Constraining the diffuse supernova axion-like-particle background with high-latitude Fermi-LAT data

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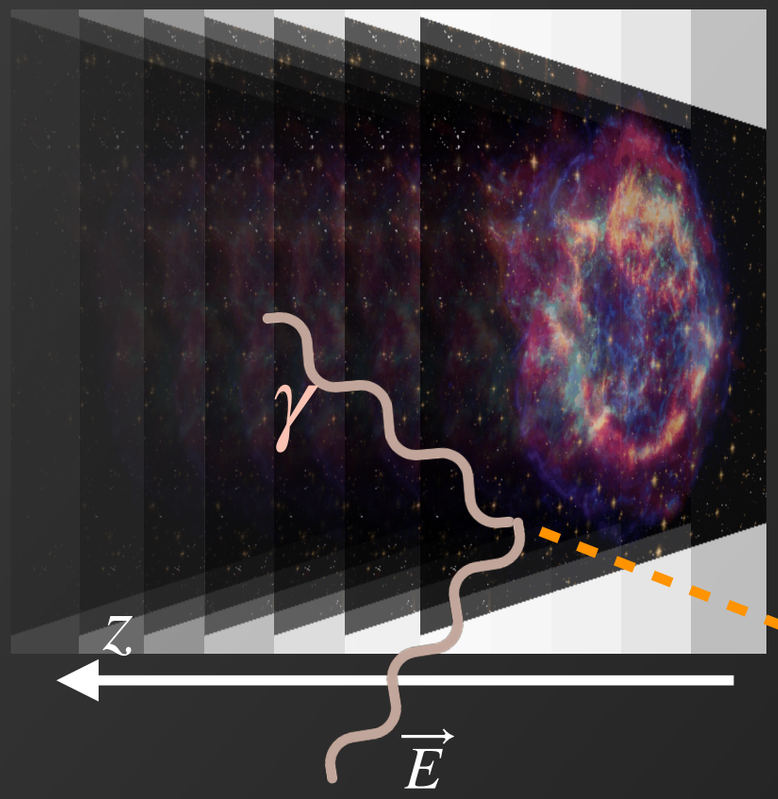
Credit: P. Oesch/University of Geneva; M. Montes/University of New South Wales/ESA/NASA
ESA Planck

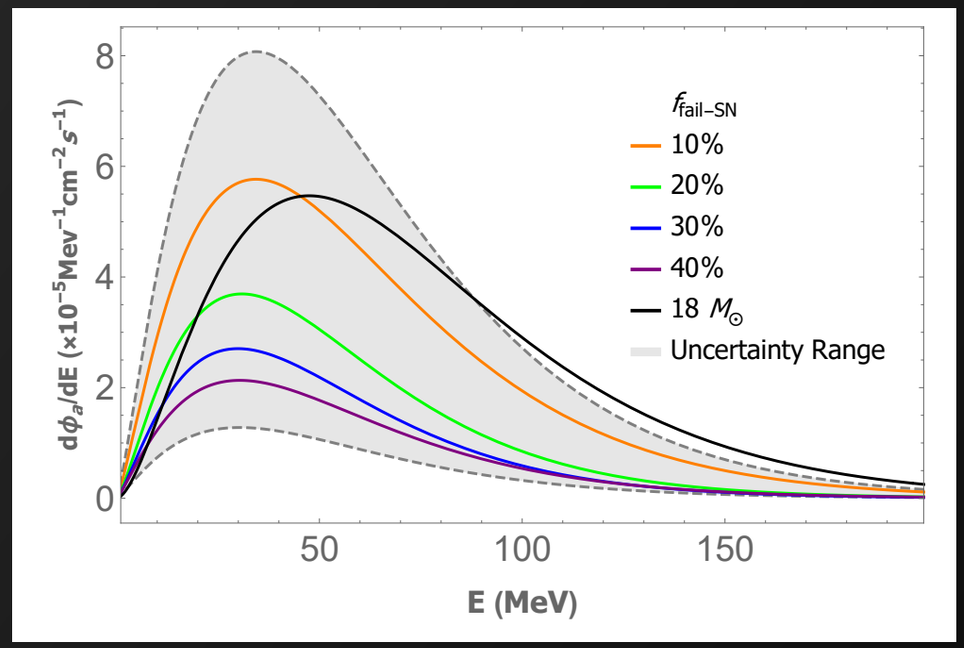
ALP-induced gamma rays from distant SNe

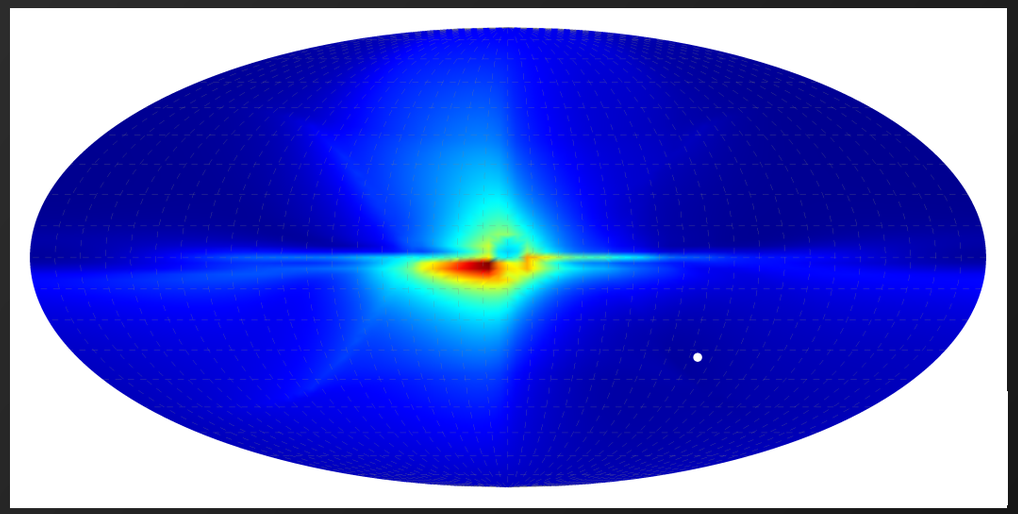
Credit: NASA/JPL-Caltech/STScI/CXC/SAO



electrostatic field of ions, electrons and protons

Cumulative emission from all extragalactic core-collapse supernovae



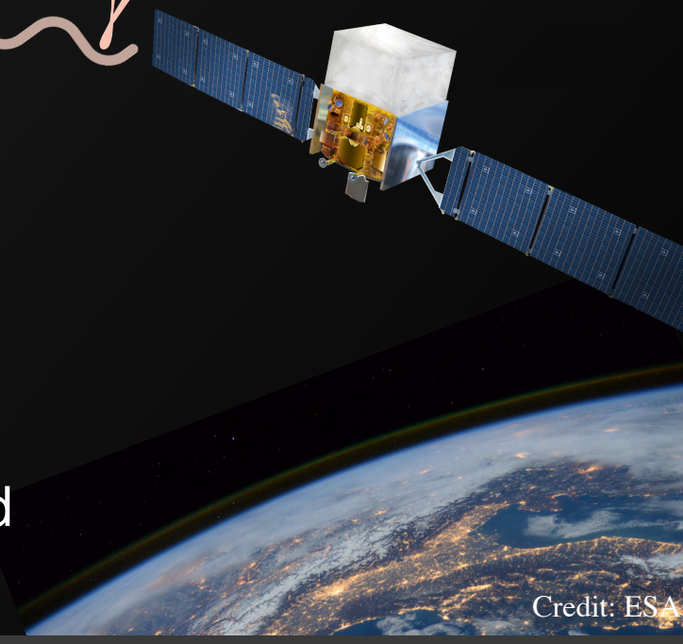


a

γ

$\vec{B}$

Milky Way's magnetic field —> conversion probability highly dependent on B-field structure



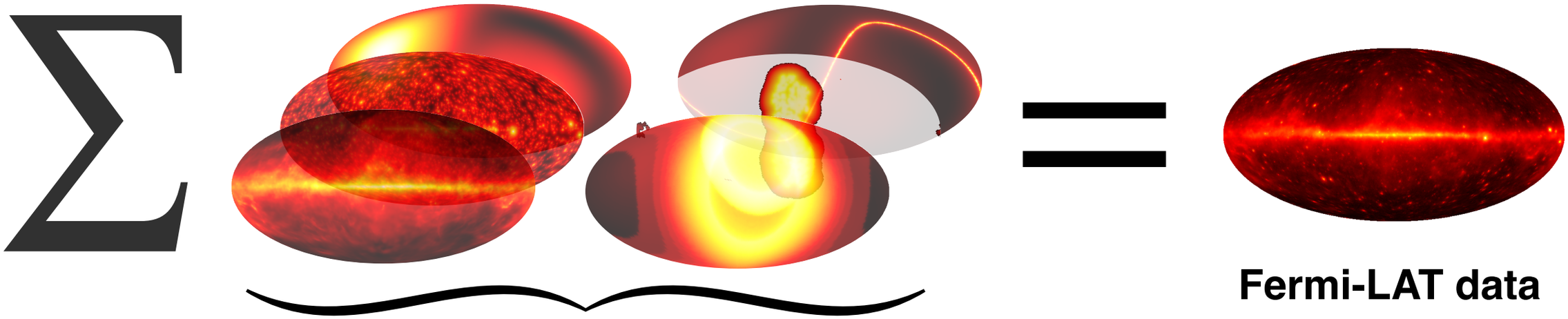
Credit: ESA

Analysis strategy using Fermi-LAT data

The diffuse extragalactic SNe ALP-flux induces an all-sky gamma-ray signal in the range up to a few hundred MeV.

Falls in the energy range of the Fermi LAT:
—> previous work [arXiv:2008.11741] only exploited the **spectral shape** of the signal and **parametric fit formula** for extragalactic LAT data

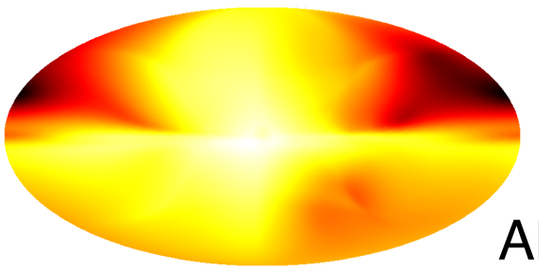
Improved approach: **template-based analysis** combining spatial and spectral features of the signal utilising the maximum likelihood method



model templates **Fermi-LAT data**

Objectives:

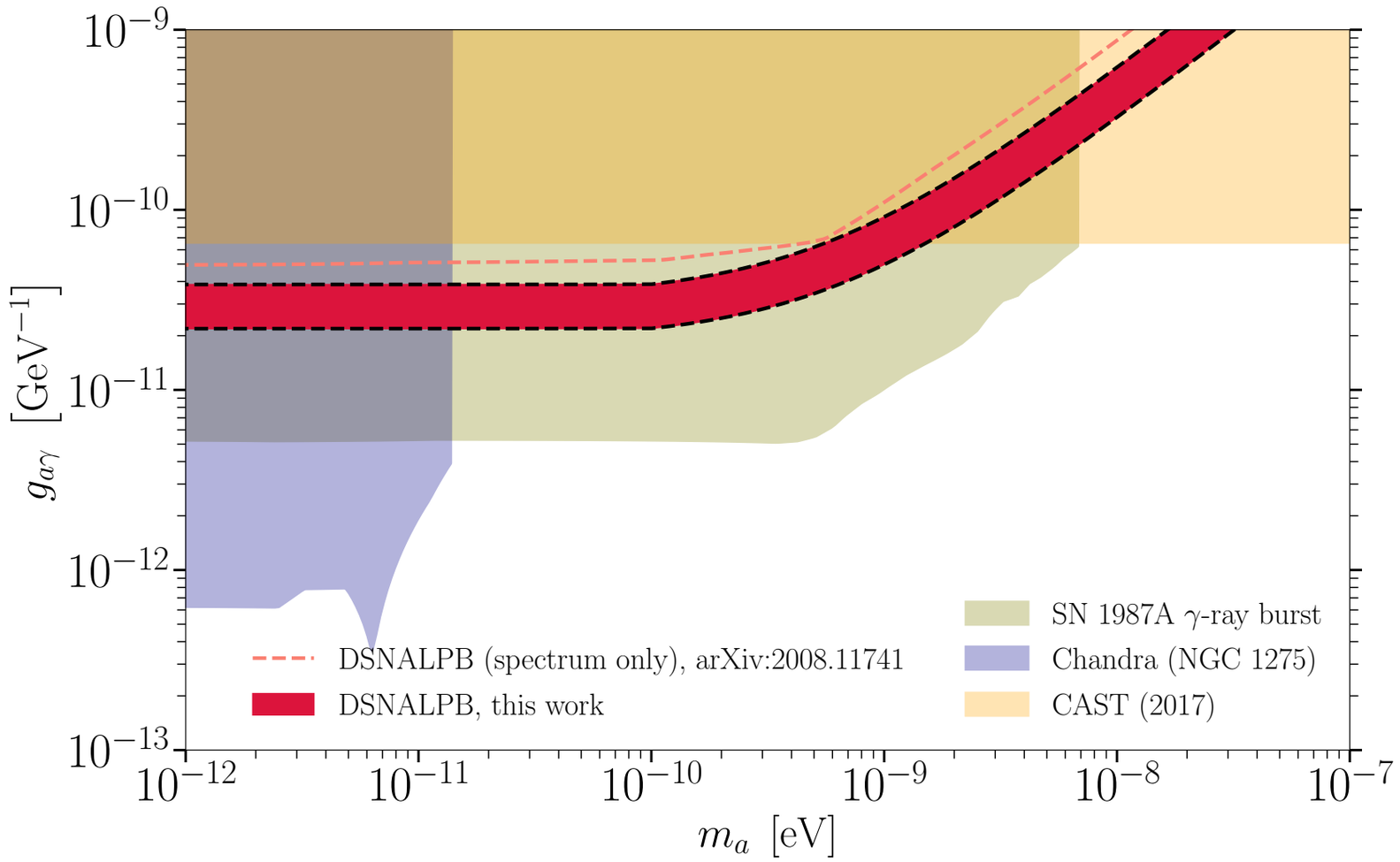
- **What is the region that yields the best consistency between model and data (baseline fit)?**
- **What is the upper limit on an additionally injected signal after this baseline fit?**



ALP signal

Results and outlook

- **The high-latitude Southern Hemisphere ($b \geq -30°$) is best suited to constrain this particular ALP signal.**
- **The addition of the spatial morphology of the ALP signal improves the 95% C.L. upper limits previously derived with solely spectral information.**



Additional/future objectives:

- Exploring the robustness under variations of the interstellar emission model.
- Exploring alternative models for the regular component of the Galactic magnetic field.
- Investigating the impact of the SNe mass function on the expected ALP spectrum.