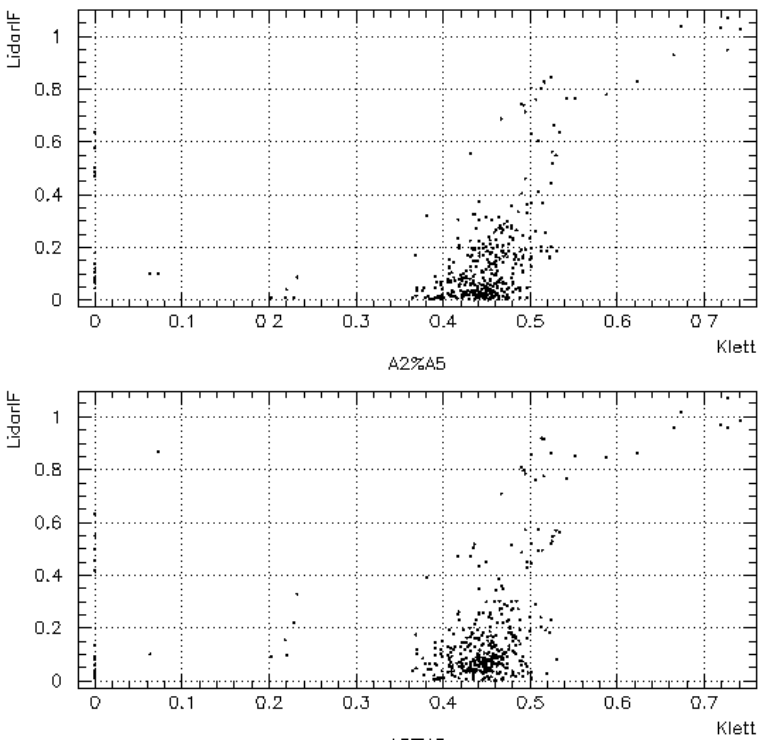




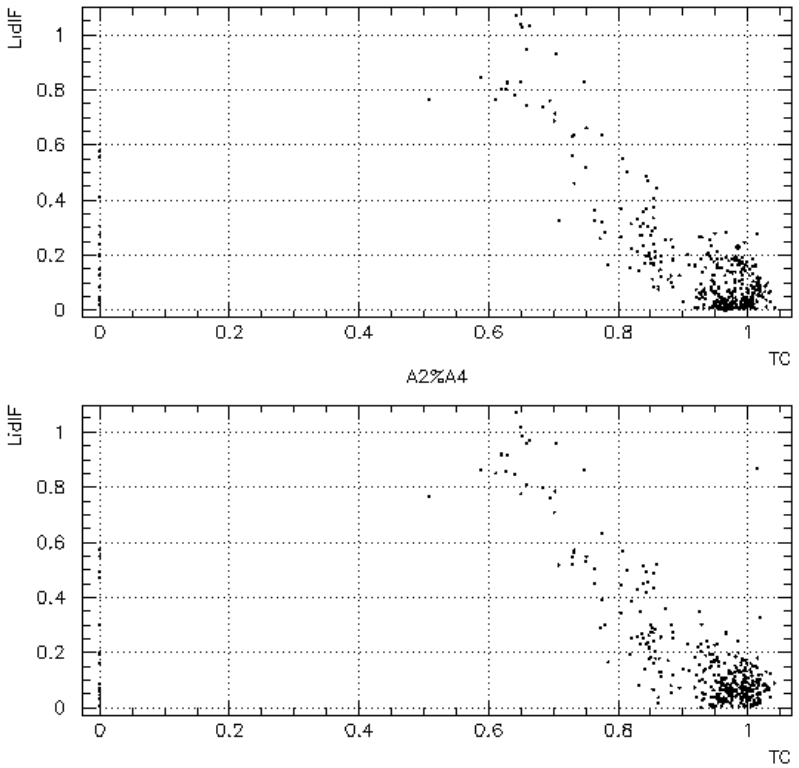
- globally, the correlation with the TC looks quite good at 532 nm but not that good at 355 nm

Crosscheck with a different algorithm

Correlation with Opacity



Correlation with TC

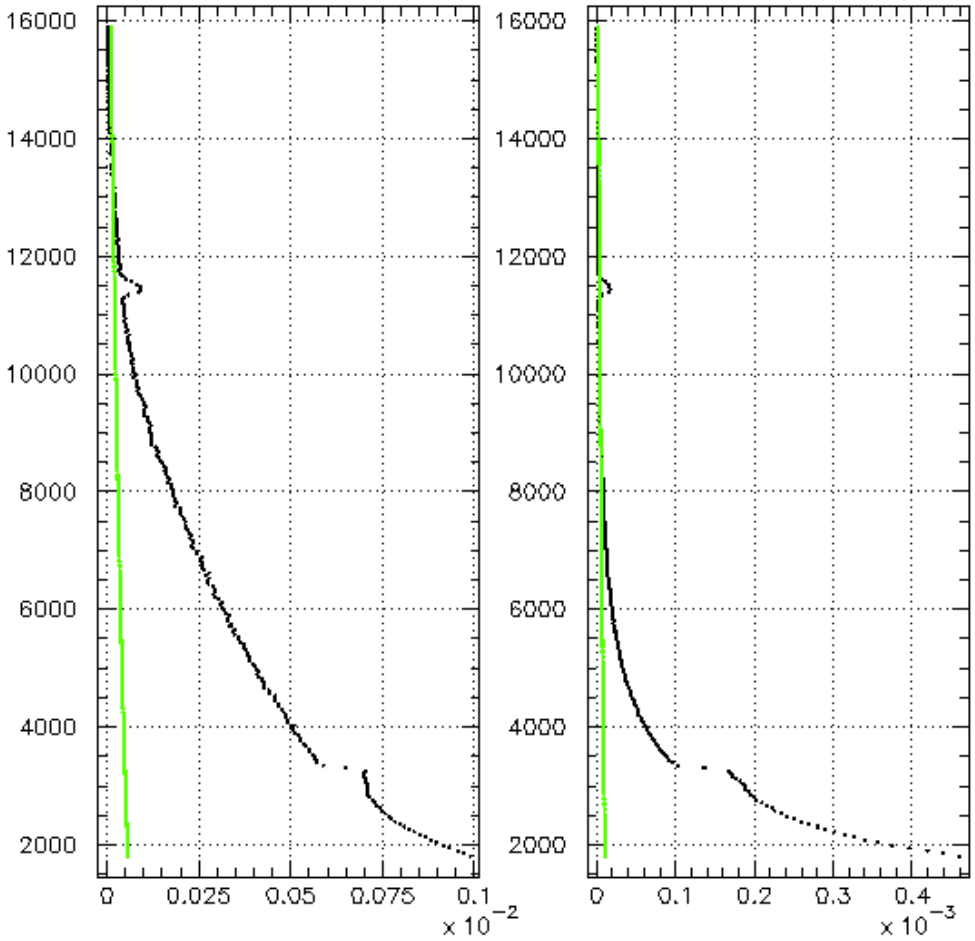


- robust method (integrate signal above linear fit)

$\Rightarrow$ coherent results found on integrated atmosphere opacity

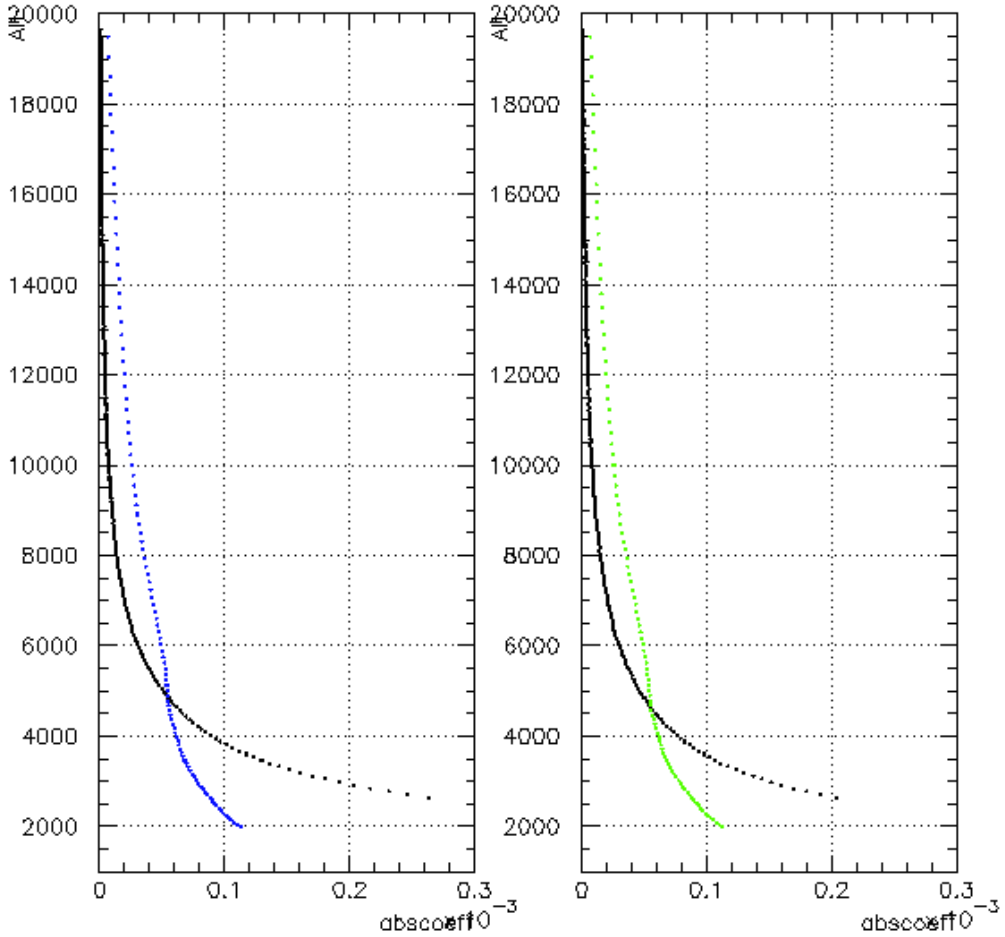
Klett Inversion

Bad Weather Run at 355 and 532 nm



- Green line correspond to expected Rayleigh scattering : "official" atmosphere P and T, derived from radiosonde data
- Dark lines Klett inverted absorption coefficient

LIDAR/MC comparison



- Green/Blue lines correspond to the extinction derived from the MODTRAN transmission profile used within H.E.S.S. MC.
- Dark lines Klett inverted absorption coefficient

Conclusions

- encouraging initial results
- Work ahead
  - look at correlation with trigger rates and meteo information in more details
  - inspect peculiar cases: high TC but high opacity or low TC but low Lidar derived opacity
  - implement cloud finder algorithm
  - study Klett inversion method sensitivity to initial conditions
  - start looking at the atmosphere opacity profiles and their integration into Kaskade/Corsika simulations
  - look for calibration sources (Crab Nebula, Galactic Center. . .)
  - look into older LIDAR runs (before 2011)