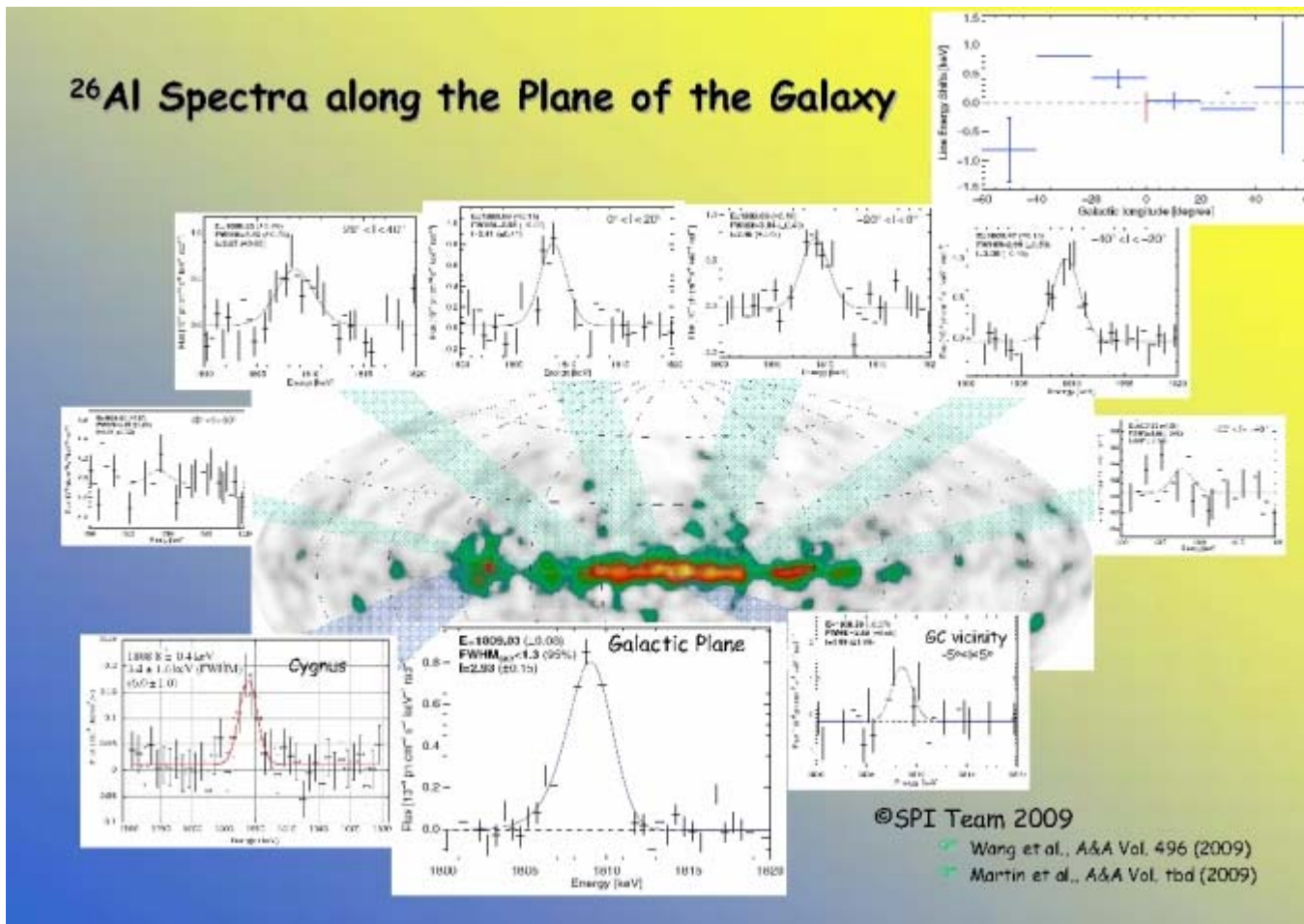


# Picture of the Month

June 2009



## Galactic Nucleosynthesis

Gamma-Rays from  $^{26}\text{Al}$  radioactivity have become a tracer of massive stars in our Galaxy, as these shed nucleosynthesis products through Wolf-Rayet winds and supernovae. With a radioactive-decay time scale of 1 Myr, ejecta from many stars and supernovae are generally superimposed. Thus,  $^{26}\text{Al}$  gamma-rays reflect *current* nucleosynthesis from massive stars in our Galaxy, and is seen from regions distributed along the plane of the Galaxy and its spiral arms.

Early INTEGRAL / SPI high-resolution spectroscopy had exploited the global signal from the inner-Galaxy's bright ridge. The  $^{26}\text{Al}$  gamma-ray line ( $E = 1809$  keV) had been found to be rather narrow and in agreement with a standard moderately-turbulent ISM around typical massive-star groups. Also, encouraged by  $^{26}\text{Al}$  line gamma-ray energy shifts from the inner Galaxy, which were recognized and

compatible with large-scale Galactic rotation, the  $^{26}\text{Al}$  flux was interpreted as a global Galactic quantity. Using model yields and the standard IMF, it is converted into a measurement of the current core-collapse supernova rate in our Galaxy of  $1.9 \pm 1.1$  supernovae per century.

Now the exposure along the Galactic plane becomes sufficient for spatially-resolved spectroscopy in the  $^{26}\text{Al}$  line, the signal exceeds  $5\sigma$  significance in 20-degree wide bins along the bright parts of the Galactic plane. The flux in the bright inner-Galaxy ridge is determined as  $2.9 \pm 0.2 * 10^{-4}$  ph cm $^{-2}$  s $^{-1}$ rad $^{-1}$ , and a small ( $\sim 1.3 \pm 0.2$ ) asymmetry favoring the fourth quadrant is indicated. The systematic shifts of line centroids from large-scale Galactic rotation are now clearly established, their detailed comparisons with expected Doppler shifts from (uncertain and model-dependent) large-scale motions in the inner Galaxy with its bar are under investigation. The line appears to be narrow with ISM velocities within the 100-km s $^{-1}$  range in all samples, except for a hint of increased velocity spread towards the Aquila region. The latitudinal scale height of  $^{26}\text{Al}$  gamma-rays is  $\sim 130$  pc and significantly exceeds the thickness of the Galactic disk in molecular gas. For the Cygnus region, a sufficiently-accurate stellar census has been derived in recent years. Employing the spatial resolution of the SPI gamma-ray telescope, the  $^{26}\text{Al}$  flux attributed to Cygnus complex of massive stars is discriminated against the large-scale Galactic-disk emission as  $3.9 \pm 1.1 * 10^{-5}$  ph cm $^{-2}$  s $^{-1}$ , with the Cygnus OB2 association as dominating source. This allows for a more detailed consistency check of observed flux against nucleosynthesis models for massive stars and their supernovae.

References:

W. Wang et al.: "Spectral and intensity variations of Galactic  $^{26}\text{Al}$  emission", A&A 496, 713 - 724 (2009)

P. Martin et al.: "The gamma-ray line emission of the Cygnus region from INTEGRAL/SPI observations", A&A (in press) (2009)

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