

Polarization Analysis of Solar Flares using Detector – Detector scattering

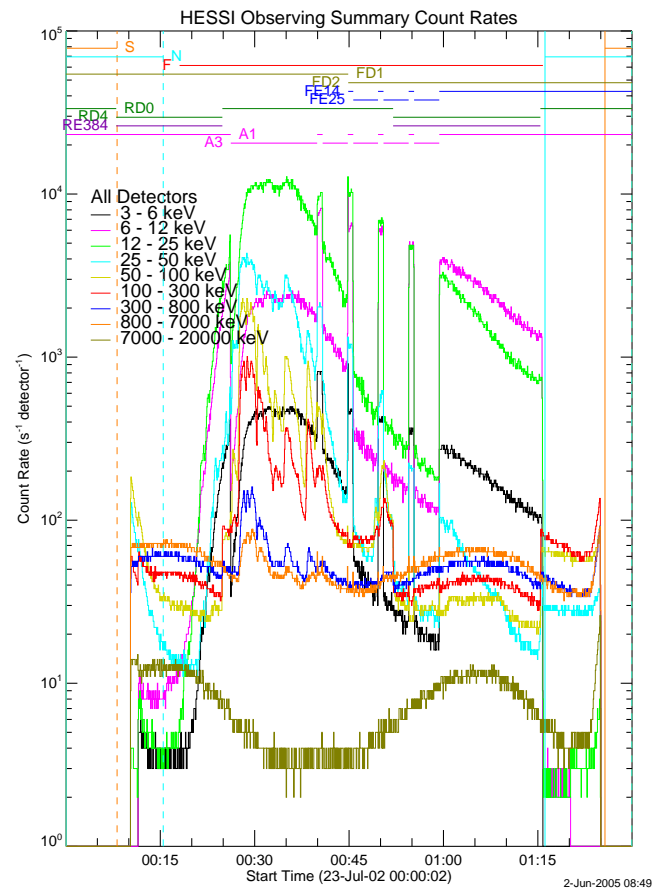
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June 3, 2005

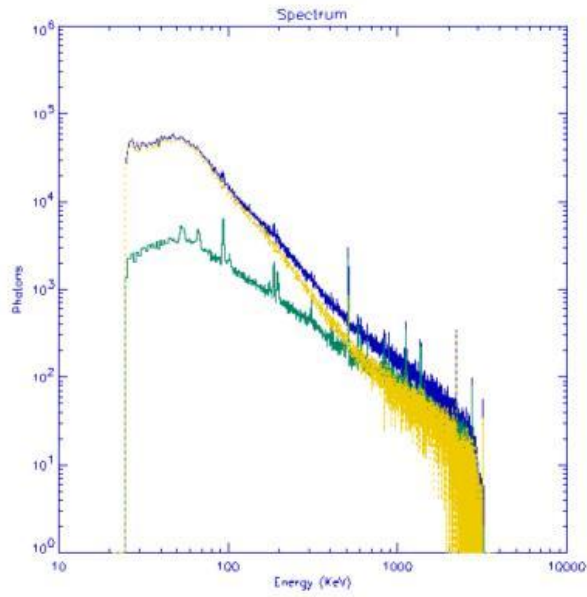
1 Flare selection

1.1 observing summary

Solar Flare of 23-Jul-2002
around 00:30:00 UT

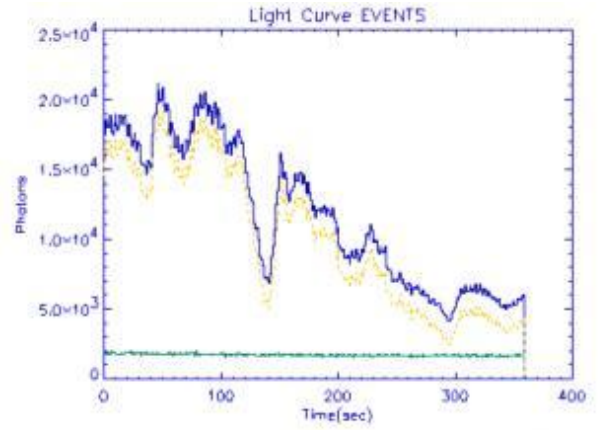


1.2 spectrum



at ≈ 700 keV :
signal \approx BG (background)

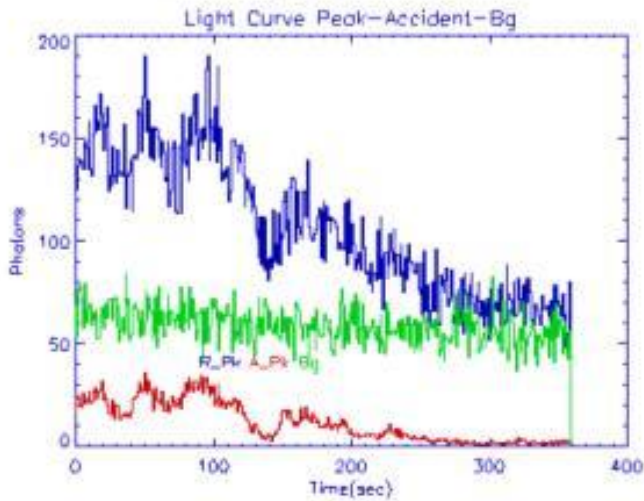
1.3 lightcurve



total counts
background
signal only

energy band: 50 – 1400 keV (?)
00:28:00 – 00:34:00 UT

1.4 lightcurve of coincidences



Energy cut:

$$50 \text{ keV} \leq E_k \leq 1400 \text{ keV}$$

$$150 \text{ keV} \leq E_i + E_j$$

N_{tot}	38274
N_{acc}	4171
N_{BG}	21265
	-129
N_C	12967

Assuming $\mu_{100} = 20\%$

$$\Rightarrow \text{MDP} = \frac{n_\sigma}{\mu_{100}} \frac{\sqrt{2N_{tot}}}{N_C} = 10.7\%$$

- Analysis time interval:
23-jul-2002, 00:28:00.00 to 00:34:00.00
- Background time interval:
22-jul-2002, 00:24:55.00 to 00:30:55.00

2 Narrower Cuts

Time interval: 23-Jul-2002 from 00:28:00 to 00:34:00 UT.

Energy cut: $50 \text{ keV} \leq E_k$, $150 \text{ keV} \leq E_i + E_j \leq 500 \text{ keV}$.

kinematical cut	none	± 45 degree	± 30 degree
N_{tot}	17440	14148	10919
N_{acc}	3341	2255	1631
N_{BG}	6577	5509	4183
	-67	-48	-35
N_C	7589	6438	5140
	± 157	± 142	± 124
μ_{fit} [%]	3.14 ± 2.95	1.97 ± 3.13	1.15 ± 3.33
μ_{100}	assuming $\approx 20\%$		
Π [%]	15.7 ± 14.8	9.9 ± 15.7	5.8 ± 16.7
MDP (1σ)[%]	12.3	13.1	14.4

$$\Rightarrow \sigma_{\Pi} \approx 15\%$$

Time interval: 23-Jul-2002 from 00:28:00 to 00:34:00 UT.

Energy cut: $50 \text{ keV} \leq E_k$, $300 \text{ keV} \leq E_i + E_j \leq 500 \text{ keV}$.

kinematical cut	none	± 45 degree	± 30 degree
N_{tot}	8838	8058	6127
N_{acc}	948	734	431
N_{BG}	4206	3781	2836
	-30	-23	-14
N_C	4714	3566	2874
	± 115	± 109	± 95
μ_{fit} [%]	4.82 ± 4.30	$5.35 \pm 4.30\%$	$3.58 \pm 4.58\%$
μ_{100}	assuming $\approx 20\%$		
Π			
MDP (1σ)[%]	18.0	17.9	19.3

$$\implies \sigma_{\Pi} \approx 18\%$$

Coburn and Boggs: 300–500 keV $\implies N_{tot} \approx 12250$ and $\Pi = 20 \pm 7\%$???

Time interval: 23-Jul-2002 from 00:28:00 to 00:34:00 UT.

Energy cut: $50 \text{ keV} \leq E_k$, $700 \text{ keV} \leq E_i + E_j \leq 1400 \text{ keV}$.

kinematical cut	none	± 45 degree	± 30 degree
N_{tot}	11449	6016	5095
N_{acc}	427	82	67
N_{BG}	8401	4578	3859
	-37	-12	-10
N_C	2658	1368	1179
	± 141	± 103	± 95
μ_{fit} [%]	10.0 ± 7.5	$8.7 \pm 10.6\%$	$17.0 \pm 11.2\%$
μ_{100}	assuming $\approx 15\%$		
Π			
MDP (1σ)[%]	38.0	53.5	57.1

$$\Rightarrow \sigma_{\Pi} \approx 40\%$$

Coburn and Boggs: 700–1400 keV $\Rightarrow N_{tot} \approx 14300$ and $\Pi = 14 \pm 7\%$???

Time interval: 23-Jul-2002 from 00:28:00 to 00:30:05 UT, i.e. first 125s .

Energy cut: $50 \text{ keV} \leq E_k$.

Kinematical Cut: ± 45 degree.

kinematical cut	150 – 500 keV	300 – 500 keV	700 – 1400 keV
N_{tot}	7175	3846	2461
N_{acc}	1553	510	52
N_{BG}	1958	1357	1641
	–16	–8	–6
N_C	3680	1987	774
	± 97	± 73	± 64
μ_{fit} [%]	1.56 ± 3.60	$1.77 \pm 5.24\%$	$7.7 \pm 10.9\%$
μ_{100}	assuming $\approx 20\%$		
Π			
MDP (1σ)[%]	16.3	22.1	45.6

3 Conclusion of preliminary analysis

the 1σ error of the polarization degree will be around 10% or more.

- try energy cuts with $120 \text{ keV} \leq E_i + E_j$ or $100 \text{ keV} \leq E_i + E_j$
- Simulation of μ_{100} with realistic spectrum
- Can detector 2 (functioning as single block) be included?
- Can front-rear coincidences be included?
- Find other suitable solar flares

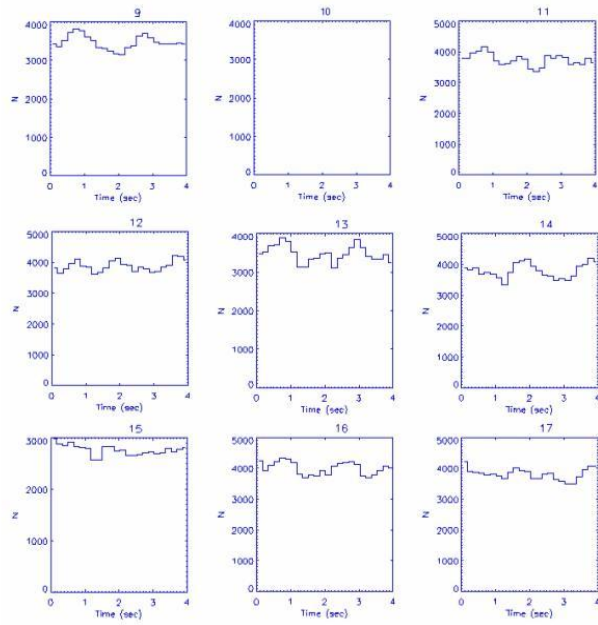
4 Problems

- if flare too intense \Rightarrow too many accidental coincidences
- if flare not intense enough \Rightarrow high number of BG coincidences ($\approx 1000 \text{ min}^{-1} = 16.5 \text{ s}^{-1}$)
- Modulation induced by atmosphere
- Suitable BG time interval must exist

4.1 modulation induced by atmosphere (or ??)

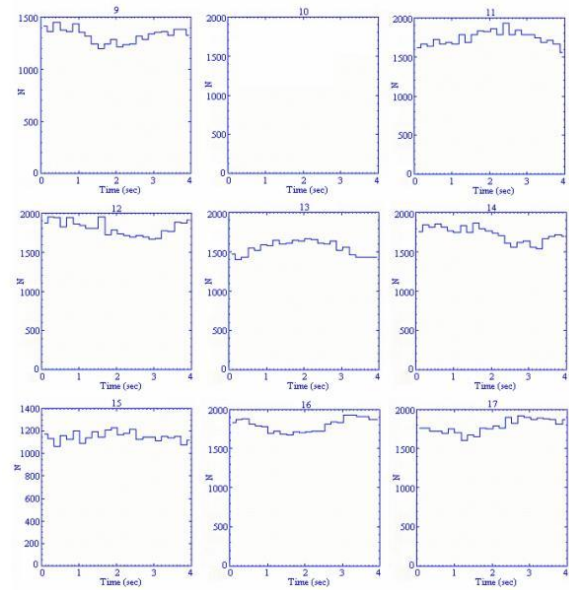
count rates in single rear detectors

29-oct-2003 : 2 peaks / T_{roll} ??



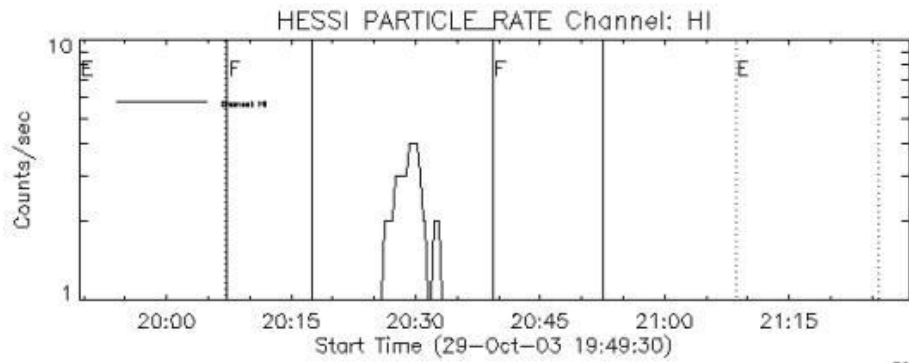
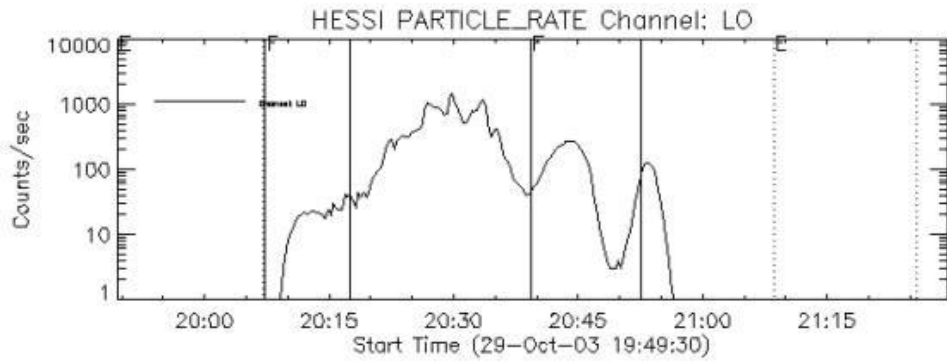
150 – 500 keV band,
20:52:00 – 20:53:30 UT .

23-jul-2002 : 1 peak / T_{roll}

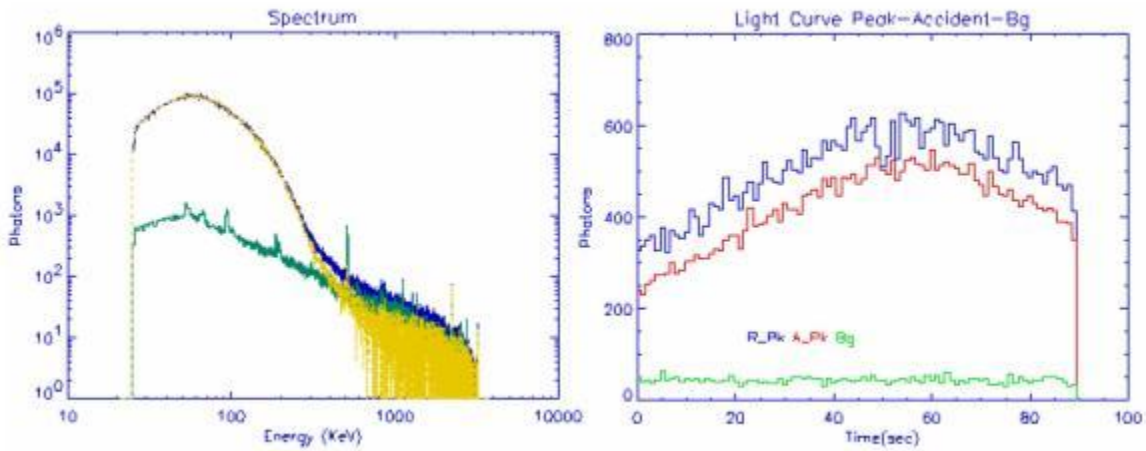


150 – 500(?) keV band,
00:28:00 – 00:34:00 UT .

particle detector had signal on 29-oct-2003



4.2 Analysis of solar flare on 29-oct-2003



- Analysis time interval:
29-oct-2003, 20:52:00.00 to 20:53:30.00
- Background time interval:
31-oct-2003, 20:52:30.00 to 20:54:00.00
- Energy cut:
 $25 \text{ keV} \leq E_k$
 $150 \text{ keV} \leq E_i + E_j \leq 500 \text{ keV}$

N_{tot}	41655
N_{acc}	37287
N_{BG}	1511 - 14
N_C	2871

Assuming $\mu_{100} = 20\%$

$\implies \text{MDP} = 50.3\%$