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ORIGINAL ARTICLE

Spectral content of ^{22}Na/^{44}Ti decay data: implications for a solar influence

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Abstract We report a reanalysis of data on the measured decay rate ratio ^{22}Na/^{44}Ti which were originally published by Norman et al., and interpreted as supporting the conventional hypothesis that nuclear decay rates are constant and not affected by outside influences. We find upon a more detailed analysis of both the amplitude and the phase of the Norman data that they actually favor the presence of an annual variation in ^{22}Na/^{44}Ti, albeit weakly. Moreover, this conclusion holds for a broad range of parameters describing the amplitude and phase of an annual sinusoidal variation in these data. The results from this and related analyses underscore the growing importance of phase considerations in understanding the possible influence of the Sun on nuclear decays. Our conclusions with respect to the phase of the Norman data are consistent with independent analyses of solar neutrino data obtained at Super-Kamiokande-I and the Sudbury Neutrino Observatory (SNO).

Keywords Astroparticle physics · Neutrinos · Nuclear reactions · Sun: particle emission

1 Introduction

Unexplained periodic variations in measured nuclear decay rates have been reported recently by a number of groups in experiments with a variety of detector types and isotopes. These reports, along with the observation of a change in the decay rate of ^{54}Mn during a solar flare by Jenkins and Fischbach (2009), suggest the possibility of a direct solar influence on nuclear decay rates through an as yet unknown mechanism. Periodicities and other "non-random" behaviors have been reported in the decays of ^{3}H (Falkenberg 2001; Lobashev et al. 1999; Veprev and Muromtsev 2012), ^{32}Si, ^{36}Cl (Alburger et al. 1986; Jenkins et al. 2009; Javorsek II et al. 2010; Sturrock et al. 2010a, 2011a, 2011b; Jenkins et al. 2012a), ^{54}Mn (Jenkins et al. 2011), ^{56}Mn (Ellis 1990), ^{60}Co (Baurov et al. 2007; Parkhomov 2010b, 2010a), ^{90}Sr (Parkhomov 2010b, 2010a; Sturrock et al. 2012b), ^{137}Cs (Baurov et al. 2007), ^{152}Eu (Siegert et al. 1998), ^{222}Rn (and/or its daughters) (Steinitz et al. 2011; Sturrock et al. 2012a), and ^{226}Ra (and/or its daughters) (Siegert et al. 1998; Jenkins et al. 2009; Javorsek II et al. 2010; Sturrock et al. 2010b, 2011a, 2011b; Fischbach et al. 2009). Since these fluctuations have been seen by groups located at various sites employing different detector technologies (e.g., gas, scintillation, solid state), it is unlikely that they can all be attributed to temperature, pressure, humidity or other "environmental" influences on the detector

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