

*Gamma-Ray Imager/Polarimeter  
for Solar flares (GRIPS)*

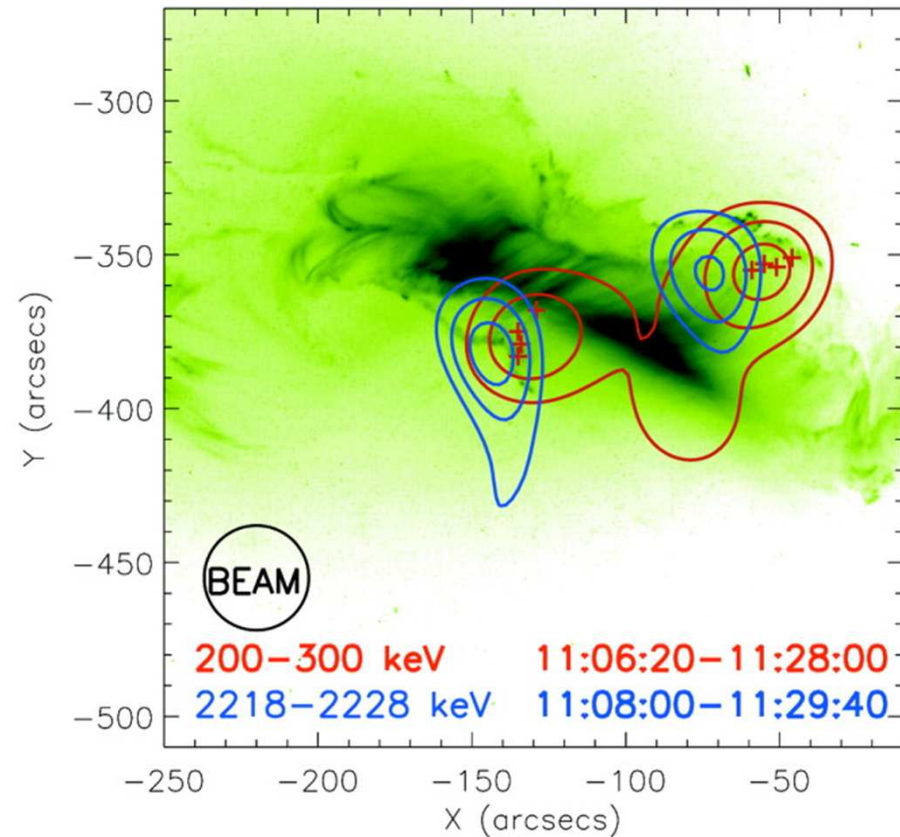
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on behalf of the *GRIPS* team

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# Solar-flare particle acceleration

- Flares are powerful and efficient accelerators
- $> \sim 10^{32}$  ergs in particles
- Spatial separation between ions (blue) and electrons (red) is not consistent with models
- Polarimetry can measure pitch-angle distributions



(Hurford et al. 2006)



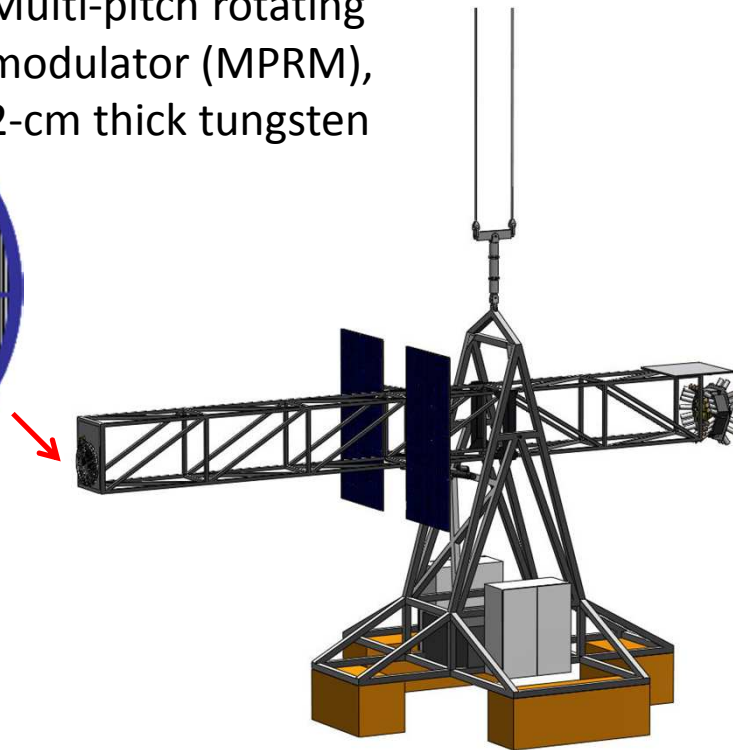
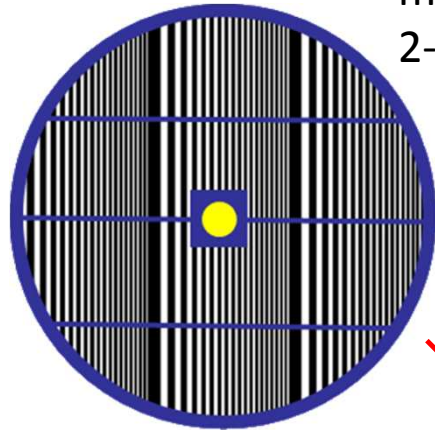
## *Gamma-Ray Imager/Polarimeter for Solar flares (GRIPS)*

- Recently funded NASA LCAS balloon mission
- 3D position-sensitive germanium spectrometer
  - High spectral resolution ( $\sim 2$  keV FWHM at 662 keV)
  - Compton-scatter track reconstruction
- Uses a rotating grid to selectively mask off the Sun to produce gamma-ray images
- Will resolve gamma-ray footpoints in many flares
- Measures gamma-ray polarization “for free”
- Proves technologies for a future space mission

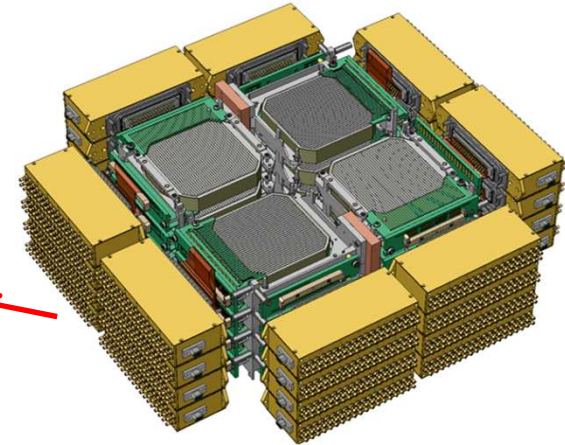


# GRIPS components

Multi-pitch rotating modulator (MPRM),  
2-cm thick tungsten



Spectrometer/polarimeter,  
>200 cm<sup>2</sup> of geometric area



Other components include:

Cryostat/cryocooler

Electronics, with ASICs

Anti-coincidence BGO shield

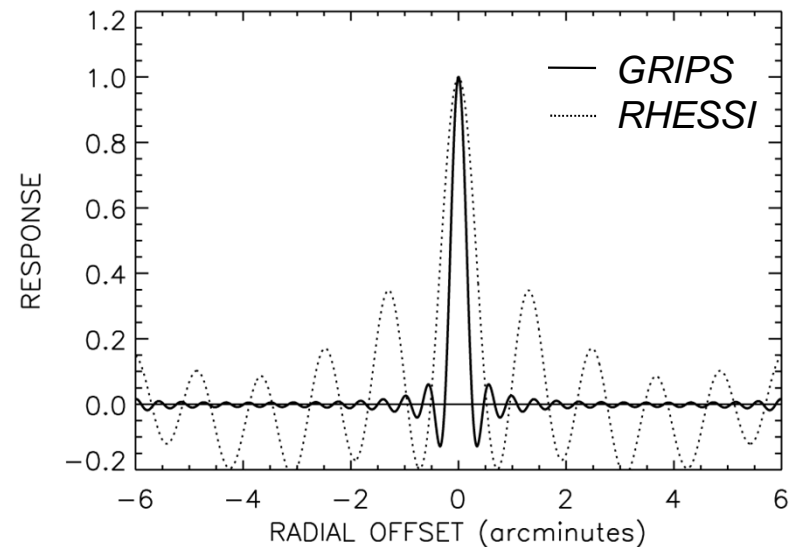
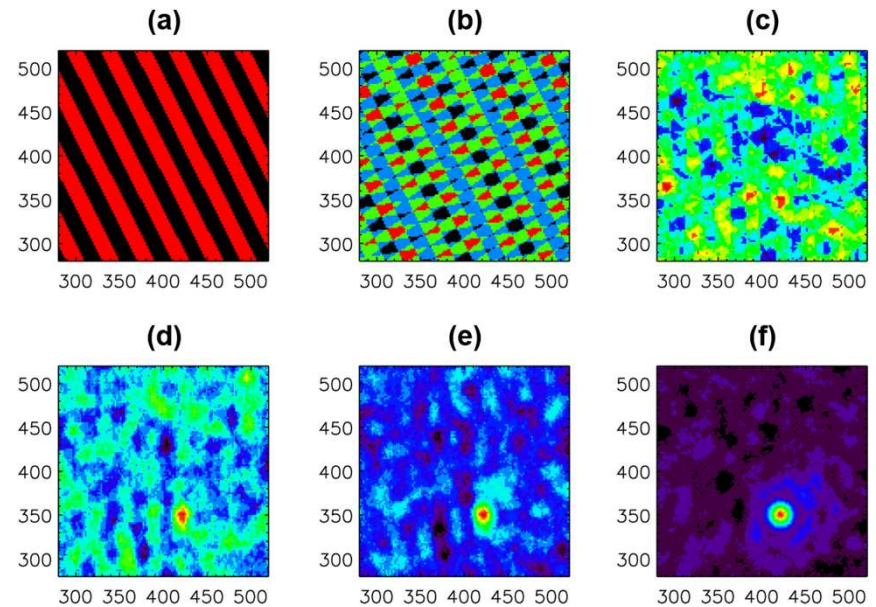
Solar aspect system

Energy range	~20 keV to >~10 MeV
Spectral resolution	~2 keV FWHM at 662 keV
Boom length	8 m
Angular resolution	12.5 to 162 arcsec

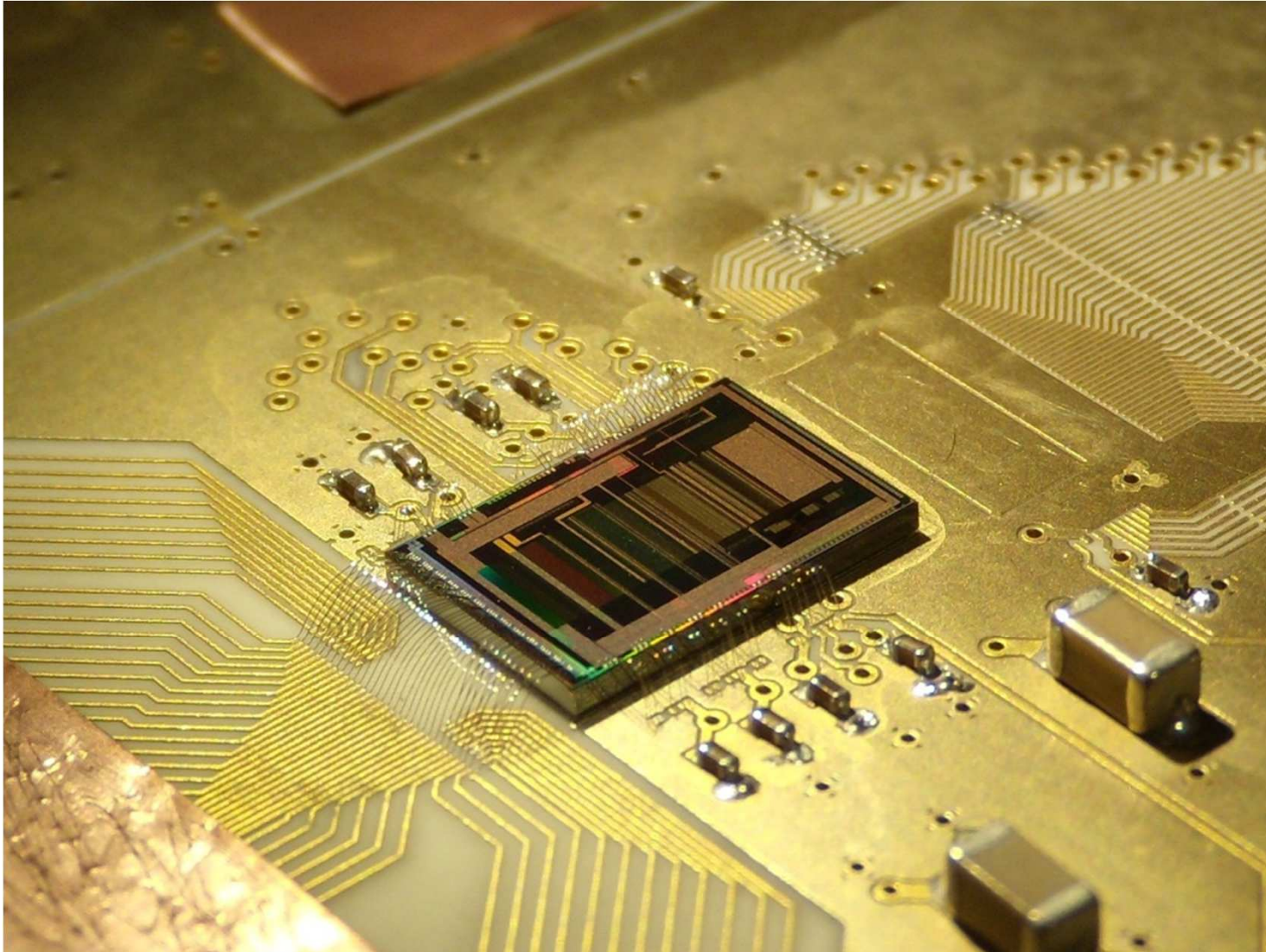
**Con-US test flight:  
spring 2012**

# GRIPS imaging simulations

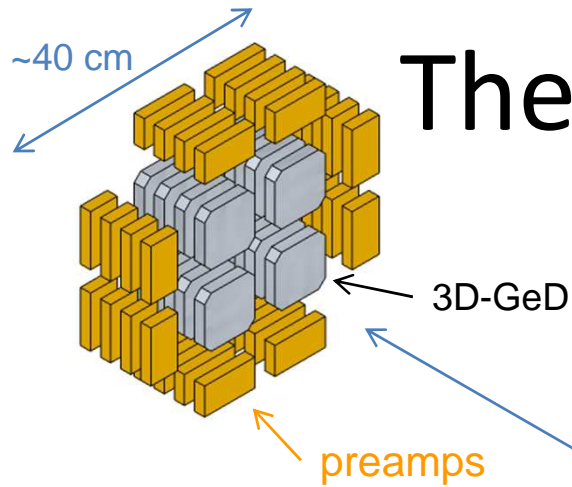
- Due to spatial sensitivity of the spectrometer, only one grid plane (and only one grid) needed
- Quasi-continuous, 2D coverage in the spatial frequency (u-v) plane
- Backprojections for (a) 1, (b) 3, (c) 10, (d) 30, (e) 100, and (f) 1000 photons
- Point-response function virtually free of sidelobes



# *GRIPS* ASIC from GM-Ideas



# The future of *GRIPS*?



Specifications	
Angular resolution	7" to 3' (5× <i>RHESSI</i> )
Spectral resolution	~4 keV at 2.2 MeV
Geometric area	~850 cm <sup>2</sup>
Effective area for imaging	~50 cm <sup>2</sup> at 2.2 MeV (>10× <i>RHESSI</i> )

- Four modules, each with a *GRIPS*-like spectrometer
- Tungsten mask for modulation
  - Rotating like *GRIPS*
  - Or, non-rotating for sparser sampling of Fourier space
- 15-meter separation for 7" FWHM angular resolution
  - Self-deploying (ATK Coilable boom)
  - Or, articulated (ATK ADAM mast)

separated by 15 meters

