MeV Probes of the Non-thermal and Dynamic Universe

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LECTURE NOTES IN PHYSICS 812

Astronomy with Radioactivities

Springer

$^{26}_{13}Al_{13}$ 5 +   0.0 $7.17\ 10^5$ y

$\beta^+ + \varepsilon$: 100%
Q(gs) = 4.004 MeV

2.938   1.1297   1.8087

2 +   2.938
2.5%
2 +   1.8087
0.2%   99.7%
0 +   0.0   Stable

$^{26}_{12}Mg_{14}$
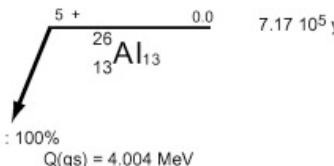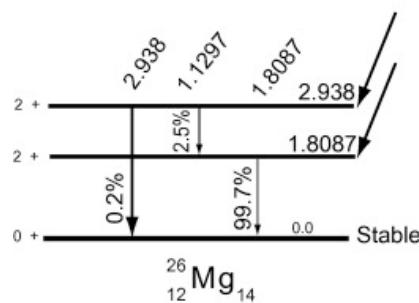
Novae, SNII, SNIa, AGB, WR* SNRs

$M_{26,eq} \sim 2\ M_\odot$

$\cong 2\ 10^{42}$ e+/s

Sources + Propagation
Martin+12
Bouchet+15

You are here.

3 slides for the AAS HEAD GammaSIG session in Chicago 2015

Isotope	Mean Lifetime	Decay Chain	γ -Ray Energy (keV)
^{7}Be	77 d	^{7}Be → ^{7}Li*	478
^{56}Ni	111 d	^{56}Ni → ^{56}Co* → ^{56}Fe*+e$^+$	158, 812; 847, 1238
^{57}Ni	390 d	^{57}Co → ^{57}Fe*	122
^{22}Na	3.8 y	^{22}Na → ^{22}Ne* + e$^+$	1275
^{44}Ti	89 y	^{44}Ti → ^{44}Sc* → ^{44}Ca*+e$^+$	78, 68; 1157
^{26}Al	$1.04\ 10^6$y	^{26}Al → ^{26}Mg* + e$^+$	1809
^{60}Fe	$2.0\ 10^6$y	^{60}Fe → ^{60}Co* → ^{60}Ni*	59, 1173, 1332
e$^+$	.... 10^5y	e$^+$+e$^-$ → Ps → $\gamma\gamma$..	511, <511

G. Weidenspointner+08

L. Bouchet+10, 15

B/D ~ 4±2

511: ~ 2×10^{43} e$^+$/s

SPI

1.5 keV + 5.4 keV superposition

P.Jean+06

New SPI Spectrum of 511 keV Line
More Statistics & Better Energy Cal

Flux vs E (keV)
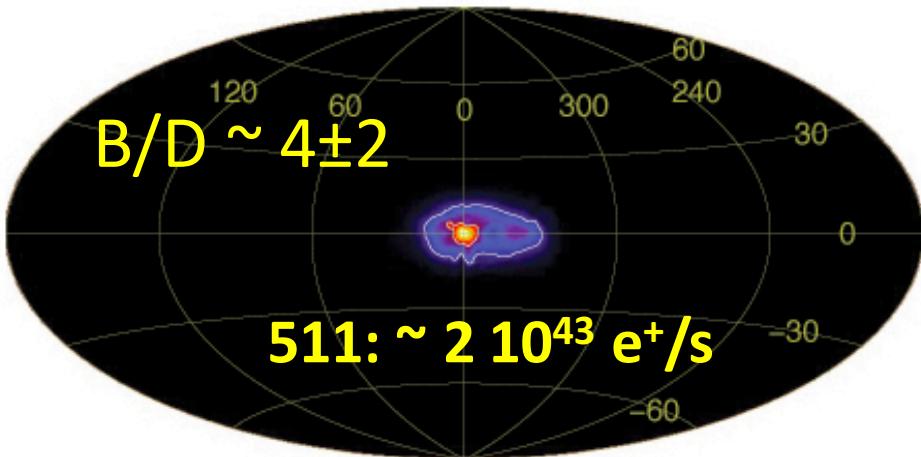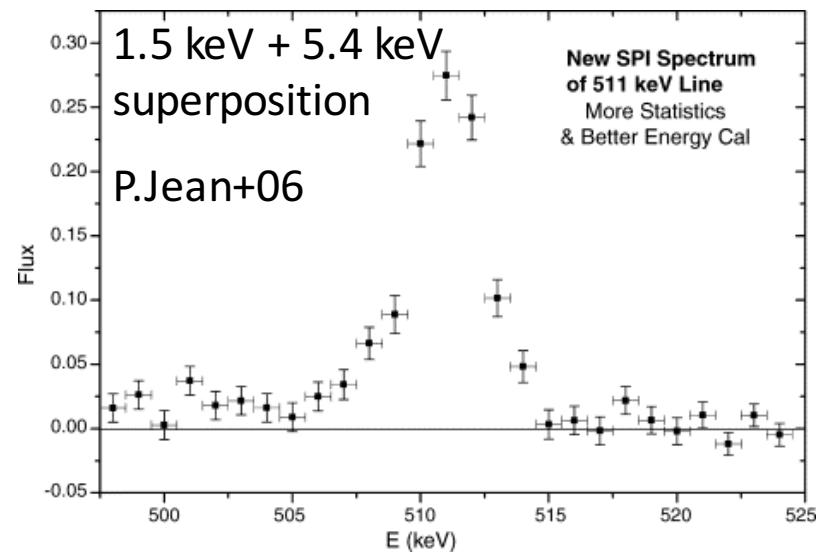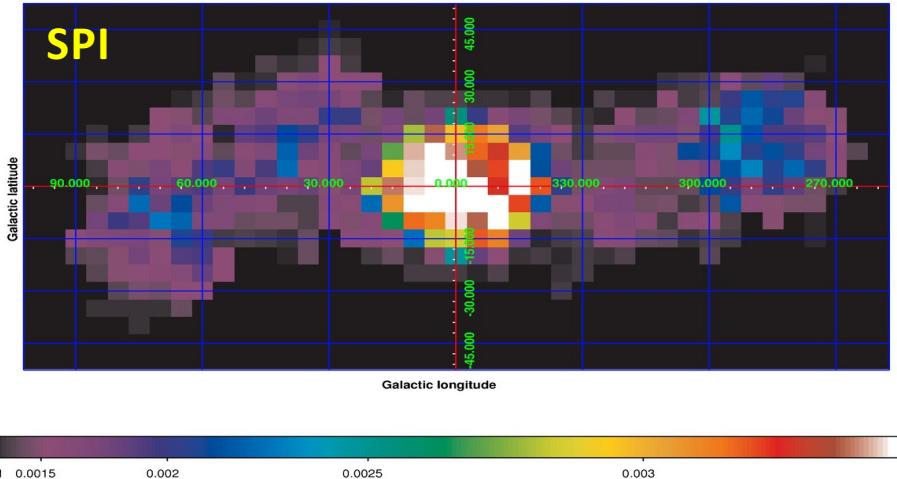
•LMXRBs
•SNIa (>10% f$_{esc}$)
SN 1006 limits
•DM annihilation
•Ca-rich .SNIa (He det)05E
•Sgr A* episodes
•^{26}Al + propagation

Bulge/Disk morphology poorly known

No spatially resolved spectroscopy

97% Positronium formation in a warm medium (bulge dominated)

What a sensitivity boost will provide (simulations by Andreas Zoglauer):

positrons
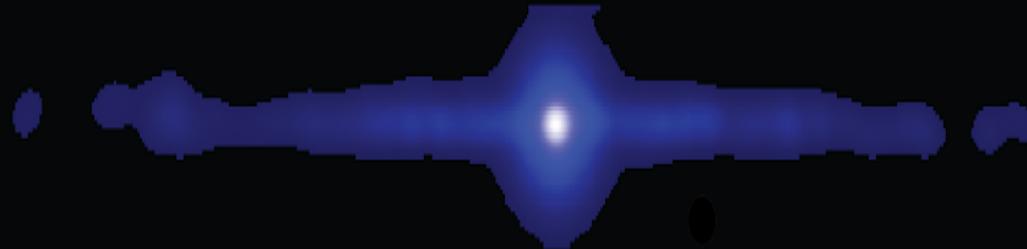
^{26}Al — Vela — Galactic Center

^{60}Fe — Cygnus

^{44}Ti — Cas A — G1.9+0.3 — Tycho

GRX: Boggs+

A next generation MeV-regime Gamma Ray mission must deliver definitive science outcomes on the above topics – and then some