

# Gamma RAY Polarimeter Experiment

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# Motivation for GRAPE

- Gamma RAY Polarimeter Experiment (GRAPE) is a Compton polarimeter optimized energies 50~300 keV.
- Measure polarization of Gamma Ray Bursts (GRBs) in a long duration balloon (LDB) flights.
- Grape design being able to measure polarization.

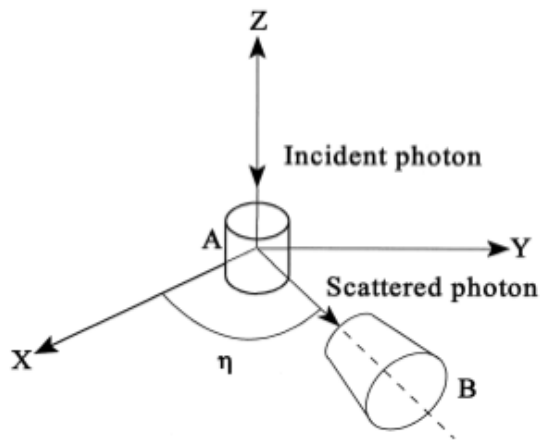
GRAPE work in 50~300 keV,

- Fill in the gap for 50 ~ 200 keV
- Verify and even improve the measurements in 200 ~ 300 keV.

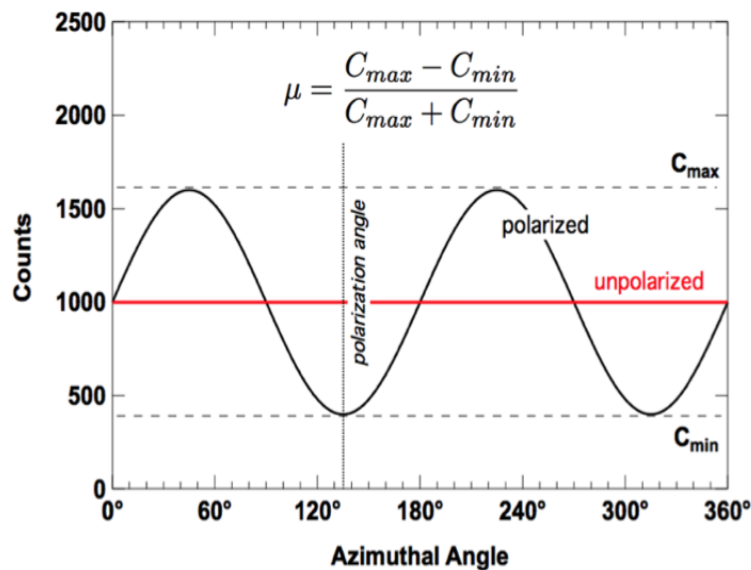
Sources	Energy	Polarization %		Angle	
Weisskopf et. al. (1976)	2.6 keV	19.2	± 1.0	156.4°	± 1.4°
Weisskopf et. al. (1976)	5.2 keV	19.5	± 2.8	152.6°	± 4.0°
Dean et. al. (2008)	0.1~1.0 MeV	<b>46.1</b>	± 10.0	123.0°	± 11.0°
Forot et. al. (2008)	200~800 keV	<b>&gt; 72 %</b>		120.6°	± 8.5°

# Compton Polarimeter

Photons prefer to scatter at right angles to the incident electric field vector.



Schematic drawing of a typical Compton polarimeter



$$\mu = \frac{C_{\max} - C_{\min}}{C_{\max} + C_{\min}}$$

Fractional polarization

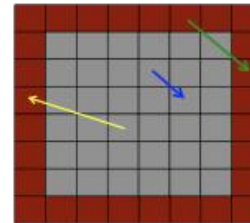
$$\Pi = \mu / \mu_{100}$$

$$MDP_{99} = \frac{4.29}{\mu_{100} C_S} \sqrt{C_S + C_B}$$

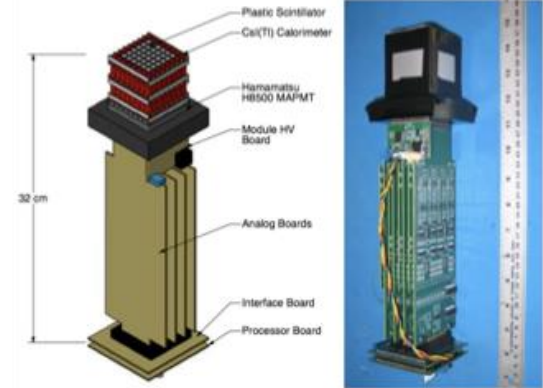
# GRAPE INSTRUMENT

- Balloon Borne Polarimeter
- 50~300 keV Gammas.
- Consists of 24 modules
- 36 plastic scintillators
- 28 CsI(Tl) scintillators. (calorimeters)
- Compton Polarimeter
- Collimators, Shielding, Pressure Vessel.

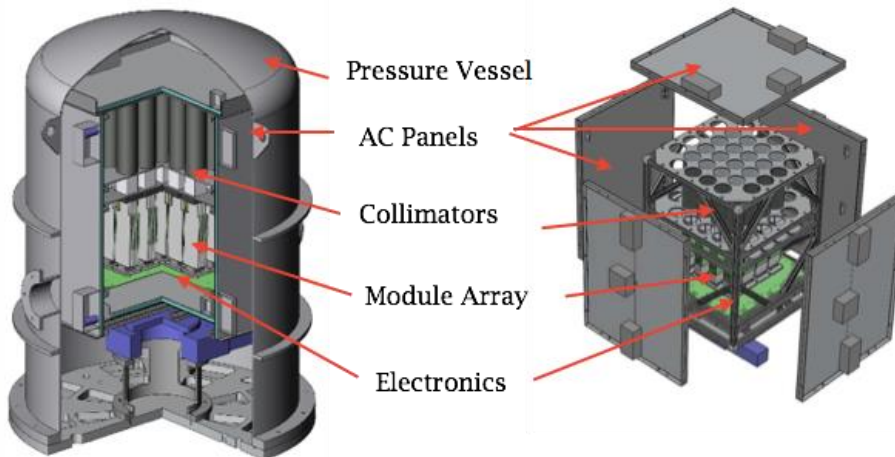
**Scintillators**  
CsI(Tl) (Red)  
Plastics (Grey)

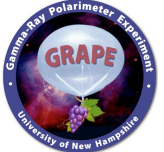


PC Events (Yellow)

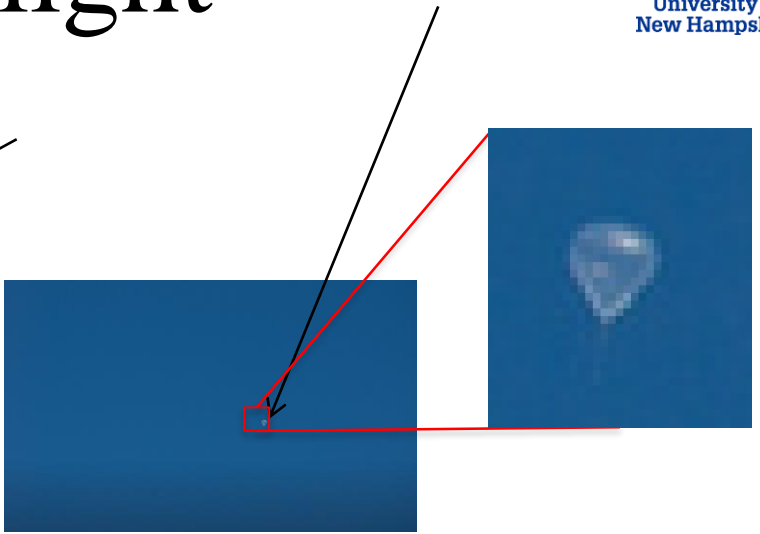


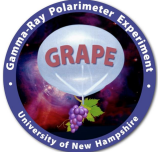
Schematic vs Fabricated Module.





# 2014 Grape Flight



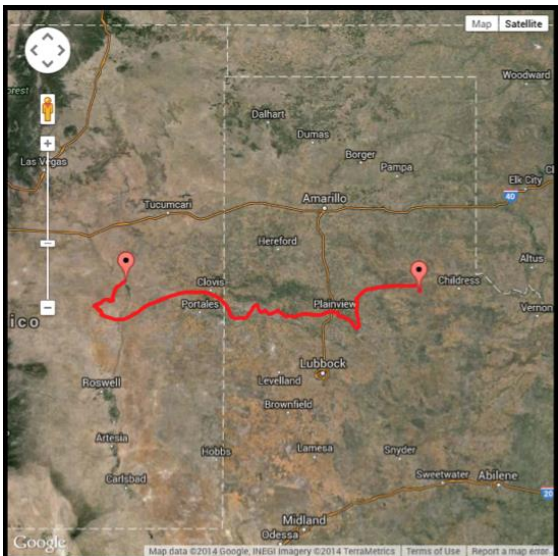
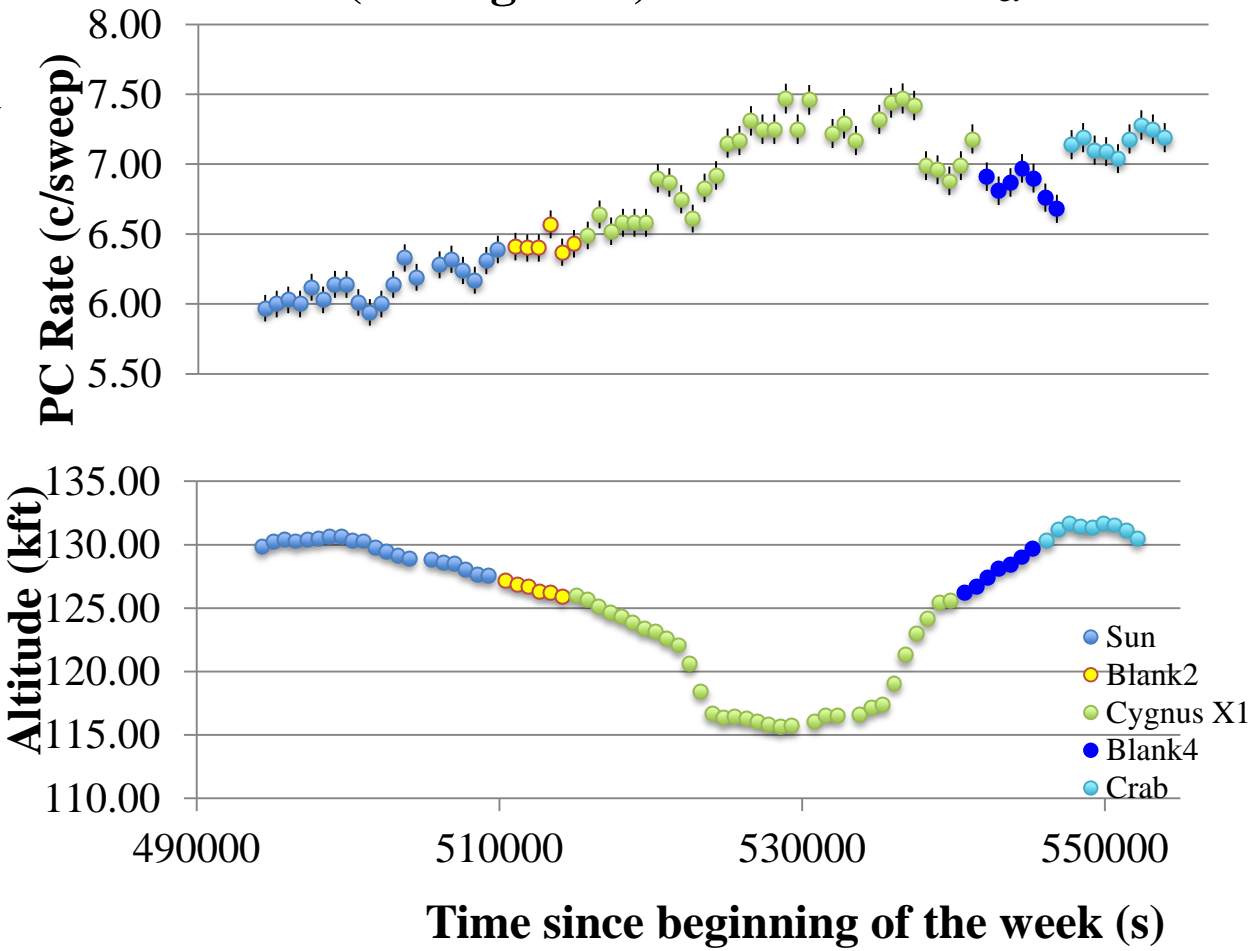


# 2014 GRAPE flight profile

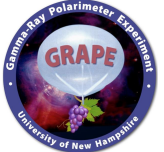
- Flown from Fort Sumner, NM
- September 26, 2014 (Friday)
- Float started at around 129 kft.
- Float period ~14.4 hours
- Crab observation period ~1.8 hrs only
- Typically we need 6~8 hrs of Crab observation for a full transient.

## PC Rate and Altitude vs Time (during float)

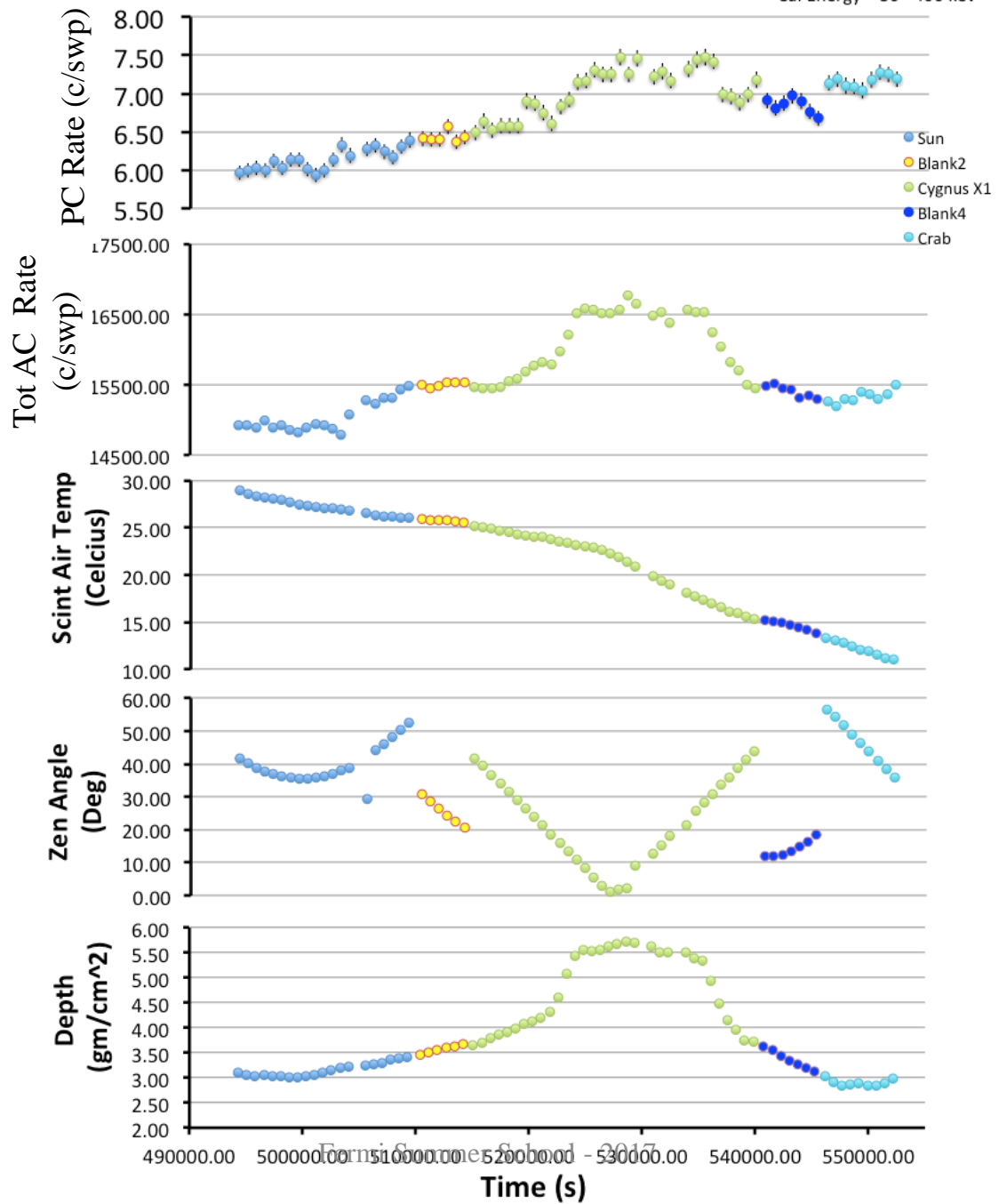
Tot Energy = 80 ~200 keV  
 Pla Energy = 12 ~200 keV  
 Cal Energy = 30 ~400 keV



Flight path of the balloon

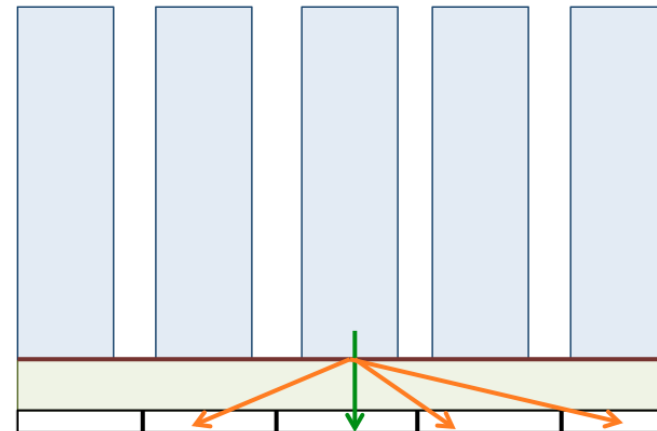
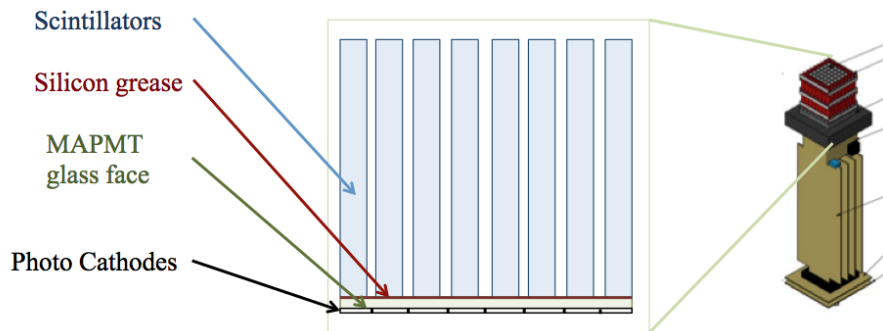


Tot Energy = 80 ~200 kev  
Pla Energy = 12 ~200 kev  
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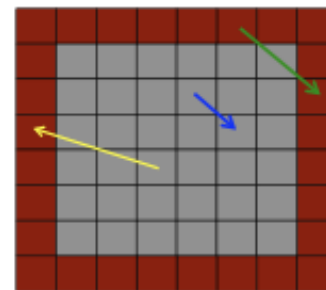
# Currently Working

- Simulations (GEANT4)
  - Cross-Talk Modelling



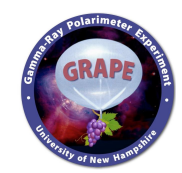
- Misclassification of events

**Scintillators**  
 CsI(Tl) (Red)  
 Plastics (Grey)



PC Events (Yellow)





# Thank You