Database Retrieval Systems for Nuclear and Astronomical Data

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Data retrieval and plot systems of nuclear and astronomical data are constructed on a common platform. Web-based systems will soon be opened to the users of both fields of nuclear physics and astronomy.

1. Introduction

The compilation of nuclear data has played an important role in contributing not only to the scientific research but also to the technological progresses. At the same time, this invokes demands for the utilization of nuclear data. There are some systems in the world that can search and plot the data from enormous database. However, no retrieval system can treat both experimental and evaluated nuclear data simultaneously. Based on the needs for comparisons of evaluated data with experimental data in a more convenient way, we have developed a web-based retrieval system (see http://www.jcprg.org/).

On the other hand, we have launched a project of constructing the database of astronomical data that treat the observed properties of stars in the Galactic halo born in the early universe [1]. This project is motivated by the recent growing number of known extremely iron-poor stars and by our recent work on the origin of such stars [2] after the discovery of the most iron-poor object [3], which is more encouraged by the recent break of the record [4]. The purpose of the project is to identify the first generation objects as well as the comprehensive understanding of the history of our universe through the accumulation of observational data. Due to the difficulty of compiling the data from individual papers, the database of this kind has not yet been opened to the astronomical society.

In this paper, we will describe the current status of the development of astronomical database. In the next section, the outline of the system is elaborated. Future development and statistics are discussed and summarized in the third section.

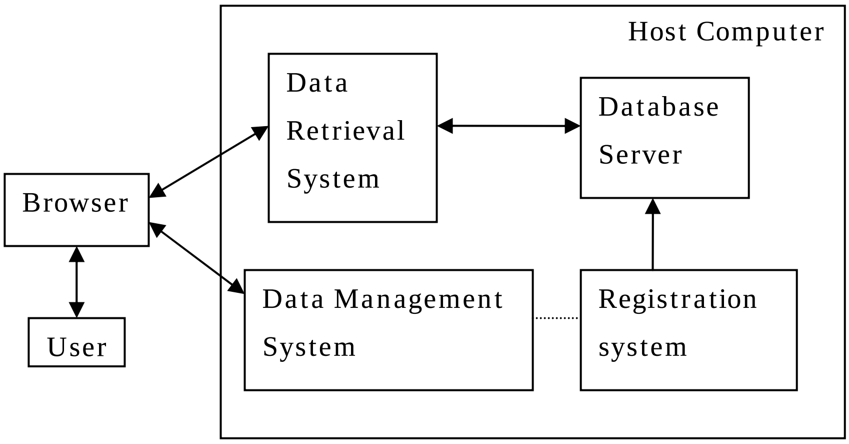


Figure 1: Internal structure of astronomical database

2. Outline of the astronomical database system

The schematic view of the structure of the whole system is illustrated in Figure 1. The system consists of some independent programs in the host computer. While users access the system only through the Internet browser, workers and administrators of the system use both browser and terminal.

Before using this system, the data to be retrieved from the web have to be prepared. We constructed the online system to compile and store the required data in CSV format. The process of data input is done through CGI form of this system. The observational data of extremely metal-poor stars are collected from literatures that focuses on the abundance analyses of field halo stars having low iron content typically one hundred times less than that of the Sun. In order to collect appropriate papers for adding to the database, we have developed the data management system. Candidate papers to be compiled are selected and listed in the management system and their identifier is allocated to each paper. Then the editors who compile the data with the system extract the data from papers and input them into the CSV files.

Stored data files, written in CSV format, are registered into the database server by running the registration system. Since the system is independent from the work via the Internet, the security of the system is ensured. In addition, CSV files can be checked easily during the registration process. At the same time, the program for registration generates text files from CSV files to review the collected data. These files are used as the quick review of data included in each paper and users can easily access the data by tracing the links to the data files of papers and objects.

At present, the database includes 472 stars and 652 records of objects. As the basic data, stellar parameters such as effective temperature, surface gravity, metallicity, and micro-turbulence factor and

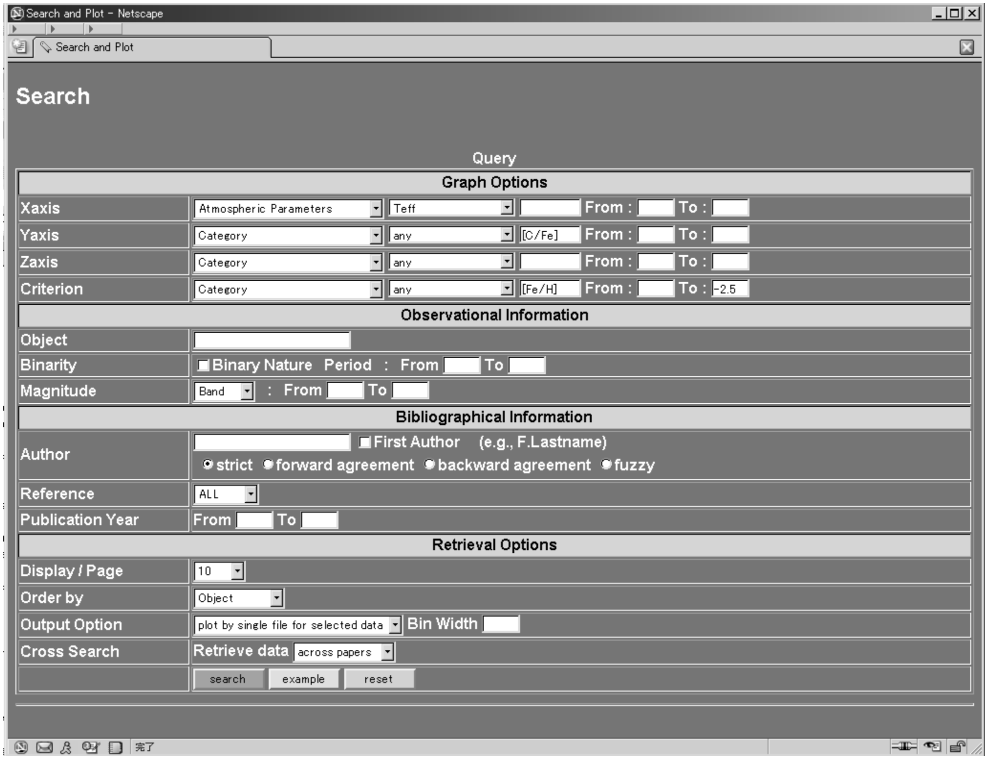
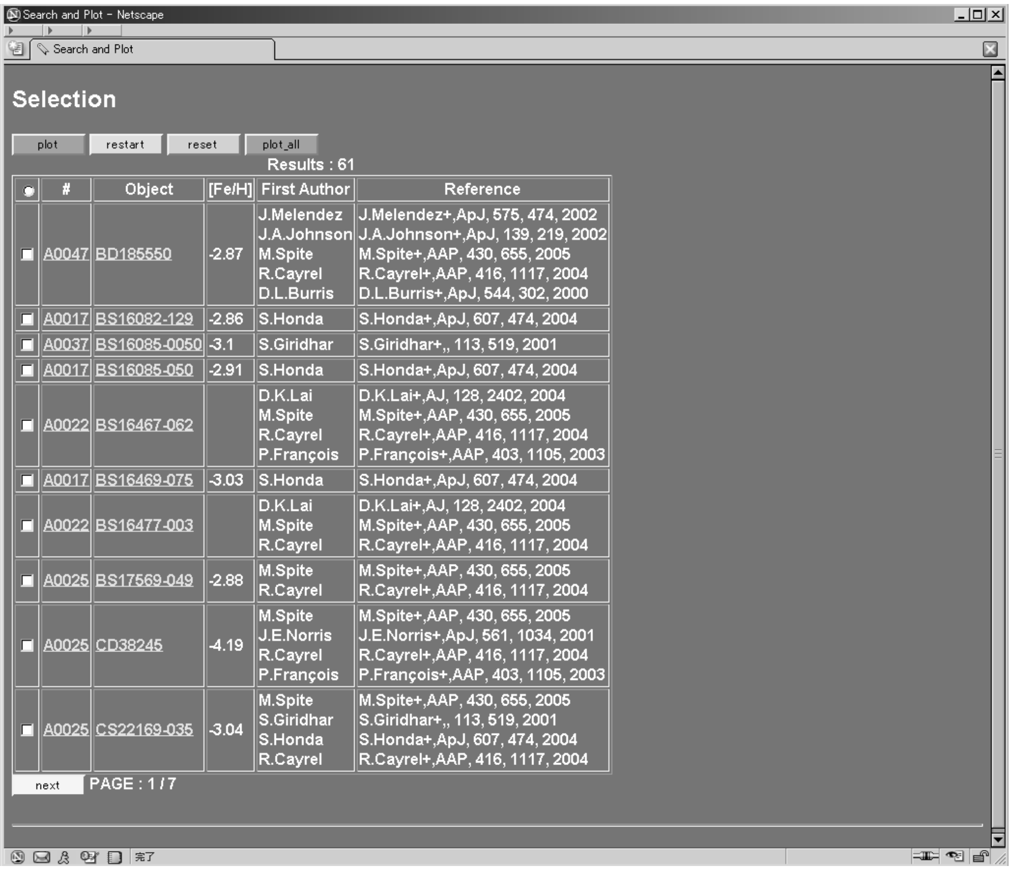


Figure 2: Snapshot of the query form of the astronomical data retrieval system

photometric data are taken with various bands such as U, B, V, I, J, K, and so on. Positions of target objects are also compiled from the other online database of object catalogues. In these papers, 10179 records of chemical abundances are derived from absorption lines by stellar atmospheres, with increased variation in the elements of derived abundances thanks to the recent observations of detecting more and more atomic lines from only one star. The binary period, the important parameters among the physical quantities, is to be assembled in the database although the number of data is very small due to the difficult detection of binarity. The binary period is determined from the variations in radial velocities between the observations at different time. It is one of the most important quantities to understand the origin of extremely metal-poor stars [2].

The retrieval system works on Internet CGI described by Perl, JavaScript, and MySQL. The snapshots of the retrieval system are shown in Figure 2. Many physical parameters such as chemical composition measured by element relative to hydrogen or iron compared with the solar ratio, number abundances in logarithm scale based on the 10^{12} hydrogen atoms, surface stellar parameters, photometry, and binary period can be used as figure axes to plot 2D and 3D viewgraphs. Users can set the criteria for each physical quantity to extract the data of required range. If only one quantity is chosen, the distribution of required parameter is displayed in the form of histogram with arbitrary size of bin width. Cross match retrieval and plot is also possible like in the case that the object name is common but its data comes from different papers. For element abundances, customized expressions in the abundances are allowed to retrieve and plot by converting the existing data; for example, [C/N], [C+N/Fe], [Pb+Ba/C], and so on.

The retrieved records from MySQL server are displayed on the browser in table format as shown in Figure 3. Each column represents the checkbox to select data to plot, identifier of the paper, object name, metallicity, the first author of the reference, and the reference code. Each link on entry numbers and object names jumps to the text data extracted from CSV files as mentioned above. The snapshot of plot stage is shown in Figure 4. Viewgraphs drawn in the browser are equipped with simple functions for editing: standard options for Gnuplot such as changing the labels, legends, scales and ranges of the viewgraph. Users can also download figures in various formats (png, eps, ps, and pdf, with color or black and white) and upload data from the form and/or local computers. If you want to edit the viewgraph in detail, the original data and the script for plotting figure can be downloaded from the server. Of course, numerical data are accessible by tracing the link on the data numbers in the left of the list.



	#	Object	[Fe/H]	First Author	Reference
	A0047	BD185550	-2.87	J.Melendez J.A.Johnson M.Spite R.Cayrel D.L.Burris	J.Melendez+,ApJ, 575, 474, 2002 J.A.Johnson+,ApJ, 139, 219, 2002 M.Spite+,AAP, 430, 655, 2005 R.Cayrel+,AAP, 416, 1117, 2004 D.L.Burris+,ApJ, 544, 302, 2000
	A0017	BS16082-129	-2.86	S.Honda	S.Honda+,ApJ, 607, 474, 2004
	A0037	BS16085-0050	-3.1	S.Giridhar	S.Giridhar+,, 113, 519, 2001
	A0017	BS16085-050	-2.91	S.Honda	S.Honda+,ApJ, 607, 474, 2004
	A0022	BS16467-062		D.K.Lai M.Spite R.Cayrel P.François	D.K.Lai+,AJ, 128, 2402, 2004 M.Spite+,AAP, 430, 655, 2005 R.Cayrel+,AAP, 416, 1117, 2004 P.François+,AAP, 403, 1105, 2003
	A0017	BS16469-075	-3.03	S.Honda	S.Honda+,ApJ, 607, 474, 2004
	A0022	BS16477-003		D.K.Lai M.Spite R.Cayrel	D.K.Lai+,AJ, 128, 2402, 2004 M.Spite+,AAP, 430, 655, 2005 R.Cayrel+,AAP, 416, 1117, 2004
	A0025	BS17569-049	-2.88	M.Spite R.Cayrel	M.Spite+,AAP, 430, 655, 2005 R.Cayrel+,AAP, 416, 1117, 2004
	A0025	CD38245	-4.19	M.Spite J.E.Norris R.Cayrel P.François	M.Spite+,AAP, 430, 655, 2005 J.E.Norris+,ApJ, 561, 1034, 2001 R.Cayrel+,AAP, 416, 1117, 2004 P.François+,AAP, 403, 1105, 2003
	A0025	CS22169-035	-3.04	M.Spite S.Giridhar S.Honda R.Cayrel	M.Spite+,AAP, 430, 655, 2005 S.Giridhar+,, 113, 519, 2001 S.Honda+,ApJ, 607, 474, 2004 R.Cayrel+,AAP, 416, 1117, 2004

Figure 3: Snapshot of the retrieval result

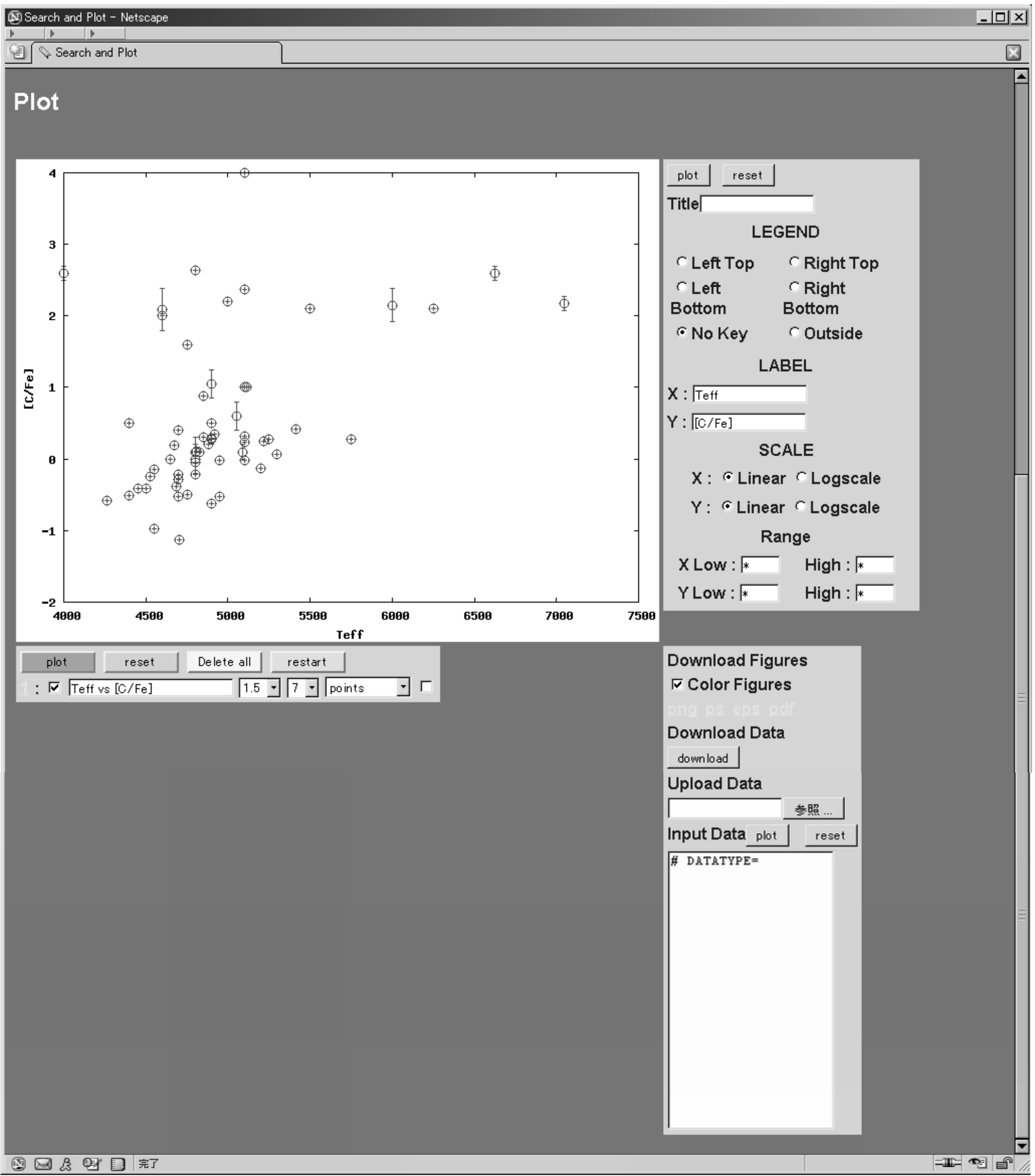


Figure 4: Snapshot of the data plot form

3. Discussion and Future Prospect

Our database system can provide various approaches to the insight into the origin and characteristics of extremely metal-poor stars currently observed by setting possible physical quantities for figure axes. We can see the relations among derived values from different papers, e.g., binary periods from one paper and carbon abundances from another paper, and so on. Some combinations of physical quantities may give new aspects of our understandings of the early universe. Many trials for statistical analyses by using this system are now going on and the test results will be published in a separate paper (Suda et al, in preparation).

This system is expected to contribute to the future observations of metal-poor candidate stars. The observers can check the current knowledge of individual stars and the data needs for further investigations. The consistency of observational data between different authors and observations can also be checked.

We are planning to collaborate with the Japan Virtual Observatory (JVO) project to extend the users to all over the world. JVO is the unified system of databases to retrieve databases simultaneously in many places and in various formats by using special network technology and unique query language. Our system will be one of the astronomical databases which include almost all kinds of objects like stars, galaxies, quasers, X-ray sources, gamma ray bursts, and so on. Our data will add detailed observational information to known catalogues of stars in the Galactic halo.

References

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