



Fermi

Gamma-ray Space Telescope

Fermi Large Area Telescope Science Overview

Eric Charles
on Behalf of the Fermi-LAT
Collaboration

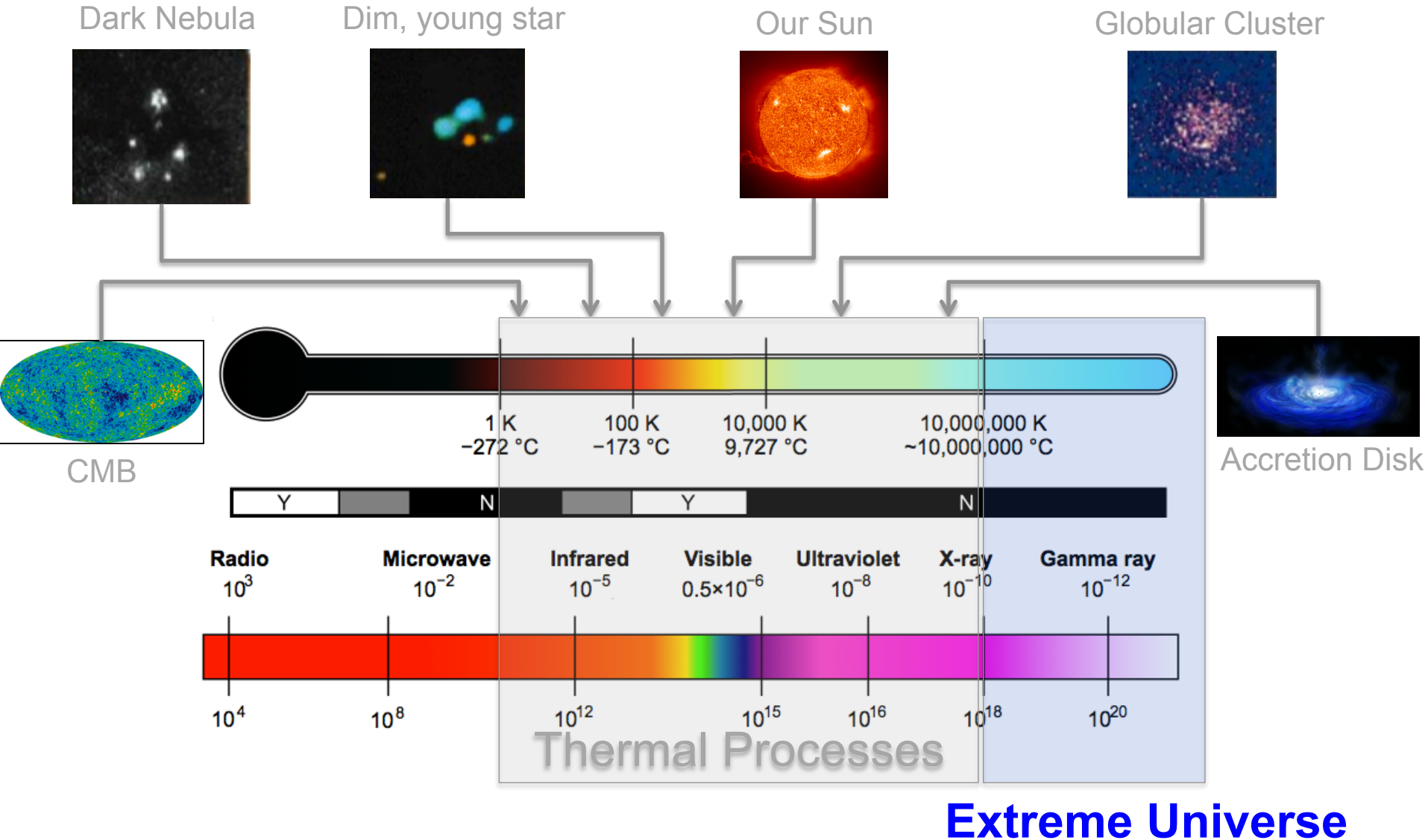
March 15, 2018
Pisa, Italia

Outline

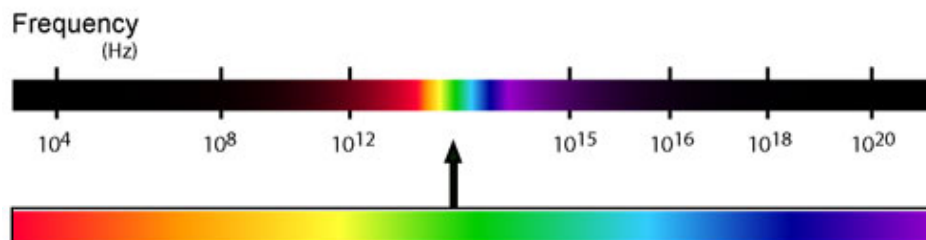
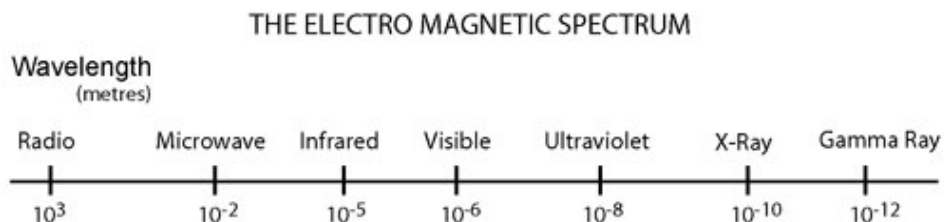
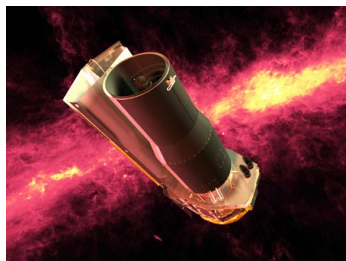
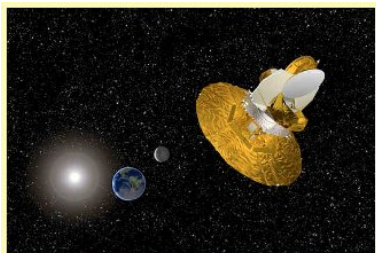
- γ -ray Astronomy & Astrophysics
- Fermi Mission & Instruments
- The Fermi Sky

γ -RAY ASTRONOMY & ASTROPHYSICS

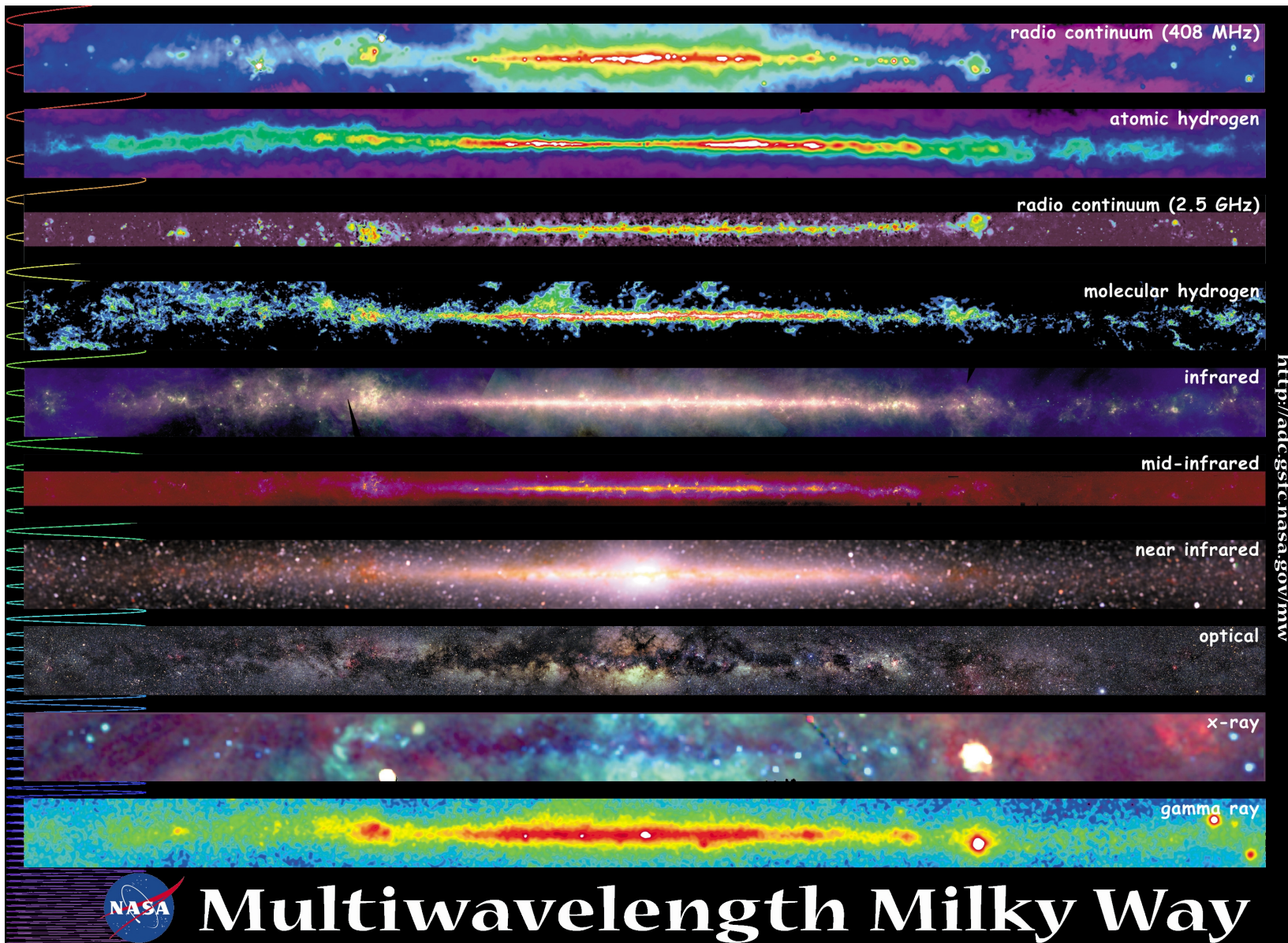
γ -rays Probe the Extreme, Non-Thermal, Universe



Astronomy across the electromagnetic spectrum

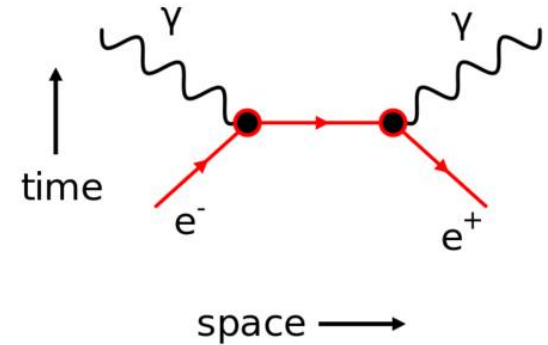


Put another way



Higher Energy

Non-thermal γ ray emission



Energy source

**Acceleration
mechanism**

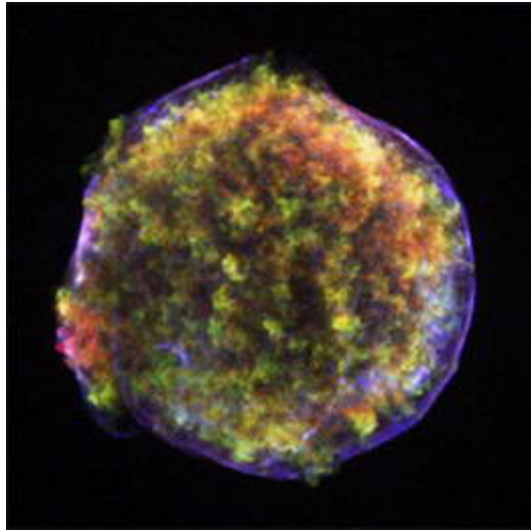
**γ -ray production
mechanism**



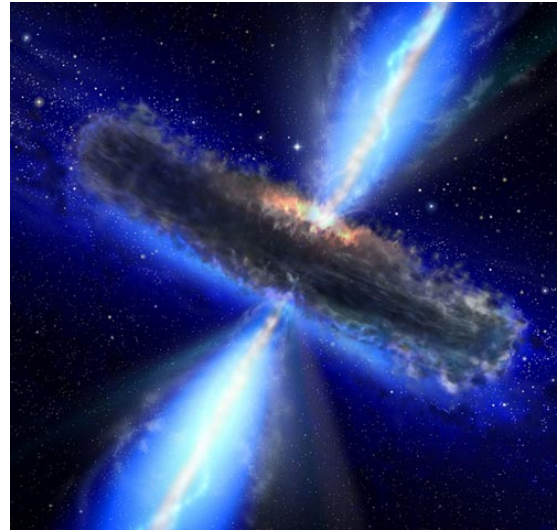
Foreground absorption

γ rays

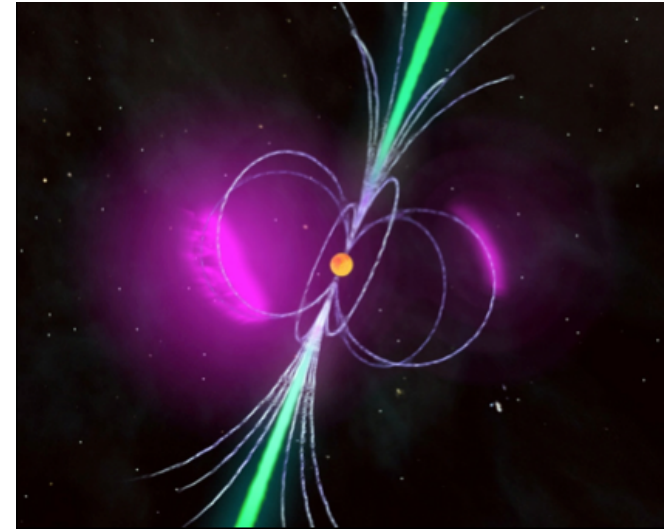
Energy sources



Explosions

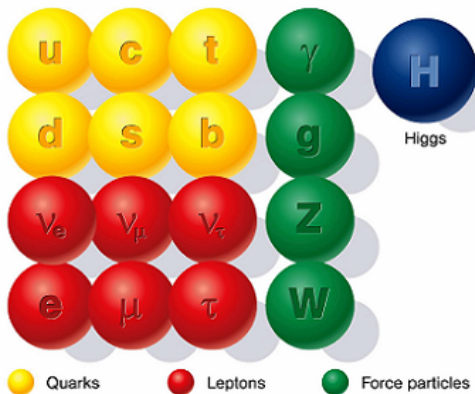


Accretion

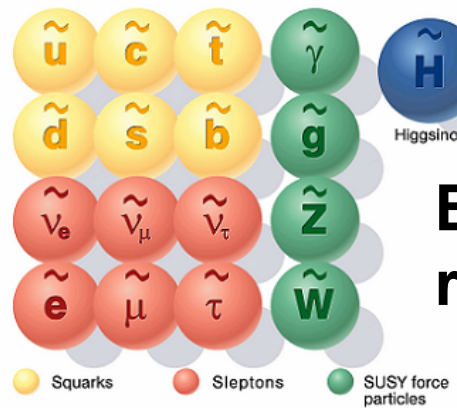


Rotating Fields

Standard particles



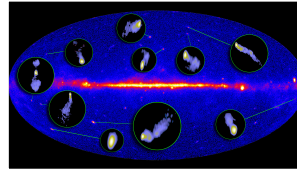
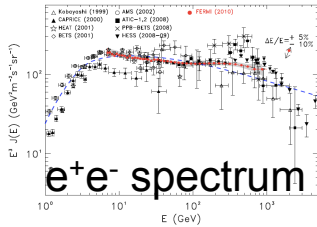
SUSY particles



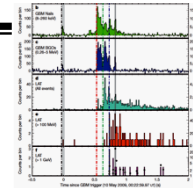
**Exotic particle
rest mass**

Fermi Source Classes

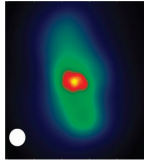
9



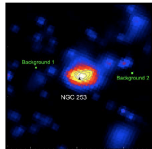
Blazars



GRBs

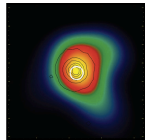
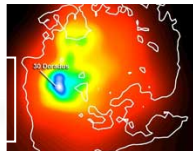


Radio Galaxies



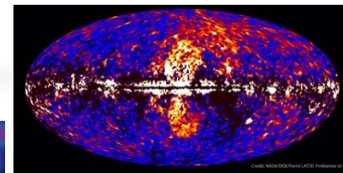
Starburst Galaxies

LMC & SMC



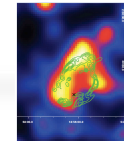
Globular Clusters

Fermi Bubbles

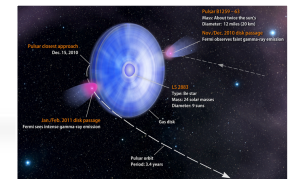


Nova (1)

SNRs & PWN

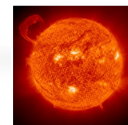


γ -ray binaries

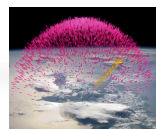


Pulsars: isolated, binaries, & MSPs

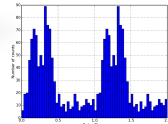
Sun: flares & CR interactions



TGFs



Unidentified Sources



Galactic

Extragalactic

FERMI MISSION & INSTRUMENTS

The *Fermi* Large Area Telescope

Sky Survey:

LAT sees $\sim 1/5$ of sky at once
Whole sky every 3 hours

Large Area:

$A_{\text{eff}} > 0.9 \text{ m}^2$ on-axis,
 $\sim 0.4 \text{ m}^2$ 60° off-axis

Huge Energy Band:

~ 30 to 2×10^6 MeV

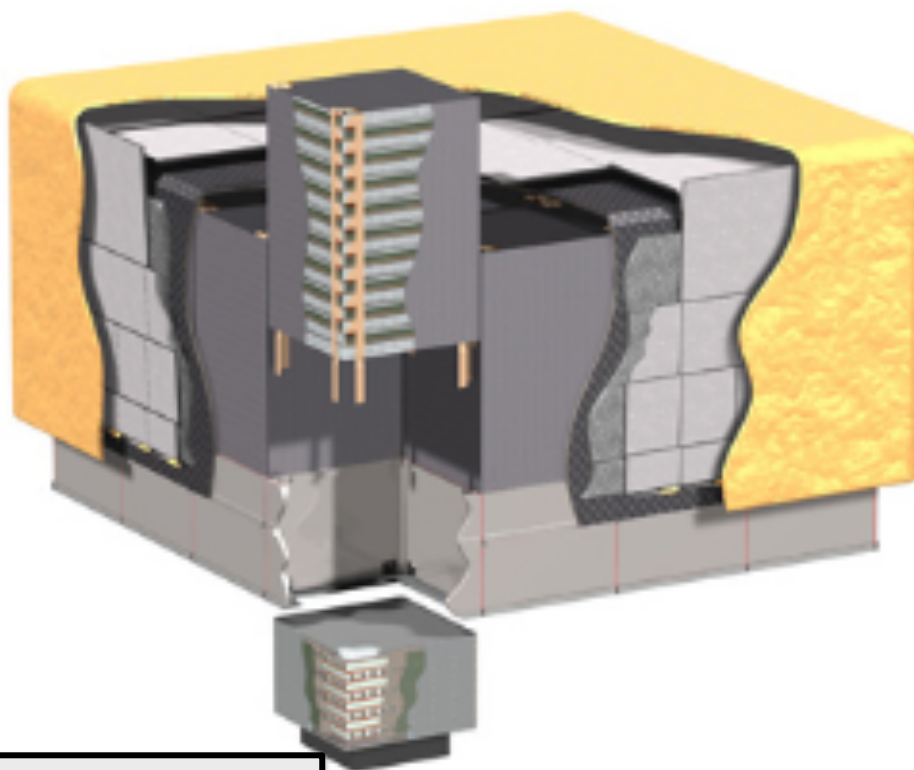
Almost 5 decades
(Visible light = $\frac{1}{4}$ decade)

Public data:

All photon data released to public within hours

Fermi-LAT Collaboration:

~ 400 Scientific Members,
NASA / DOE & International
Contributions

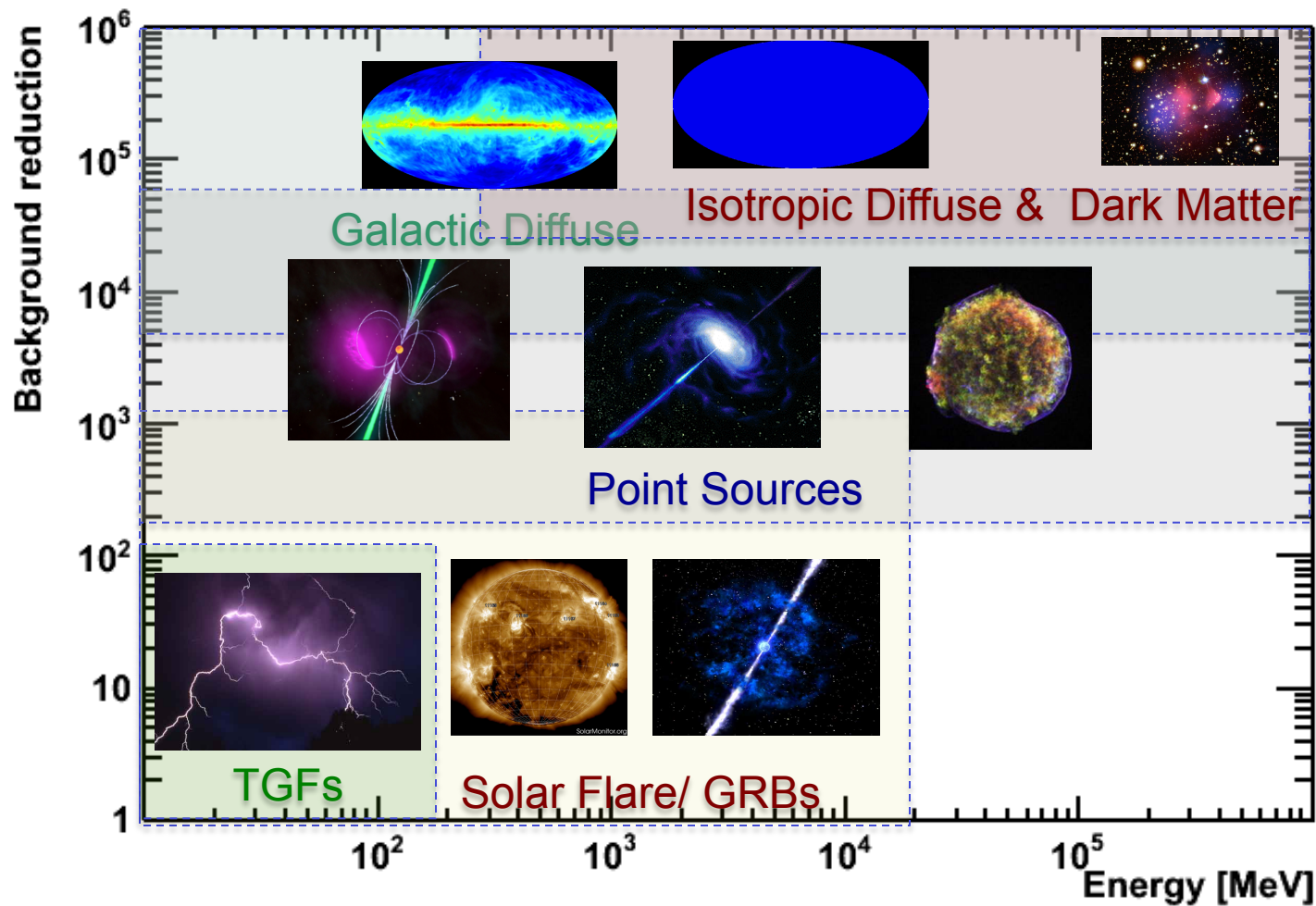


Atwood et al. [LAT Cib] [2009ApJ...697.1071A](https://arxiv.org/abs/2009ApJ...697.1071A)
Ackermann et al. [LAT Cib] [2012ApJS...203....4A](https://arxiv.org/abs/2012ApJS...203....4A)
<http://www-glast.stanford.edu/>

Launch: June 13th 2008



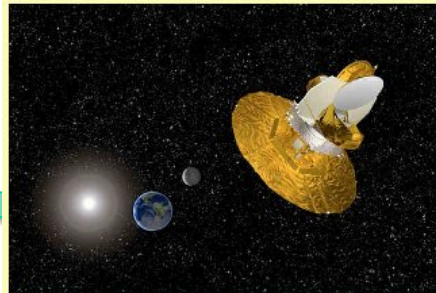
Fermi-LAT Science Covers Huge Space



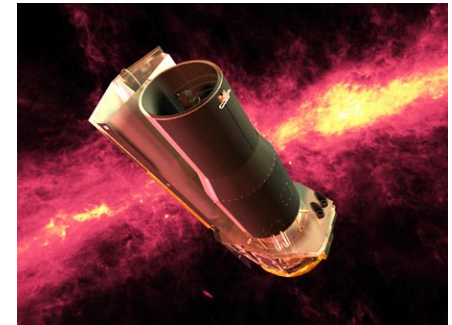
Synergy with Other Instruments



Radio: pulsations, synchrotron emission, gas / dust maps, high resolution imaging of host galaxies...



Microwave: diffuse maps & morphology, host galaxy characteristics...



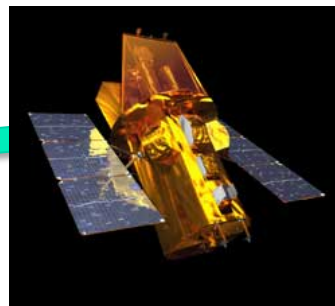
IR: gas/ dust maps, host galaxy characteristics

LAT Source Localization $\sim 0.1^\circ$ -- 0.01°
comparable to many the field of view of many telescopes... Great for followups

Energy



TeV: High-energy spectral breaks, supernovae morphology...



X-ray: GRB afterglows, Galactic source morphology & pulsar association...

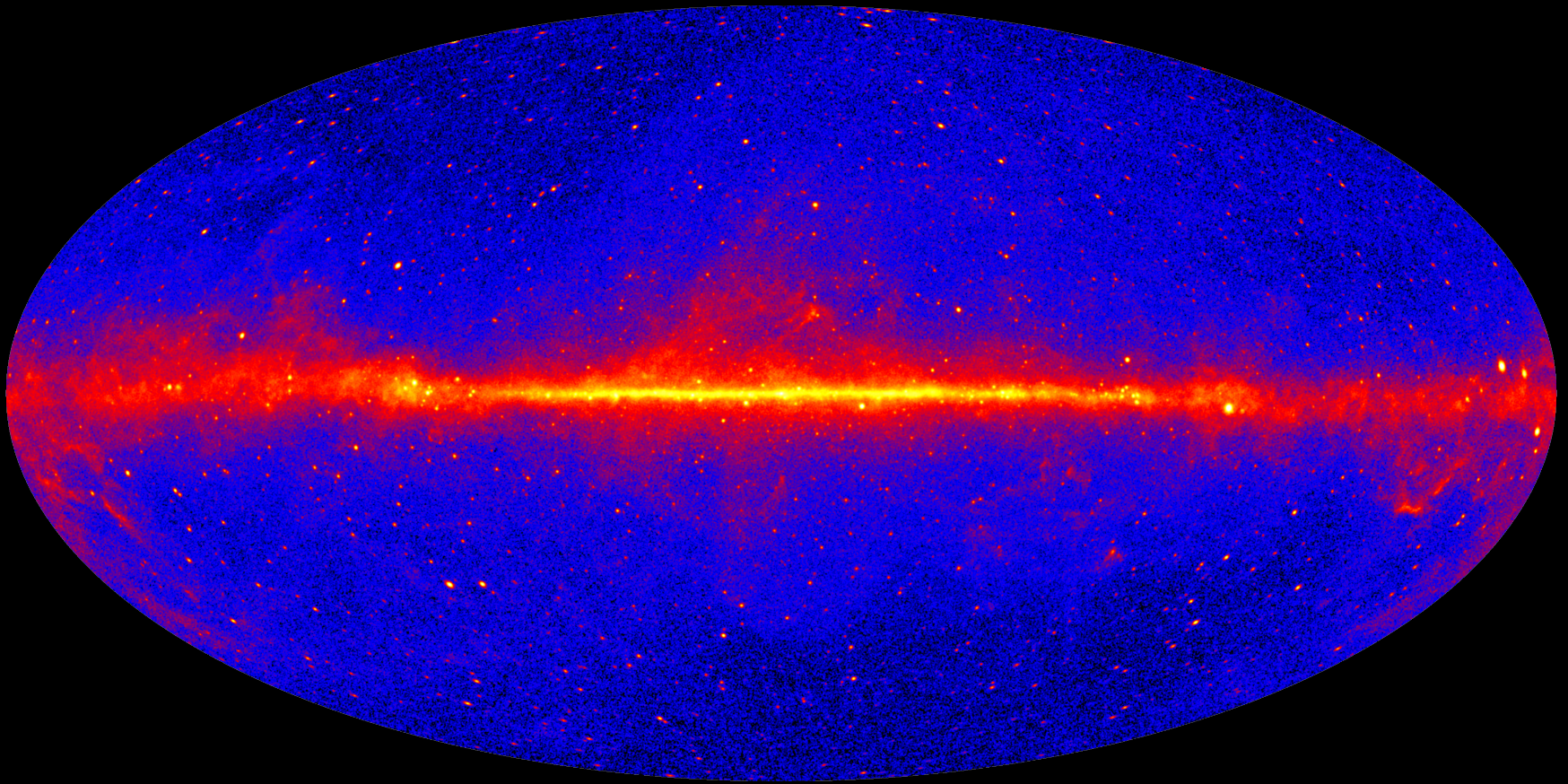


Optical: GRB afterglows, AGN/ GRB redshifts...

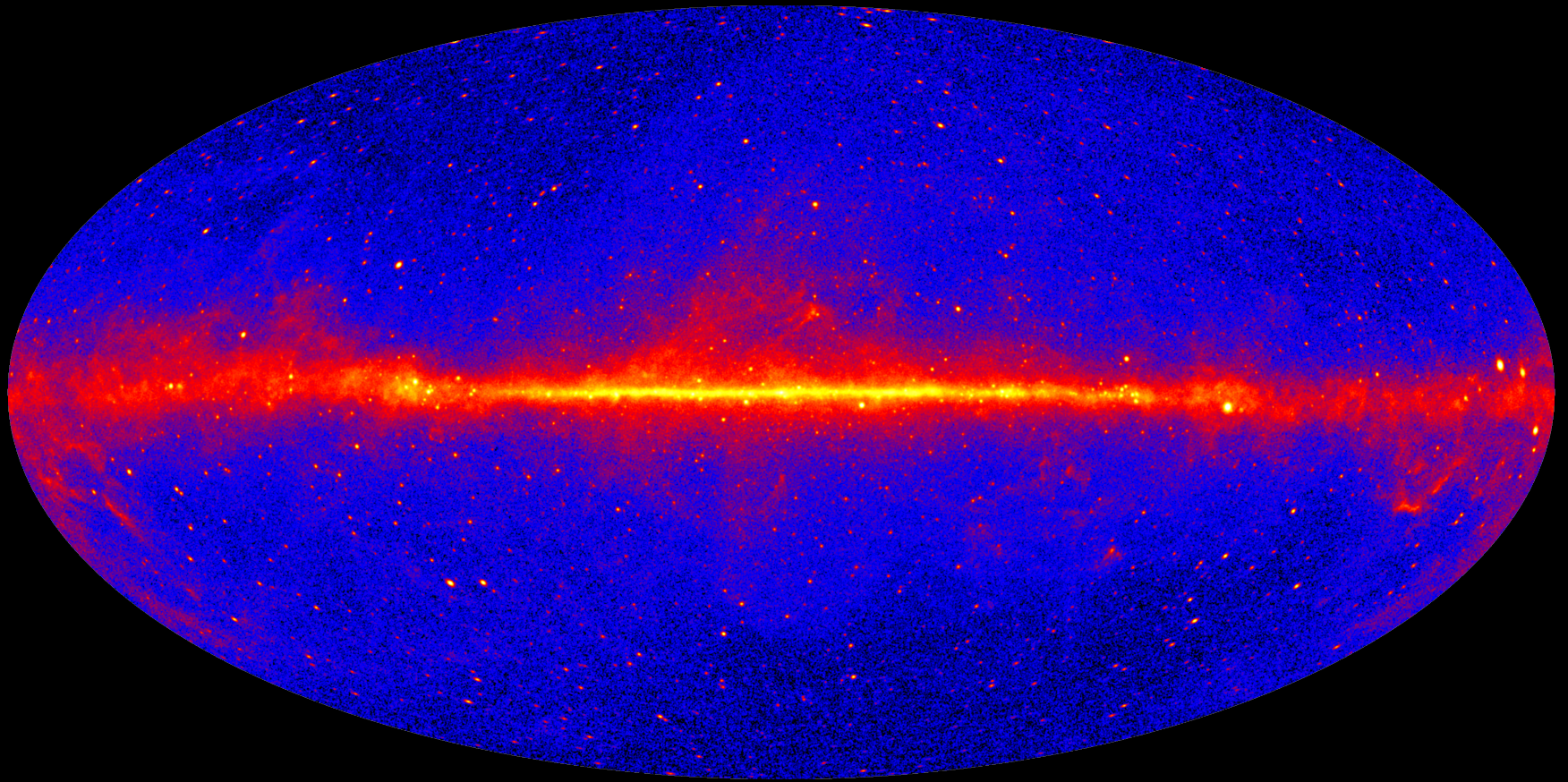
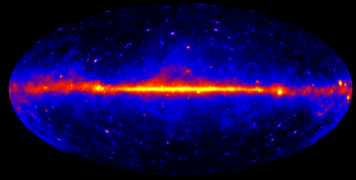
THE FERMI SKY

The Fermi-LAT Sky

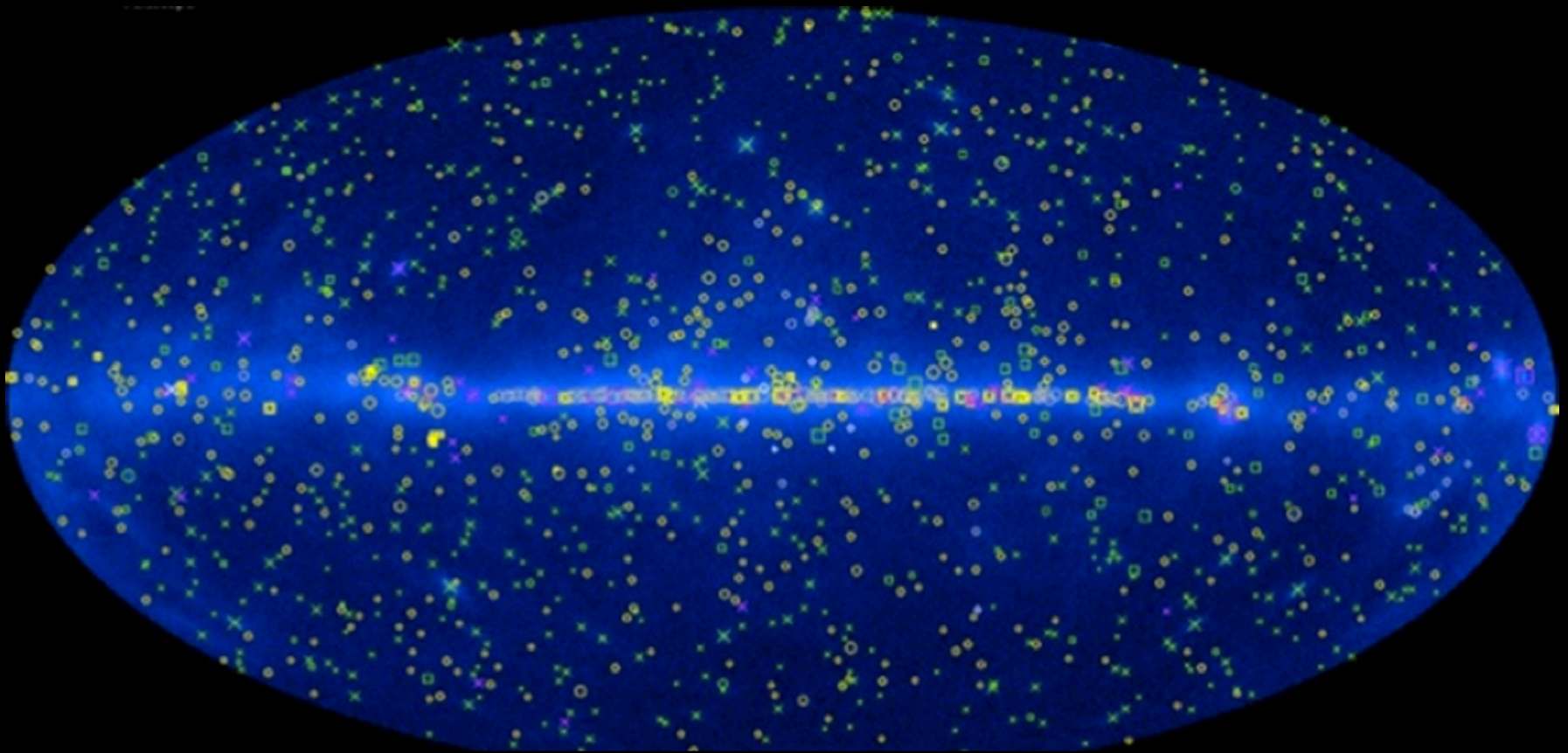
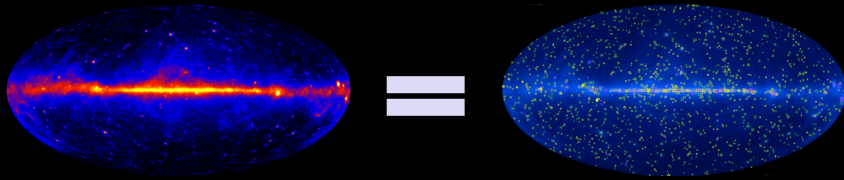
Nine years, Intensity > 1 GeV. Aitoff projection in Galactic Coordinates



Decomposing the Fermi-LAT Sky

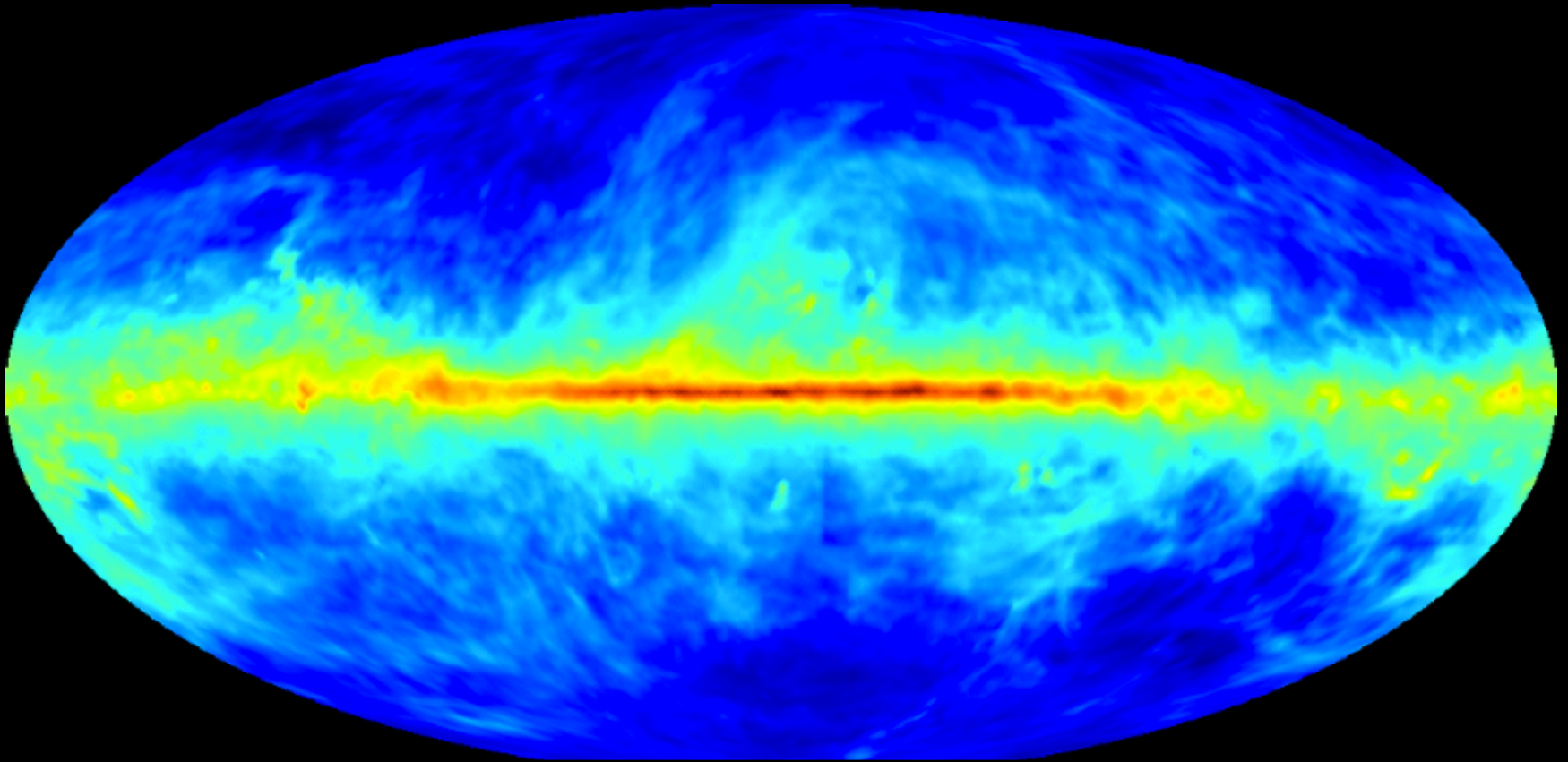
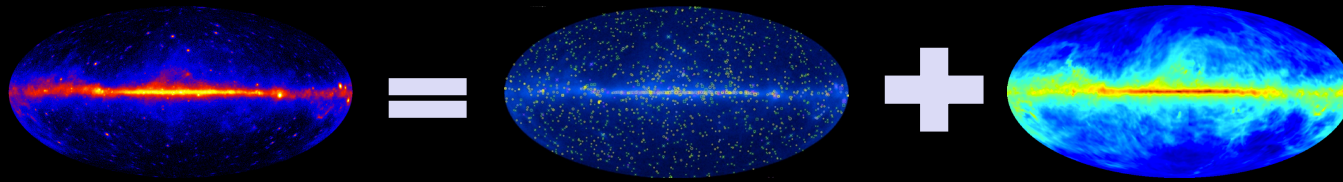


Point Sources



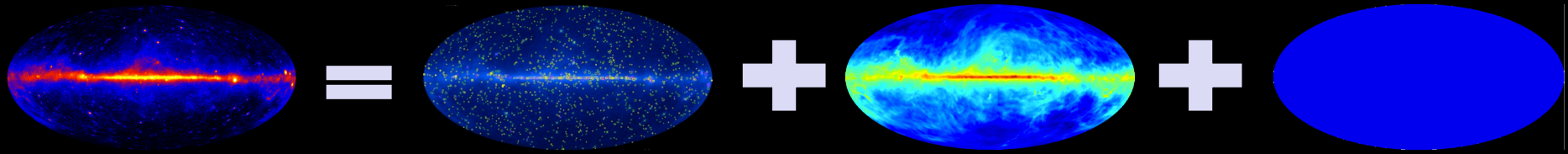
5000+ γ -ray sources: several source classes, including Active Galaxies, Pulsars, Supernova Remnants and more.

Diffuse Emission



Galactic Diffuse Emission: g-rays from high-energy cosmic rays interacting with dust, gas and radiation fields in the Galaxy

Isotropic Emission



Isotropic emission: unresolved emission from extra-Galactic sources, possibly other contributions

**STAY TUNED:
SETH DIGEL WILL PRESENT FERMI-
LAT SCIENCE HIGHLIGHTS IN THE
NEXT SESSION**