# The *Nuclear Compton Telescope*

## *A balloon-borne γ-ray spectrometer, polarimeter & imager*


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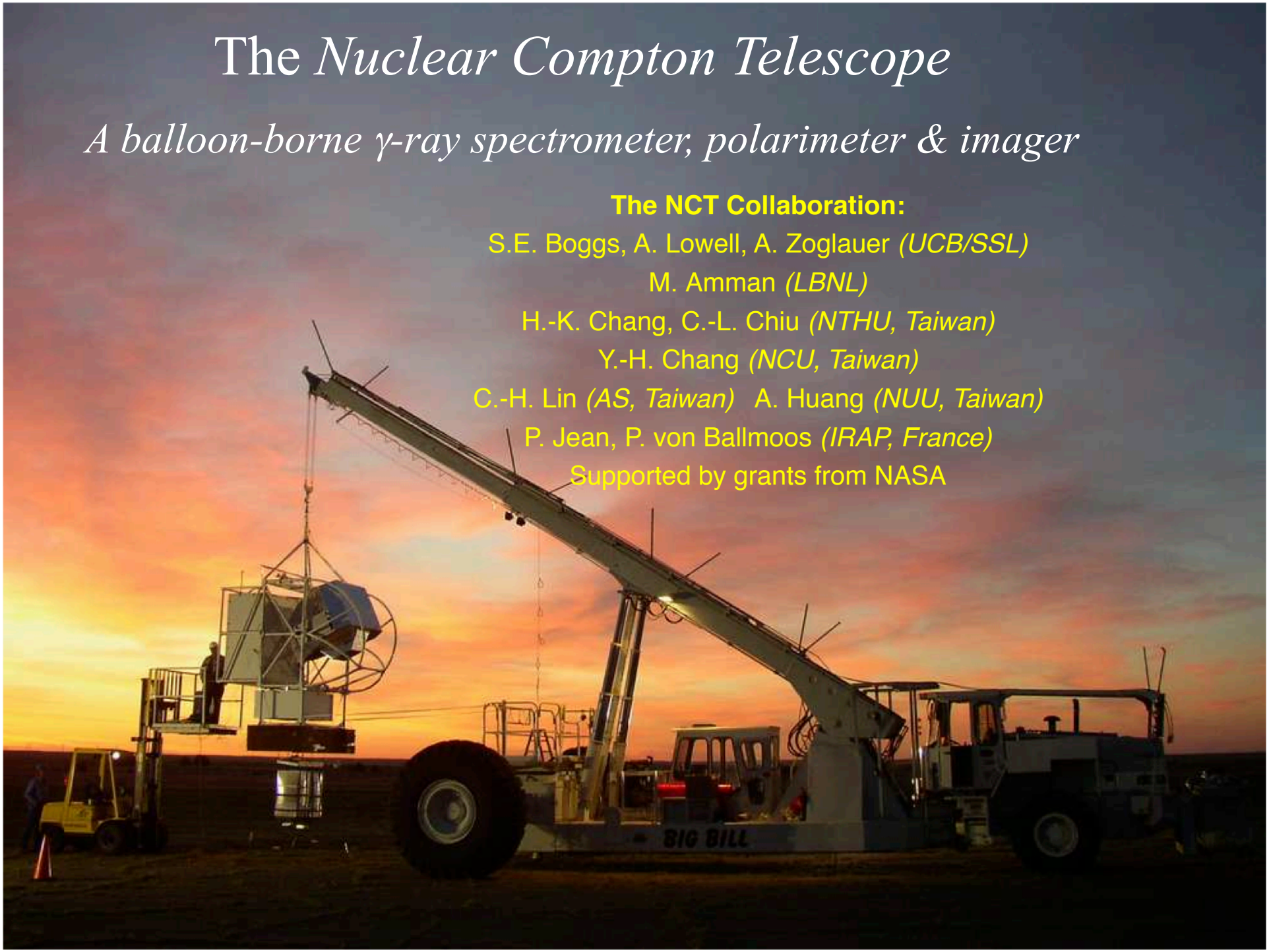
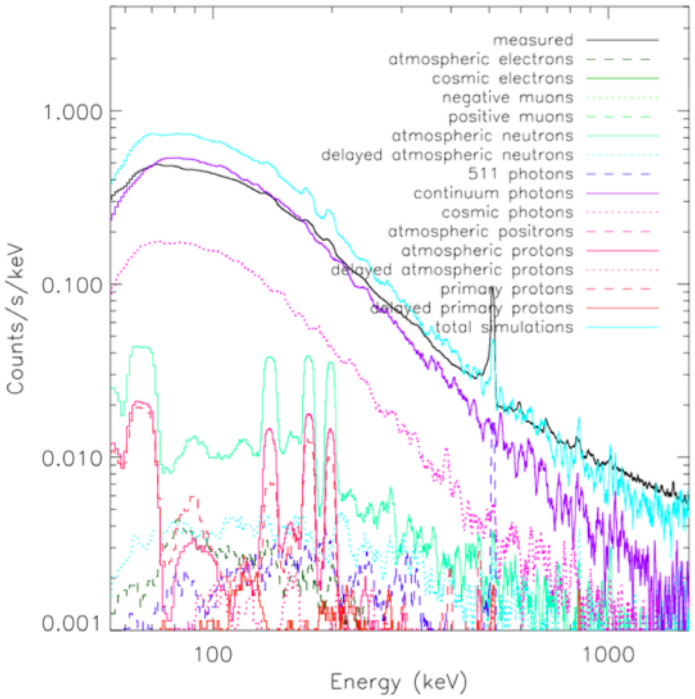





## NCT Prototype Flight 2005

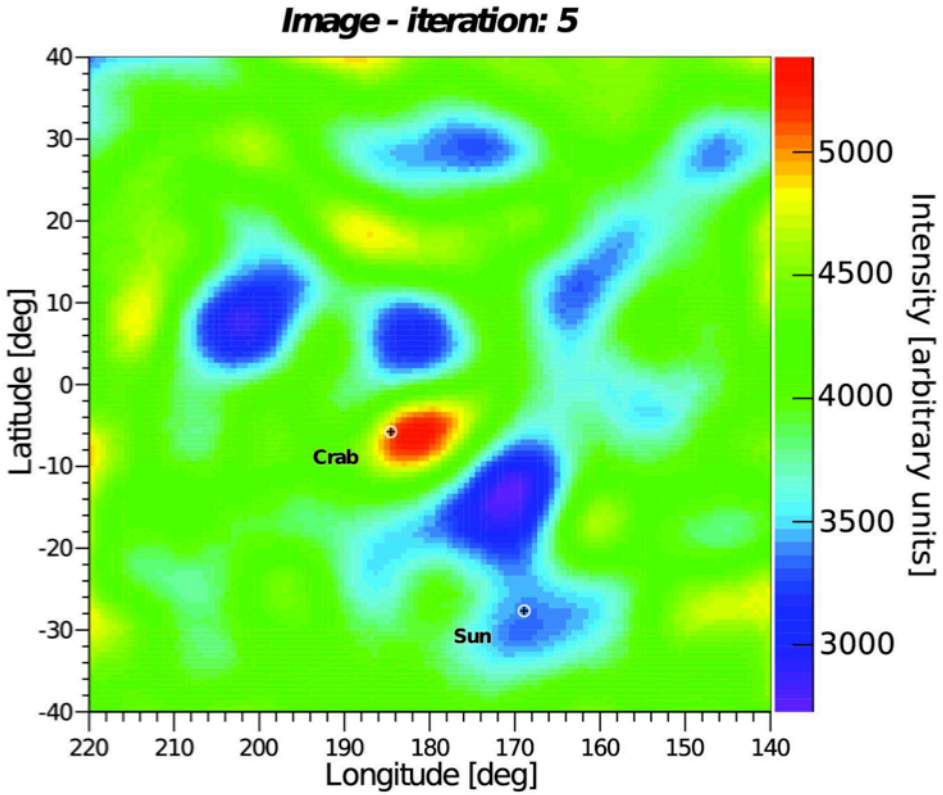
• 6 hour prototype flight (2 detectors) from Ft. Sumner, New Mexico on June 1st, 2005.

• Measurement of gamma-ray background at balloon float altitudes (J.D Bowen et. al., IEEE, 2007)

## 1st NCT Science Flight 2009

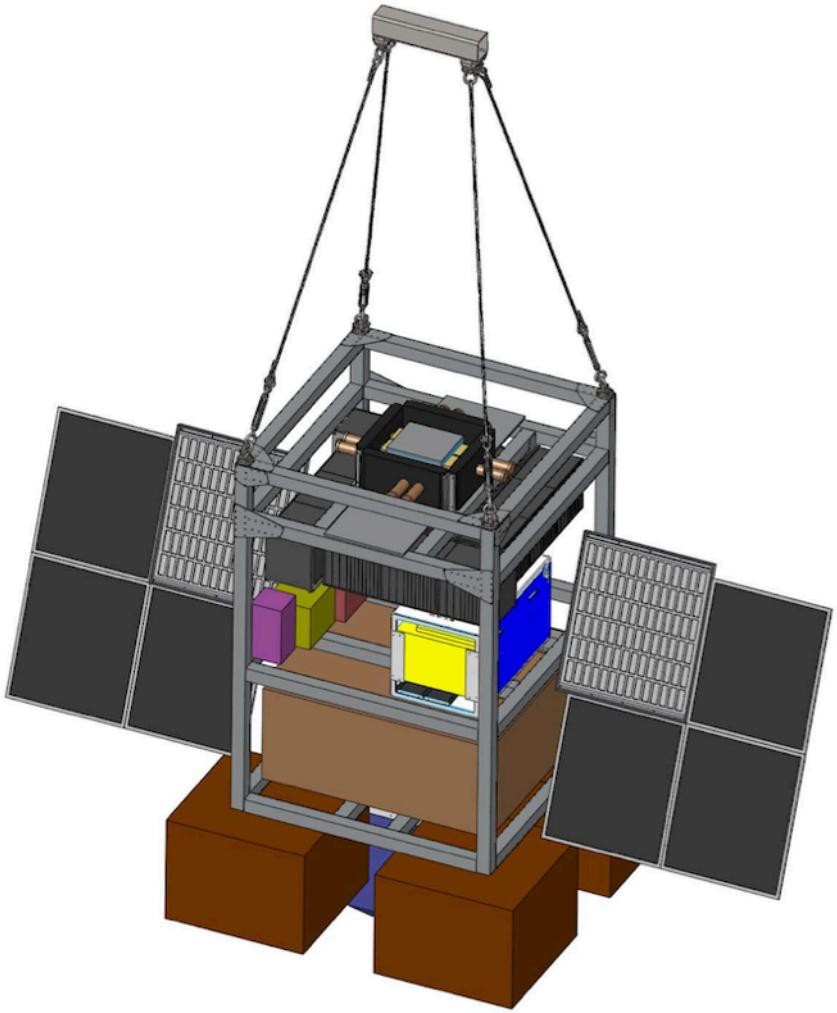
• 37 hour flight with 10 detectors from Ft. Sumner, New Mexico on May 17-18, 2009.

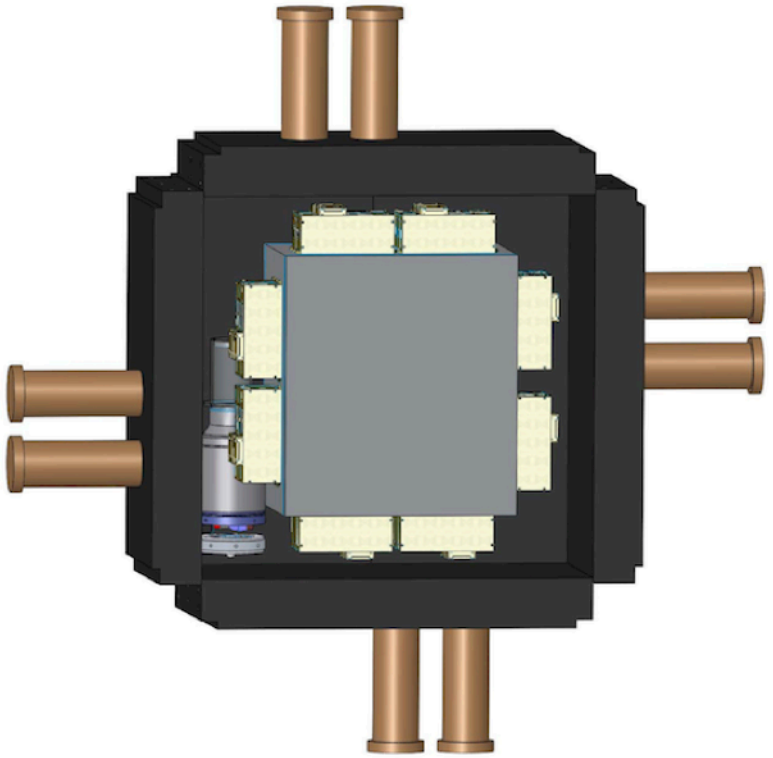
• Sufficient data to produce an image of the Crab Nebula, first image of an astrophysical source with a compact Compton Telescope! (Bandstra et al., ApJ, 2011)

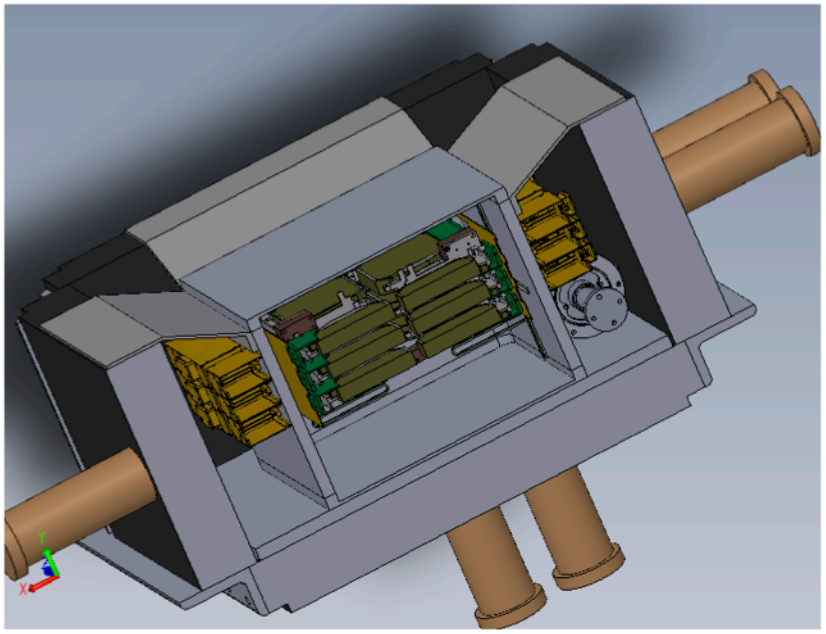


**NCT 2.0**

- New detector geometry, better FoV, low-energy response, polarimetry
- All new gondola, designed for superpressure, ULDB
- Solar power
- LN2 replaced by cryocooler
- replace BGO with CsI shields







**2014/2015 Flight Campaign:**

- Rebuilding of instrument has begun
- Designing for superpressure balloon
- Southern hemisphere launch, eventual ULDB Flight

**Primary Science Goal:**

- Use Compton Imaging to map the 511 keV positron annihilation line from the galactic center

**Secondary Science Goals:**

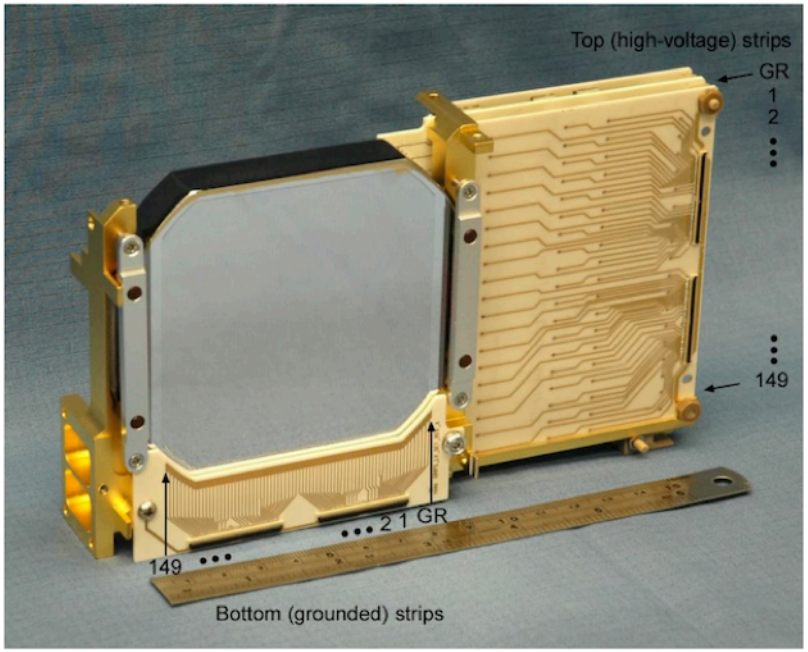
- SNe gamma-ray lines

($^{26}$Al at 1.809 MeV, $^{60}$Fe at 1.173/1.333 MeV, $^{44}$Ti at 1157 MeV)

- Compact Objects (AGN, black holes, neutron stars)
- Gamma-ray polarization

| Source | Decay | Energy | Goal |
|---|---|---|---|
| SNe Ia (?) | $e^+e^-$ | 0.511 | 36σ map |
| SNe II/Ib | $^{26}$Al | 1.809 MeV | 36σ map |
| | $^{60}$Fe | 1.173, 1.333 | 5σ detect |
| SNe | $^{44}$Ti | 1.157 | resolved line |
| BHs | $e^+e^-$ | ≤0.511 | discovery |

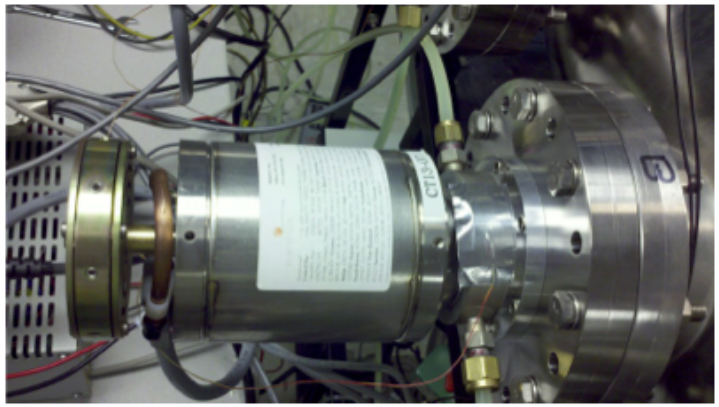
# Developments for Ge Compton telescopes:




- finer strip pitch
- ✓ better interaction resolution
- ✓ intrinsic angular resolution

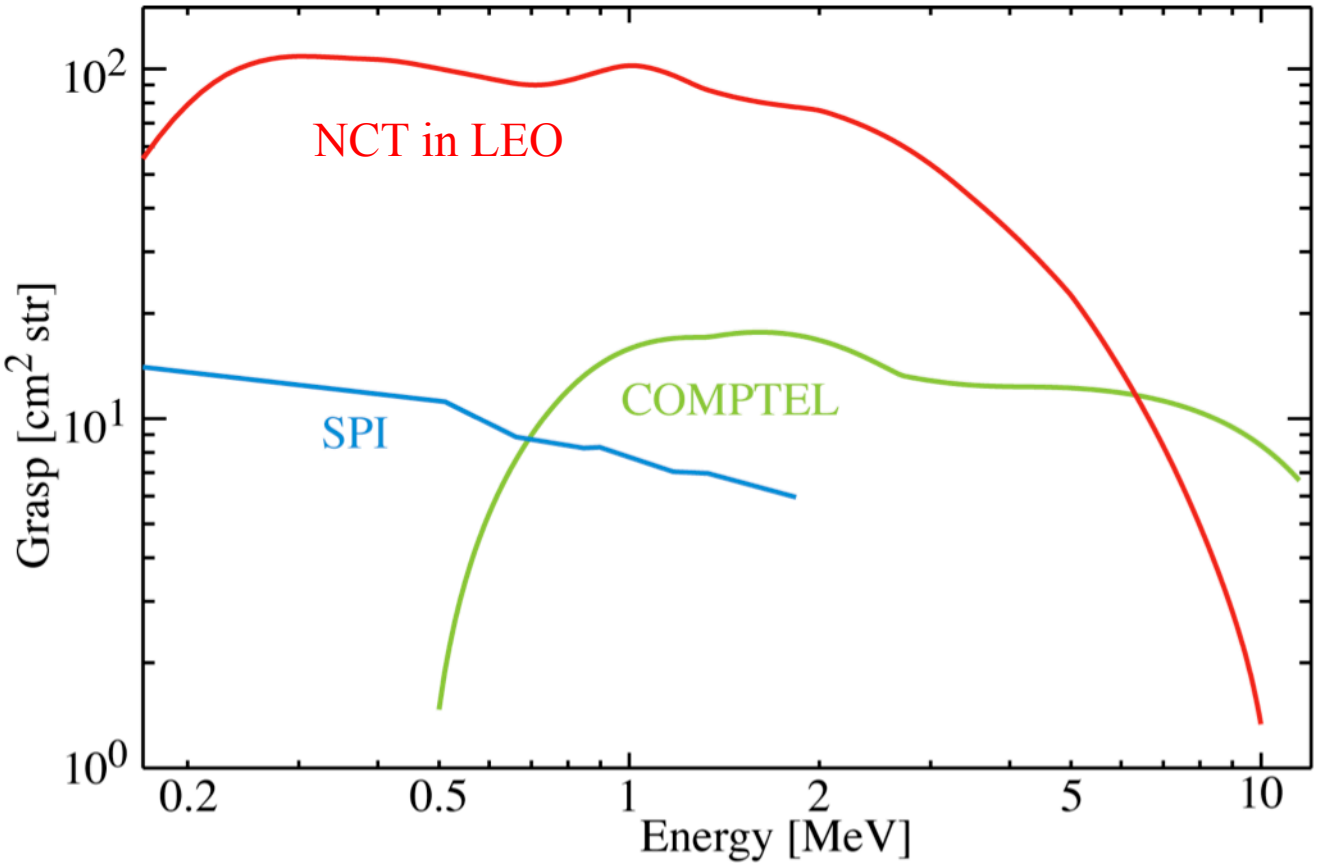
- low-noise ASIC readout
- ✓ low power
- ✓ low mass
- ✓ more channels/better resolution

- mechanical cooling



All 3 are being developed between NCT & GRIPS!

# NCT Future Plans:




- Fermi model – all sky survey
- bridge the MeV gap
- background rejection
- high spectral resolution
- polarization