GALPROP modelling of the high-energy Galaxy

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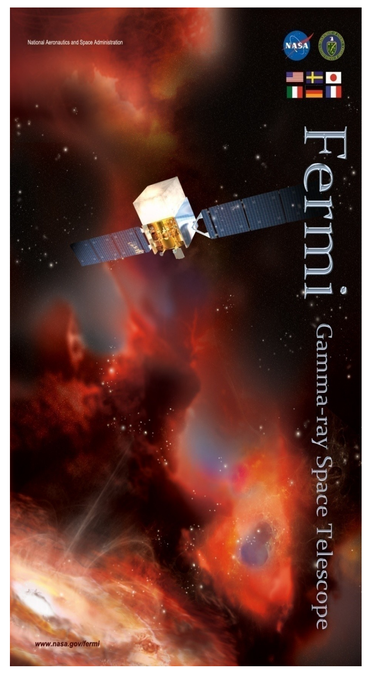
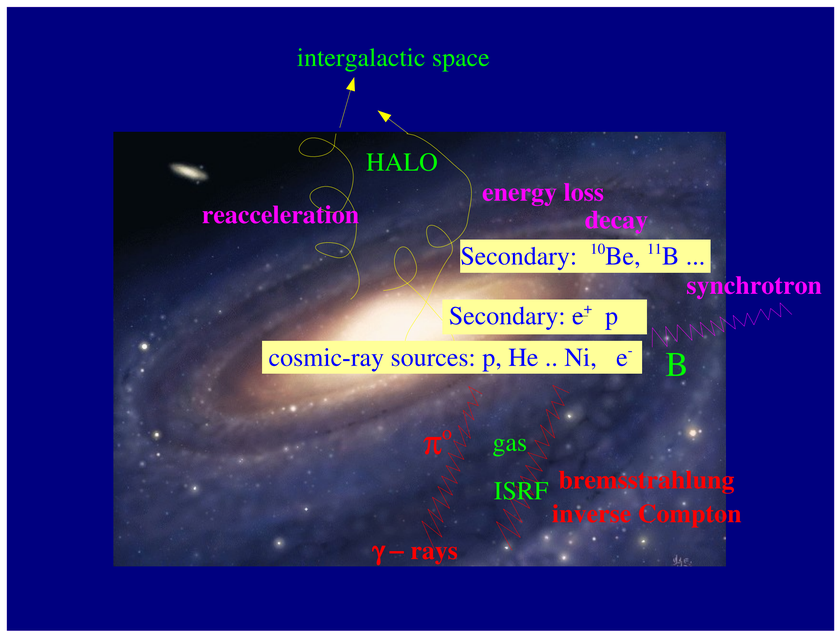
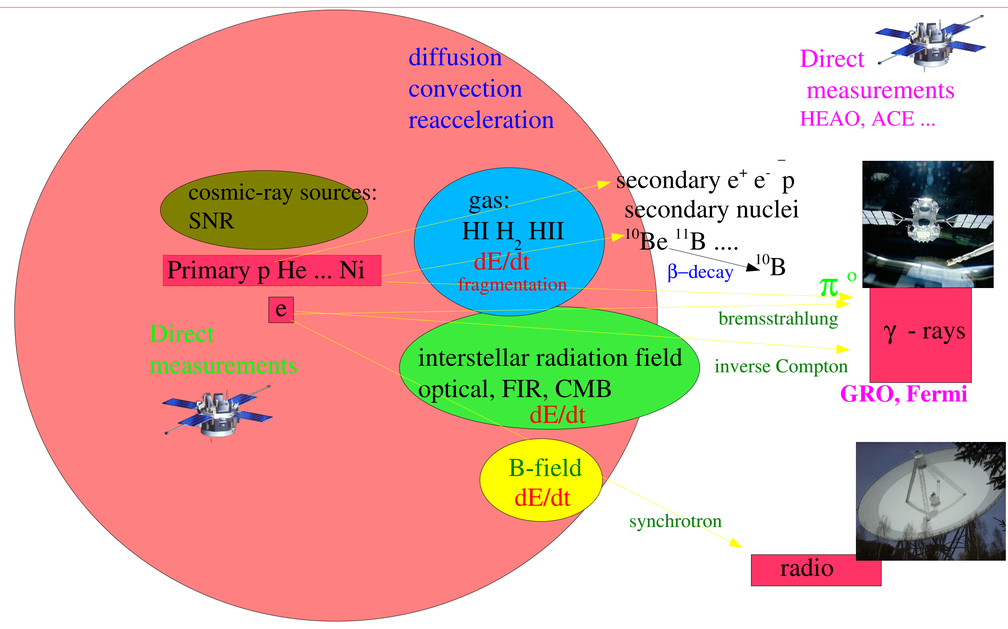
on behalf of the Fermi Large Area Telescope Collaboration

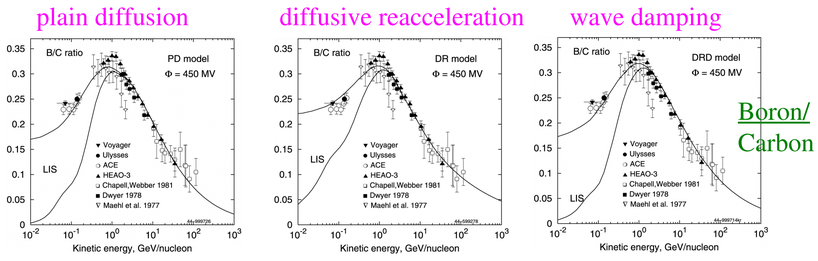


The quality of data from the Fermi Large Area Telescope on the emission from the Galaxy requires support from a correspondingly detailed physical model.
The GALPROP model has been developed over the last decade to make predictions of cosmic-propagation and the resulting interstellar emission for gamma rays and synchrotron radiation.
It has been adopted in the Fermi collaboration as the basis for the physical interpretation of the Galactic emission. A new release of GALPROP is planned to correspond to results presented at this Symposium. We describe this release and its new features, and illustrate with comparisons with a range of data including Fermi gamma-ray and electron results.



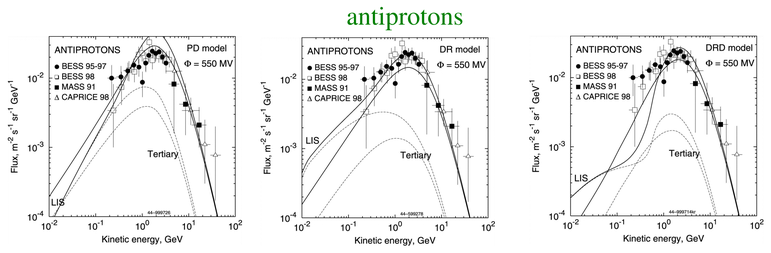


plain diffusion | diffusive reacceleration | wave damping

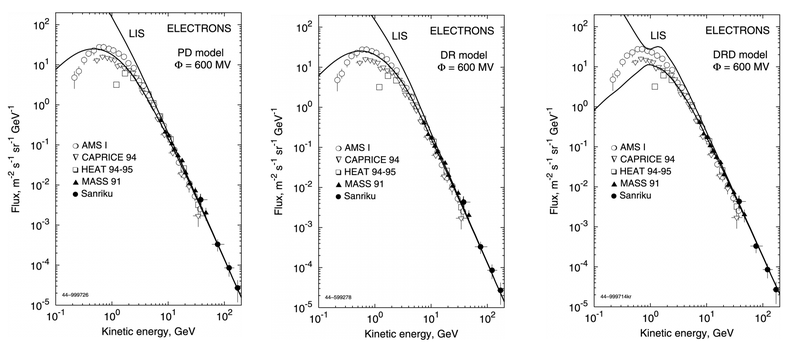


Boron/ Carbon

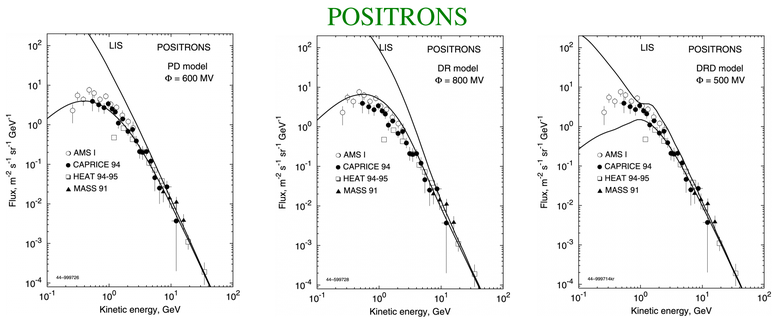
antiprotons



ELECTRONS



POSITRONS



Ptuskin et al. 2006

Cosmic-ray propagation

$$\partial\psi(\underline{r},p)/\partial t = q(\underline{r},p)$$

cosmic-ray sources (primary and secondary)

$$+ \nabla\cdot(D_{xx}\nabla\psi - v\psi)$$

diffusion convection

$$+ \partial/\partial p\,[p^2 D_{pp}\,\partial/\partial p\,\psi/p^2]$$

diffusive reacceleration (diffusion in p)

$$- \partial/\partial p\,[dp/dt\,\psi - p/3\,(\nabla\cdot v)\,\psi]$$

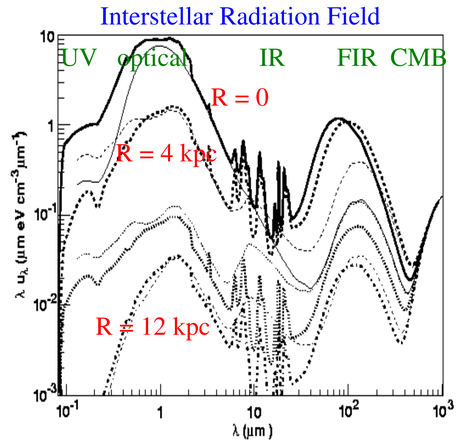
momentum loss (ionization, bremsstrahlung) adiabatic momentum loss

$$- \psi/\tau_f$$ nuclear fragmentation

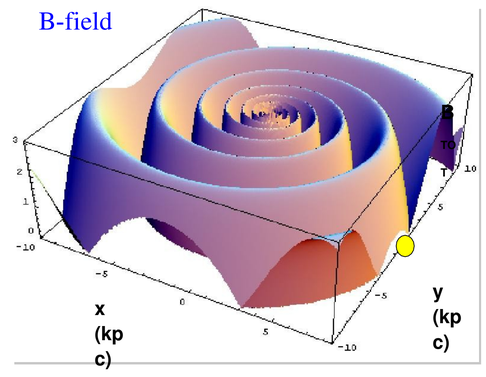
$$- \psi/\tau_r$$ radioactive decay

Numerical solution on a grid

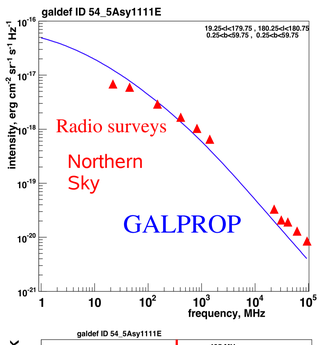
Interstellar Radiation Field

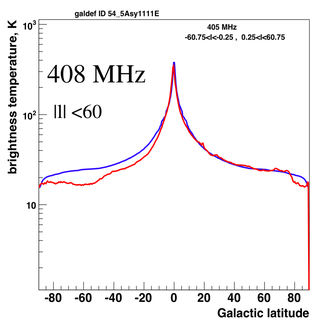


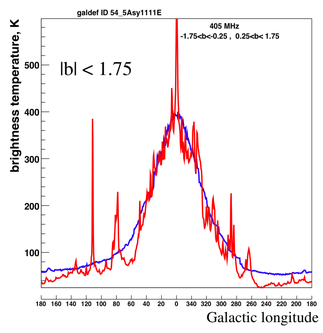
B-field



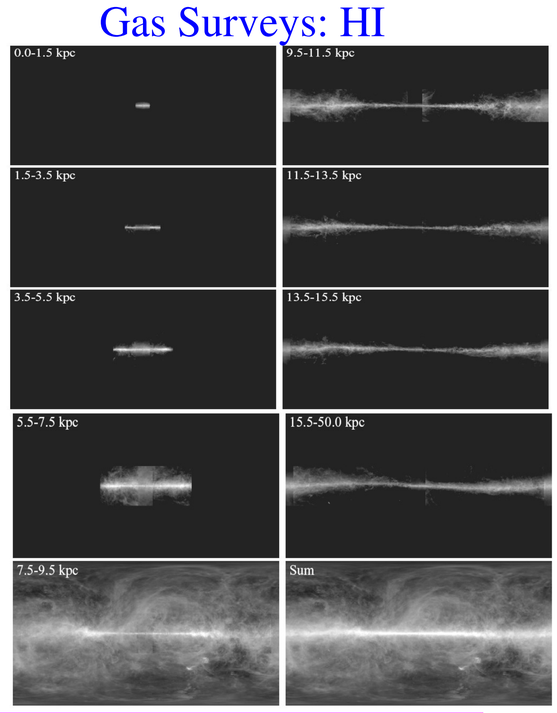
SYNCHROTRON







Gas Surveys: HI



GALPROP is a public code, last release was 2004
New Release: planned for this year.

see GALPROP website: http://galprop.stanford.edu
for code, user forum and more.

New features include :

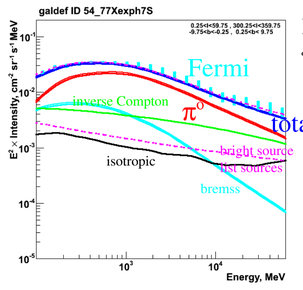
new interstellar radiation field using FraNKIE code
new HI and CO gas surveys
Healpix gamma-ray skymaps, Fermi-LAT compatible skymaps
gamma-ray skymaps in Galactocentric rings
3D models of Galactic magnetic field
synchrotron computed using regular and random B-fields
inverse Compton scattering on anisotropic radiation field
parallel processing support, memory optimization

Fermi Gamma-ray Space Telescope

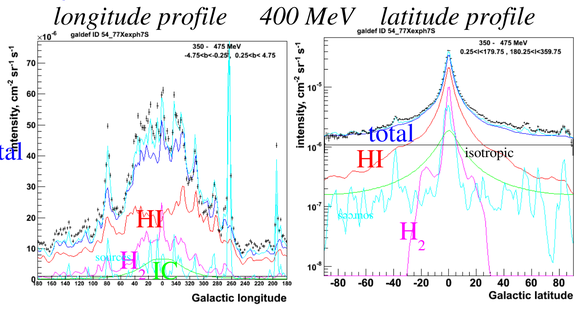
GAMMA RAYS

GALPROP model with cosmic-ray spectra adjusted to fit Fermi-LAT data.

Spectrum of inner Galaxy $300^o<l<60^o$, $|b| < 10^o$



longitude profile *400 MeV* *latitude profile*

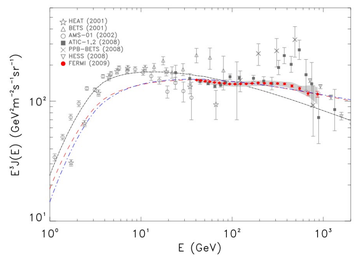


PRELIMINARY PLOTS

Fermi-LAT Applications

ELECTRONS

GALPROP models for Fermi-LAT electrons



Abdo et al. 2009 PRL 102, 181101
Grasso et al. 2009, arXiv: 0905.0636