GALACTIC EXTINCTION MODEL: NEW DEVELOPMENTS

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ABSTRACT

Progress toward a new three-dimensional model of the dust distribution in the Milky Way is presented that will be used to construct a new extinction model over the disc of the Galaxy. The new dust model currently under construction will include an eccentric molecular ring/central hole in the disc and temperature gradients associated with the spiral arms, as expected from the heating of young stars. Description of the dust within a few kiloparsecs of the Sun, associated with the local Orion arm, is constrained by recent observations of nearby HII regions.

Key words: Gaia: simulations; Galaxy: structure; Dust, Extinction.

1. 3D EXTINCTION: CURRENT STATUS

The Gaia mission preparation effort includes a sophisticated simulation effort which incorporates a model of the Universe that is meant to give a realistic description of the sources (stars, galaxies, quasars, etc) that Gaia will detect, and their distribution on the sky. The majority of the complexity of this model resides in a model of the Galaxy (Gaia's primary target), including a three-dimensional model of Galactic extinction. The extinction model currently installed in the Universe model is based on a model of the dust distribution in the Galaxy, mainly constrained by FIR emission as observed by the COBE satellite (Drimmel & Spergel 2001; Drimmel et al. 2003).

The Galactic dust distribution model of Drimmel & Spergel (2001, hereafter DS01) is described by three components: a warped, but otherwise axisymmetric disc, the spiral arms as traced by the Galaxies HII regions (Georgelin & Georgelin 1976; Taylor & Cordes 1993), and a local spiral arm segment usually referred to as the Orion arm. A radial temperature gradient is assumed for the disc component while a constant temperature is applied to the spiral arm component. The size of the inner hole in the disc and the inner extent of the spiral arms are not constrained by the data. The resulting extinction model also employs direction dependent rescaling factors that are based on the FIR residuals between the COBE data and the dust emission model of DS01. Figure

Figure 1. Dust surface density in the Milky Way after Drimmel & Spergel (2001). The Sun is at top-centre, indicated by a small point.

1 shows the Galactic dust distribution model of DS01, projected onto the Galactic plane, on which the extinction model is based. A later version of the DS01 model, used to construct a Galactic extinction model (Drimmel et al. 2003), extended the geometry of the spiral arms, as proposed by Bland-Hawthorn & Maloney (2002), and rescaling factors at high Galactic latitudes ($|b| > 30^\circ$) based on the Galactic extinction map of Schlegel et al. (1998, Figure 2).

2. 3D EXTINCTION: NEW DEVELOPMENTS

The following improvements on the dust distribution model are being implimented:

- a central hole and molecular ring in the disc component constrained by the FIR emission toward the Galactic centre ($|l| < 30^\circ$)

Figure 2. Dust surface density in the Milky Way after Drimmel et al. (2003). The Sun is at centre-left, indicated by a small point.

Figure 3. Dust surface density of the Milky Way according to the current dust model, still under development. The Sun is at top-centre, indicated by a small point.

- the local arm segment observationally constrained by nearby HII regions
- temperature gradients associated with spiral arms
- an improved instrument model including beam smearing

The first two items in the list above have been completed and already some interesting preliminary results can be reported. First, the molecular ring shows clear evidence of significant ellipticity; second, the inner limit to the spiral arms is better constrained; and third, the local Orion arm feature is significantly enlarged with respect to the previous model. Figure 3 shows the Galactic dust distribution as described by the model in its current state.

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