# EVOLUTION FROM THE NUCLIDES TO THE CHEMICAL ELEMENTS

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ABSTRACT. The chemical evolution of Universe and it's objects (from grains to black holes) were of main goal of recent reviews and investigations. The evolution of chemical elements and their isotopes (early nuclides) discussed as indicator of evolution of Universe from Big Bang to now. The problem of determination of contents of chemical elements and their isotopes in atmospheres of cool giants to use method of the models of atmospheres and the synthetic spectra is discussed briefly. The determination of fundamental characteristics of cool stars (the effective temperature $T_{eff}$, surface gravity lg $g$, metallicity [Fe/H]) are discussed too. The evolution of all nuclides heaver $^4$He (with the exception, possibly, of most lightest nuclides - $^6$Li, $^7$Li, $^9$Be, $^{10}$B, $^{11}$B) are caused of these stars.

Key **words:** stars: fundamental characteristics-stars, abundances-stars, nucleosynthesis-stars, evolution-stars.

## Introduction

The interpretation of the «earth» Mendeleev's table and/or the distribution of contents of chemical elements and their isotopes in different objects of Universe must be accounted with theory of the origin and evolution of these objects.The evolution of the Universe may be looked as evolution of nuclides, and then as evolution of chemical elements and their isotopes! The first nuclides were formed in result of the Big Bang. The accuracy of determination of contents of chemical elements and their isotopes in various objects our Universe is the key in our understanding of evolution of all objects Universe after Big Bang. The answer on question about origin of nuclides heaver $^4$He is basic for understanding of evolution us of surroundings. Why haven't stars without heavy elements? What is the distribution of nuclides from its masses (mass of chemical element from Mendeleev's table is of weighted mean value on all stable isotopes of this element plus electons) or what Mendeleev's table is at other objects of the Universe? What the «cosmic», «normal», «standard» or «solar» of contents of all nuclides must be adopted?

The main results of determination of content of chemical elements in the atmospheres of the cool giants of only oxygen sequence of the Galaxy disk and their fundamental characteristics are given in this brief review. A brief survey of results is presented. The conclusion are making possible about evolution of the contents of chemical elements in the atmospheres of cool stars at transition stages from main sequence (MS) to red giant (FRGB), from the upper boundary of a giant branch to the horizontal one, and eventually, at the stage of asymptotic giant branch (AGB). The velocity of stellar evolution, efficiency of mixing depends on initial mass of the stars and primordial chemical composition of progenitor matter.

The full description about it was made by Trimble (1975, 1991), Geheren (1988), Lyubimkov (1995), Komarov (1999). The current «standard» distribution of contents of nuclides usually are comparing with theoretical predictions in results nuclear reactions (synthesis or decay), of theory stellar and galactic evolution, theory of Big Bang and so on. The distribution of nuclides should be exchanged in time and therefore it is very interesting to investigate contents of chemical elements and their isotopes in various objects of Galaxy and Universe having of various ages.

## «Cosmic», «Normal», «Standard» and «Solar» abundance

The lightest nuclides have arisen in result of Gamow's Big Bang. The Big Bang hypothesis support of four pillars:

1) The Hubble expansion. It can be proved of redshift of spectra lines in galaxies and supernovae. In spite of the numerous attempts are determining the Hubble constant, its actual value remains one of the fundamental problems in cosmology. However, now, the most probable value for this constant is $H_0 = 59\pm6$ km(sMpc)$^{-1}$.

2) The relict radiation. It is Plank function with temperature equal 2.726±0.010 K at 95% confidence level. The fluctuations of radiation are present. Small spatial anisotropy could indicate that the matter wasn't distributed homogeneously when microwave background radiation originated, and small deviations with respect to the black body spectrum should indicate the presence of high energy sources in the primordial Universe. You cannot make galaxies without disturbing the microwave background and without chemical elements.

3) The abundance of light nuclides. The predicted cosmological abundance of light nuclides depends mainly on the universal baryonic density. Common particles at that epoch include: photons, neutrons, electrons, and quarks. After another phase, the quark condenses into ordinary particles: neutrons and protons. Then we finally enter into a regime where there is a direct comparison with our observations of galaxies and stars. So, the light elements with observed abundance ~75% for H and ~25% for He in weight fit with the cosmological predictions with only the one value the baryon density $\Omega_b$~0.05±0.03. Two paths are for formation of $^4$He:

a) The deuterium nucleus collides with proton to form $^3$He, then a neutron to form $^4$He.

b) The deuterium collides first with a neutron to form $^3$H (tritium), then with a proton to form $^4$He.

4) The kind of neutrinos, The Big Bang model predicts that the contents of light nuclides would fit only if there were no more than three families of neutrinos. This was exactly what was observed at Large Electron-Proton collider. So, the light elements with abundance ranging from 76% for H to $10^{-10}$ for Li all fit with the cosmological predictions with the one adjustable parameter being the baryon density $\Omega_b$~0.05±0.03.

The density of particles was dropped to value ~$10^5$ grsm$^{-3}$ after 1s of the Big Bang ($T = 10^{10}$ K, dimension of Universe was increased to $10^{14}$ km, or 10 ly). The thermodynamic equilibrium of neutrino with other particles can't more to stay in this condition. This neutrino began to move in Universe freely. The electrons and protons have been stop to form in a few second (energy below $10^6$ eV).The protons and neutrons began coupling in the 100 s after Big Bang ($T = 10^9$ K, and dimension 100 ly) in lightest nuclides H, D. $^3$He, $^4$He and $^7$Li (more heavier nuclides can't formed in result absent of stable nuclides with masses number 5 and 8). Besides H, the nuclides $^4$He had been appeared in main, which consists of nearly 1/4 baryonic mass of Universe. This process call of first nucleosynthesis, but relative distribution in Universe of lightest nuclides is good test of model of Big Bang. The final step to the formation of nuclides was capture of the suitable number of free electrons to form neutral atoms! However, the remaining electrons still had plenty of energy. The Universe was obscured. The cooling was continued about 3x$10^5$ years. Temperature was decreased to $10^4$□K diameter of Universe had of dimension $10^8$ ly, the nuclides have been surrounded of electronic envelopes and first light atoms H and He (first of chemical elements) have been formed. The average energy of photons was became a few eV in this time and it was not enough to destroy of atoms. At that moment, Universe became *transparent to radiation* because it became without free electrons. When the temperature was decreased to 3000 K of gravitation forces between atoms was became to exceed of other forces. The gravitation was acted on fluctuation of density in spatial distribution of atoms (mainly H and He) was led to accretion of matter and was formed of large scale structures – proto-galaxies. In latter, the stars and stellar systems - galaxies (the dimension $10^8$ light yrs after Big Bang and $T$~100 K) were formed on this base.

The other nuclides were formed in result of nucleosynthesis in core stars and their subsequent development. Most the reactions occur during of the evolution of the star, but some are formed in the shock wave that accompanies a supernovae explosion (in example, *e*-process). The atoms of these newly formed elements are injected into the interstellar medium at high velocity, and by processes that are not well understood, many of them, such silicon and iron atoms, become constituents of tiny interstellar dust grains. The interstellar shocks can then act to destroy these particles. The charged grains move on a spiral in the post-shock magnetic field and are actually accelerated as the post-shock gas (a process called betatron acceleration). The refractory grain such as graphite and silicates destroy in shock with $V$>100 kms$^{-1}$. The compression and cooling behind shock waves may be trigger of the formation of galaxies as well as stars. During the era of galaxy formation, the propagation of huge shock waves – driven by the collective effect of supernovae in "seed" galaxies – or possibly by super-conducting loops of cosmic string, may have swept up and compressed by hydrogen gas to galactic proportions, and triggered the collapse of protogalactic gas clouds. In addition, the shock waves can produce $H_2$, enabling the nearly pure hydrogen gas to cool significantly below $10^4$ K and thereby form stars.

Some stars observe as supernovae in result of super explosions. The interstellar shocks driven by supernovae may determine the structure of the interstellar medium (ISM). A five-phase model of the ISM has been developed.:

- most of the volume of the ISM is hot ($T$=$10^6$ K) gas that has been shocked by supernova blast waves;

- most the mass of the ISM is in cold ($T$<100K) clouds;

- clouds are surrounded by warm envelopes that are heated to $T$=8000K and are partially ionized of radiation.

- the cold, warm, and hot phases are all at about the same pressure;

- inside non-radiating blast waves, evaporation of the clouds and their envelopes injects material into the hot gas phase; after the blast waves become radiating, the hot gas cools and returns to the warm and cold phases.

The meteorites contain dust grain with presolar (other stellar systems or interstellar medium) matter, which formed from nuclides forming in result nuclear reactions in cores of stars of various types. Then they have reached of stellar atmospheres in result of mixing. The pre-solar, may be interstellar medium, contains $SiO_2$ and SiC grains. The individual grain have of different isotopic contents Al, O, Si and C. The major effect is due to galactic heterogenity. The many grains contains isotopes of noble gases and the elements Ba, Nd, Sm and Dy. The contents of nuclides of Sr, Zr and Mo in single SiC grains had been measured (Zinner&Amari, 1999). The meteorites give important information on nucleosynthesis, and stellar evolution, and the evolution of the Mendeleev's table of the Galaxy. The contents of isotopes in the various grains are completely different from those found in the Solar System. These grains represent true stellar material and preserved the isotopic abundance of their primordial sources. The analysis of different dust grains show that their matter was been formed from stars giant. So, presolar grains give information on the isotopic abundance of individual stellar sources and on their evolution status (red giant or asymptotic giant branches). Variations in the $^{16}O/^{17}O$ ratio reflect differences in stellar mass but variations in the $^{16}O/^{18}O$ ratio can only be explained by differences in the original isotopic ratio of the stars. The presence of large $^{26}Mg$ excesses from the decay of $^{26}Al$ in many grains is observed. Since $^{26}Al$ is produced at the higher temperatures of shell burning of H and these nuclides was formed in AGB-stars. The part dust grains was formed in time burst supernovae and novae stars.

The meteoritic SiC have of pre-solar origin from carbon stars.

The heave elements show that nuclides were produced in result of the $s$-processes (Kr, Sr, Zr, Mo, Xe, Ba, Nd, Sm and Dy).

This evolution is going about $10^{10}$ years. The contents of chemical elements in atmospheres of various types of stars can provide some information about cosmic contents *pf* nuclides from Gamow's Big Bang to now. They can give information about nuclear processes, about evolution of stars and of Galaxy. The stars may be divided on two main groups - unevolved and evolved. In first group stars' of elemental abundances in their atmospheres has probably not affected by nuclear reactions in appointed stage of evolution, but in second group - vice versa. We investigated of evolved stars for testing of theories of nucleosynthesis, of stellar evolution and chemical evolution of Galactic disk. For it is necessary to know of the distribution of chemical elements from mass number in the atmospheres of stars with different masses. They have passed through this or that stage of evolution.

The distribution contents nuclides from atomic number $Z$, or number of neutrons $N$, or upon mass number $A$=$N$+$Z$ (atomic weight) is of source for testing of theories of their evolution. The information about distribution of nuclides is of Earth crust, meteorites, atmosphere of Sun with corona and solar wind, atmospheres of planets, soil of Moon, atmospheres of stars, interstellar medium and so on. The distribution of chemical elements in atmospheres of Sun can be taken from Anders&Grevesse (1989), Rykaljuk (2000), Grevesse&Sauval (1998), but distribution of isotopes was taken according to their distribution in Earth crust and meteorites Anders&Grevesse (1989), Cameron (1986), Grevesse&Sauval (1998). The contents of nuclides relate to the progenitor matter of solar system. The initial distribution was taken to account nuclear decay which may to bring to change of abundances of parent and daugther nuclides This distribution of elemental abundance is adopted as "cosmic", "normal", "standard" one. The solar abundances of some nuclides are different from "normal" one (Tabl. I). The distribution of nuclides have of characteristic properties: the contents of nuclides expotentially decrease of with the growth of mass number to $A$=100, and than observe a considerable slowing down; large fluctuations in abundances of light elements; peaks of abundances of nuclides with definite of mass numbers.

The analysis of contents of chemical elements in atmospheres of stars shows that have of stars with different from "solar" contents of elements (for example, stars of Population II of the Galaxy, stars of the RCrB-type, peculiar, metallic, zirconium, carbon and so on stars). It should be noted, however, that at the same time the contents of elements of interstellar medium in regions HII around newly formed stars and in planetary nebulae (old objects) is close to that of the solar system. Moreover, elemental contents in other galaxies and quasars (at oldest objects of the Universe) don't differ almost from solar one. The theory of formation and evolution of nuclides, and then of chemical elements and all their isotopes (stable and non-stable) must explain all this.

Table 1: The abundances of nuclides and chemical elements

| Z | El | A | process | An&Gr 1989 | An&Gr 1989 | Cam 1986 | Ryk 3000 | Gr&Sau 1998 | Gr&Sau 1998 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | H | 1 | U | 12.00 | 12.00 | 12.00 | | | |
| | | 1.0079 | | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | |
| | D | 2 | U?,l | 7.53 | | 7.22 | | | |
| 2 | He | 3 | U? | 7.14 | | 7.08 | | | |
| 4 | | | U,H | 10.99 | [10.99] | 10.83 | | | |
| | | 4.00280 | | 10.99 | [10.99] | 10.83 | 10.92 | [10.93±0.04] | |
| 3 | Li | 6 | l | 2.19 | | 2.22 | | | |
| | | 6.941 | | 3.31 | 1.16 | 3.32 | 1.08 | 1.10±0.10 | 3.31±0.04 |
| 3 | | 7 | l,H,U? | 3.28 | | 3.32 | | | |
| 4 | Be | 9 | l,U? | 1.42 | 1.15 | 1.65 | 1.15 | 1.40±0.09 | 1.42±0.04 |
| 5 | B | 10 | l,U? | 1.83 | | 1.83 | | | |
| | | 10.81 | | 2.89 | (2.6) | 2.53 | 2.3 | [2.55±0.30] | 2.79±0.05 |
| | | 11 | l.U? | 2.43 | | 2.43 | | | |
| 6 | C | 12 | He,α | 8.55 | | 8.62 | | | |
| | | 12.011 | | 8.56 | 8.60 | 8.62 | 8.57 | 8.52±0.30 | |
| | | 13 | H | 6.60 | | 6.67 | | | |
| 7 | N | 14 | H | 8.05 | | 7.94 | | | |
| | | 14.0067 | | 8.05 | 8.00 | 7.93 | 7.94 | 7.92±0.06 | |
| | | 15 | H | 5.62 | | 5.50 | | | |
| 8 | O | 15.9994 | | 8.93 | 8.93 | 8.84 | 8.86 | 8.83±0.06 | |
| | | 16 | He | 8.93 | | 8.84 | | | |
| | | 17 | H | 5.51 | | 5.54 | | | |
| | | 18 | He,N | 6.23 | | 6.15 | | | |
| 9 | F | 19(18.9984) | H | 4.48 | 4.56 | 4.41 | 4.56 | [4.56±0.3] | 4.48±0.06 |
| 10 | Ne | 20 | He,s | 8.06 | | 7.94 | | | |
| | | 20.179 | | 8.09 | [8.09] | 7.99 | 7.63 | 8.08±0.06 | |
| | | 21 | He,N,s | 5.44 | | 5.42 | | | |
| | | 22 | He,N,s | 6.92 | | 7.02 | | | |
| 11 | Na | 23(22.9897) | C,s | 6.31 | 6.31 | 6.35 | 6.32 | 6.33±0.03 | 6.32±0.02 |
| 12 | Mg | 24 | He,C,α | 7.48 | | 7.50 | | | |
| | | 24.305 | | 7.59 | 7.58 | 7.60 | 7.6 | 7.58±0.05 | 7.58±0.01 |
| | | 25 | C,s | 6.58 | | 6.60 | | | |
| | | 26 | C,s | 6.63 | | 6.65 | | | |
| 13 | Al | 27(26.98154) | C,s | 6.48 | 6.47 | 6.50 | 6.47 | 6.47±0.07 | 6.49±0.01 |
| 14 | Si | 28 | O,α,s | 7.52 | | 7.54 | | | |
| | | 28.085 | | 7.55 | 7.55 | 7.58 | 8.0 | 7.55±0.05 | 7.56±0.01 |
| | | 29 | O,s | 6.22 | | 6.25 | | | |
| | | 30 | O,s | 6.05 | | 6.07 | | | |
| 15 | P | 31(30.97378) | O,s | 5.57 | 5.45 | 5.39 | 5.48 | 5.45±0.04 | 5.56±0.06 |
| 16 | S | 32 | O,б,s | 7.24 | | 7.25 | | | |
| | | 32.06 | | 7.27 | 7.21 | 7.27 | 7.23 | 7.33±0.11 | 7.20±0.06 |
| | | 33 | O,Si,s | 5.14 | | 5.15 | | | |
| | | 34 | O,Si,s | 5.89 | | 5.90 | | | |
| | | 36 | N,Si,s | 3.57 | | 3.41 | | | |
| 17 | Cl | 35 | O,Si,s | 5.13 | | 5.13 | | | |
| | | 35.453 | | 5.27 | 5.5 | 5.25 | 5.50 | [5.5±0.3] | 5.28±0.06 |
| | | 37 | O,Si,s | 4.51 | | 4.64 | | | |
| 18 | Ar | 36 | O,Si.б,s | 6.48 | | 6.53 | | | |
| | | 38 | O,Si,s | 5.76 | | 5.80 | | | |
| | | 39.948 | | 6.56 | [6.56] | 6.60 | 6 | [6.40±0.06] | |
| | | 40 | s | 2.97 | | 3.96 | | | |
| 19 | K | 39 | O,Si,s | 5.10 | | 5.09 | | | |
| | | 39.098 | | 5.13 | 5.12 | 5.12 | 5.15 | 5.12±0.13 | 5.13±0.02 |
| | | 40 | O,Si,s | 1.20 | | 2.26 | | | |
| | | 41 | O,Si,s | 3.96 | | 3.96 | | | |
| 20 | Ca | 40 | O,Si,α | 6.33 | | 6.36 | | | |
| | Ca | 40.08 | | 6.34 | 6.36 | 6.37 | 6.45 | 6.36±0.02 | 6.35±0.01 |
| | | 42 | Si,s | 4.15 | | 4.18 | | | |

| Z | El | A | process | An&Gr 1989 | An&Gr 1989 | Cam 1986 | Ryk 3000 | Gr&Sau · 1998 | Gr&Sau 1998 |
|---|---|---|---|---|---|---|---|---|---|
| | | 43 | Si,s | 3.47 | | 3.53 | | | |
| | | 44 | Si,s,α | 3.99 | | 4.69 | | | |
| | | 46 | NSi | 1.93 | | 1.89 | | | |
| | | 48 | NSi | 3.61 | | 3.63 | | | |
| 21 | Sc | 45(44.9559) | | 3.09 | 3.10 | 3.07 | 3.06 | 3.17±0.10 | 3.10±0.01 |
| 22 | Ti | 46 | E | 3.84 | | 3.85 | | | |
| | | 47 | E | 3.80 | | 3.82 | | | |
| | | 47.90 | | 4.93 | 4.99 | 4.96 | 5 | 5.02±0.06 | 4.94±0.02 |
| | | 48 | E,α | 4.80 | | 4.82 | | | |
| | | 49 | E | 3.67 | | 3.70 | | | |
| | | 50 | E,NSi | 3.67 | | 3.68 | | | |
| 23 | V | 50 | E | 1.42 | | 1.36 | | | |
| | | 50.9414 | | 4.02 | 4.00 | 3.98 | 4 | 4.00±0.02 | 4.02±0.02 |
| | | 51 | E | 4.02 | | 3.98 | | | |
| 24 | Cr | 50 | E | 4.32 | | 4.31 | | | |
| | | 51.996 | | 5.68 | 5.67 | 5.68 | 5.7 | 5.67±0.03 | 5.69±0.01 |
| | | 52 | E | 5.61 | | 5.60 | | | |
| | | 53 | E | 4.56 | | 4.66 | | | |
| | | 54 | E | 4.06 | | 4.06 | | | |
| 25 | Mn | 55(54.9380) | E | 5.53 | 5.39 | 5.54 | 5.4 | 5.39±0.03 | 5.53±0.01 |
| 26 | Fe | 54 | E | 6.27 | | 6.29 | | | |
| | | 55.847 | | 7.51 | 7.67 | 7.53 | 7.6 | 7.50±0.05 | 7.50±0.01 |
| | | 56 | E,s | 7.47 | | 7.49 | | | |
| | | 57 | E,s | 5.85 | | 5.86 | | | |
| | | 58 | E,s | 4.96 | | 5.05 | | | |
| 27 | Co | 59(58.9332) | E,s | 4.91 | 4.92 | 4.92 | 4.94 | 4.92±0.04 | 4.91±0.01 |
| 28 | Ni | 58 | E,s | 6.08 | | 6.09 | | | |
| | | 58.70 | | 6.25 | 6.25 | 6.26 | 6.3 | 6.25±0.04 | 6.25±0.01 |
| | | 60 | E,r | 5.66 | | 5.67 | | | |
| | | 61 | E,r | 4.30 | | 4.33 | | | |
| | | 62 | E,r | 4.80 | | 4.82 | | | |
| | | 64 | E,r | 4.25 | | 4.29 | | | |
| 29 | Cu | 63 | E,s | 4.11 | | 4.15 | | | |
| | | 63.541 | | 4.27 | 4.21 | 4.31 | 4.06 | 4.21±0.04 | 4.29±0.04 |
| | | 65 | E,r | 3.76 | | 3.80 | | | |
| 30 | Zn | 64 | E,s | 4.34 | | 4.36 | | | |
| | | 65.38 | | 4.65 | 4.60 | 4.68 | 4.45 | 4.60±0.08 | 4.67±0.04 |
| | | 66 | E,s | 4.10 | | 4.12 | | | |
| | | 67 | E,s | 3.27 | | 3.28 | | | |
| | | 68 | E,s | 3.93 | | 3.94 | | | |
| | | 70 | E,r | 2.45 | | 2.47 | | | |
| 31 | Ga | 69 | E,s | 2.91 | | 2.94 | | | |
| | | 69.72 | | 3.13 | 2.88 | 3.16 | 2.8 | 2.88±0.10 | 3.13±0.04 |
| | | 71 | E,s | 2.73 | | 2.75 | | | |
| 32 | Ge | 70 | E,s | 2.94 | | 2.96 | | | |
| | | 72 | E,r | 3.07 | | 3.08 | | | |
| | | 72.59 | | 3.63 | 3.41 | 3.64 | 3.4 | 3.41±0.14 | 3.63±0.04 |
| | | 73 | E,r | 2.52 | | 2.53 | | | |
| | | 74 | E,r | 4.19 | | 3.20 | | | |
| | | 76 | E,r | 2.52 | | 2.53 | | | |
| 33 | As | 75(74.9216) | s,r | 2.37 | - | 2.37 | - | - | 2.37±0.02 |
| 34 | Se | 74 | p | 1.29 | | 1.34 | | | |
| | | 76 | s | 2.30 | | 2.36 | | | |
| | | 77 | s,r | 2.23 | | 2.28 | | | |
| | | 78 | s,r | 2.72 | | 2.77 | | | |
| | | 78.96 | | 3.34 | - | 3.40 | - | - | 3.41±0.03 |
| | | 80 | s,r | 3.04 | | 3.10 | | | |
| | | 82 | r | 2.31 | | 2.36 | | | |
| 35 | Br | 79 | s,r | 2.33 | | 2.24 | | | |
| | | 79.904 | | 2.63 | - | 2.54 | - | - | 2.63±0.04 |

| Z | El | A | process | An&Gr 1989 | An&Gr 1989 | Cam 1986 | Ryk 3000 | Gr&Sau 1998 | Gr&Sau 1998 |
|---|---|---|---|---|---|---|---|---|---|
| | | 81 | s,r | 2.32 | | 2.23 | | | |
| 36 | Kr | 78 | p | 0.74 | | 0.74 | | | |
| | | 80 | s,p | 1.55 | | 1.55 | | | |
| | | 82 | s | 2.27 | | 2.25 | | | |
| | | 83 | s,r | 2.27 | | 2.25 | | | |
| | | 83.80 | | 3.21 | - | 3.19 | - | - | 3.31±0.08 |
| | | 84 | s,r | 2.96 | | 2.95 | | | |
| | | 86 | r | 2.45 | | 2.43 | | | |
| 37 | Rb | 85 | s,r | 2.26 | | 2.22 | | | |
| | | 85.4675 | | 2.41 | 2.60 | 2.36 | 2.6 | 2.60±0.15 | 2.41±0.02 |
| | | 87 | r | 1.85 | | 1.84 | | | |
| 38 | Sr | 84 | p | 0.67 | | 0.68 | | | |
| | | 86 | r | 1.92 | | 1.93 | | | |
| | | 87 | r | 1.77 | | 1.75 | | | |
| | | 87.62 | | 2.93 | 2.90 | 2.94 | 2.9 | 2.97±0.07 | 2.92±0.02 |
| | | 88 | r | 2.84 | | 2.85 | | | |
| 39 | Y | 89(84.9054) | s,r | 2.22 | 2.24 | 2.26 | 2.2 | 2.24±0.03 | 2.23±0.02 |
| 40 | Zr | 90 | s,r | 2.32 | | 2.37 | | | |
| | | 91 | s,r | 1.66 | | 1.70 | | | |
| | | 91.22 | | 2.61 | 2.60 | 2.65 | 2.68 | 2.60±0.02 | 2.61±0.02 |
| | | 92 | s,r | 1.85 | | 1.89 | | | |
| | | 94 | r | 1.85 | | 1.90 | | | |
| | | 96 | r | 1.06 | | 1.11 | | | |
| 41 | Nb | 93(92.9064) | s,r | 1.40 | 1.42 | 1.53 | 1.86 | 1.42±0.06 | 1.40±0.02 |
| 42 | Mo | 92 | p | 1.13 | | 1.38 | | | |
| | | 94 | p | 0.93 | | 1.13 | | | |
| | | 95 | s,r | 1.16 | | 1.37 | | | |
| | | 95.94 | | 1.96 | 1.92 | 2.18 | 2.09 | 1.92±0.05 | 1.97±0.02 |
| | | 96 | s | 1.18 | | 1.40 | | | |
| | | 97 | s,r | 0.94 | | 1.15 | | | |
| | | 98 | s,r | 1.34 | | 1.55 | | | |
| | | 100 | r | 0.94 | | 1.16 | | | |
| 43 | Tc | [97] | s,r | | | -0.6 | | | |
| 44 | Ru | 96 | p | 0.57 | | 0.60 | | | |
| | | 98 | p | 0.10 | | 0.13 | | | |
| | | 99 | s,r | 0.93 | | 0.96 | | | |
| | | 100 | s | 0.93 | | 0.96 | | | |
| | | 101 | s,r | 1.06 | | 1.09 | | | |
| | | 101.01 | | 1.82 | 1.84 | 1.85 | 1.85 | 1.84±0.07 | 1.83±0.04 |
| | | 102 | s,r | 1.32 | | 1.35 | | | |
| | | 104 | r | 1.09 | | 1.12 | | | |
| 45 | Rh | 103(102.9055) | s,r | 1.09 | 1.12 | 1.18 | 1.34 | 1.12±0.04 | 1.10±0.04 |
| 46 | Pd | 102 | p | -0.29 | | -0.33 | | | |
| | | 104 | s | 0.74 | | 0.73 | | | |
| | | 105 | s,r | 1.05 | | 1.04 | | | |
| | | 106 | s,r | 1.13 | | 1.13 | | | |
| | | 106.4 | | 1.70 | 1.69 | 1.69 | 1.56 | 1.69±0.04 | 1.70±0.04 |
| | | 108 | r | 1.12 | | 1.12 | | | |
| | | 110 | r | 0.77 | | 0.76 | | | |
| 47 | Ag | 107 | s,r | 0.96 | | 0.94 | | | |
| | | 107.868 | | 1.24 | (0.94) | 1.24 | 0.9 | (0.94±0.25) | 1.24±0.04 |
| | | 109 | r | 0.92 | | 0.93 | | | |
| 48 | Cd | 106 | p | -0.14 | | -0.15 | | | |
| | | 108 | p | -0.29 | | -0.29 | | | |
| | | 110 | r | 0.86 | | 0.85 | | | |
| | | 111 | r | 0.87 | | 0.87 | | | |
| | | 112 | r | 1.14 | | 1.15 | | | |
| | | 112.40 | | 1.76 | 1.86 | 1.77 | 2 | 1.77±0.11 | 1.76±0.04 |
| | | 113 | r | 0.85 | | 0.85 | | | |
| | | 114 | r | 1.22 | | 1.23 | | | |

| Z | El | A | process | An&Gr 1989 | An&Gr 1989 | Cam 1986 | Ryk 3000 | Gr&Sau 1998 | Gr&Sau 1998 |
|---|---|---|---|---|---|---|---|---|---|
| | | 116 | r | 0.64 | | 0.64 | | | |
| 49 | In | 113 | p,s | -0.55 | | -0.52 | | | |
| | | 114.82 | | 0.82 | (1.66) | 0.85 | 1.7 | (1.66±0.15) | 0.82±0.04 |
| | | 115 | r | 0.80 | | 0.84 | | | |
| 50 | Sn | 112 | p | 0.12 | | 0.12 | | | |
| | | 114 | p | -0.04 | | -0.04 | | | |
| | | 115 | p,s,r | -0.33 | | -0.31 | | | |
| | | 116 | s | 1.30 | | 1.30 | | | |
| | | 117 | s,r | 1.02 | | 1.03 | | | |
| | | 118 | s,r | 1.52 | | 1.52 | | | |
| | | 118.69 | | 2.14 | 2.0 | 2.14 | 2 | 2.0±(0.3) | 2.14±0.04 |
| | | 119 | s,r | 1.07 | | 1.02 | | | |
| | | 120 | s,r | 1.65 | | 1.66 | | | |
| | | 122 | r | 0.80 | | 0.82 | | | |
| | | 124 | r | 0.90 | | 0.92 | | | |
| 51 | Sb | 121 | s,r | 0.80 | | 0.83 | | | |
| | | 121.75 | | 1.04 | 1.0 | 1.07 | 1 | 1.0±(0.3) | 1.03±0.07 |
| | | 123 | r | 0.67 | | 0.92 | | | |
| 52 | Te | 120 | p | -0.81 | | -0.66 | | | |
| | | 122 | s | 0.65 | | 0.78 | | | |
| | | 123 | s | 0.19 | | 0.34 | | | |
| | | 124 | s | 0.91 | | 1.05 | | | |
| | | 125 | s,r | 1.09 | | 1.23 | | | |
| | | 126 | s,r | 1.51 | | 1.66 | | | |
| | | 127.80 | | 2.24 | - | 2.39 | - | - | 2.24±0.04 |
| | | 128 | r | 1.74 | | 1.89 | | | |
| | | 130 | r | 1.77 | | 1.93 | | | |
| 53 | I | 127(126.9045) | s,r | 1.51 | - | 1.68 | - | - | 1.51±0.08 |
| 54 | Xe | 124 | p | -0.69 | | -0.56 | | | |
| | | 126 | p | -0.74 | | -0.60 | | | |
| | | 128 | s | 0.57 | | 0.68 | | | |
| | | 129 | s | 1.66 | | 1.78 | | | |
| | | 130 | s | 0.87 | | 0.97 | | | |
| | | 131 | s,r | 1.56 | | 1.67 | | | |
| | | 131.30 | | 2.23 | - | 2.34 | - | - | 2.17±0.08 |
| | | 132 | s,r | 1.64 | | 1.76 | | | |
| | | 134 | r | 1.22 | | 1.35 | | | |
| | | 136 | r | 1.13 | | 1.275 | | | |
| 55 | Cs | 133(132.9054) | s,r | 1.12 | - | 1.17 | 2.1 | - | 1.13±0.02 |
| 56 | Ba | 130 | p | -0.77 | | -0.74 | | | |
| | | 132 | p | -0.79 | | -0.76 | | | |
| | | 134 | s | 0.59 | | 0.80 | | | |
| | | 135 | s,r | 1.03 | | 1.07 | | | |
| | | 136 | s | 1.10 | | 1.15 | | | |
| | | 137 | s,r | 1.26 | | 1.31 | | | |
| | | 137.34 | | 2.21 | 2.13 | 2.26 | 2.01 | 2.13±0.05 | 2.22±0.02 |
| | | 138 | s,r | 2.06 | | 2.11 | | | |
| 57 | La | 138 | p | -1.85 | | -1.89 | | | |
| | | 138.9055 | | 1.20 | 1.22 | 1.14 | 1.32 | 1.17±0.07 | 1.22±0.02 |
| | | 139 | s,r | 1.20 | | 1.14 | | | |
| 58 | Ce | 136 | p | -1.11 | | -1.06 | | | |
| | | 138 | p | -0.99 | | -0.95 | | | |
| | | 140 | s,r | 1.58 | | 1.60 | | | |
| | | 140.12 | | 1.61 | 1.55 | 1.65 | 1.68 | 1.58±0.09 | 1.63±0.02 |
| | | 142 | r | 0.65 | | 0.70 | | | |
| 59 | Pr | 141(140.9077) | s,r | 0.78 | 0.71 | 0.83 | 0.76 | 0.71±0.08 | 0.80±0.02 |
| 60 | Nd | 142 | s | 0.91 | | 0.91 | | | |
| | | 143 | s,r | 0.56 | | 0.56 | | | |
| | | 144 | s,r | 0.85 | | 0.85 | | | |
| | | 144.24 | | 1.47 | 1.50 | 1.47 | 1.38 | 1.50±0.06 | 1.49±0.02 |

| Z | El | A | process | An&Gr 1989 | An&Gr 1989 | Cam 1986 | Ryk 3000 | Gr&Sau 1998 | Gr&Sau 1998 |
|---|---|---|---|---|---|---|---|---|---|
| | | 145 | s,r | 0.39 | | 0.39 | | | |
| | | 146 | s,r | 0.71 | | 0.71 | | | |
| | | 148 | r | 0.23 | | 0.23 | | | |
| | | 150 | r | 0.22 | | 0.22 | | | |
| 62 | Sm | 144 | p | -0.54 | | -0.55 | | | |
| | | 147 | s,r | 1.42 | | 1.14 | | | |
| | | 148 | s | 0.02 | | 0.01 | | | |
| | | 149 | s,r | 0.11 | | 0.10 | | | |
| | | 150 | s | -0.16 | | -0.17 | | | |
| | | 150.4 | | 0.97 | 1.00 | 0.95 | 0.86 | 1.01±0.06 | 0.98±0.02 |
| | | 152 | r | 0.39 | | 0.38 | | | |
| | | 154 | r | 0.32 | | 0.31 | | | |
| 63 | Eu | 151 | s,r | 0.22 | | 0.23 | | | |
| | | 151.96 | | 0.54 | 0.51 | 0.55 | 0.61 | 0.51±0.08 | 0.55±0.02 |
| | | 153 | s,r | 0.26 | | 0.27 | | | |
| 64 | Gd | 152 | p | -1.62 | | -1.50 | | | |
| | | 154 | s | -0.59 | | -0.47 | | | |
| | | 155 | s,r | 0.24 | | 0.37 | | | |
| | | 156 | s,r | 0.38 | | 0.51 | | | |
| | | 157 | s,r | 0.27 | | 0.39 | | | |
| | | 157.25 | | 1.07 | 1.12 | 1.20 | 1.14 | 1.12±0.04 | 1.09±0.02 |
| | | 158 | s,r | 0.47 | | 0.59 | | | |
| | | 160 | r | 0.41 | | 0.54 | | | |
| 65 | Tb | 159(158.9254) | s,r | 0.33 | -0.1 | 0.46 | -0.1 | (-0.1±0.3) | 0.35±0.02 |
| 66 | Dy | 156 | p | -2.10 | | -2.14 | | | |
| | | 158 | p | -1.87 | | -1.90 | | | |
| | | 160 | s | -0.48 | | -0.50 | | | |
| | | 161 | s,r | 0.43 | | 0.42 | | | |
| | | 162 | s,r | 0.56 | | 0.35 | | | |
| | | 162.50 | | 1.15 | 1.1 | 1.14 | 1.1 | 1.14±0.08 | 1.17±0.02 |
| | | 163 | s,r | 0.55 | | 0.54 | | | |
| | | 164 | s,r | 0.60 | | 0.59 | | | |
| 67 | Ho | 165(154.9304) | s,r | 0.50 | (0.26) | 0.54 | - | (0.26±0.16) | 0.51±0.02 |
| 68 | Er | 162 | p | -1.90 | | -1.93 | | | |
| | | 164 | p,s | -0.84 | | -0.87 | | | |
| | | 166 | s,r | 0.48 | | 0.46 | | | |
| | | 167 | s,r | 0.31 | | 0.30 | | | |
| | | 167.26 | | 0.95 | 0.93 | 0.94 | 0.83 | 0.93±0.06 | 0.97±0.02 |
| | | 168 | s,r | 0.38 | | 0.40 | | | |
| | | 170 | r | 0.13 | | 0.11 | | | |
| 69 | Tm | 169(167.26) | s,r | 0.13 | (0.00) | 0.12 | 0.28 | (0.00±0.15) | 0.15±0.02 |
| 70 | Yb | 168 | p | -1.94 | | -1.99 | | | |
| | | 170 | s | -0.57 | | -0.64 | | | |
| | | 171 | s,r | 0.10 | | 0.03 | | | |
| | | 172 | s,r | 0.29 | | 0.21 | | | |
| | | 173 | s,r | 0.16 | | 0.08 | | | |
| | | 173.04 | | 0.95 | 1.08 | 0.88 | 0.8 | 1.08±(0.15) | 0.96±0.02 |
| | | 174 | s,r | 0.45 | | 0.38 | | | |
| | | 176 | r | 0.05 | | -0.02 | | | |
| 71 | Lu | 175(174.97) | s,r | 0.11 | (0.76) | 0.11 | 0.76 | 0.06±0.10 | 0.13±0.02 |
| | | 176 | s | -1.47 | | -1.40 | | | |
| 72 | Hf | 174 | p | -2.05 | | -1.93 | | | |
| | | 176 | s | -0.54 | | -0.48 | | | |
| | | 177 | s,r | 0.01 | | 0.07 | | | |
| | | 178 | s,r | 0.18 | | 0.24 | | | |
| | | 178.49 | | 0.74 | 0.88 | 0.81 | 0.85 | 0.88±(0.08) | 0.75±0.02 |
| | | 179 | s,r | -0.12 | | -0.06 | | | |
| | | 180 | s,r | 0.29 | | 0.35 | | | |
| 73 | Ta | 180 | p | -4.05 | | -4.04 | | | |
| | | 180.9479 | | -0.13 | - | -0.12 | - | - | -0.13±0.02 |

| Z | El | A | process | An&Gr 1989 | An&Gr 1989 | Cam 1986 | Ryk 3000 | Gr&Sau 1998 | Gr&Sau 1998 |
|---|---|---|---|---|---|---|---|---|---|
| | | 181 | s,r | -0.13 | | -0.12 | | | |
| 74 | W | 180 | p | -0.22 | | -1.82 | | | |
| | | 182 | s,r | 0.10 | | 0.47 | | | |
| | | 183 | s,r | -0.17 | | 0.21 | | | |
| | | 183.85 | | 0.68 | (1.11) | 1.05 | 1.18 | (1.11±0.15) | 0.69±0.03 |
| | | 184 | s,r | 0.17 | | 0.53 | | | |
| | | 186 | r | 0.13 | | 0.51 | | | |
| 75 | Re | 185 | s,r | -0.18 | | -0.15 | | | |
| | | 186.207 | | 0.27 | - | 0.28 | -0.3 | - | 0.28±0.03 |
| | | 187 | s,r | 0.06 | | 0.12 | | | |
| 76 | Os | 184 | p | -2.36 | | -2.33 | | | |
| | | 186 | s | -0.42 | | -0.48 | | | |
| | | 187 | s | -0.42 | | -0.52 | | | |
| | | 188 | s,r | 0.51 | | 0.54 | | | |
| | | 189 | s,r | 0.59 | | 0.62 | | | |
| | | 190 | s,r | 0.80 | | 0.84 | | | |
| | | 190.2 | | 1.38 | 1.45 | 1.41 | 1.45 | 1.45±0.10 | 1.39±0.02 |
| | | 192 | r | 1.00 | | 1.03 | | | |
| 77 | Ir | 191 | s,r | 0.95 | | 1.00 | | | |
| | | 192.22 | | 1.37 | 1.35 | 1.43 | 1.45 | 1.35±(0.10) | 1.37±0.02 |
| | | 193 | s,r | 1.17 | | 1.23 | | | |
| 78 | Pt | 190 | p | -2.21 | | -2.17 | | | |
| | | 192 | s | -0.42 | | -0.38 | | | |
| | | 194 | s,r | 1.20 | | 1.24 | | | |
| | | 195 | s,r | 1.21 | | 1.25 | | | |
| | | 195.95 | | 1.68 | 1.8 | 1.72 | 1.75 | 1.8±0.3 | 1.69±0.04 |
| | | 196 | s,r | 1.08 | | 1.13 | | | |
| | | 198 | r | 0.54 | | 0.58 | | | |
| 79 | Au | 197(196.9665) | s,r | 0.83 | (1.01) | 0.90 | 0.95 | (1.01±0.15) | 0.85±0.04 |
| 80 | Hg | 196 | p | -1.73 | | -1.93 | | | |
| | | 198 | s | 0.08 | | -0.09 | | | |
| | | 199 | s.r | 0.31 | | 0.12 | | | |
| | | 200 | s,r | 0.45 | | 0.26 | | | |
| | | 200.59 | s,r | 1.09 | - | 0.90 | 1.9 | - | 1.13±0.08 |
| | | 201 | s,r | 0.21 | | 0.19 | | | |
| | | 202 | s,r | 0.56 | | 0.37 | | | |
| | | 204 | r | -0.08 | | -0.07 | | | |
| 81 | Tl | 203 | s,r | 0.29 | | 0.32 | | | |
| | | 204.37 | | 0.82 | (0.9) | 0.85 | 0.9 | (0.9±0.2) | 0.83±0.04 |
| | | 205 | s,r | 0.67 | | 0.70 | | | |
| 82 | Pb | 204 | s | 0.34 | | 0.28 | | | |
| | | 206 | s,r | 1.33 | | 1.27 | | | |
| | | 207 | s,r | 1.37 | | 1.31 | | | |
| | | 207.2 | | 2.05 | 1.85 | 1.99 | 1.93 | 1.95±0.08 | 2.06±0.04 |
| | | 208 | s,r | 1.82 | | 1.76 | | | |
| 83 | Bi | 209(208.9804) | s,r | 0.71 | - | 0.72 | 1.9 | - | 0.71±0.04 |
| 90 | Th | 232(232.0381) | r | 0.08 | 0.12 | 0.23 | 0.2 | - | 0.09±0.02 |
| 92 | U | 235 | r | -0.62 | | -0.62 | | | |
| | | 238(238.02) | r | -0.49 | (<-0.47) | -0.12 | | (<-0.47) | -0.50±0.04 |

A remarkable complication arises due to scanty number of stable isotopes (islands of stability) among the set of unstable isotopes (the sea of non-stability). Therefore, the distribution of nuclides to a greater extent must be modified as a result of radioactive decay. The process may be different under these or those conditions (up to no decay all, example neutron). The chemical composition of atmospheres of the stars of first evolution stage is not contaminated with stellar nucleosynthesis products, whereas that of the second evolution stars can be diluted with products of nucleosynthesis and to differ from abundance progenitor matter. The atoms of these newly formed elements are injected into the interstellar medium at high velocity, and by processes that are not well understood, many of them, such silicon and iron atoms, become constituents of tiny interstellar dust grains. The interstellar shocks can then act to destroy these grains by collisions with high velocity atoms and by collisions with other dust particles. The stars of the Galactic disk are objects second or third stars' of generation.

The testing of theories of nucleosynthesis and stellar evolution, chemical and dynamical evolution of the Galaxy is the one from problem of modern astrophysics The testing was based upon data of abundances of chemical elements and their isotopes in diverse object of the Galaxy. In particular, for this goal necessary to know the almost precision about the contents of chemical elements and their isotopes in the atmospheres of stars different masses which have passed through this or that stage of evolution. The cool giants and super-giants are of the convenient object for such investigation. They are the brightest objects of stellar population in the Galaxy and in their spectra a great number of absorption and\or emission lines various chemical elements and their compounds are detected (even for stars with extreme iron deficiency).

According to the present concepts of theory of stellar evolution, the star's time stay at a certain stage (in this at that locus of H-R diagram) considerably depends of its mass, initial chemical composition and nucleosynthesis processes. The belonging of stars to various types of population of the Galaxy, to different types of clusters and dynamic groups gives an excellent possibility of tracing evolution of chemical composition of their atmospheres.

## The contens of chemical elements in stellar atmospheres

In this paper we shall to spoke about results of investigation of chemical composition in the atmospheres of cool giants of oxygen sequence of the Galaxy thick and thin disks which have been obtained at Astronomical Observatory of Odessa National University.

The stars-giant in the Galaxy disk are at various stages of evolution – the first and subsequent giant branches (FRGB and other), blue and red parts of the horizontal branch (BHB and RHB), the asymptotic giant branch (AGB), the post-asymptotic giant branch (post-AGB). These stars have located in the regions H-R diagram, which will penetrate each other. If the mixing of atmospheres of stars with products of elements nucleosynthesis hold true, that the contents of nuclides in atmospheres of stars in common with their known fundamental characteristics can provide information about evolution status of stars, about its of mass and about chemical composition of progenitor matter (Sweigart et al., 1989).

The existence of three stages of possible deep mixing is supposed:

- on a stage MS, or at an exist on a stage FRGB,
- on a stage AGB (in time burning H and He in layers sources),
- on a stage of thermal flares of He.

The simplest interpretation of spectral classification of stars makes necessary to suggest a difference between chemical compositions in the atmospheres of cool giants stars. It are stars with excess or deficiency of elements of iron group, with various ratio of abundances of carbon and oxygen elements with even and odd Z, with excess or deficiency of elements of *s*-process and so on.

A great number of works have been issued recently on the determination of contents of chemical elements and their isotopes in the atmospheres of stars, and other fundamental characteristics, by using spectra with a high signal-noise ratio ($S/N$~300) and the method of model atmospheres and of synthetic spectra. We shall consider in brief the results of survey given in literature.

The stars of the main sequence (MS) of the Galaxy disk in the solar vicinities have the following contents of elements CNO - group relative to the Sun:

$[C/H] = -0.23, [N/H] = 0.38, [O/H] = -0.03,$

where $[El/H] = \log(El/H)^{*} - \log(El/H)_{\odot}$ and $\log(El)$ is the abundance of element in the scale of log H=12.0. The ratio of contents of isotopes $^{12}C$ and $^{13}C$ range from 4 to 90 (The average value $^{12}C/^{13}C$ = 22.5 whereas that of $^{12}C/^{13}C$ for the solar atmosphere is equal ~90). The values $^{12}C/^{13}C$ from 20 to 30 have of stars with $M>2M_{\odot}$ The ratio swiftly decrease for stars with more little mass according to observations and that contradicts of theory. To explain this effect it is necessary to suppose unknown mechanism of mixing. During further evolution of stars with $M<1.5M_{\odot}$ they proceeds in sequence of spectral types M-MS-S-SC-C (R or N).

The progenitors of G−M giant stars are F−G dwarf stars with masses ranging from $0.8 < M/M^{\circ} < 3.0$. Therefore, the products of nucleosynthesis in their atmospheres should be expected Is the parent matter in atmosphere of stars-giant diluted with products nuclear synthesis? Indeed, the average ratio abundances is equal C/N=0.9 for open clusters of the Hyades and Praesepes (Mishenina et al.,1990, Komarov&Basak,1992) while for the Sun C/N=4.8, but for star-dwarfs of Hyades was found $C/N=(C/N)^{\circ}$. The average value C/N=2.3 is obtained for cool giant stars of Galaxy field (Komarov, 1999). It means that the content N grows while content C decrease. It should be noted that theory of evolution of single star predicts ratio C/N=2.0 after mixing. The ratio of isotopes $^{12}C/^{13}C$ for atmospheres of cool star-giants are much less than the solar (earth) one. The ratio contents of nuclides due to convection and circulation, He-flares deeply penetrating convection and loss mass can be changed on the stellar atmospheres. It was obtained that C/N=2.3, i.e. the content of nitrogen was found to enhance while that of carbon to decrease, incidentally, for metal deficient stars and for those with $M<1M^{\circ}$ the ratio $(C/N)^{*}=(C/N)^{\circ}$, whereas $(N/Fe)^{*}>(N/Fe)^{\circ}$ and $(C/Fe)^{*}<(C/Fe)^{\circ}$ for all the giants (Kjaergaard et al., 1987). At the same time the total abundance of C,N,O elements for dwarf stars and giant stars of Hyades cluster is nearly identical. The carbon and essential nuclides were synthesized in the interior of giant stars, and then were injected into the space by means of violent supernova explosions, or continuously, although with much less efficiency via stellar winds. The atmospheres of star-giants must be carbon poor, nitrogen rich at the constant oxygen abundance in comparison to the contents of these elements in the atmospheres of dwarf stars.

The light elements Li, Be and B are easily destructed at low temperatures (nearly from 2x106 to 5x106) that must decrease abundance these elements in atmospheres giant stars especially Li. These nuclides can't be formed during of stellar evolution (during of the processes nuclear synthesis), excluding may be, $^{7}$Li. However, content of $^{7}$Li in some star-giant exceeds the cosmological content! The contents of $^{7}$Li in meteorites and the solar atmosphere differ by nearly two orders. Now it is necessary to determine of contents of these elements in atmospheres oldest of Galaxy stars with big deficiency of metal.

The contents of chemical elements had obtained for the atmospheres of field giant stars and it is in good agreement with that of dwarf stars in the region of metallicity $-2.4<[Fe/H]<0.35$. The elements of the α-process are overabundant in the atmospheres of metal deficient stars, but Na and Al are in deficiency relative to elements α-process (Gratton et al., 1987). It should be noted that "excess" of some elements relative to the solar abundance could be result from either hyperfine structure of atomic lines or isotopic shift. The excess in contents is observed not only for Na, but also for Al and Si. The overabundances increase with luminosity of stars. The observed anomalies provide evidence that, in addition to the CNO hydrogen-burning cycle, the MgAl and NeNa cycles operate of main-sequence phase. The anomalies in contents of *s*-process elements, also observed in the atmospheres of field stars, testify to the presence of a substantial number of neutrons. The anomalies in contents of s-process elements are absent from giant of the young Hyades cluster. The readers can to write of capital reviews by Gehren (1988).

Therefore, the structure of a lower level of every line of absorption is necessary to carefully analyze in determining elemental abundance. The contents of chrmical elements can be in several times overestimate. It is necessary to take account of relative contents of all stable isotopes at determination of content a certain chemical element. The isotopic shift for the elements of iron group is unlikely to occur since isotopes $^{54}$Cr, $^{55}$Mn, $^{56}$Fe, $^{59}$Co, $^{58}$Ni are primarily observed. For elements with odd Z the hyperfine structure of atomic levels is probable. Abundance ratios of isotopes of elements C, O, Ng, Al, Si, Ca, Ti, Zr can differ from those of the Earth and give information about nucleosynthesis process of addition of α-particles and neutrons.

The structure of a red giant can exist only at absence of full mixing between outer and inner layers. However, as was shown above, the $^{12}C/^{13}C$ isotopic ratio for giant stars is considerably less than that of the Earth (the Sun). The interest represent of metal-poor red giants with $[Fe/H]<-2$ which are likely to be stars with low mass ($M<0.8M^{\circ}$) and which have originated from a cloud with mass $10^{5}\div10^{6}\,M^{\circ}$. Massive stars have of short lifetimes and they supply the cloud with different metals and products of the CNO-cycle. Variations in intensity bands of CN, CH and NH indicate that red giants originated from progenitor matter with various ratios of nucleosynthesis products. In this respect, rather illustrative is the Cas A object - a remnant of the supernovae flared up approximately 350 year ago. The clouds are found with a primary oxygen abundance ($[H/O]=-3.7$, $[He/O]<-1.9$ and $[C/O]<-2.1$). The lines of S, Ar and Ca elements are visible in various clouds. This means that the star is in the pre-supernovae stage of evolution has layer structure, and thickness of corresponding layers depend on initial mass of the star.

The determination of contents of chemical elements of cool stars is associating with the problem of determining fundamental characteristics, i.e. of effective temperatures $T_{eff}$, of gravities on the surface ($g$), of metallicities ([Fe/H]), of microturbulent velocities ($V_t$), with that of calculation of model atmospheres adequate to the structure of atmospheres of real stars, with that of determining physical-chemical parameters of radiation and of collision of atoms and molecules Ridgway et al. (1980), Komarov et al. (1985), Korotina et al. (1992), Komarov (1999).

The value of microturbulent velocity $V_t$ in the first approximation was estimated from the curve of growth for absorption lines FeI. The value $V_t$ was revised by the method of model atmospheres by means of calculation of abundance log (Fe), the values $V_t$ being diverse. The correlation between log (Fe) and $W_\lambda$ was found, and the value $V_t$ was selected when there was no correlation between log (Fe) and $W_\lambda$. The influence of rotation and macroturbulence on the profile of absorption lines was taken into account by the convolution of a synthetic spectrum with the apparatus function of a spectral device.It is suggested that broadenings of a profile of the line due to rotation and macroturbulence are small as compared to those caused by the apparatus function of the device.

For cool stars it is difficult to select relatively pure absorption lines by taking no account of a synthetic spectrum and its convolution with the apparatus function of the device as the apparatus function of a spectral device. The apparatus function of a spectral device was taken the Gaussian with a half-width equal to spectral resolution. For selecting pure and weakly blended absorption lines the calculation of synthetic spectra were carried out. The models atmospheres was taken from the grid (Bell et al., 1978) with parameters $T_{eff}$, log $g$, [Fe/H] corresponding to K0 III and K5 III stars, but namely (5000, 3.00, 0.0) and (4000, 1.50, 0.0) respectively.

The fundamental characteristics and chemical composition of same stars γ Tau, δ Tau, ε Tau (clusters of Hyades), α Tau, γ Sge their were found from spectrograms with reciprocal dispertion to be not worse than 5.6 A/mm with the wavelength range 5360–6700 A. In the same detail chemical composition of stars BS 3427 and BS 3428 of open clusters Hyades and Praesepe was investigated Komarov et al. (1985), Komarov et al. (1985), Mishenina et al. (1986), Gopka et al. (1990), Gopka et al. (1990), Komarov et al. (1992).

The chemical contents in the atmospheres of cool giant stars of oxygen sequence depends from belonging of stars to various stages of star evolution (Korotina et al., 1989; Korotina et al., 1992). It is related to our possibility of only rough estimating mass of field of stars and in even such assumption there arises a question on reliability of the results. We judge of evolutionary status of a star from it position in the H-R diagram but at the same locus of H-R diagram can be located stars proceeding different stages of evolution affected by distinctions in masses and initial chemical composition of pro-star medium. The best position of stars seemed to be those belonging to the open clusters or dynamical groups because of a possibility of estimating there age. But here we come across a paradox. As is known (Korotina et al., 1989, Korotina et al., 1992) relative quantity of stars of G5 III – K0 III spectral types with "standard" chemical composition must be small but that of stars in K2 III - K5 III range with "standard" chemical composition is predominant. However, in the most nearby open Hyades and Praesepe clusters K0 III giant stars have "standard" abundance (except for same elements C, O, Na) whereas in the most well studied dynamical group the a Boo star (K2 IIIp) is certain to be metal-deficient. In the analysis and comparisons of results obtained various authors the abundances should be given relative to hydrogen in the same star rather than relative to abundance in the solar atmospheres. From our data The elemental contents in atmospheres of star giants belonging to the thick disk and thin of Galaxy are obtained.

The quality of determination of contents of chemical elements and their isotopes in atmospheres of stars must be connected with problems of possible influence of fundamental characteristics of atmospheres of stars as well as of effects:

-non-LTE;
-rotation;
-chromosphere, corona and wind;
-starspotting;
-fluorescence;
-nonthermal of transfer of energy.

The elemental contents of ~120 of cool giant stars in vicinity of Sun have been determined. The method of model atmospheres and of synthetic spectra was used. It should be noted that many elements show discrepancies in content determined absorption lines of atoms and ions. For us, astrophysics-observers, the following question is of importance:

"At what stage does the mixing of interstellar medium with matter, as having passed through the stellar evolution stage, take place."

As is well known, the basic suppliers for newly synthesized nuclides into the interstellar medium are of the outburst of supernovae types SNI, SNII, possibly, of outburst of novae $N$. The stars being on the AGB are as a result of outflow of matter (stellar wind and super-wind). Massive, short-living stars $M>8M_\odot$ synthesize oxygen, elements of a-process and light $Z$-odd and $N$-even elements

(Na, Al). The SNI-type stars with $M \sim (1 \div 3) M_o$ are the source of elements iron-group. These stars are evolved slower than those of SNII-type. SNI-type stars are basic suppliers of these elements into the interstellar medium because during the outburst a complete fragmentation of the stare takes place. The AGB-stars determine the content of heavy elements s-processes. as well as elements CNO-group and their isotopes (for example, the values of ratios of isotopes $^{12}C/^{13}C$ vary in the atmospheres cool stars from 4 to 90). The stars of the given metallicity can have various contents of other elements, in particular, elements of $\alpha$-process. The AGB-stars have of a degenerate CO-nucleus and two thin layer sources of He and H. The He flares occurs. This promotes to the mixing of interstellar medium with newly formed stable and unstable nuclides, which passed through nucleosynthesis, with matter of stellar atmospheres. These stars have $M$ from 1 to 8 $M_o$.

In the Astronomical Observatory of Odessa National University the new data about temperature, gravity, microturbulent velocity, radius, mass and total luminosity of ~1500 G-, K-, M star-giants are obtained (Korotina et al., 1989, Korotina et al., 1992, Komarov et al., 1996). The metallicities of star-giants belonging to 27 open clusters and moving groups of various ages were determined. The dispersion of metallicities for old stars amounts from 0.0 to -0.5 dex, but for young stars amounts from 0.1 to -0.1 dex. It is assumed that the division of star-giants in vicinity Sun into two groups corresponds to their division into two ages' groups or into two star formation flashes localized in time. The processes of mixing in interstellar medium have been increased in the course its evolution. It should be noted that $T_{eff}$ of these stars for the same spectral type increases with growth metallicity. It is shown that their luminosities are increased with growth metallicity too. The distribution of stars for various intervals of metallicities and for various intervals of space velocities was studied. It was found that for stars with slow space velocities $V_{sp}$ <60 kms$^{-1}$ (stars of Galactic disk ) have maximum in distribution for [Fe/H]=-0.2 dex. The distribution of stars from metallicities with $V_{sp}$>60 kms$^{-1}$ is nearly constant.

The contents of chemical elements in atmospheres of K-supergiants belonging in the Small Magellan Cloud were determined. The all investigated of stars have a deficit in the contents of iron on a comparison with the solar ones. For all stars the same method was used. All stars have close photometric and spectral characteristics. The variations of the contents of iron [Fe/H] at selected stars SMC, on all probability, reflect differences primordial of chemical structure of an interstellar medium. The interest represents the contents of elements of $\alpha$-process in our case the contents of elements Ca, Si. In our Galaxy in atmospheres of stars with a deficit of metals have the enrichment contents of these elements. At investigated stars SMC, on the contrary, the small deficit in the contents Si, Ca to relative iron are observed. The values [Si/Fe] vary from -0.5dex up to -0.1dex. The contents Ca is more close the contents one for stars with solar content of iron (Komarov et al., 2001).

We began of investigation of contents of nuclides to use of molecules-hydrides namely Mg, Ca, Zr and etc. The new molecular characteristics of radiation have been used. The stars belongs thick (old?) and thin (young?) disks of Galaxy. It should be noted, the production of nitrogen is dominated by primary processes at low metallicity and secondary processes at high metallicity for spiral galaxies and vice versa. The production of carbon increases with increasing metallicity. The masses depend neither from the spectral type nor from the metallicity. The most impressive result is that of cool star-giants in the spectral region from G5 to K5 have masses statistically less then solar one, and consequently, these have the ages compared with that of a globular clusters. The determination of contents of elements and their isotopes in atmospheres cool giant stars was made (Komarov et al., 1985a, Komarov et al., 1985b, Gopka et al., 1990a, Gopka et al., 1990b, Komarov&Basak, 1992, Komarov et al., 1994, Komarov, 1999, Kovtyukh et al., 2000, Komarov et al., 2001) to use of model atmospheres Bell et al. (1978), Kurucz (1993) and codes of Tsymbal (1994, 1995).

## Conclusion

The accretion of small satellite galaxies appears to have been important in the formation of the halo, thick and thin discs of the Galaxy. The disrupting Sgr dwarf galaxy and the recent discovery of a young, metal-poor component of the halo indicate that this is a continuing process. The Milky Way is large disk galaxy. Its main components are the rapidly rotating thin and thick disks, the very slowly rotating metal-poor halo, the bulge, and the dark corona. The contents of chemical elements in atmospheres of stars belonging of thin disk gives information about the later stage of evolution.

The differences in the relative contents of nuclides of a Mg for cold stars - giants of thin and thick disks of a Galaxy are within the limits of errors of their determination. The study of the relative contents of nuclides of a Mg, and nuclides of other elements, and for the greater number of star-giants of thick and thin disks of a Galaxy is necessary for final conclusions. As shown early, in processes of enrichment of atmospheres of stars by products of nuclear fusion (*s*-process) can happens at the stage of transition from MS on a branch of the star-giants.

We believe that cool star-giants in vicinity of Sun don't belong to one group. They belong of thick and thin disks of Galaxy. Therefore, the contents of light as well as heavy nuclides in their atmospheres must be studied by the same method, same observable material, same input physics and same physical approximations. The conclusion about evolution of chemical elements and their isotopes in stellar stage of evolution may be made only in this a case.

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