Spectrum Analyzing X-ray Data Image (FITS) Using Ds9 Program

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Abstract

In this study, data or X-ray images Fixable Image Transport System (FITS) of objects were analyzed, where energy was collected from the body by several sensors; each sensor receives energy within a specific range, and when energy was collected from all sensors, the image was formed carrying information about that body. The images can be transferred and stored easily. The images were analyzed using the DS9 program to obtain a spectrum for each object, an energy corresponding to the photons collected per second. This study analyzed images for two types of objects (globular and open clusters). The results showed that the five open star clusters contain roughly the same materials. The clusters are composed of Carbon, Sodium, Magnesium, Aluminum, Silicon, Phosphorus, Sulfur, Nickel, and Germanium, while globular clusters contain the same elements but differ from the elements in the other type in terms of type and abundance. The three stars cluster contains roughly the same material, Carbon, Silicon, Phosphorus, Nickel, and Germanium, except for a small percentage of Neon that appears in the NGC 6121 stars cluster.

Keywords: *Star clusters, Globular cluster, FITS image, Abundance of Material, Observed Energy.*

Introduction

The Flexible Image Transmission System "FITS" has been used as a data exchange and archiving format for over 30 years; software packages now handle files. Since the last printing of the FITS ("Standard") Format Definition document in 2001, Several new features have been developed and standardized, including support for 64-bit integers in images and arrays, variable-length arrays in paintings, and new words. A coordinate system convention provides an array of physical coordinates in the sky or spectrum [1]. If this quantity exists, the ontological definition could be accepted that star clusters are gravitationally coupled groups of stars in a closed tidal plane, with the two following conditions.

1. dark matter- not dominated

2. at least contains 12 stars. [2]

The question of the star clusters' originality is old. William Herschel first considered this question in the pages of these Transactions as early as 1785, when he deduced the origin of galaxy clusters Messier 80 and Messier 4 Snake Tamer. More than 200 years later, despite significant advances in astronomy, the physical origin of our discovery of star clusters remains largely a mystery. This is partly because star cluster formation is a complex physical process closely related to the process of star formation for which there is no perfect theory. This is how the theoretical understanding of star and cluster formation developed. It relies on obtaining detailed empirical knowledge of these phenomena. For example, consider globular clusters, the most massive star clusters in our galaxy. These star systems are over 12 billion years old and no longer formed in the Milky Way galaxy. Therefore, it is impossible to process study its formation process directly empirically. For open clusters in galaxies, things are pretty good. They typically range in age from 1 Myr to 1 Gyr and require constant training. The Milky Way can, at least in principle, be observed directly as it forms. However, such studies have been seriously hampered by the fact that open star clusters form within molecular clouds and are entirely embedded in molecular gas and dust during their formation and early evolution. They are therefore intercepted at optical wavelengths where conventional astronomical techniques are most effective [3].

Most of the stars in the galactic disk may have been born in embedded star clusters rather than isolated star clusters. This conclusion was drawn by Lada & Lada (1991) after studying the distribution of the young stars in the L1630 molecular cloud of the Orion complex, finding that there is no appreciably dispersed population of young stars. Strom & Merrill (1993) "found a dispersed cluster of about 1500 young stars. Molecular cloud L1641, 7 clusters with 10-50 young stars, and partially embedded clusters with 150 young stars (<1 Myrs) of the stellar objects in the detected clusters appeared to be younger than in the distributed population (5–7 Myrs). This is consistent with the latter originating from now-dissolved aggregates. Nevertheless, the observations point to the dominant star cluster formation Mode remaining suggestive rather than definitive. However, since star formation mainly produces binary stars (as suggested by observations of pre-main-sequence stars), cluster star formation must be the predominant form [4].

The flexible image transport system:

A flexible Image Transmission System "FITS" is A digital file format that aids in storing, transmitting, and processing scientific and other images. The FITS is the most commonly used digital file format in astronomy. Unlike many image formats, FITS was developed specifically for scientific data. The photometric and spatial calibration information has been described, which contains the term and the original metadata of the image [5].

The FITS is commonly used to store non-image data such as spectra, photon lists, data cubes, and structured data such as multi-table databases. The FITS files can contain multiple extensions containing data objects; for example, the same file can save X-ray and infrared images [5]. Astronomers used SAO Image DS9 to process, load and save FITS images as Data cubes, mosaics, arrays, and other formats such as TIFF, JPEG, and PNG. [6]

Stars Clusters Classification

Star clusters can be seen in the sky with the unaided eye. Looking closely, showing that they form separate star clusters in space called star clusters. There are many types, such as:

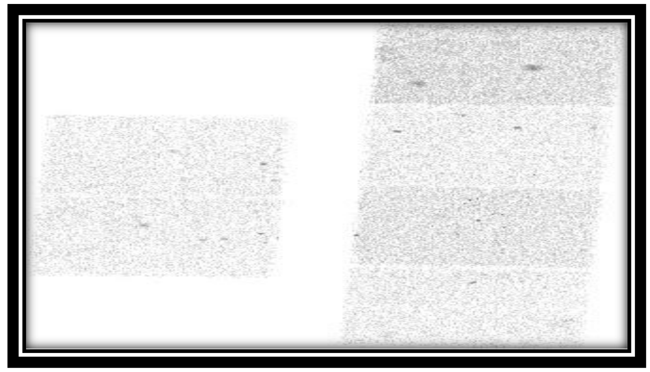
Open Star Clusters: Open clusters typically contain tens to hundreds of stars. The kinetic energies of the cluster constituents, the differential rotation of the Milky Way, and external gravitational perturbations tend to break up open clusters gradually. Still, many of them are pretty permanent. For example, the Pleiades star cluster is hundreds of millions of years old but still reasonably dense [7].

Globular Star Clusters: Globular clusters typically contain about 10^5 stars. Distribution is spherical. It is symmetrical and has a central density of about ten times that of open clusters. Globular clusters are among the oldest stars in the Milky Way galaxy and are essential in studying stellar evolution. The Milky Way galaxy has about 150-200 globular clusters [7].

Methodology:

Data collecting Chandra telescope data was used, and identifying the item's composition was studied at some point in this research—data were stored as a FITS photo. The full x-ray FITS photo of any item was divided into many rectangular areas because the Chandra telescope consists of six sensors in a matrix, every of which gets electricity inside the positive channel. Energy collected from all sensors can be used to get complete information about the object, and the total spectrum of the body SAO image DS9 software was used to load and analyze the FITS image.

Figure (1) the full x-ray image (FITS) of the NGC 6205 stars cluster



Result and Discussion

1-Globular stars cluster

The coordinates of three Globular stars cluster are listed in Table (1)

Table (1): The coordinates of NGC 6205, NGC7089, and NGC6121 stars cluster

Coordinates	NGC 6205	NGC7089	NGC6121
Observation ID	5436	8960	946
RA	16 41 41.50	21 33 29.30	16 23 35.50
Dec	+36 27 37.00	-00 49 23.00	-26 31 31.10
Instruments	ACIS-S	ACIS-S	ACIS-S

Figure 1

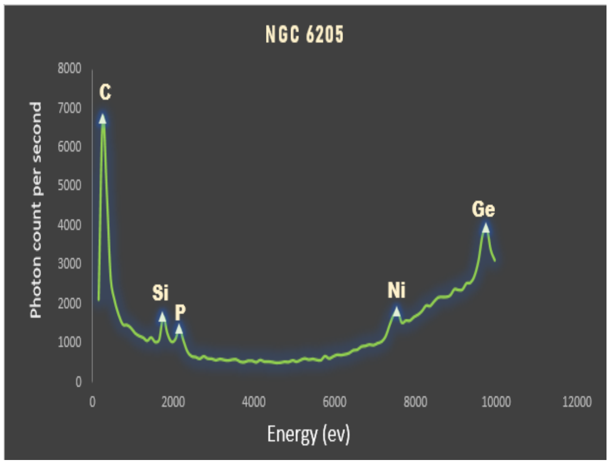


Figure 2

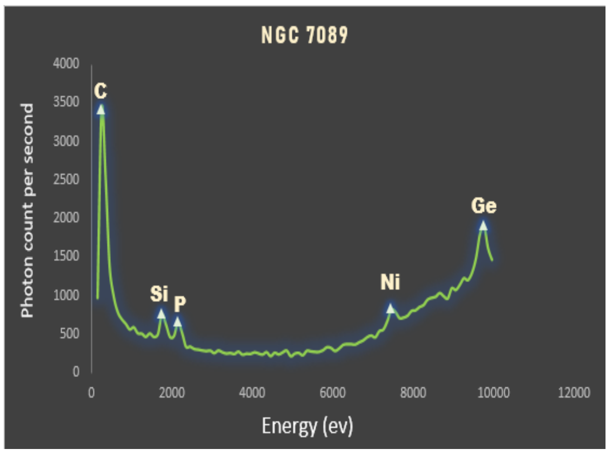
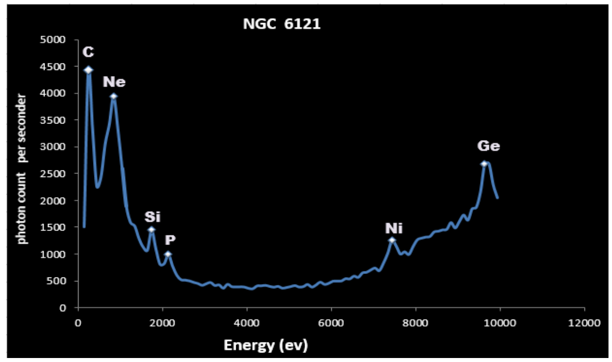


Figure 3



All the Figures in this group are Globular clusters: Fig 1 is the spectrum of NGC 6205; the mean materials found in this cluster were (C, Si, P, Ni, and Ge). Fig 2 is the NGC 7089 spectrum, and it was observed that there are five clear peaks, each representing a specific substance, which was (C, Si, P, Ni, and Ge). Fig 3 is the NGC 6121 spectrum which found six materials (C, Ne, Si, P, Ni, Ge). Table (2) shows that the three stars cluster contains roughly the same material as a star cluster, consisting of Carbon, Silicon, Phosphorus, Nickel, and Germanium. Except for a small amount of Neon, it appears in the star cluster NGC 6121., Table (2) represents the standard and observed energy for the studied object.

Table (2): The results of the primary materials found in the three globular clusters

Material	NGC 6121	NGC 6205	NGC 7089
Carbon	C	C	C
Neon	Ne	-	-
Silicon	Si	Si	Si
Phosphorus	P	P	P
Nickel	Ni	Ni	Ni
Germanium	Ge	Ge	Ge

Table (3): The observed and the standard energy of material found in the three globular clusters

Material	Observed Energy			Standard Energy
	NGC 6121	NGC 6205	NGC 7089	
Carbon	250	250	250	277
Neon	850	-	-	848.6
Silicon	1750	1750	1750	1,739.98
Phosphorus	2150	2150	2150	2,013.7
Nickel	7450	7450	7450	7,478.15
Germanium	9650	9650	9650	9,886.42

Table (4): The abundance of material found in the three globular clusters

Material	Abundance of Material			The Average Of Abundance
	NGC 6121	NGC 6205	NGC 7089	
Carbon	30 %	43 %	45 %	39 %
Neon	27 %	-	-	9 %
Silicon	10 %	11 %	10%	10 %
Phosphorus	7 %	9 %	9 %	8 %
Nickel	8 %	12 %	11 %	11 %
Germanium	18 %	25 %	25 %	23 %

Open star clusters :

Similarly, the open star clusters were studied, and the result is presented below.

Table (5) shows the coordinates M16, NGC 6530, NGC 2244, Trapezium, and IC 348 star clusters.

coordinates	M16	NGC 6530	NGC 2244	Trapezium	IC 348
Observation ID	978	977	3750	3	606
RA	18 18 44.72	18 04 24.00	06 31 55.50	05 35 15.00	03 44 30.00
Dec	-13 47 56.72	-24 21 20.00	+04 56 34.00	-05 23 29.50	+32 08 00.00
Instruments	ACIS-S	ACIS-I	ACI-I	ACIS-S	ACIS-I

Figure 4

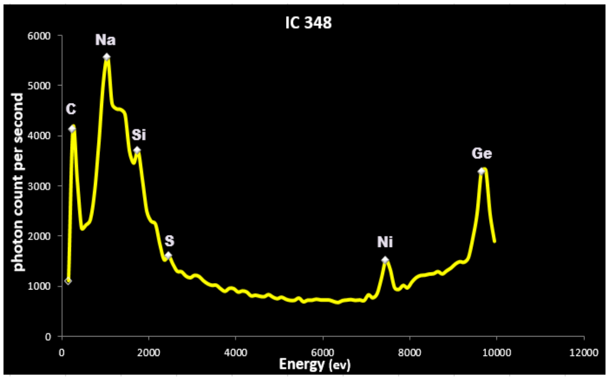


Figure 5

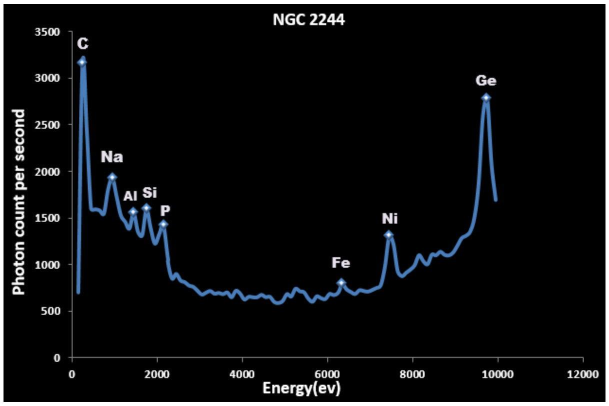


Figure 6

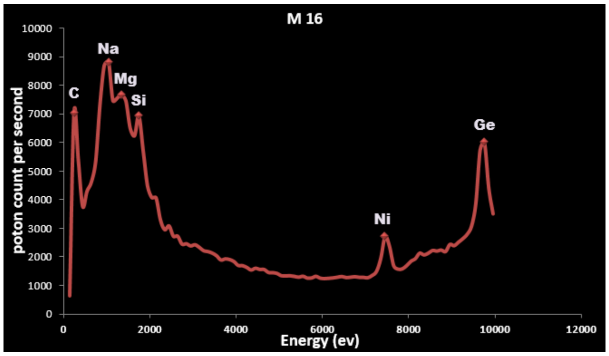


Figure 7

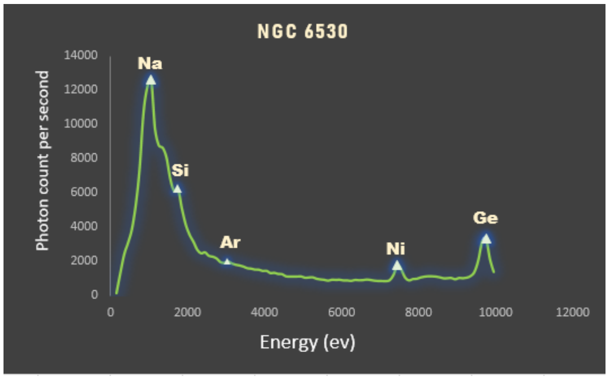
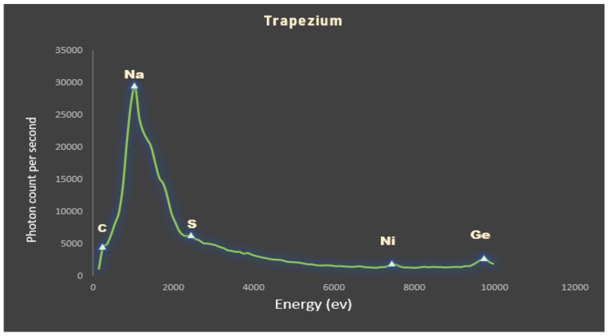


Figure 8



The figures above represent the open clusters spectrums: Fig 4 is a spectrum of IC 348, with six peaks; this peak comes from the materials (C, Na, Si, S, Ni, and Ge). Fig 5 is the NGC 2244 star clusters spectrum; it was observed that there were eight clear peaks, each representing a specific substance, and these substances are (C, Na, Ai, Si, P, Fe, Ni, and Ge). Fig 6 is the Trapezium spectrum; the mean materials found in this cluster were five (C, Na, S, Ni, Ge). Fig 7 M 16 spectrum found six peaks from (C, Na, Mg, Si, Ni, and Ge). Fig 8 was the NGC 6530 spectrum; this cluster has five substances (Na, Si, Ar, Ni, and Ge). The five open star clusters also contain roughly the same materials. The clusters comprise Carbon, Sodium, Magnesium, Aluminum, Silicon, Phosphorus, Sulfur, Nickel and Germanium. The spectrum showed that Sodium, the five-star clusters had the most abundant carbon and sodium element. As seen in the spectrum, the amount of heavy elements of open clusters like Nickel and Germanium is low compared with their abundance in the globular star clusters.

Table (6): The results of the perk for most materials found in the five open clusters

Material	IC 348	M 16	NGC 2244	NGC 6530	Trapezium
Carbon	C	C	C	-	C
Sodium	Na	Na	Na	Na	Na
Magnesium	-	Mg	-	-	-
Aluminum	-	-	Al	-	-
Silicon	Si	Si	Si	Si	-
Phosphorus	-	-	P	-	-
Sulfur	S	-	-	-	S
Argon	-	-	-	Ar	-
Iron	-	-	Fe	-	-
Nickel	Ni	Ni	Ni	Ni	Ni
Germanium	Ge	Ge	Ge	Ge	Ge

Table (7): The absorbed and standard energy of martial

Material	Observed Energy					Standard Energy
	IC 348	M 16	NGC 2244	NGC 6530	Trapezium	
Carbon	250	250	250	-	250	277
Sodium	1050	1050	950	1050	1050	1,040.98

Magnesium	-	1350	-	-	-	1,253.60
Aluminum	-	-	1450	-	-	1,486.70
Silicon	1750	1750	1750	1750	-	1,739.98
Phosphorus	-	-	2150	-	-	2,013.7
Sulfur	2450	-	-	-	2450	2,307.84
Argon	-	-	-	3050	-	2,957.70
Iron	-	-	6350	-	-	6,403.84
Nickel	7450	7450	7450	7450	7450	7,478.15
Germanium	9650	9650	9750	9750	9750	9,886.42

Table (8): Shows the abundance of material found in the five open clusters

Material	**Abundance of material**					**Average abundance**
	IC 348	**M16**	**NGC2244**	**NGC6530**	**Trapezium**	
Carbon	21 %	18 %	22 %	-	10 %	14 %
Sodium	28 %	23 %	13 %	48 %	66 %	36 %
Magnesium	-	19 %	-	-	-	4 %
Aluminum	-	-	11 %	-	-	2 %
Silicon	19 %	18 %	11 %	24 %	-	14 %
Phosphorus	-	-	10 %	-	-	2 %
Sulfur	8 %	-	-	-	14 %	4 %
Argon	-	-	-	8 %	-	2 %
Iron	-	-	5 %	-	-	1 %

Nickel	8 %	7 %	9 %	7 %	4 %	7 %
Germanium	16 %	15 %	19 %	13 %	6 %	14 %

From all the above, it can be noticed that almost all objects studied contain carbon, even at different rates. Also, there was a difference between the observed and standard energy; the spectrum shows that the globular star clusters (NGC 6205, NGC 7089, and NGC 6121) contain the same elements but differ from elements that were found in the open star clusters (M16, NGC 6530, NGC 2244, Trapezium, and IC 348), which also contain the same material. Tables (4) and (8) represent the material abundance in the star clusters under study. The average abundance of elements in the three globular star clusters was Carbon 39%, Neon 9%, Silicon 10%, Phosphorus 8%, Nickel 11%, and Germanium 23%. In comparison, the average abundance of elements in the five open star clusters was Carbon 14%, Sodium 36%, Magnesium 4%, Aluminum 2%, Silicon 14%, Phosphorus 2%, Sulfur 4%, Argon 2%, Nickel 7%, and Germanium 14%. Nickel and Germanium were considered heavy elements, as both abundances in open clusters are less than in globular clusters. Their concentration in open clusters was 7% and 14%, while their concentration in globular clusters was 14% and 23%.

Conclusion:

The FITS images are one of the most critical forms of digital images; they could give excellent results about the composition of objects and elements identification and concentration in the studied shapes. The DS9 program gave a high ability in image analysis and showed excellent results. The three globular star clusters contain roughly the same materials: Carbon, Silicon, Phosphorus, Nickel, and Germanium, due to being all from the same type. The concentration of heavy elements, Nickel and Germanium, in globular clusters was higher than in the open clusters because the globular clusters were old and their stars were old, so their elements were heavy. There was a difference between observed and standard energies; observed objects were in motion and shifted wavelengths. Noticing that the elements, Carbon and Sodium, were the most abundant in the open clusters spectrum. Because its stars were young, the concentration of light elements was high.

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