Hence $N^m(0) = \varpi + \Xi$, and we can add to both sides of Eq. (A.11) the quantity Ξ, so that we recover the standard form

$$\mathcal{N}^j(0) = N^j(0) - \frac{2h}{A^j}\left(b(E)\frac{d\mathcal{N}^j(0)}{dE} + c(E)\frac{d^2\mathcal{N}^j(0)}{dE^2}\right) ,$$

which we solve numerically.

This is the solution in the disc ($z = 0$). The solution for any z is obtained from Eq. (A.7), making the substitution

$$\varpi \rightarrow \varpi^* = \mathcal{N}^j(0) - \Xi. \qquad \text{(A.13)}$$

We note that for $\Theta = 0$ (i.e., no radioactive contribution) the result for standard sources in the disc is recovered.

A.2. 2D geometry

Cylindrical symmetry is now assumed, both the CR density N and the source terms depending on r. Compared to Eq. (A.1), the operator $\triangle_r$ now acts on $N(r, z)$.

An expansion along the first order Bessel function is performed

$$N(r, z) = \sum_{i=1}^{\infty} N_i(z) J_0\left(\zeta_i \frac{r}{R}\right) . \qquad \text{(A.14)}$$

The quantity ζ_i is the i-th zero of J_0, and this form automatically ensures the boundary condition $N(r = R, z) = 0$. We have

$$-\triangle_r J_0\left(\zeta_i \frac{r}{R}\right) = \frac{\zeta_i}{R^2} J_0\left(\zeta_i \frac{r}{R}\right),$$

so that each Bessel coefficient $N_i(z)$ follows an equation very similar to Eq. (A.1), where

$$\Gamma_{\rm rad} \Rightarrow \Gamma_{\rm rad} + \frac{\zeta_i}{R^2},$$

and where each source term must also be expanded on the Bessel basis. More details can be found in Maurin et al. (2001).

The full solutions for mixed species, with stable or radioactive parents, is straightforwardly obtained from 1D ones, after making the substitutions

$$N^j(z) \overset{\text{2D model}}{\Longrightarrow} N_i^j(z), \qquad \text{(A.15)}$$

$$S^j \overset{\text{2D model}}{\Longrightarrow} S_i^j \equiv \sqrt{\frac{V_c^2}{K^2} + 4\frac{\zeta_i^2}{R^2} + 4\frac{\Gamma_{\rm rad}^j}{K^2}} , \qquad \text{(A.16)}$$

$$A^j \overset{\text{2D model}}{\Longrightarrow} A_i^j \equiv 2h\Gamma^j + V_c + K S_i^j \coth\left(\frac{S_i^j L}{2}\right), \qquad \text{(A.17)}$$

and

$$\Theta^j(S^r, N^r(0)) \Longrightarrow \Theta_i^j(S_i^r, N_i^r(0)) , \qquad \text{(A.18)}$$

$$\varpi^j(S^j, A^j) \Longrightarrow \varpi_i^j(S_i^j, A_i^j) , \qquad \text{(A.19)}$$

$$\lambda^r(S^r) \Longrightarrow \lambda_i^r(S_i^r) . \qquad \text{(A.20)}$$

The above formulae, for the radioactive source, differ slightly from those presented in Maurin et al. (2001). However, the only difference is in the flux for $z \neq 0$, which was not considered in this paper.

Appendix B: The local bubble

The underdensity in the local interstellar matter (LISM) is coined the local bubble[4]. The LISM is a region of extremely hot gas ($\sim 10^5 - 10^6$ K) and low density ($n \lesssim 0.005$ cm^{-3}) within an asymmetric bubble of radius $\lesssim$ 65-250 pc surrounded by dense neutral hydrogen walls (Sfeir et al. 1999; Linsky et al. 2000; Redfield & Linsky 2000). This picture has been refined by subsequent studies, e.g., Lallement et al. (2003). The Sun is located inside a local interstellar cloud (LIC) of typical extension ~ 50 pc whose density $N_{HI} \sim 0.1$ cm^{-3} (Gloeckler et al. 2004; Redfield & Falcon 2008). Despite these successes, a complete mapping and understanding of the position and properties of the gas/cloudlets filling the LISM, as well as the issue of interfaces with other bubbles remains challenging (e.g., Redfield & Linsky 2008; Reis & Corradi 2008). Based on existing data, numerical simulations of the local bubble infer that it is the result of $14 - 19$ SNe occurring in a moving group, which passed through the present day local H$_{\rm I}$ cavity $13.5 - 14.5$ Myr ago (Breitschwerdt & de Avillez 2006). The same study suggests that the local bubble expanded into the Milky Way halo roughly 5 Myr ago.

A last important point, is that of the existence of turbulence in the LISM to scatter off CRs. The impact of the underdense local bubble on the production of radioactive nuclei as modelled in Eq. (10) depends whether the transport of the radioactive nuclei in this region is diffusive or not. In a study based on a measurement of the radio scintillation of a pulsar located within the local bubble, Spangler (2008) infers that values for the line of sight component of the magnetic field are only slightly less, or completely consistent with, lines of sight through the general interstellar medium; the turbulence is unexpectedly high in this region.

These pieces of observational evidences support the model used in Sect. 2.3, leading to an enhanced decrease in the flux of radioactive species at low energy. A detailed study should take into account the exact morphology of the ISM (asymmetry, cloudlets). However, there are so many uncertainties in this distribution and the associated level of turbulence, that a crude description is enough to capture a possible effect in the CR data.

Appendix C: MCMC optimisation

The efficiency of the MCMC increases when the PDFs of the parameters are close to resembling Gaussians. Large tails in PDFs require more steps to be sampled correctly. A usual task in the MCMC machinery is to find some combinations of parameters that ensure that these tails disappear. This was not discussed in the case of the LBM as the efficiency of the PDF calculation was satisfactory. In 1D (or 2D) DMs, the computing time is longer and the efficiency is found to be lower. To optimise and speed up the calculation, we provide combinations of parameters that correspond to a Gaussian distribution.

A typical PDF determination with four free parameters $\{V_c, \delta, K_0, V_a\}$ (see next section) is shown in Fig. C.1. The diagonal of the left panel shows the PDF of these parameters (black histogram), on which a Gaussian fit is superimposed (red line). We see a sizeable tail for the K_0

[4] For a state-of-the-art view on the subject, the reader is referred to the proceedings of a conference held in 2008: *The Local Bubble and Beyond II* — http://lbb.gsfc.nasa.gov/