

HEROES

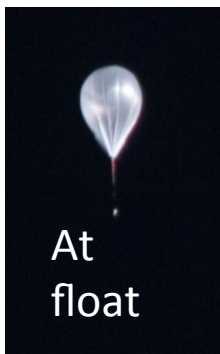
High Energy Replicated Optics to Explore the Sun (code 671)

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MSFC: Jessica Gaskin, Colleen Wilson-Hodge, Brian Ramsey, et al.

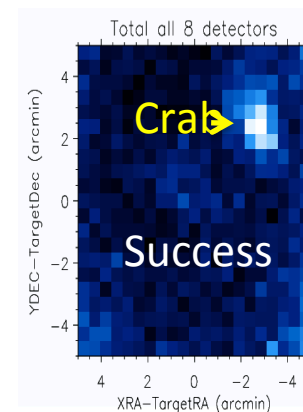


- **Funded by Hands-On Project Experience (HOPE) program**
- Collaboration between GSFC and MSFC to make new high-sensitivity hard X-ray observations of the Sun and astrophysical targets
- **GSFC developed and built a novel Solar Aspect System in one year**
- **Successful balloon flight on Sept 21, 2013!** Observed the Sun for 7 hours and also observed the Crab Nebula & GRS 1915+105
- HEROES has set a new limit on the number of energetic electrons in the corona and their possible contribution to coronal heating
- **Paving the way for an Explorer proposal**



At
float

Optics Type	Replicated Grazing incidence optics
Angular Resolution	~13 arcsec (FWHM), ~26 arcsec (HPD)
Energy	20 to 70 keV
Sensitivity (30-50 keV)	$>5.6 \times 10^{-5}$ ph $\text{cm}^2 \text{s}^{-1}$ keV^{-1}



- Joint balloon payload between GSFC and MSFC - to develop and fly a cross-discipline mission (heliophysics and astrophysics) with two PIs one for each discipline (MSFC was the lead institution).
- Goal to train early-career scientists and engineers on space-flight mission from conception through flight operations while holding to the review cycle typical of spacecraft missions (i.e. NPR 7120 5D).
- The heliophysics science goal of the mission was to investigate Parker's theory of nano flare heating of the solar corona whereby many small flares are constantly going off, accelerating electrons which lose their energy and heat the solar atmosphere.
- The HEROES flight is also a pathfinder for applying high-sensitivity and high resolution (twice the resolution of NuStar) hard x-ray focusing optics to solar observations something that has not been done before on a satellite platform. With the sensitivity provided by focusing optics (>50x better than previous observations) such a mission will be able to address the question of how particles are accelerated in magnetized plasmas by directly observing electrons in the acceleration region of solar flares or coronal mass ejections as well as what path they take to escape from the Sun and (possibly) interact at Earth. **This new technology is underpinning an Explorer mission concept out of HSD.**