JAVA-APPLET FOR RADIO SPECTRA ANALYSIS

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Abstract

New services for Clusters of Galaxies Database created in the Astronomical Institute of SPbU have been constructed. The detailed description of database and its content is available at http://www.astro.spbu.ru/CLUSTERS/.

The information contained in the database can be used for solution of the specific astronomical problems. One of these problems is the researches of radio emission spectra of clusters’ objects. The researches can give help in solution of the problems of origin and evolution of extragalactic radio sources. Spectra of radio galaxies contain important information about radio power in the processes responsible for their activity.

This report presents the software for the database that provides work with radio spectra of extragalactic sources. This client-application has been released as the Java-applet and thus provides a Web based interface that is supported on many operating systems. The facilities of the applet such as approximations of spectra measurement points and calculation of spectral parameters are illustrated in the report. Also we demonstrate new version of the application that realized on Java2 and gave access to additional functions such as printing.

Keywords: astronomical database: radio spectra – analysis: java applet.

1 Introduction

The Web-server of Astronomical Institute of the St-Petersburg University had opened the extended services on assignment of clusters data since 1995. The description of Clusters of Galaxies Database and its content are available at http://www.astro.spbu.ru/CLUSTERS/.

The information contained in the database can be used for solution of the specific astronomical problems. Two big projects - “Identifications of Radio Sources in Clusters of Galaxies” and ”The Study of Radio Emission Spectra of Cluster Radio Sources” those carrying out in Astronomical Institute at present time - use the Clusters of Galaxies Database actively. The second one can give help in solution of the problems of origin and evolution of extragalactic radio sources.

This report presents the client-application for the database that provides work with radio spectra of extragalactic sources. It has been released as a Java-applet and thus provides a Web based interface that is supported on many operating systems. The facilities of the applet such as approximations of spectra measurement points and calculation of spectral parameters are illustrated in the report. Also we demonstrate last version of the Java2 realized application that gives additional functions such as printing.
2 Clusters of Galaxies Database

2.1 Content of the database.

The Clusters of Galaxies Database contains information about objects from ACO catalogue ([1]). For all 4076 rich clusters the Database includes information about the main optical and radio characteristics.

There are many services on the server for the presentation of this database information, for example, the visualization of the cluster galaxies fields, the generation of requests to different astronomical data centers, the calculation of some parameters of the cluster objects.

The Clusters of Galaxies Database has free access to these services and data by Internet. One of the given services is a Java applet for analysis of radio spectrum data.

2.2 Spectra applet access.

User obtains access to Clusters of Galaxies Database (http://www.astro.spbu.ru/CLUSTERS/) by Internet-browser and requests necessary data by the name of the cluster.

The server processes the request and prepares data that user needs. The client receives hypertext document containing links to the various services and data. In particular it has the link [radio spectra 1.2 or 1.1] to a document with Java-applet call. Following this link the client browser requests Java-applet from the server and runs it.

At first the applet loads data from the Database. On theirs receiving user gets capabilities to work with a graph of radio source spectrum, to calculate its spectral characteristics and to change data on the graph and their graphical presentation. At the beginning he can select more comfortable sizes of user-interface widgets by menu options.

3 Main applet functions

Client gets the following functions to work with radio spectra.

The diagram functions.

Spectral data are displayed as a diagram of the dependence of measurement flux densities with their errors on frequency of the observations. Axes of the diagram have logarithmic scale as usual. User can change ranges of the axes and put a coordinate grid. He has an essential possibility to add new spectral points on the graph if necessary and to delete/restore superfluous or non-exact measurements. In this case the approximation uses new points and leaves out of account the deleted points automatically.

Also user can save diagrams as jpg-files on his computer.

The approximation of the spectral data.

The radio spectrum measurement points are approximated by a curve for the calculation of spectral parameters (radio emission power, spectral index and others). The curve type is defined by some general functional dependencies. The least squared method is used for approximation of the spectral data. User can choose one of curve types himself. Also the applet has an automatic option of a choice of the best approximation that has minimum deviation.
from the measurements. The line with spectral index $\alpha = 0.8$ is used as default approximation for only one measurement point. The curve values of frequency, of flux density and of spectral index are displayed by mouse moving along curve in the special GraphInfo window.

**The calculation of the radio emission parameters.**

User can calculate radio luminosity for the selected radio source at any frequency range and the spectral power of the emission at any frequency. As is well known, the calculation of these values for extragalactic radio sources depends on a choice of the cosmological model. So it’s used the most common formulas contained the necessary cosmological parameters, as Hubble constant, deceleration parameter $q_0$, redshift and the comoving frames calculations. The RadioEmission window allows to user to choose these parameters. In principle the applet permits to calculate the spectral parameters for any distant radio source (even for radio source out of database).

**The printing.**

The capability of Java2 enables to realize the printing function. The applet allows to user to print the graph of the radio spectrum. There is a special PrintView window containing the options for the preparing the graph to print. User can choose the parameters of paper (its format, orientation and position of graph) and change a name of graph and axes titles, their colors, fonts and positions. And after diagram preparing it is possible to print the diagram or to save in the jpg-file.

**The help.**

All functions have the detailed descriptions. The help contains a set of hypertext documents, concerned with each other. They are available from the applet and from Cluster Database user interface.

**4 Applet structure**

Java as object-oriented language requires deep analysis of the application domain, flexible organization of the Graphical User Interface (GUI) and their clear interaction with each other under applet construction. During working and maintenance of the applet the authors design the main required functions and three basic versions of the radio spectral applet were realized. The final version of the applet uses the all past experience.

Spectra applet consists of five packages. The main package spectra responds in the initialization of all modules of the applet, its life cycle and stops it. The package spectra.clusterData contains classes to storage parameters of cluster and its objects and to request database information. The module spectra.graphics gives a tool to the interactive work with a graph of a spectrum. The spectra.emission consists of classes used for the calculation the radio emission parameters. The package spectra.print provide the functions for the preparing and the printing a graph of a spectrum. Standard java.awt package is used for the building GUI of the applet.

In general there are about 50 classes in the applet. Classes of the applet may be used as
class library to support other astronomical information systems.

At present there are two versions of the applet on the server of Astronomical Institute those are realized on JDK1.1 and Java2 correspondingly. It was done for useful access to the applet because most of Internet-browsers have the built-in JDK1.1 support still but ones require to install the plug-ins for Java2.

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References

[1] Abell G.O., Corwin H.G., Olowin R.P. 1989, ApJSS, 70, 1.