

# Shadows of the Moon and the Sun observed by Milagro detector

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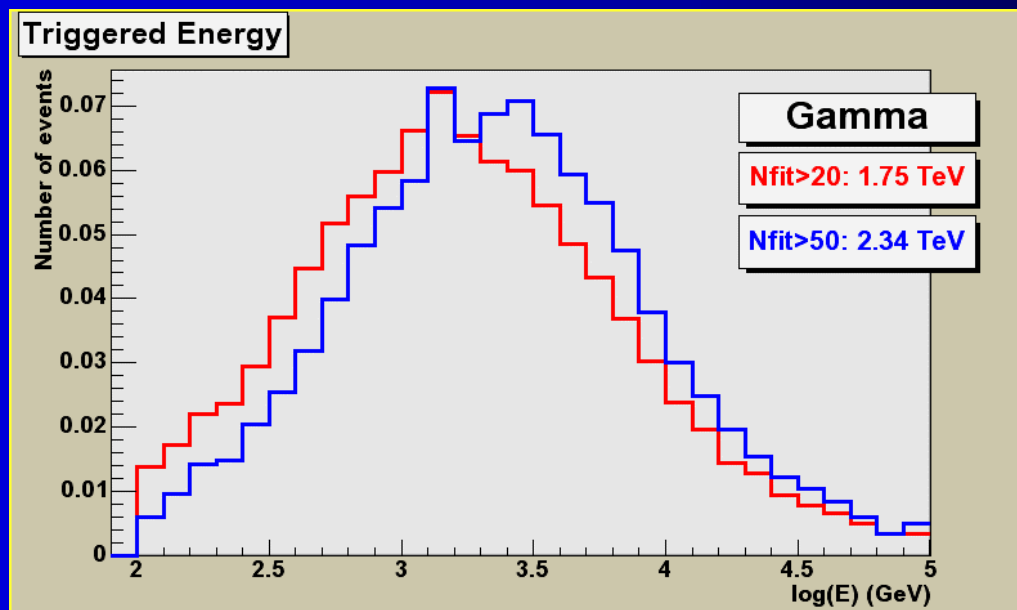
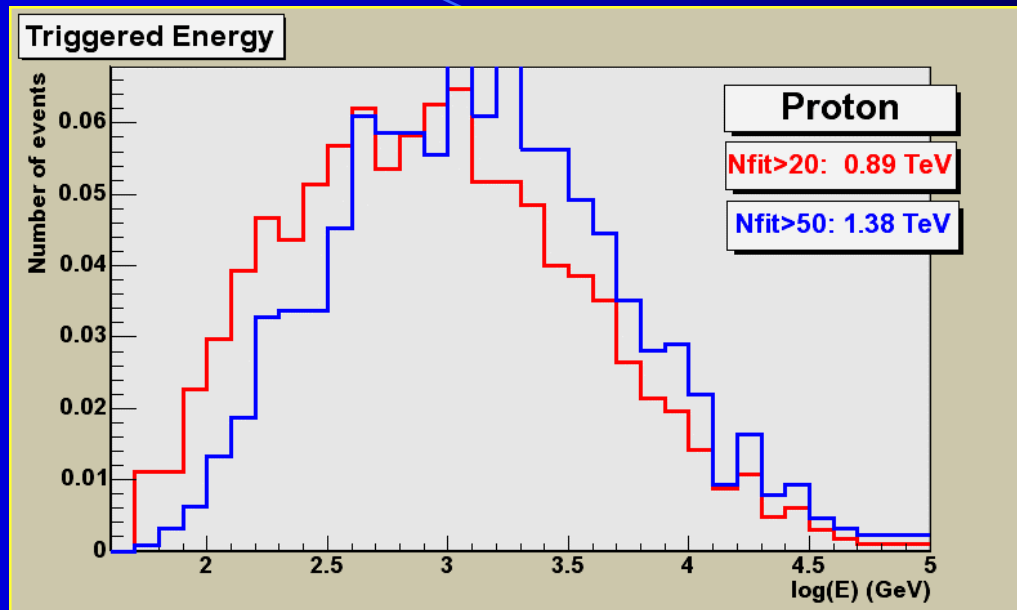
Xianwu Xu

- Shadow of the moon
- Angular resolution
- Shadow of the sun
- Shift of shadow of the sun and the solar activity.

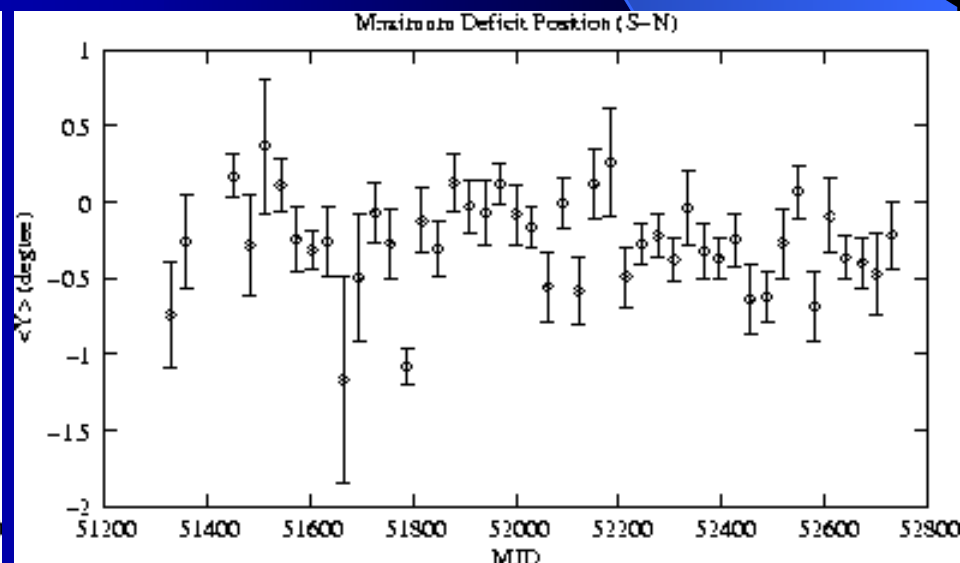
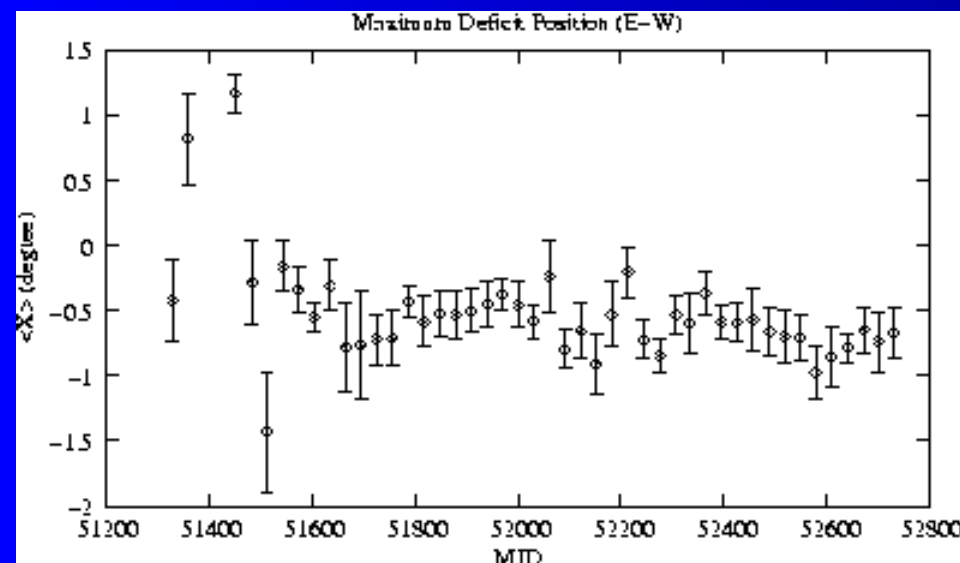
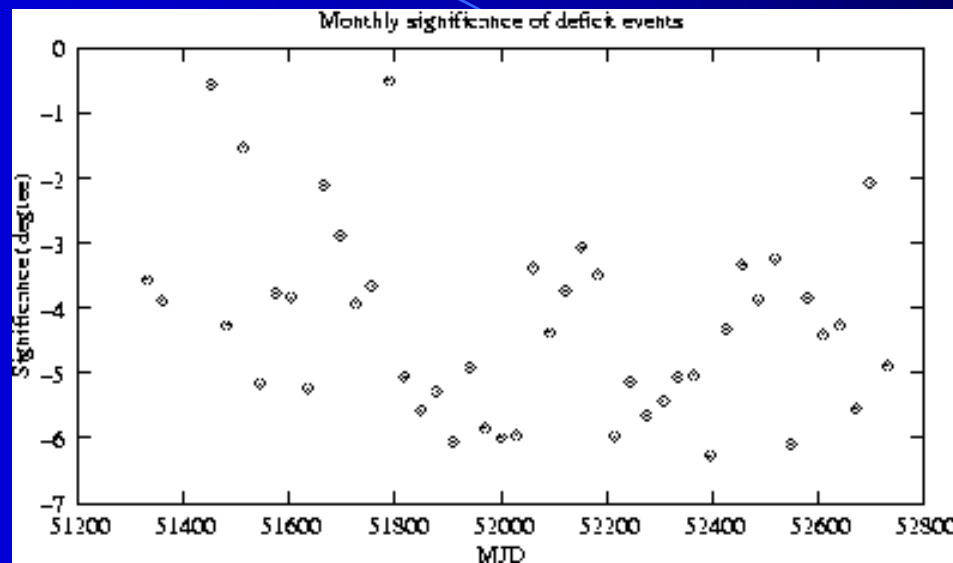
# Dataset and analysis method

- Data: June 1999 – April 2003
- Method: Skymap
- Zenith angle  $\leq 45$  deg
- $N_{\text{fit}} \geq 50$
- The radius of summation: 1.2 deg
- The radius of smoothing:
  - Background: 1.2 deg
  - On-source: 0.2 deg

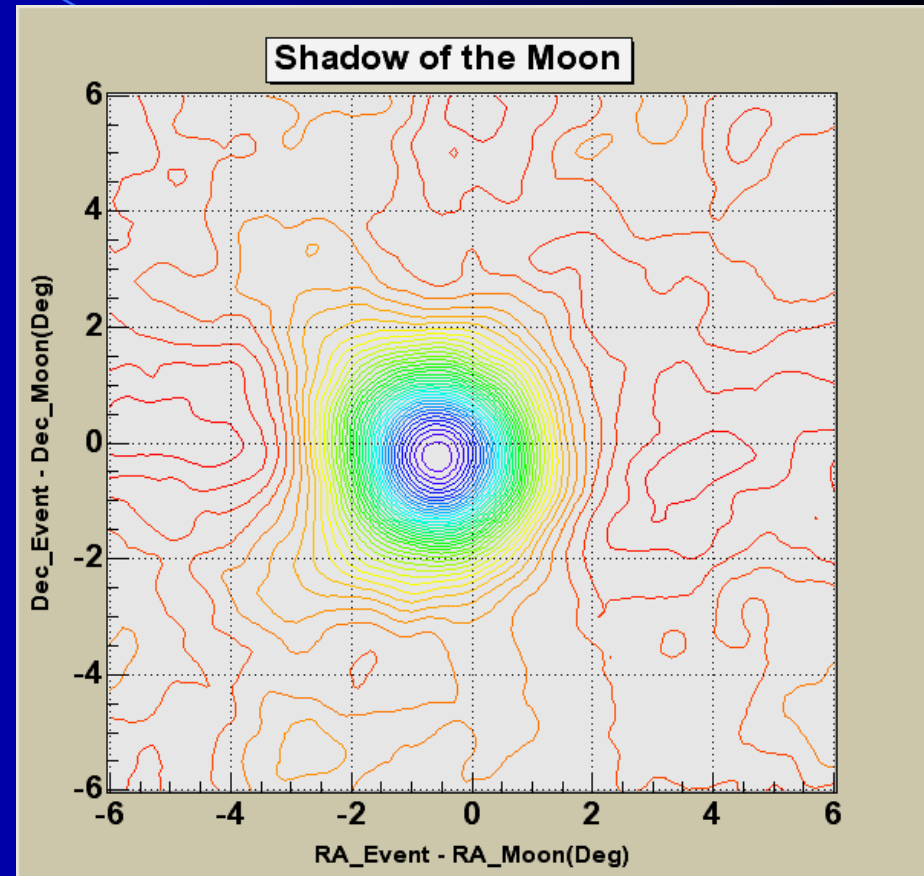
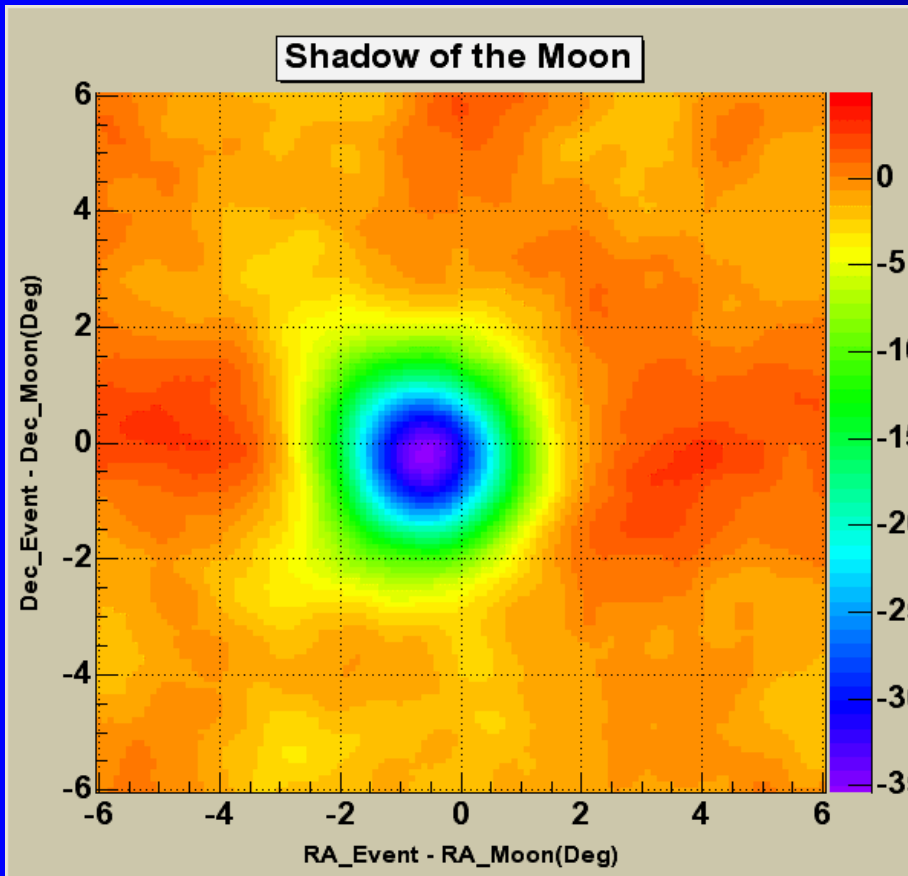
# Energy response of Milagro detector



# Monthly shadows of the moon



# Shadow of the Moon for all data

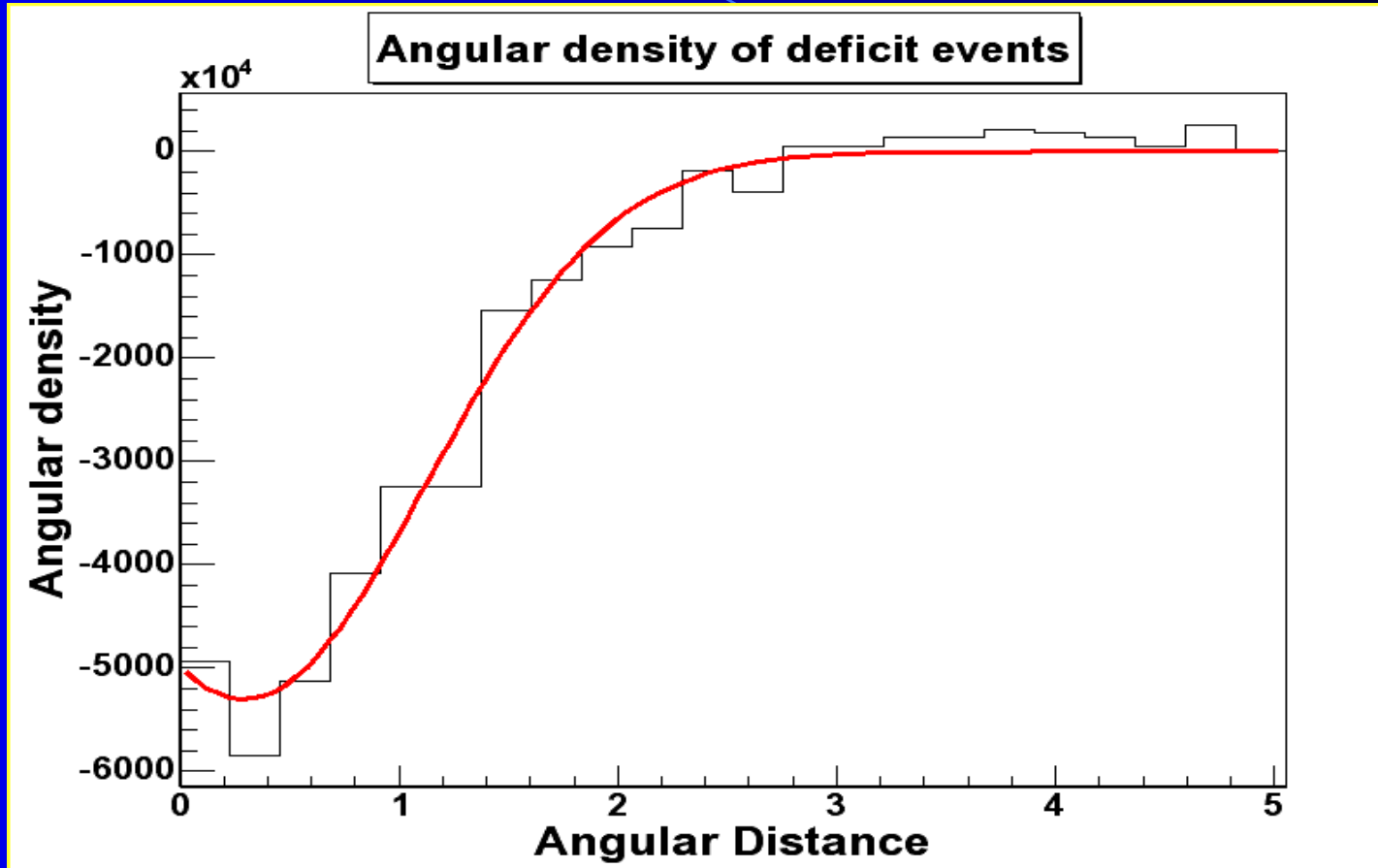


$$\langle x \rangle = -0.57 \pm 0.03$$

$$\langle y \rangle = -0.23 \pm 0.03$$

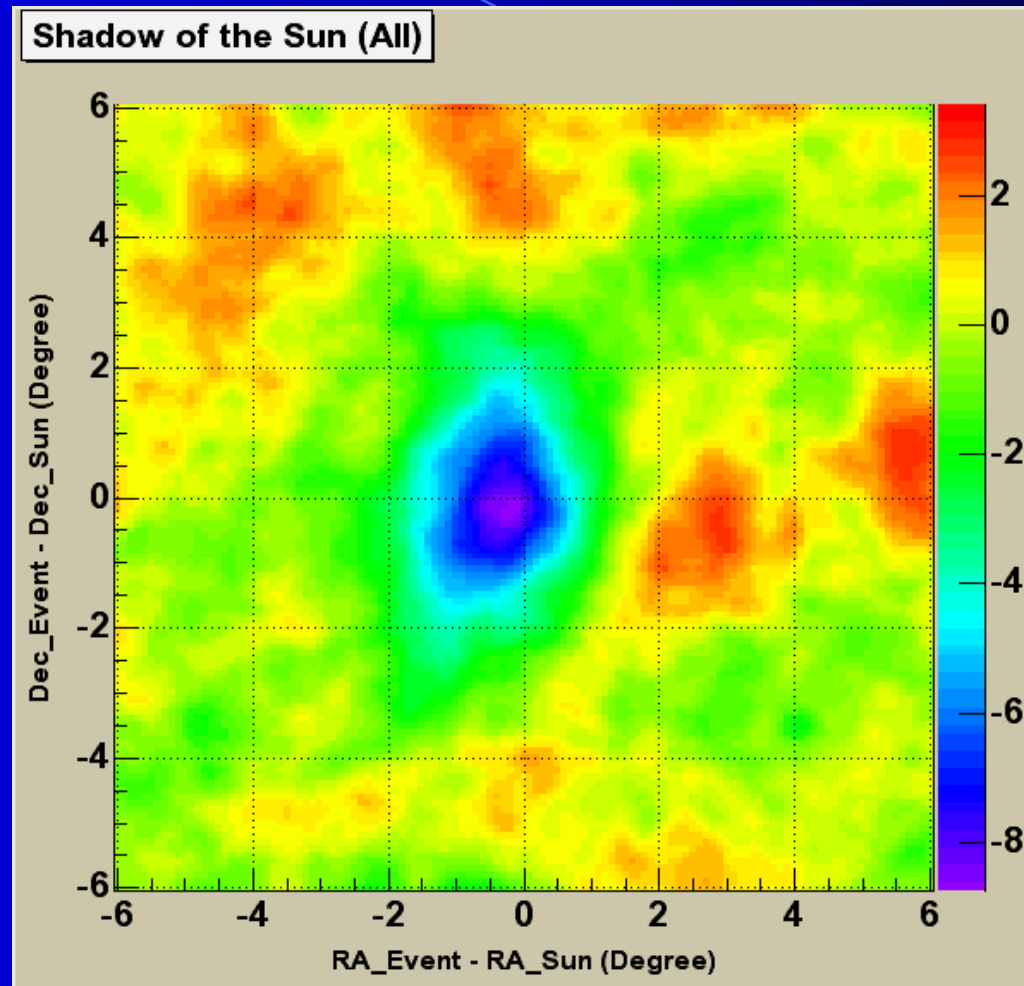
$$-35.2 \sigma$$

# Angular resolution of Milagro detector



$$\sigma = 0.84 \pm 0.02 \quad (\text{Nfit} > 50, 1.38 \text{ TeV})$$

# Shadow of the sun for all data

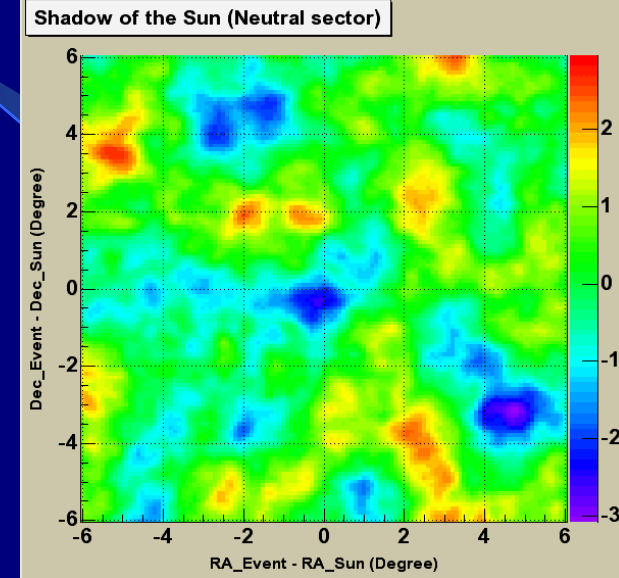
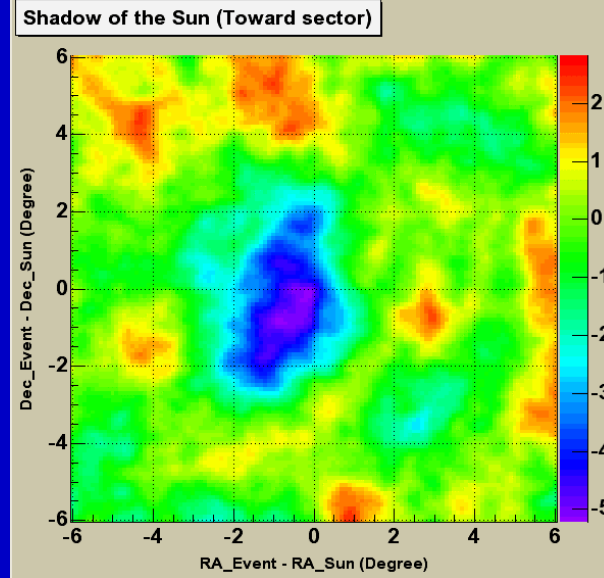
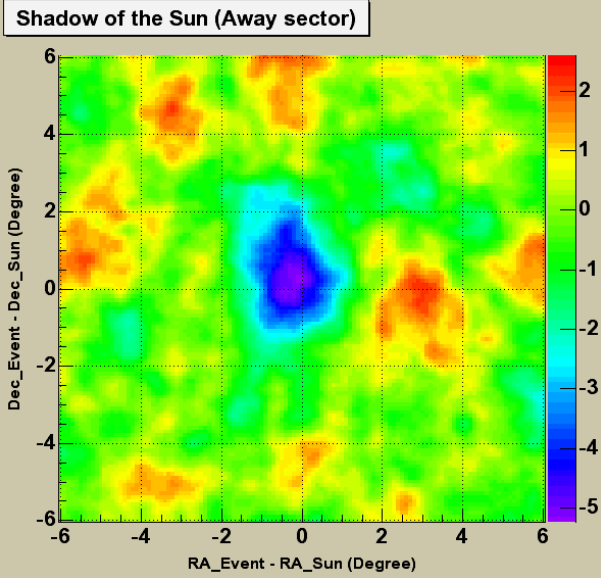


$$\langle x \rangle = -0.43 \pm 0.13$$

$$\langle y \rangle = -0.12 \pm 0.17$$

$$-8.75\sigma$$

# Shadow of the sun in IMF's sectors



$$\langle x \rangle = -0.29 \pm 0.18$$

$$\langle y \rangle = 0.27 \pm 0.27$$

$$-5.22\sigma$$

$$\langle x \rangle = -0.85 \pm 0.24$$

$$\langle y \rangle = -0.28 \pm 0.32$$

$$-5.18\sigma$$

$$\langle x \rangle = -1.47 \pm 2.21$$

$$\langle y \rangle = 0.29 \pm 2.28$$

$$-2.51\sigma$$



# Shifts of shadow of the sun

Subtract geomagnetic field effect, the shifts of shadow of the sun by SMF and IMF are:

All:             $\langle x \rangle = 0.14 \pm 0.13$        $\langle y \rangle = 0.12 \pm 0.17$        $-8.75\sigma$

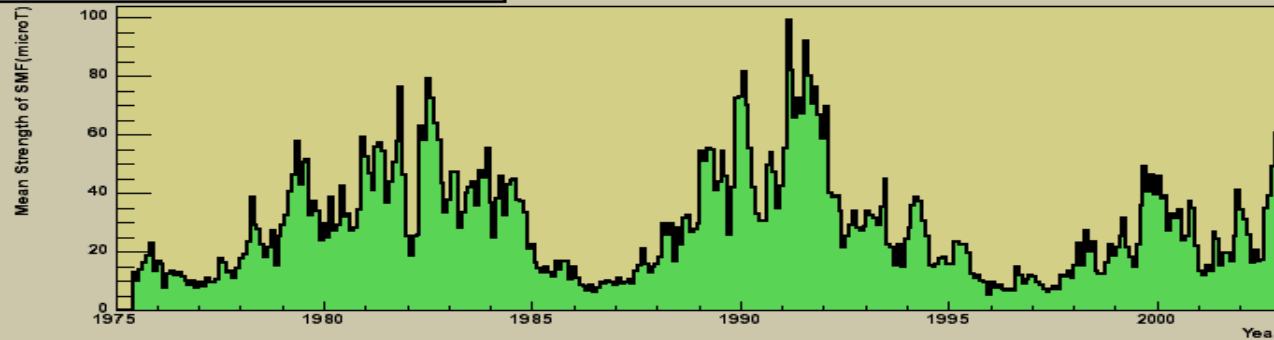
Away:            $\langle x \rangle = 0.28 \pm 0.18$        $\langle y \rangle = 0.50 \pm 0.27$        $-5.22\sigma$

Toward:         $\langle x \rangle = -0.28 \pm 0.24$        $\langle y \rangle = -0.05 \pm 0.32$        $-5.18\sigma$

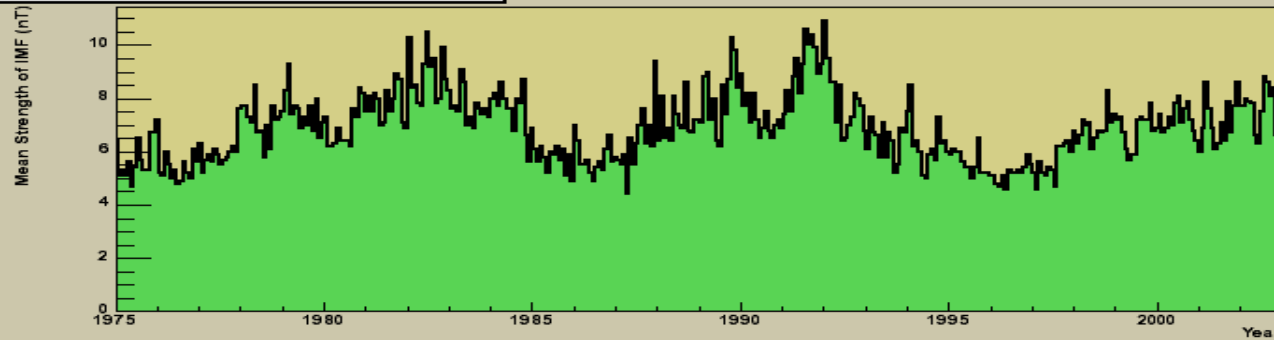
Away-Toward:     $1.87 \sigma$  and  $1.31 \sigma$

# SMF, IMF and Number of Sunspots

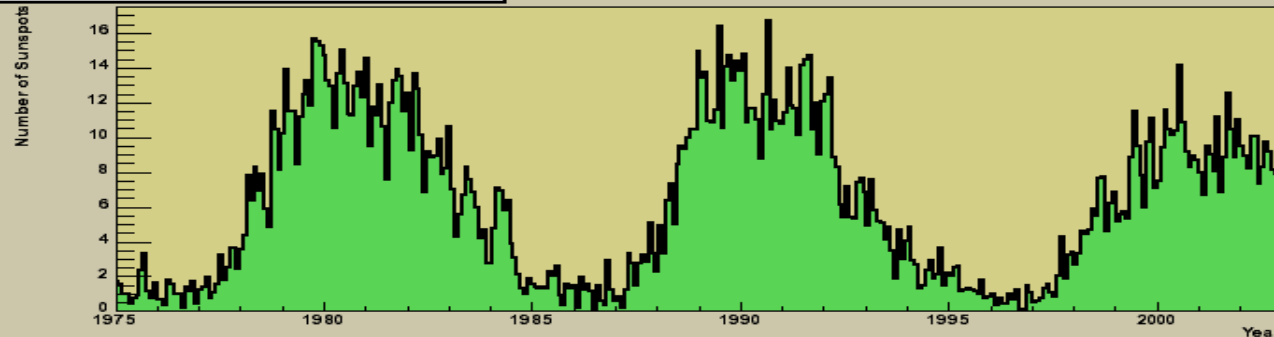
Solar Magnetic Field (Monthly)



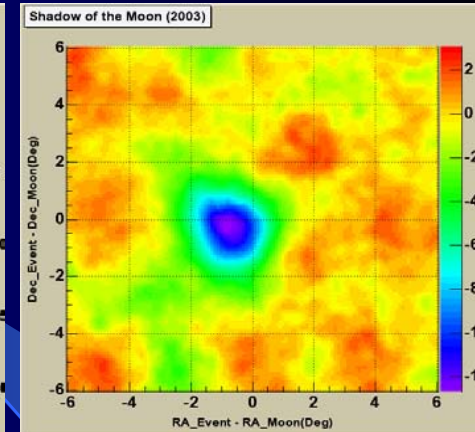
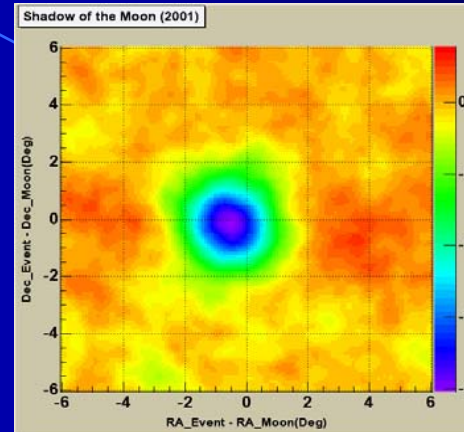
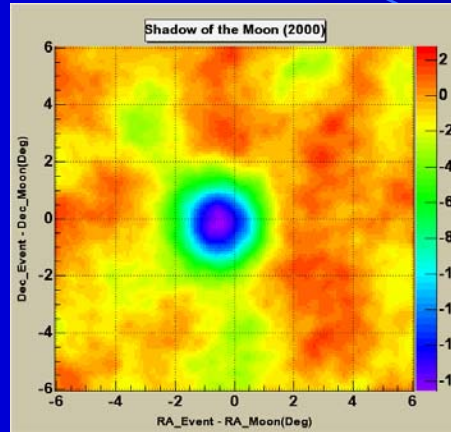
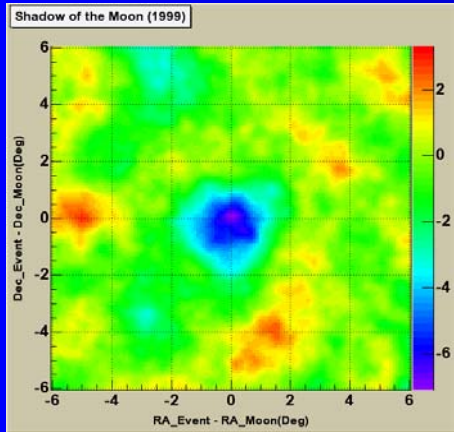
Mean Magnitude of IMF (27days)



Number of Sunspots (Monthly)



# Yearly shadows of the sun



$$\langle x \rangle = -0.05 \pm 0.16$$

$$\langle x \rangle = -0.49 \pm 0.05$$

$$\langle x \rangle = -0.53 \pm 0.05$$

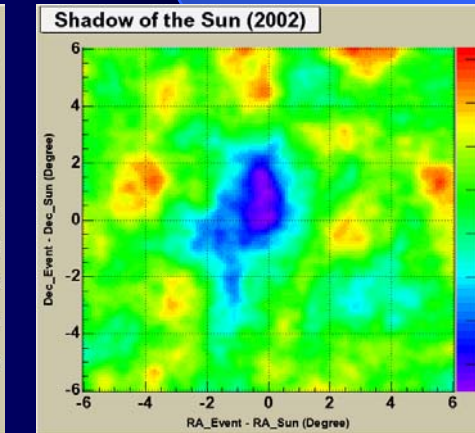
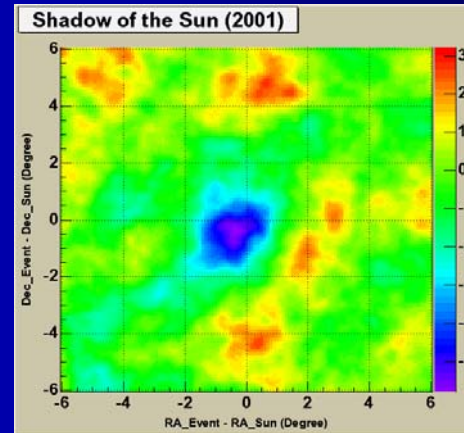
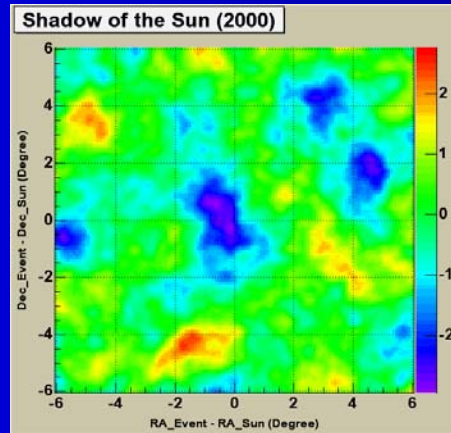
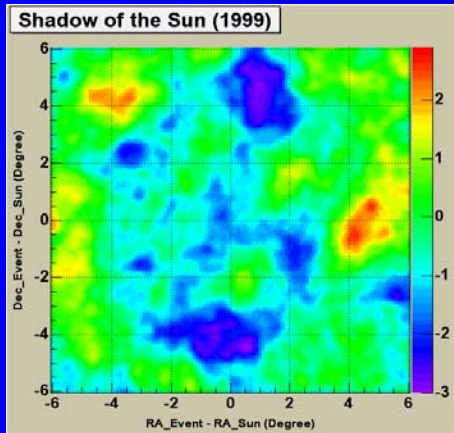
$$\langle x \rangle = -0.66 \pm 0.05$$

$$\langle y \rangle = -0.33 \pm 0.17$$

$$\langle y \rangle = -0.16 \pm 0.06$$

$$\langle y \rangle = -0.18 \pm 0.05$$

$$\langle y \rangle = -0.30 \pm 0.05$$



$$\langle x \rangle = -0.01 \pm 0.71$$

$$\langle x \rangle = -0.58 \pm 0.20$$

$$\langle x \rangle = -0.42 \pm 0.17$$

$$\langle x \rangle = -0.49 \pm 0.27$$

$$\langle y \rangle = -0.21 \pm 0.60$$

$$\langle y \rangle = 0.37 \pm 0.28$$

$$\langle y \rangle = -0.42 \pm 0.20$$

$$\langle y \rangle = 0.26 \pm 0.37$$

# Summary

- The maximum deficit significance of the moon:  $-35.2 \sigma$
- Angular resolution:  $0.84 \pm 0.02$  (degree) ( $N_{\text{fit}} > 50$ )
- The maximum significance of the moon:  $-8.75 \sigma$
- The shifts of shadow of the sun in IMF's away and toward sectors is consistent with expected, but the difference significant is low.
- We did not observed significant correlation between the yearly shadow of the sun and the solar activity.