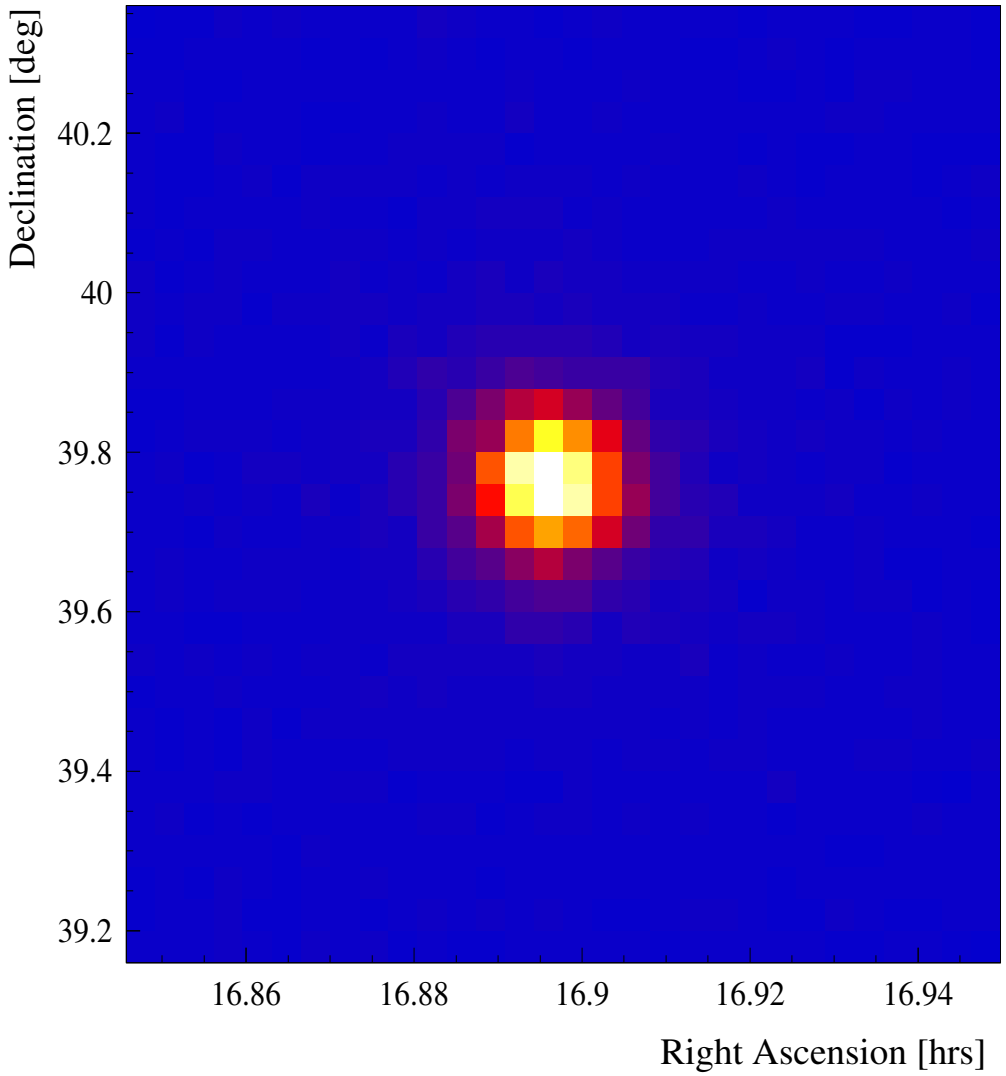
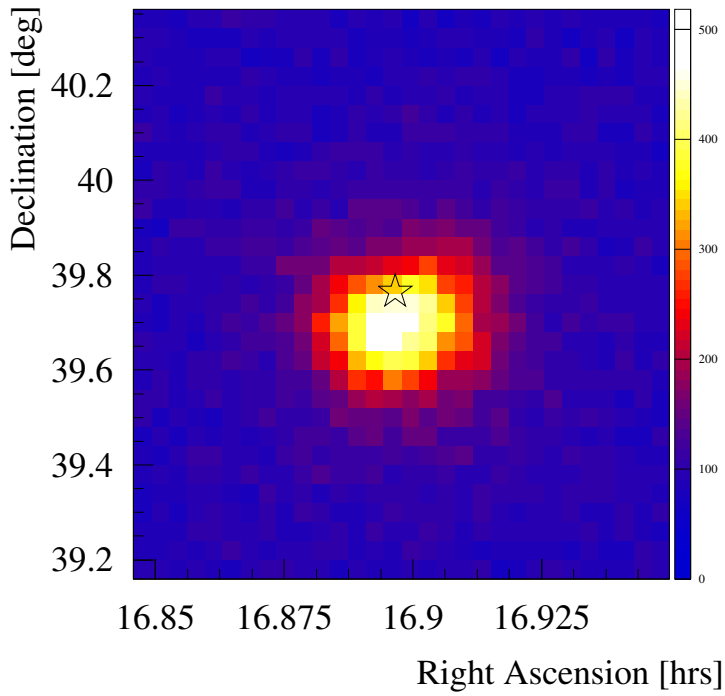
Locating TeV γ-ray Sources with Sub-Arcminute Precision

G. Pühlhofer
MPI für Kernphysik, Heidelberg
HEGRA-Kollaboration



presented at the Ringberg Castle Workshop on TeV-Gamma-Ray Astrophysics
Gamma-Ray Astronomy with Systems of Cherenkov Telescopes
28. September - 3. October 1997

Motivation



Resolution

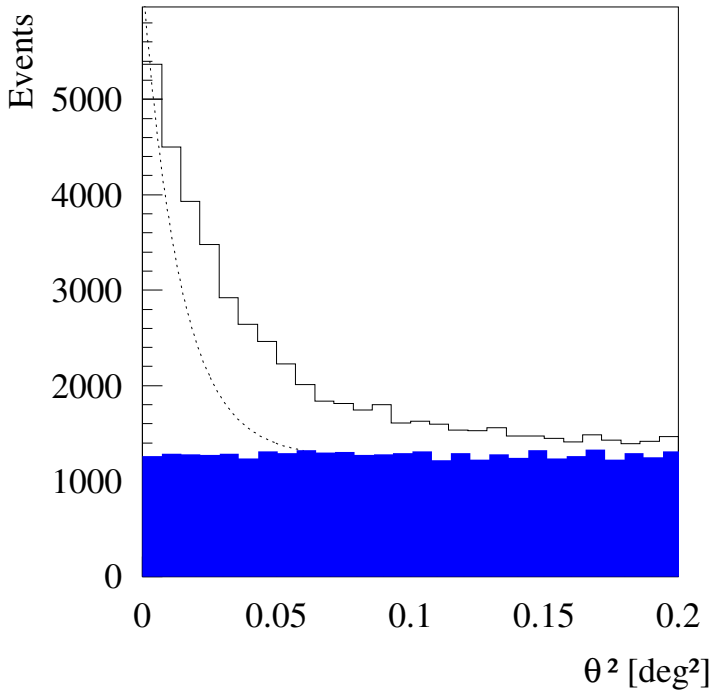
0.11° → <0.1°

Source Location

0.07° → ~0.01°

→

Minimum Detectable Flux



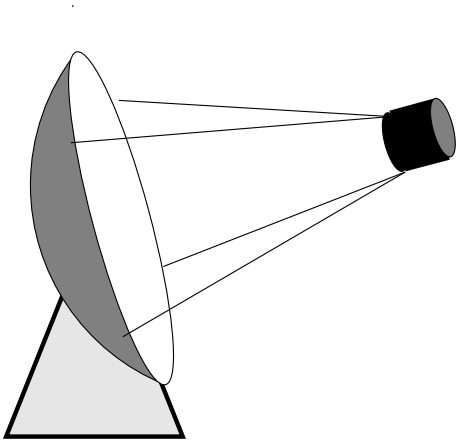
→

Counterparts

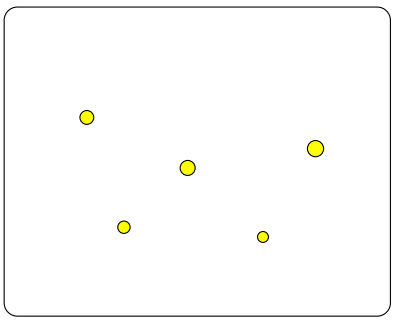
→

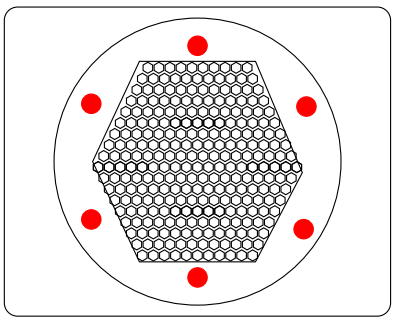
Mapping of Extended Sources

Ways of Tracking Control

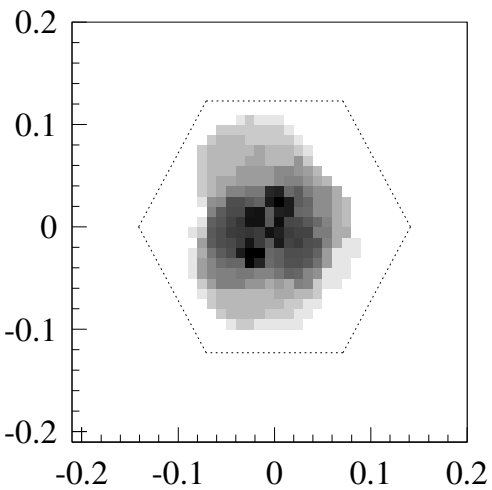


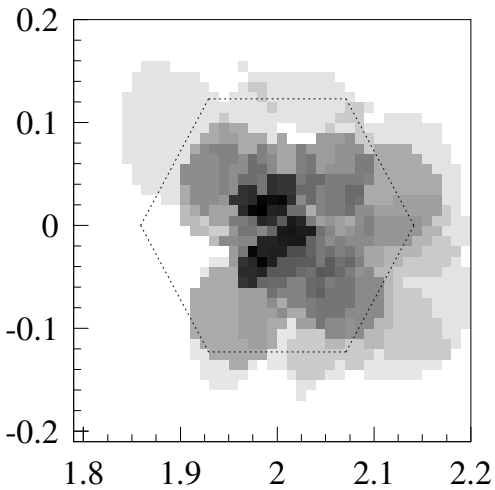
Video Cameras



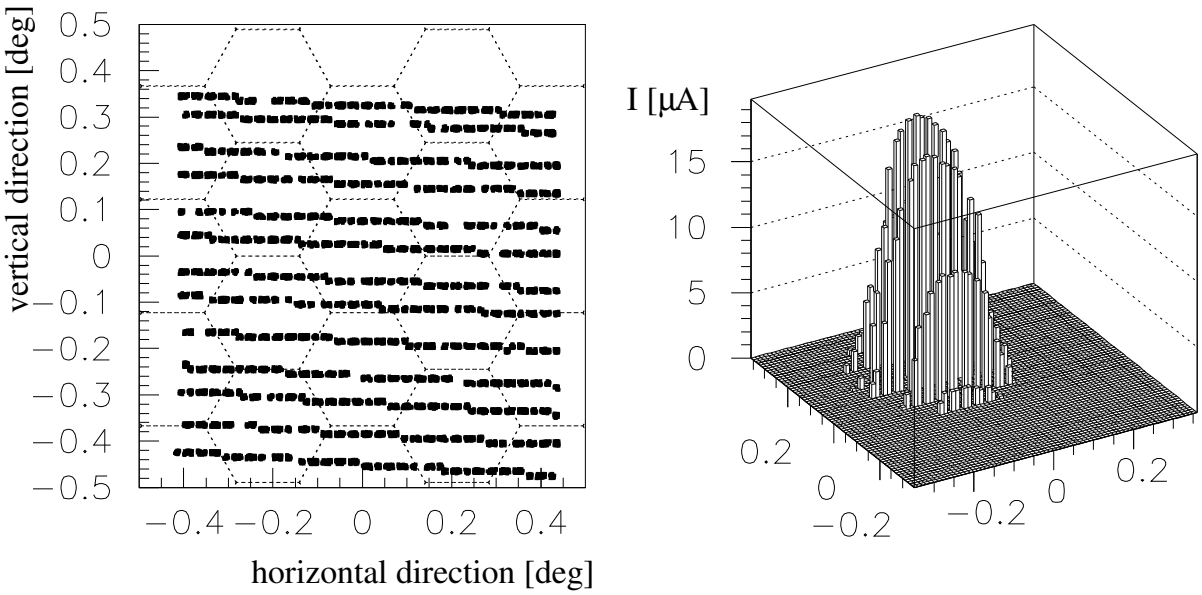


Star Images in PM Camera





Pointruns



Pointruns = Offline Calibration

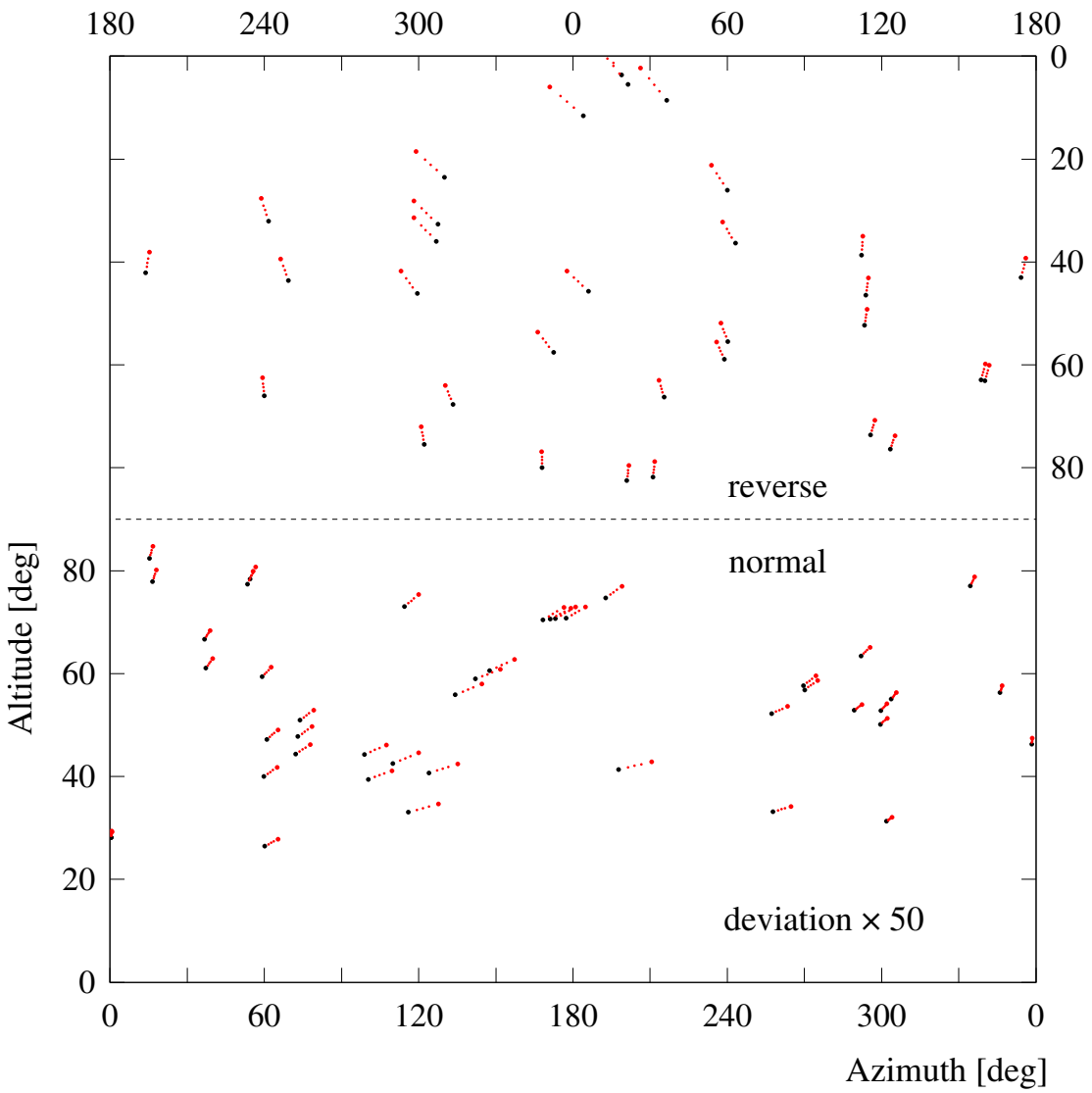
- Scan of star image in central pixel
- Single measurement accuracy ~ 0.01°

→ Relation

current telescope position

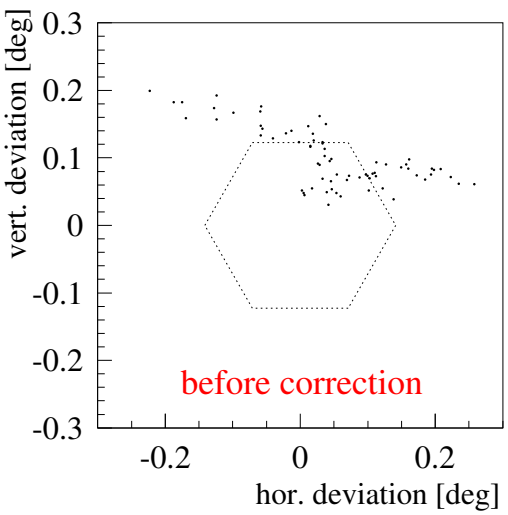
current camera displacement

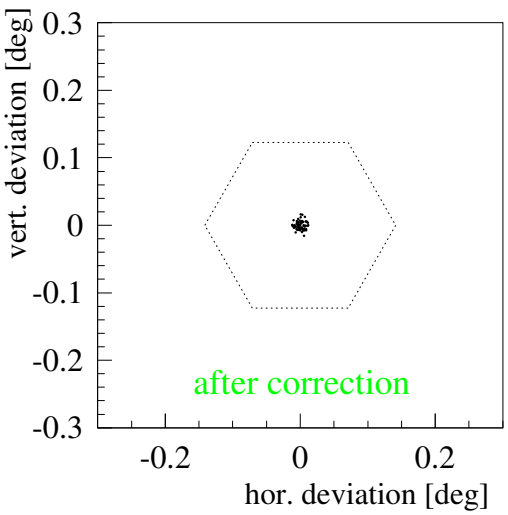
Full Sky Survey



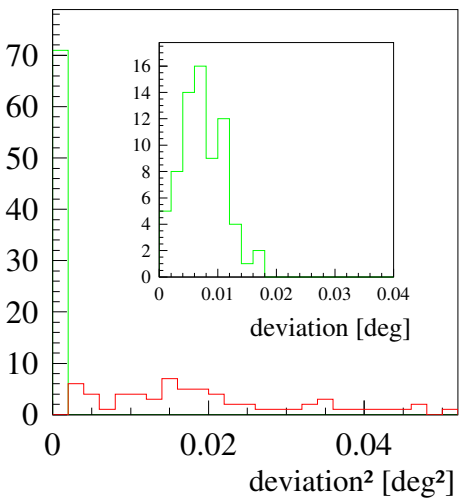
- grid must correspond to scales of deviation changes
- model of mechanical misalignments for
  - interpolation between calibration points
  - understanding of telescope behaviour
  - time scales of telescope hardware changes
  - monitor, trigger for intervention

Correction Model





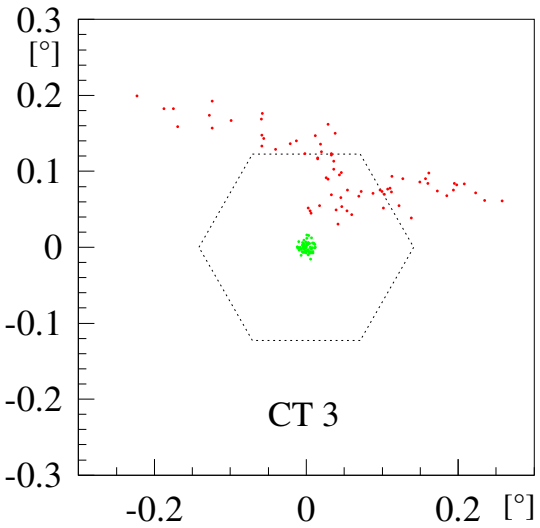
	number of parameters	order of
Azimuth axis alignment	2	0.05°
Altitude axis alignment	1	0.03°
Bending	1	0.07°
Offsets	3	0.1°
Shaft encoder modulation (first harmonics)	4	<0.05° (0.2°)
total	11	0.2°

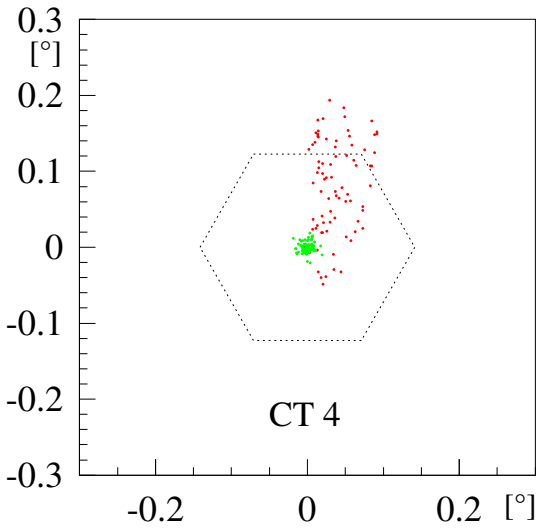


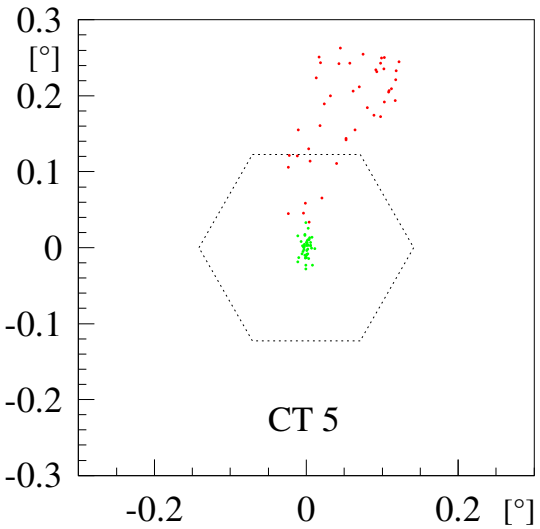
RMS

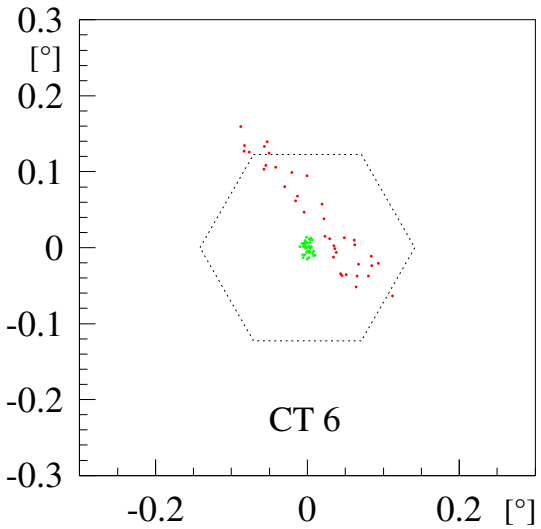
before correction	0.1°
after correction	0.01°

Catching Flies

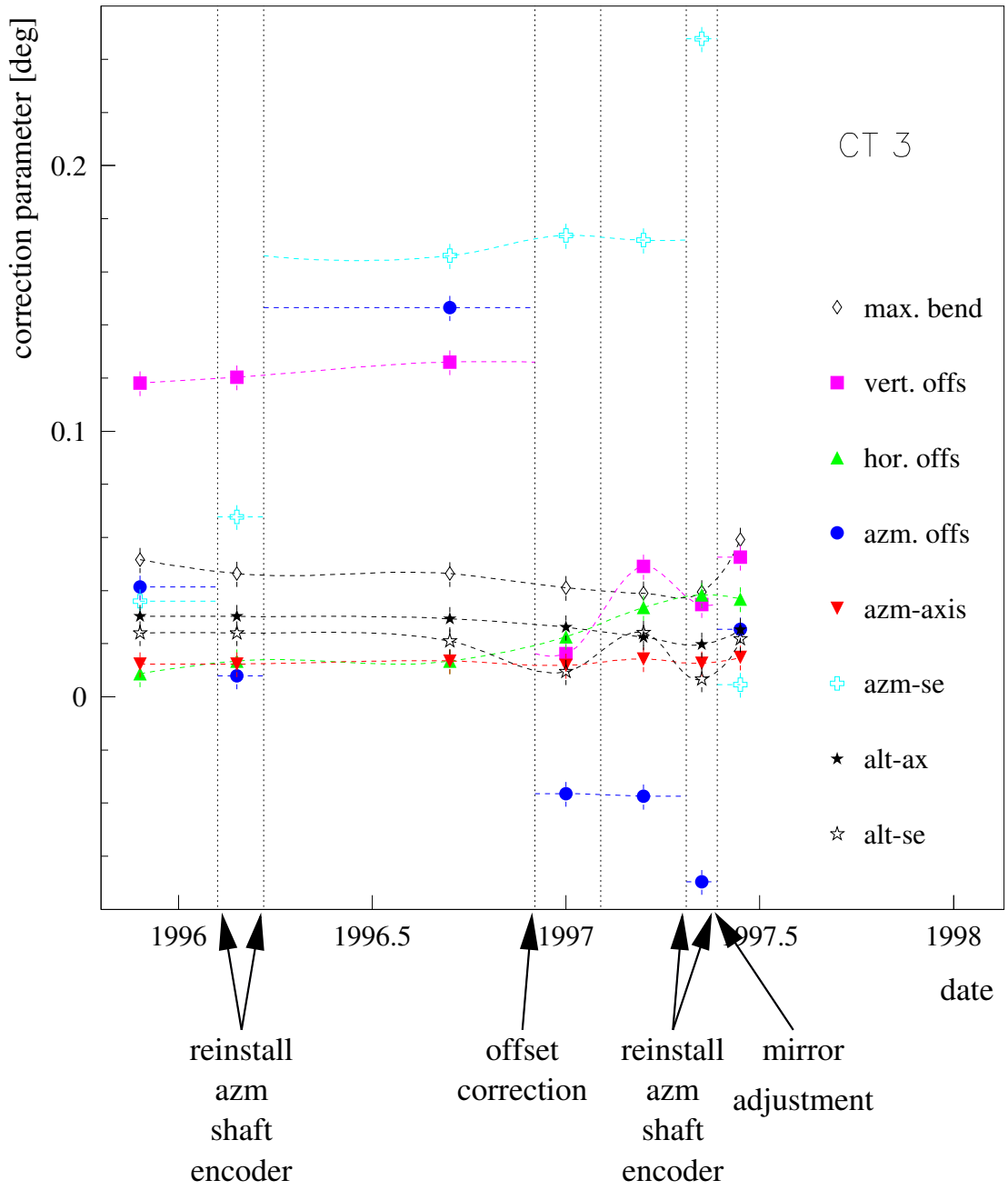




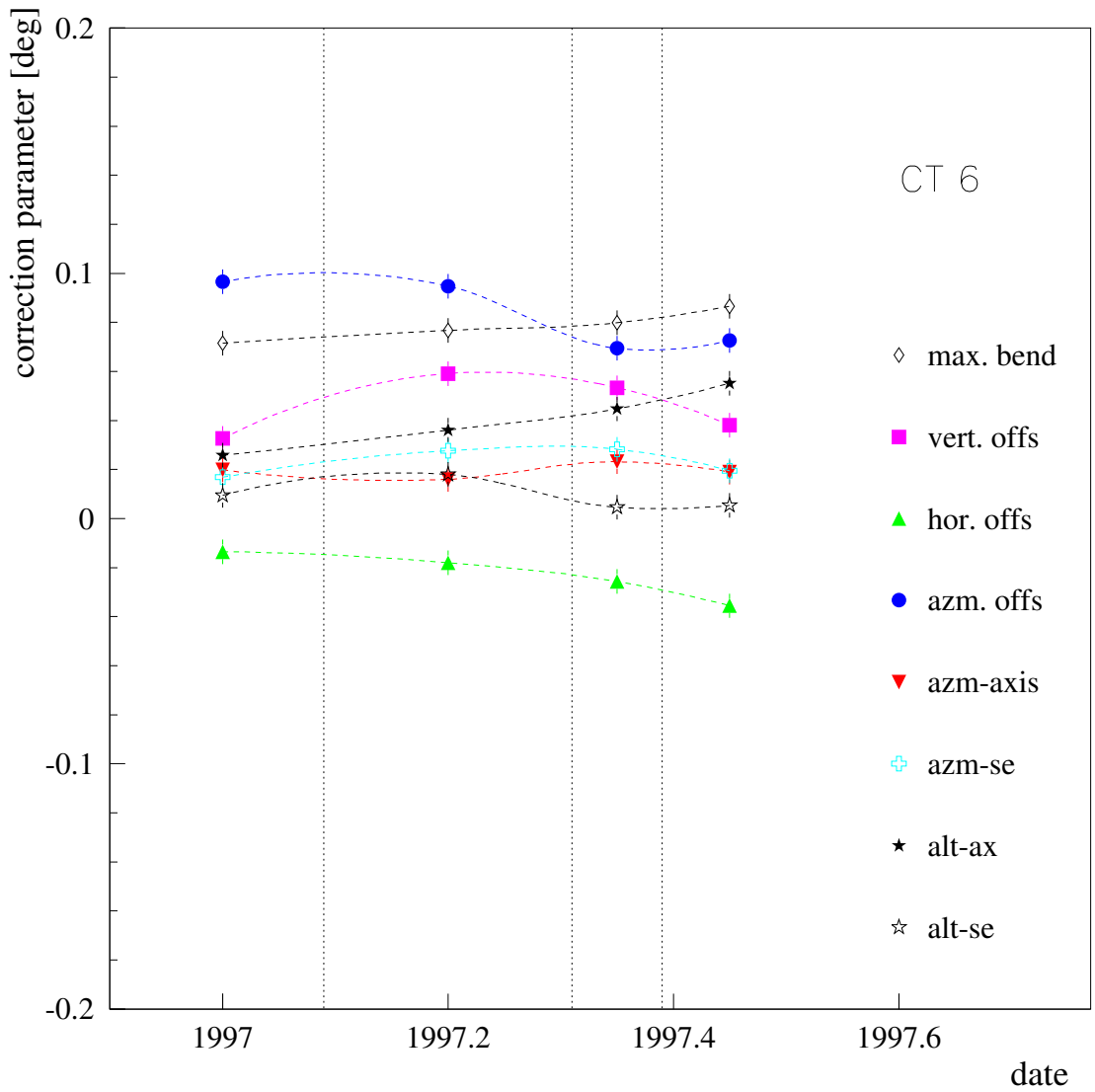




Course of Correction Parameters CT 3

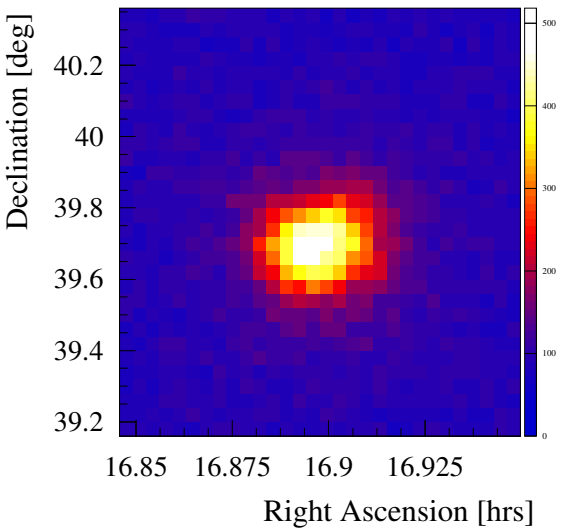


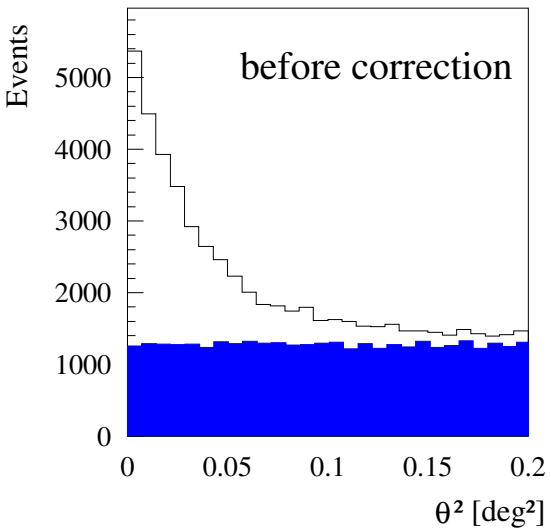
Course of Correction Parameters CT 6

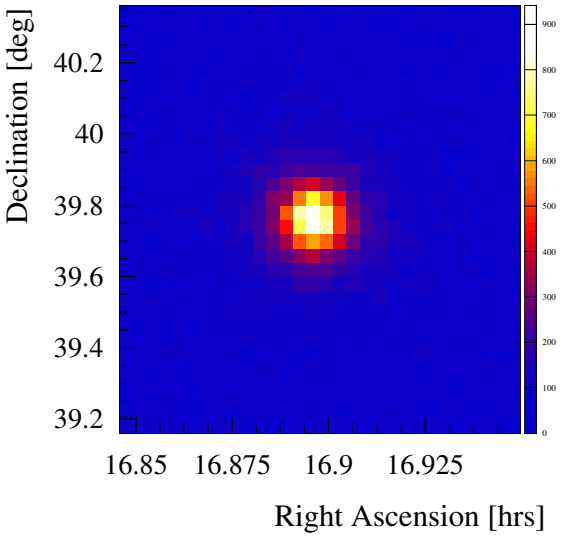


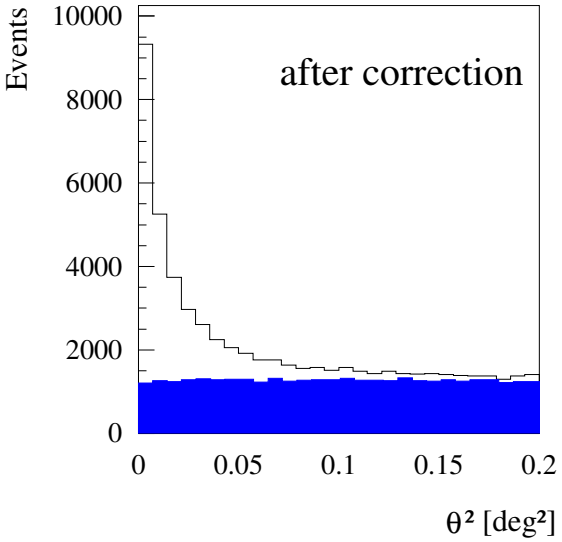
getting better !

Markarian 501





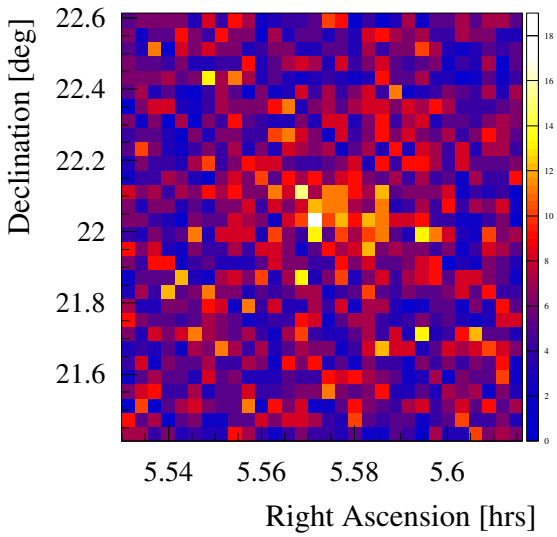


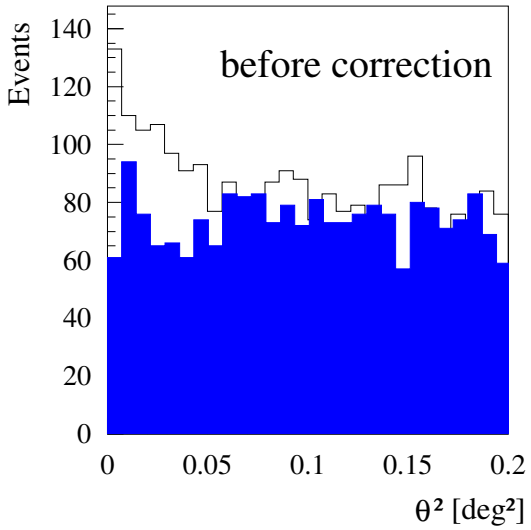


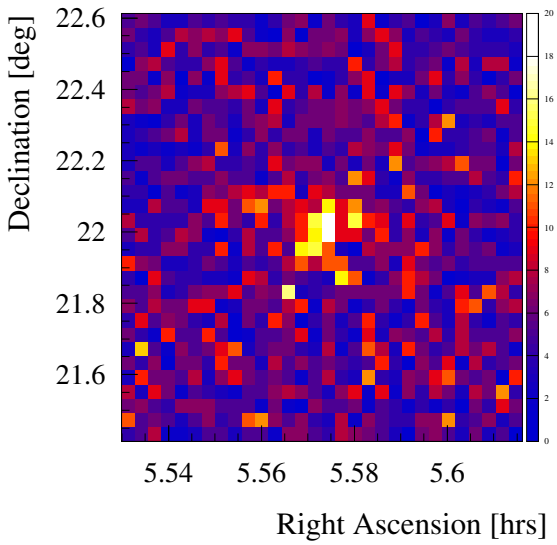
89 hrs April-August 1997, zenith angle < 45°

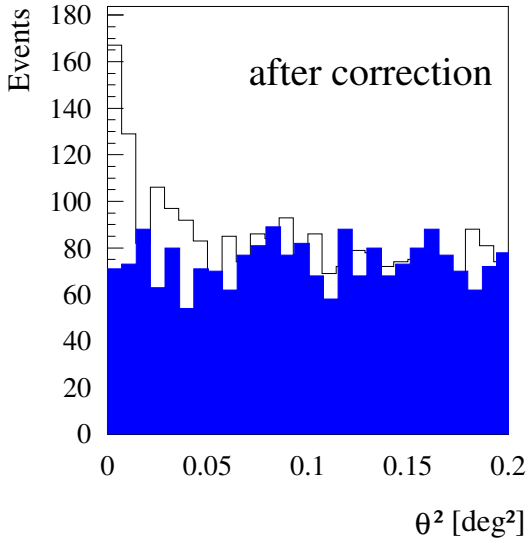
Source position	nominal	before correction	after correction
Ra [hrs]	16.89647	16.89740	16.89622
Dec [deg]	39.7644	39.6961	39.7635
Distance		4’ 9" ± 0.4"	12" ± 0.2" ± 35"
σ		0.11°	0.08°

4.5 Hours Crab Nebula September 1997

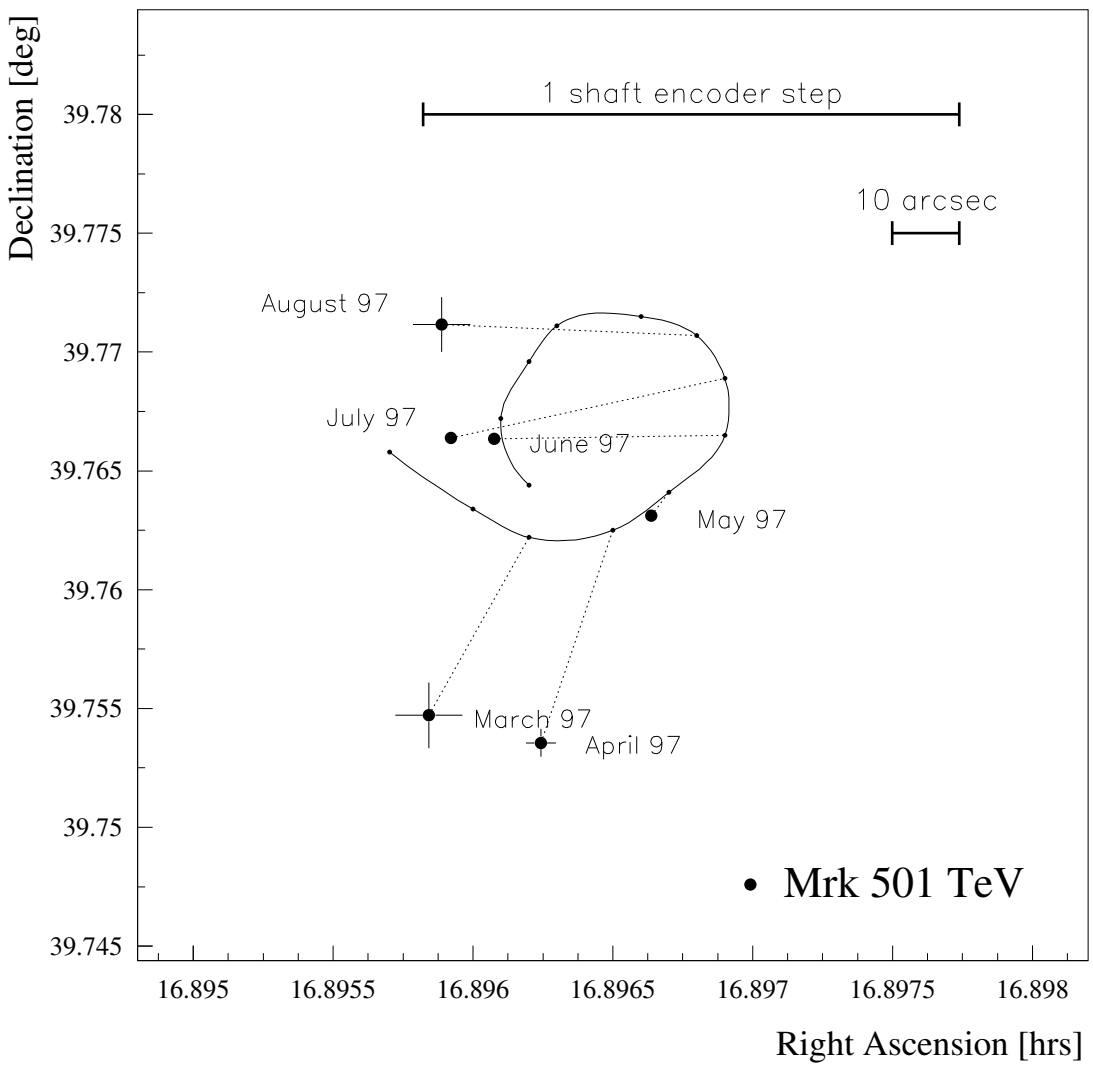








4.5 hrs September 1997, zenith angle 25°-45°

Source position	nominal	before correction	after correction
Ra [hrs]	5.57306	5.57602	5.57334
Dec [deg]	22.0128	22.0552	22.0094
Distance		3’ 33" ± 34"	18" ± 18" ± 35"
σ		0.11°	0.08°

Going Beyond ?