Roles of SNIa and SNII in ICM Enrichment

Yuhri ISHIMARU
Department of Astronomy, School of Science, The University of Tokyo, Bunkyo-ku, Tokyo 113
E-mail(YI): ishimaru@astron.s.u-tokyo.ac.jp

and

Nobuo ARIMOTO
Institute of Astronomy, Faculty of Science, University of Tokyo, 2-21-1 Osawa, Mitaka, Tokyo 181
Institut für Theoretische Astrophysik, Universität Heidelberg, Tiergartenstrasse 15, D-69121 Heidelberg, Germany

and

Department of Physics, University of Durham, South Road, Durham, DH1 3LE, U.K.

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Abstract

Based on ASCA observations Mushotzky et al. (1996, ApJ 466, 686) have recently derived the relative-abundance ratios of $\alpha$-elements to iron, $[\alpha/Fe] \approx 0.2 - 0.3$, for four rich clusters, and have suggested that the origin of metals in an intra-cluster medium (ICM) is not a type-Ia supernovae (SNIa), but a type-II supernovae (SNII). However, these authors used the solar photospheric iron abundance for ASCA data reduction, while the meteoritic iron abundance is usually adopted in chemical-evolution studies. It is true that although the photospheric and meteoritic solar abundances are consistent for most of the elements, a serious discrepancy is known to exist for iron; indeed, the photospheric abundance of iron is $N_{Fe}/N_{H} = 4.68 \cdot 10^{-5}$ by number, while the meteoritic value is $3.24 \cdot 10^{-5}$. The argument concerning the relative roles of SNIa and SNII in ICM enrichment is quite sensitive to the precise values of $[\alpha/Fe]$, and one should use an identical solar iron abundance in data reduction as well as in theoretical arguments. We therefore adopt the meteoritic iron abundance, which is consistent with chemical-evolution studies, and shift Mushotzky et al.'s ASCA data by $\Delta[\alpha/Fe] \approx -0.16$ dex. By comparing the corrected $[\alpha/Fe]$ values with theoretical nucleosynthesis prescriptions of SNIa and SNII, we reach a conclusion that an SNIa iron contribution of 50% or higher in the ICM enrichment could not be ruled out, and might indeed be favoured based on the ASCA spectra.

Key words: Galaxies: elliptical — Galaxies: evolution — Galaxies: intergalactic medium — Galaxies: X-rays — Supernovae

1. Introduction

Clusters of galaxies are surrounded by hot X-ray emitting ICM enriched with a large amount of iron (Rothenflug, Arnaud 1985; Hatsukade 1989; Edge, Stewart 1991; Arnaud et al. 1992; Ikebe et al. 1992; Tsuru 1993). The universal ratio of the iron mass in the ICM to the total galaxy luminosity (i.e., so-called IMLR; Arnaud et al. 1992; Renzini et al. 1993) suggests that most of the iron was synthesized in cluster ellipticals, and ejected via SN-driven winds (e.g., Larson 1974; Arimoto, Yoshii 1987).

The relative-abundance ratios of $\alpha$-elements to iron in the ICM is one of the most important observational constraints on chemical-evolution models, because it directly tells the relative roles of SNIa and SNII in the enrichment of ICM. Recently, based on the ASCA X-ray spectra of four rich clusters of galaxies, Abell 496, Abell 1060, Abell 2199, and AWM7, Mushotzky et al. (1996) reported on a rather unexpected result, which shows that $[\alpha/Fe] \approx 0.2 - 0.3$ in the ICM of these clusters. The authors claim that these $[\alpha/Fe]$ ratios are consistent with the origin of all metals in SNII.

The observed trend of $[\alpha/Fe]$ vs $[Fe/H]$ of G-dwarfs in the solar-neighbourhood of our Galaxy can be explained based on the different nucleosynthesis yields and lifetimes of SNIa and SNII (cf. Greggio, Renzini 1983; Wheeler et al. 1989; Matteucci, François 1992; Edvardsson et al. 1993). A detailed model suggests that 57% of iron in the Sun should come from SNIa (Tsujimoto et al. 1995). The number ratio of SNIa progenitors to those of SNII is roughly determined by the initial-mass function (IMF) and a frequency of binaries in the mass interval corresponding to that of SNIa progenitors. If the IMF and binary frequency are the same in the solar neighbourhood and in elliptical galaxies, and if most of the interstellar medium of ellipticals is eventually mixed with the ICM, a significant amount of iron in the ICM must come...
from SNIa. Indeed, previous chemical-evolution studies suggested that the ICM was enriched mainly by SNIa (Matteucci, Vettolani 1988; Renzini et al. 1993; Mihara, Takahara 1994). Thus, if the interpretation of the ASCA data by Mushotzky et al. is correct, it would require a somewhat complicated mechanism for enriching the ICM and/or a completely different understanding concerning SNIa nucleosynthesis.

Recent theoretical studies have attempted to interpret the observed high values of $[\alpha/Fe]$. Elbaz et al. (1995) suggest a bimodal star-formation model, in which the formation of SNIa progenitors is strongly suppressed, originally proposed by Arnaud et al. (1992). Matteucci, Gibson (1995) find that the SNIa products should remain in the halo of ellipticals, since the thermal energy input from SNIa is not sufficient to induce a late-time wind.

In this paper we argue that Mushotzky et al. (1996) might not interpret the ASCA data properly, because the iron abundance in the solar photosphere is used when the authors estimate the abundances of the X-ray emitting gas by fitting a spectral synthesis model to the ASCA data. Although the solar abundances, estimated from either the solar photosphere or meteorites, are almost consistent for most of the elements, a serious discrepancy is known to exist concerning the iron abundance (Anders, Grevesse 1989). On the other hand, studies of stellar nucleosynthesis use the solar abundances derived from the meteorites by Anders and Grevesse (1989) to explain the observed $[\alpha/Fe]$ of low-metal G-dwarf stars (e.g., Thielemann et al. 1993, 1996); also, galactic chemical-evolution studies use the meteoritic abundances to explain the observed trend of $[\alpha/Fe]$ vs $[Fe/H]$ in the solar neighbourhood (e.g., Timmes et al. 1995; Tsujimoto et al. 1995). Moreover, the meteoritic solar abundances are generally used in chemical-evolution studies, including recent studies concerning ICM enrichment (e.g., Elbaz et al. 1995; Matteucci, Gibson 1995). As we shall demonstrate in the following sections, the iron-abundance discrepancy between the solar photosphere and meteorites is not negligibly small; thus, for studying the origin of iron in the ICM one should use the same iron abundance in the data reduction as well as in theoretical modeling.

We therefore modified Mushotzky et al.'s (1996) relative-abundance ratios with the meteoritic solar iron abundance (Anders, Grevesse 1989). By using the modified data and the stellar yields of SNIa and SNII nucleosynthesis, we find that the observed relative abundances are consistent with an origin of iron more than half, perhaps even more, in SNIa and less in SNII. We will present a more extended study concerning cluster chemical-evolution in a companion paper.

In section 2 we discuss the solar iron-abundance discrepancy and apply the meteoritic values to the relative-abundance ratios of the ICM of the four clusters of galaxies studied by Mushotzky et al. (1996). In section 3 we calculate the SNIa and SNII stellar yields in order to derive the fractional contribution of the SNIa products to the ICM. Discussions and our conclusions are given in section 4, and section 5, respectively.

2. Solar Iron Abundance and $[\alpha/Fe]$ of the ICM

The elemental abundances of astrophysical objects are usually expressed by the relative values to the solar abundances. The so-called solar abundances have two alternative definitions: 1) those abundances based on the meteorites and 2) those based on the solar photospheric values. The meteoritic abundances have converged to the point where most elements are known to better than 10% (Anders, Grevesse 1989 and references therein). The solar photospheric values have also been considerably improved; Anders and Grevesse (1989) give quite consistent values for most of the accurately determined elements with respect to the meteoritic abundances. Nevertheless, significant discrepancies between the solar photosphere and the meteorites still remain in several important elements, such as Fe, Mn, Ge, and Pb. In particular, the solar photospheric abundance of $^{26}$Fe is as high as log $N_{Fe}$/log $N_H$ = 7.67 ± 0.03 (where log $N_H$ = 12 and therefore $N_{Fe}$/log $N_H$ = 4.68 $10^{-5}$) by number, while a meteoritic analysis gives a much lower value of log $N_{Fe}$/log $N_H$ = 7.51 ± 0.01 ($N_{Fe}$/log $N_H$ = 3.24 $10^{-5}$) (Anders, Grevesse 1989). This discrepancy had already been known previously: high iron abundances in the solar photosphere (e.g., Allen 1973; Grevesse 1984a, b) and low values in the meteorites (e.g., Cameron 1970, 1982; Anders, Ebihara 1982).

The iron abundance of the solar photosphere was recently re-determined by Pauls et al. (1990), Holweger et al. (1990), and Biémont et al. (1991) based on the Fe II lines, though it has often been determined from the Fe I lines in the past (e.g., Blackwell et al. 1984). Fe II ion is the dominant stage in the solar photosphere, and its abundance is much less dependent on modeling and non-LTE effects (Biémont et al. 1991). Pauls et al. (1990) derived a high value of log $N_{Fe}$/log $N_H$ = 7.66 ± 0.06 from a sample of three Fe II infrared lines, in contrast with the low values of log $N_{Fe}$/log $N_H$ = 7.48 ± 0.09 by Holweger et al. (1990) and log $N_{Fe}$/log $N_H$ = 7.54 ± 0.03 by Biémont et al. (1991), both from extensive samples of Fe II lines. Perhaps the high iron abundance found by Pauls et al. (1990) is not statistically significant (see Holweger et al. 1990). Somewhat similar low result of log $N_{Fe}$/log $N_H$ = 7.50 ± 0.07 has been derived by Holweger et al. (1991), who re-determined the solar photospheric iron abundance by using the Fe I lines along with newly calculated oscillator strengths. It thus seems that the iron abundances of the solar photosphere and the meteorites (C1 chondrites) are identical within the uncertainties of the observations. We note that this low iron abundance of the solar photosphere is much lower than the solar iron abundance that Mushotzky et al. (1996)
Table 1. Abundances of ICM normalized by the meteoritic abundances.

|        | Abell 496 | Abell 1060 | Abell 2199 | AWM 7 | Average |
|--------|-----------|------------|------------|-------|---------|
| **SIS** |           |            |            |       |         |
| O/H    | −0.17     | (−0.47, +0.05) | −0.47     | (−0.72, −0.31) | −0.36 | (−0.74, −0.15) | −0.32 | (−0.68, −0.11) | −0.32 |
| Ne/H   | −0.04     | (−0.22, +0.11) | −0.24     | (−0.39, −0.14) | −0.17 | (−0.42, −0.01) | −0.47 | (−0.92, −0.24) | −0.21 |
| Mg/H   | −0.33     | (−0.75, −0.11) | −0.70     | (−1.31, −0.45) | −0.34 | (−0.77, −0.11) | −0.87 | (< −0.70)       | —       |
| Si/H   | −0.26     | (−0.41, −0.13) | −0.25     | (−0.32, −0.18) | −0.04 | (−0.14, +0.04) | −0.28 | (−0.39, −0.18) | −0.19 |
| S/H    | −0.55     | (−0.94, −0.34) | −0.69     | (−0.94, −0.54) | −0.61 | (−1.15, −0.01) | −0.78 | (−1.28, −0.54) | −0.66 |
| Ar/H   | −0.50     | (< −0.12)     | −1.70     | (< −0.62)     | —    | (< −0.61)     | —    | (< −0.83)       | —       |
| Ca/H   | −0.57     | (< −0.12)     | —         | (< −0.62)     | —    | (< −0.39)     | —    | (< −0.70)       | —       |
| Fe/H   | −0.32     | (< −0.38, −0.24) | −0.39     | (< −0.44, −0.26) | −0.30 | (−0.35, −0.25) | −0.31 | (−0.36, −0.27) | −0.33 |
| Ni/H   | +0.18     | (< −0.07, +0.33) | −0.16     | (−0.72, +0.22) | +0.08 | (−0.30, +0.25) | −0.12 | (−0.51, +0.09) | +0.01 |

| **GIS** |           |            |            |       |         |
| Si/H   | −0.07     | (< −0.27, +0.07) | −0.26     | (−0.42, −0.12) | −0.004* | (< −0.13, +0.12) | −0.12 | (−0.50, +0.00) | —       |
| S/H    | −0.44     | (< −1.28, −0.17) | −0.61     | (−1.15, −0.36) | −0.59 | (< −0.28)     | −0.28 | (−0.52, −0.11) | —       |
| Ar/H   | —         | (< −0.13)     | −1.70     | (< −0.44)     | —    | (< −0.15)     | —    | (< −0.04)       | —       |
| Ca/H   | −0.02     | (< −0.90, +0.25) | −0.64     | (< −0.15)     | —    | (< −0.05)     | −0.49 | (< −0.03)       | —       |
| Fe/H   | −0.31     | (< −0.38, −0.25) | −0.29     | (−0.36, −0.22) | −0.33 | (−0.38, −0.27) | −0.25 | (−0.29, −0.19) | —       |
| Ni/H   | −0.66     | (< −0.13)     | −1.04     | (< −0.01)     | +0.18 | (−0.35, +0.42) | +0.29 | (−0.02, +0.48) | —       |

* The original table of Mushotzky et al. seems to have a typographical error in the GIS silicate abundance for Abell 2199. We therefore assume [Si/H]≈ 0 for this cluster (Y. Fukazawa, private communication).

have adopted. Because the low iron abundance is supported by these recent studies, the meteoritic value of log \(N_{\text{Fe}}\) ∼ 7.50 has been adopted in recent estimates of the iron abundance of G-dwarfs in the solar neighbourhood (Edvardsson et al. 1993; King 1993; Nissen et al. 1994). Norris et al. (1993) also mentioned that their [Fe/H] values for field stars would increase when the low iron abundance of the Sun is proven to be correct. Thus, in this paper we use the iron abundance derived from the meteorites, log \(N_{\text{Fe}} = 7.51\), together with meteoritic abundances of other elements, and re-scale the ratios of the relative abundance of the elements of the ICM for the clusters of galaxies reported by Mushotzky et al. (1996). The resulting ratios are given in table 1. The error bars indicate 90% confidence intervals. As shown in table 1, [Fe/H] should increase by ∼ 0.16 dex and [α/Fe] should decrease by the same amount. It is no longer evident whether the heavy elements in the ICM are all produced in SNII. In the next section we estimate quantitatively the fractional contribution from SNIa and SNII to the enrichment in clusters of galaxies by using the averaged stellar yields of SNIa and SNII.
3. SNII vs SNII

In section 2 we show that the relative abundances \(\alpha/Fe\) of the ICM given by Mushotzky et al. (1996) should be decreased by 0.16 dex. The resulting \(\alpha/Fe\) ratios are nearly solar, strongly suggesting that the heavy elements in the ICM should be a mixture of SNII and SNII ejecta. We therefore consider the role of SNII and SNII concerning the nucleosynthesis in clusters of galaxies by using the latest stellar nucleosynthesis prescriptions.

We take SNII nucleosynthesis data from Thielemann et al. (1996) for stars of 13, 15, 20, and 25 \(M_\odot\), and from Tsujimoto et al. (1995) for 18, 40, and 70 \(M_\odot\) stars. For SNII nucleosynthesis data, we use table 2 of Tsujimoto et al. (1995), who give the updated W7 model of Nomoto et al. (1984), calculated with the latest nuclear reaction rates by Thielemann et al. (1993).

The mass of the \(i\)-th element produced in a single event, i.e., the stellar yield (Tinsley 1980), of SNII \(y_{i,SNII}\) is constant irrespective of the details concerning progenitors, while that of SNII \(y_{i,SNII}(m)\) depends on the progenitor mass \(m\). Thus, to estimate the relative contribution of SNII and SNII to the enrichment of various elements in the ICM, we introduce the average stellar yield of SNII taken for the mass range of SNII progenitors \(m_1-m_u\):

\[
\langle y_{i,SNII}\rangle = \frac{\int_{m_1}^{m_u} y_{i,SNII}(m) \phi(m) m^{-1} dm}{\int_{m_1}^{m_u} \phi(m) m^{-1} dm}.
\]

In equation (1), a Salpeter-like IMF, i.e., \(\phi(m) \propto m^{-x}\) is assumed. We adopt the Salpeter IMF \((x = 1.35)\) and a flat IMF \((x = 0.95)\) from Arimoto and Yoshii (1987). In this paper the lower and upper mass limits of SNII progenitors \(m_1, m_u\) are assumed to be \(10M_\odot\) and \(50M_\odot\), respectively. Although the exact value of \(m_1\) is uncertain, because it strongly depends on the mass-loss rate during the AGB phase of \(8-10M_\odot\) stars, one can safely assume that SNII nucleosynthesis from low-mass stars of \(m < 10M_\odot\) is negligible (Hashimoto et al. 1993; Tsujimoto et al. 1995). We assume that the stellar yields decrease linearly in mass from \(13M_\odot\) to \(10M_\odot\). The upper mass limit \(m_u\) corresponds to a critical mass of stars which form black holes. We adopt the value of \(50M_\odot\) derived by Tsujimoto et al. (1994). The fractional contribution of SNII to the ICM iron is then given as

\[
\frac{M_{Fe,SNII}}{M_{Fe,total}} = \frac{\zeta y_{Fe,SNII}}{\zeta y_{Fe,SNII} + (1 - \zeta) \langle y_{Fe,SNII}\rangle},
\]

where \(\zeta\) indicates the relative frequency of SNII. With a help of equation (2), we calculate the abundance ratios \([Z_i/Fe]\) for \(Z_i = O, Ne, Mg, Si, S, Ar, Ca,\) and Ni as a function of \(M_{Fe,SNII}/M_{Fe,total}\). The solar abundances derived from the meteorites are taken from Anders and Grevesse (1989).

Figures 1a and 1b illustrate the relative-abundance ratio of silicate to iron as a function of the fractional SNII contribution. The error bars give 90% confidence intervals. (a) Same as figure 1a, but the observational data are corrected by using the meteoritic iron abundance. The error bars give the 90% confidence intervals.
for the four clusters of galaxies are superposed in such a way that the theoretical locus with \( x = 1.35 \) gives a good fit to each of the SIS data. Since the SIS value of Abell 2199 is much higher than the theoretical curve, we simply locate it at the left-hand edge of the figure. Although figure 1b is the same as figure 1a, the [Si/Fe] values are corrected using the meteoritic abundances. We first note that if [Si/Fe] \( \simeq 0 \), as is the case in the Sun, \( \sim 60\% \) of the iron comes from SNIa (Tsujimoto et al. 1995). With the Salpeter IMF, the average of ASCA SIS data (dotted line) suggests that only 10\% of the iron comes from SNIa if the solar photosphere abundance is assumed, while if the meteoritic abundance is adopted, SNIa produces more than 45\% iron in the ICM. The SNIa contribution further increases by \( \sim 10\% \) if a flat IMF \( (x = 0.95) \) is assumed.

Figure 2 shows the \([Z_i/Fe]\) ratios for O, Ne, Mg, Si, S, Ar, Ca, and Ni. The error bars give the 90\% con-
fidence levels. Except for Ni, all of the elements are the so-called α-elements, and the theoretical loci show a similar trend to that of the fractional contribution of SNIa. GIS data were not available for Ne, Mg, Ar, and Ca. The accuracy of the SIS data for Mg, Ar, and Ca are very poor (Mushotzky et al. 1996); these elements were therefore not considered in this study. Although Ni is shown for a comparison, it does not provide any information about the SNIa fraction, because both Ni and Fe are mainly produced in SNIa. The [O/Fe] ratios give $M_{\text{Fe, SNIa}}/M_{\text{Fe, total}} = 0.45-0.70$, similar to that derived from [Si/Fe]. [S/Fe] gives an even higher value of $M_{\text{Fe, SNIa}}/M_{\text{Fe, total}} \geq 0.75$. Although [Ne/Fe] suggests a lower value, $\sim 0.05-0.65$, the metallicity gradient for about 50 ellipticals, Elbaz et al. (1997) have estimated the mean stellar iron abundance for each galaxy, and find that luminous giant ellipticals have at most [Fe/H] $\sim 0$, and less luminous ones a much smaller value. Since [Fe/H]=+0.15 is a direct consequence of their model, a proper account of the metallicity gradient in ellipticals would require a lower amount of locked-up iron produced by SNII, which in turn implies an additional source of iron, i.e., SNIa, to quantitatively explain the iron mass in the ICM.

A proper chemical model should also accommodate the iron abundance of hot X-ray gas in an elliptical-galaxy halo. Although ASCA has detected a surprisingly low iron abundance, less than half solar or even less (Awaki et al. 1994; Loewenstein et al. 1994; Mushotzky et al. 1994), the interpretation of the iron-L lines is still not well understood (Arimoto et al. 1997). For the same reason, a recent claim that [$\alpha$/Fe] of the hot gas in ellipticals is sub-solar, implying the dominant contribution from SNIa, needs to be confirmed (e.g., Awaki et al. 1994).

Loewenstein and Mushotzky (1996) discussed the IMLR of O, Si, and Fe in addition to the relative abundance ratios ([O/Fe], [Ne/Fe], [Si/Fe], and [S/Fe]) with a help of an ICM enrichment model in which only the SNII nucleosynthesis was taken into account. Since the solar photospheric value was assumed in the ASCA data analyses, the same high iron abundance was adopted in their model. If the ICM is enriched by SNII alone, the relative abundance ratios studied by Loewenstein and Mushotzky (1996) decrease as a function of the IMF slope $x$. They therefore found that the abundance ratios could be explained by SNII alone, provided that the IMF has a very steep slope of $x \sim 1.5$. Since the stellar yields given by the IMF with such a steep slope is too low to explain the observed IMLR of O, Si, and Fe, the authors claimed that the ICM must have been enriched by a significant number of SNII stars during the initial stage of evolution, where only high-mass stars were formed, i.e., bimodal star formation. However, SNIa were entirely ignored in their model, and indeed the solution to the problem is quite different if both SNIa and SNII are properly taken into account.

Following Tsujimoto et al. (1995), we have assumed the mass range of SNII progenitors to be $10 \leq m/M_\odot \leq 50$. Stars of $8-10M_\odot$ produce negligible iron, a crucial element in our discussion, through O-Ne-Mg core collapse.
(Hashimoto et al. 1993). However, there still remain several uncertainties in the present day SNII nucleosynthesis: 1) Nucleosynthesis prescriptions for $10 \leq m/M_\odot < 13$ are not available. Tsujimoto et al. (1995) assumed that the stellar yields decrease linearly with mass from $13M_\odot$ to $10M_\odot$, which we also adopted in this study. Since this might underestimate the iron production from stars of this mass range, we repeated our calculation by assuming the same stellar yields for $10 \leq m/M_\odot < 13$ as those of $13M_\odot$. A fit to the $M_{Fe,SNII}/M_{Fe,total}$ vs [Si/Fe] diagram was obtained at $M_{Fe,SNII}/M_{Fe,total} \simeq 0.30$ if $x = 1.35$ and 0.45 if $x = 0.95$. Thus, a rather low SNII contribution is suggested. However, this is an extreme case, which gives a considerably lower [O/Fe] ratio than those observed for halo giants in our Galaxy (Tsujimoto et al. 1995). 2) The light curve of SN 1993J (SNII) suggests that the iron production of $13–15M_\odot$ stars should be $\sim 0.1M_\odot$ (Nomoto 1996, private communication), while the values predicted from a nucleosynthesis study are around 0.15$M_\odot$ (Thielemann et al. 1996). We therefore calculated the SNII contribution while assuming that $13–15M_\odot$ stars produce $0.1M_\odot$ iron, and keeping the stellar yields of all other elements the same as that of Thielemann et al. (1996). The resulting $M_{Fe,SNII}/M_{Fe,total}$ is $\simeq 0.60$ if $x = 1.35$ and 0.65 if $x = 0.95$. Obviously, SNII contributes significantly in this case, because these stars dominate the SNII nucleosynthesis, and even a slight decrease in the stellar iron yield crucially reduces the SNII contribution to the ICM enrichment. 3) Although Tsujimoto et al. (1995) found 50$M_\odot$ as the best fit of their chemical-evolution model to the solar neighbourhood, the precise value of the lower mass limit for black hole formation is still quite uncertain. We calculated the SNII fraction by assuming $m_0 = 70M_\odot$ instead of 50$M_\odot$. The resulting $M_{Fe,SNII}/M_{Fe,total}$ is $\simeq 0.60$ if $x = 1.35$ and 0.70 if $x = 0.95$. It is clear from these calculations that our conclusions would not be seriously influenced by the uncertainties involved in the present-day SNII nucleosynthesis prescriptions.

5. Conclusions

A long-outstanding disagreement concerning the solar photospheric iron abundance has recently converged to the so-called low value (Biémont et al. 1991; Holweger et al. 1991), which agrees well with the meteoritic one (Anders, Grevesse 1989). Mushotzky et al. (1996) recently determined the abundances of O, Ne, Mg, Si, S, Ar, Ca, Ni, and Fe in a sample of four rich clusters of galaxies. They found that the abundance pattern of each cluster is very similar, and suggested that the ratio of the relative abundance of the elements is consistent with the origin of most of the heavy elements in SNII. However, their results were derived based on the use of the so-called high solar iron abundance taken from the old solar photospheric data (Anders, Grevesse 1989). We have corrected Mushotzky et al.’s abundances by using the meteoritic values, and have estimated the relative role of SNIa and SNII in the ICM with the help of the latest nucleosynthesis prescriptions for both SNIa and SNII. We find that an SNIa iron fraction of 50% or higher could not be ruled out, and might actually be favoured by the ASCA spectra. This result is rather contrary to what Mushotzky et al. suggest, and does not support the so-called bimodal IMF scenario proposed by Arnaud et al. (1992) and discussed extensively by Elbaz et al. (1995).

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