

Любительские наблюдения
объектов далекого космоса

Обработка астрофотографии

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Обработка астрофотографии

Основные графические форматы в любительской астрофотографии:

- JPEG
- TIFF
- RAW
- FITS

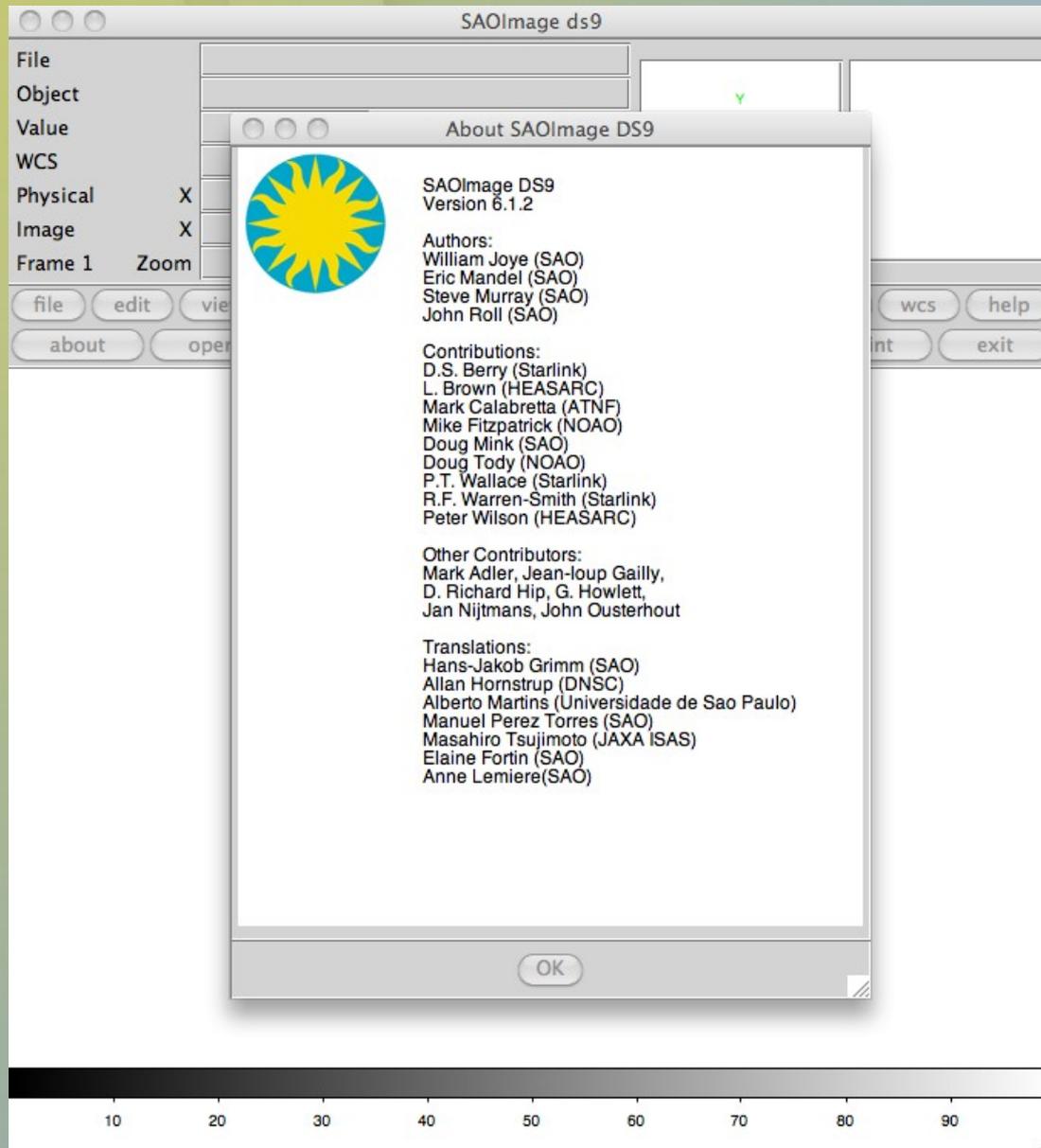
Обработка астрофотографии

FITS - Flexible Image Transport System (Гибкая Система Передачи Изображений) - цифровой формат файлов используемый в науке для хранения, передачи и редактирования изображений и их метаданных. Чаще всего FITS используется в астрономии. В отличие от других форматов изображений, FITS разработан специально для научных данных и потому включает в себя метаданные, описывающие информацию о фотометрической и пространственной калибровке, вместе с метаданными исходного изображения.

Подробнее на <http://ru.wikipedia.org/wiki/FITS>

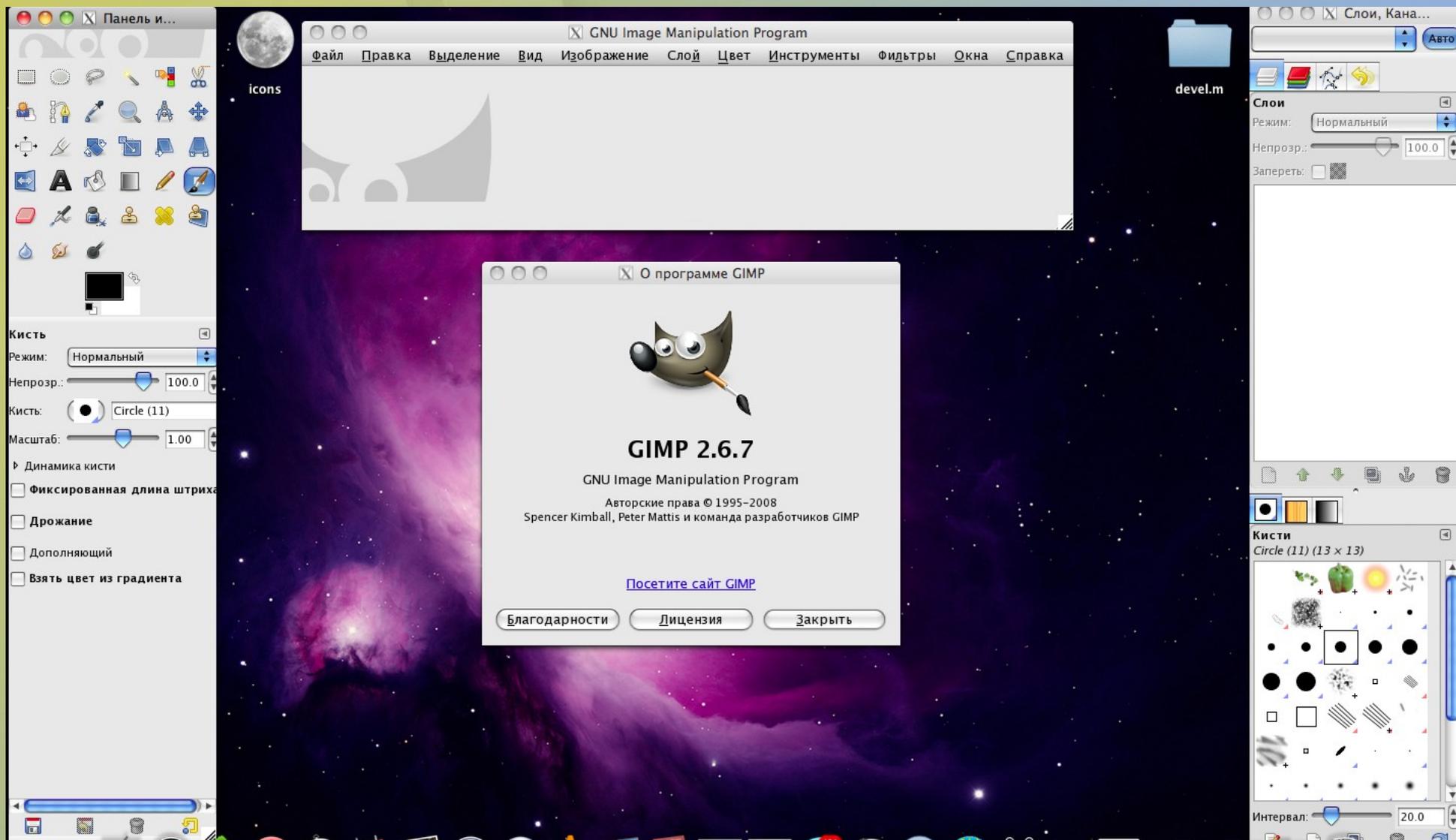
Обработка астрофотографии

SAOImage DS9 - <http://hea-www.harvard.edu/RD/ds9/>



Обработка астрофотографии

GIMP - <http://www.gimp.org/>



Обработка астрофотографии

Источники получения FITS-изображений:

- **Bradford Robotic Telescope**
- Faulkes Telescopes
- Chandra X-ray Observatory
- ...

или

- Aladin, VirGO, SkyView, Chandra Chaser...

Обработка астрофотографии

Bradford Robotic Telescope - <http://www.telescope.org/>

BRADFORD ROBOTIC TELESCOPE



search

Bradford Robotic Telescope

The Bradford Robotic Telescope is a collection of telescopes and other instruments on Mount Teide, Tenerife. It is free to use for all, using this web site. For more information, [click here](#).



Gallery Image



MESSIER 17, avg. rating 8.8

Login

Username
alexwolf

Password

Login

Forgotten your details?
[Click here](#)

[Click here to register for a new account](#)



Learn with the Robotic Telescope

schools.telescope.org

[Click here to find out more](#)

Information

- [News and Current Status](#) - What's going on?
- [First Contact!](#) - See what you can see
- [Reviews And Articles](#) - What do *they* say?
- [Telescope Images gallery](#) - The telescope's work
- [Photo gallery](#) - What does it really look like?
- [Forum](#) - Type your mind
- [Help us by donating!](#) And More...

Tenerife Site

The Tenerife site reports the weather is bad for observing.

- [Web cams](#)
- [Weather](#)
- [Real time data](#)
- [Site information](#)



© Sep 2010 10:50:02 400/200 1/3 601 Tenerife Teide-Com

Обработка астрофотографии

Анкета регистрации на BRT - <http://telescope.org/signup/signup.php>

BRADFORD ROBOTIC TELESCOPE

BRRT

search

Login

Username
alexwolf

Password
.....

Login

Forgotten your details? [Click here](#)

[Click here to register for a new account](#)

Main Menu

- Main page
- System status
- Real time data
- Weather
- Image gallery
- Information
- Photo galleries
- Webcams
- Statistics
- Forums
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- Contact us

Account Registration

Welcome to the Bradford Robotic Telescope!

We would like to collect some information from you in order to set up your account. Some of the information will be used in anonymous statistics to support the objectives of persuading our sponsors that the Bradford Robotic Telescope is excellent use of the resources that they provide. This information will only be held as long as is necessary. The Bradford Robotic Telescope is completely free to use.

Answers are required for questions marked with a red asterisk (*).

Please tick any that apply. Are you: *

- A lay person interested in astronomy
- A school student
- A 21st Century Science student
- A university or college student
- A teacher
- A parent helping a student learn
- An amateur astronomer
- A researcher
- An alien from another planet checking up on home

How did you hear about the Bradford Robotic Telescope?

- A search engine:
- Other - please enter:
- A magazine article, please enter the magazine name:
- A newspaper article:
- Other - please enter:
- A TV programme
- A radio programme
- Word of mouth
- Bradford University web site
- Astronomy web site

Обработка астрофотографии

Персональное меню BRT (Справа – управление классом)

The screenshot shows the Telescope.org Personal Menu interface. At the top left, it says "BRADFORD ROBOTIC TELESCOPE" and features the BRT logo. A search bar is located at the top right. The main content area is divided into several sections: "Welcome" with a greeting for alexwolf and a login timestamp; "Your account" with a link to "Edit your details"; "Your Observation Requests" with links for "Your Requests" and "Submit a job request"; "Other Observations" with links for "Search the telescope jobs database" and "View the gallery"; "Weather Data" with a link for "Weather data viewer"; "Teachers' Pages" with links for "Teachers' overview of Learningscope Educational Material" and "List your groups"; and "Educational Activities" with a link for "Learningscope programme". A "Log out" button is located at the bottom left. A vertical navigation menu on the left side includes links for "Main page", "System status", "Real time data", "Weather", "Image gallery", "Information", "Photo galleries", "Webcams", "Statistics", "Forums", "Project news", and "Contact us".

BRADFORD ROBOTIC TELESCOPE

BRT

search

Welcome
- Hello alexwolf
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[Your Requests](#)
[Log out](#)

Main Menu
[Main page](#)
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Telescope.org Personal Menu
Greetings Alexander V. Wolf! You last logged In on the 26 September 2010 at 09:57, from 178.187.74.62.

Your account
[Edit your details](#)

Your Observation Requests
[Your Requests](#)
[Submit a job request](#)

Other Observations
[Search the telescope jobs database](#)
[View the gallery](#)

Weather Data
[Weather data viewer](#)

Teachers' Pages
[Teachers' overview of Learningscope Educational Material](#)
[List your groups](#)

Educational Activities
[Learningscope programme](#)

Log out
[Log out](#)

Обработка астрофотографии

Управление группами в BRT

BRADFORD ROBOTIC TELESCOPE

BRT

search

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Your Groups

Group ID: 1634
Group Name: BarnaulOG
Description: Barnaul Observer Group
Creation date: 01/10/09
There is no joining password assigned to this group. Nobody can join this group at the moment. To assign a password so that people can join the group, click 'assign password'.
[View group](#) | [Assign password](#) | [Create student accounts](#)

Group ID: 1657
Group Name: AltSPA-OG
Description: Altai State Pedagogical Academy Observers Group
Creation date: 23/10/09
There is no joining password assigned to this group. Nobody can join this group at the moment. To assign a password so that people can join the group, click 'assign password'.
[View group](#) | [Assign password](#) | [Create student accounts](#)

Times on this page are in current British time, which is currently 11:02:57 and is GMT +1 hour

[Create a new group](#)

Обработка астрофотографии

Просмотр участников групп и их задач в BRT

The screenshot displays the BRT website interface. At the top left, the text 'BRADFORD ROBOTIC TELESCOPE' is visible above the BRT logo. A search bar is located in the top right corner. The left sidebar contains a navigation menu with the following items: Welcome, Your Menu, Your Requests, Log out, Main Menu, Main page, System status, Real time data, Weather, Image gallery, Information, Photo galleries, Webcams, Statistics, Forums, Project news, and Contact us. The main content area is titled 'Group Members' and provides details for Group ID: 1634, Group Name: BarnaulOG, Description: Barnaul Observer Group, and Creation date: 01/10/09. Below this, a table lists group members with columns for checkboxes, User ID, Username, Real name, Edit user, and List jobs. Two users are listed: sanek (User ID 56999) and alekap (User ID 56995). A button labeled 'Create new passwords for ticked accounts' is positioned below the table, and a link 'Back to groups list' is at the bottom of the main content area.

BRADFORD ROBOTIC TELESCOPE

BRT

search

Welcome
- Hello alexwolf
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Log out

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Main page
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Group Members

Group ID: 1634
Group Name: BarnaulOG
Description: Barnaul Observer Group
Creation date: 01/10/09

	<u>User ID</u>	<u>Username</u>	<u>Real name</u>	<u>Edit user</u>	<u>List jobs</u>
<input type="checkbox"/>	56999	sanek	Alexander Saveliev	Edit user	User's jobs
<input type="checkbox"/>	56995	alekap	Alexander Kaplinsky	Edit user	User's jobs

Create new passwords for ticked accounts

[Back to groups list](#)

Обработка астрофотографии

Список задач и их статус

BRADFORD ROBOTIC TELESCOPE



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Your observation requests

RID	Object Type	Object ID	Object Name	Status	Comment
R214304	SSBODY	JUPITER	The Planet Jupiter	Waiting	
R214269	MESSIER	82	The Cigar Galaxy	Waiting	
R214265	SSBODY	JUPITER	The Planet Jupiter	Waiting	
R214260	MESSIER	56		Waiting	
R214259	MESSIER	22		Waiting	
R214258	MESSIER	20	The Triffid Nebula	Waiting	
R214257	MESSIER	16	Part of the Eagle Nebula	Waiting	
R214256	MESSIER	15		Waiting	
R214255	MESSIER	13	The Great Hercules Globula Cluster	Waiting	
R214254	MESSIER	4		Complete	
R214253	MESSIER	6	The Butterfly Cluster	Waiting	
R214252	MESSIER	8	The Lagoon Nebula	Waiting	
R214251	MESSIER	11	The Wild Duck Cluster	Waiting	
R214250	MESSIER	82	The Cigar Galaxy	Complete	
R214249	MESSIER	3		Waiting	
R214248	MESSIER	2		Waiting	
R214247	SSBODY	JUPITER	The Planet Jupiter	Complete	
R213936	SSBODY	JUPITER	The Planet Jupiter	Invalid	
R213935	SSBODY	JUPITER	The Planet Jupiter	Waiting	
R213932	SSBODY	JUPITER	The Planet Jupiter	Complete	
R213929	SSBODY	URANUS	The Planet Uranus	Complete	
R213928	SSBODY	URANUS	The Planet Uranus	Waiting	
R213927	SSBODY	JUPITER	The Planet Jupiter	Waiting	
R203515	SSBODY	SATURN	The Planet Saturn	Complete	
R203514	RADEC	04:26:49.00 +48:14:00.00 C/2009 R1 (McNaught)		Complete	
R200224	SSBODY	URANUS	The Planet Uranus	Complete	
R184707	SSBODY	MOON	The Moon	Complete	
R183059	SSBODY	SATURN	The Planet Saturn	Complete	
R183057	MESSIER	97	The Owl Nebula	Complete	
R183056	NGC	2392		Complete	
R183055	IC	2177		Complete	

Обработка астрофотографии

Создание заявки на снимок объекта на BRT

BRADFORD ROBOTIC TELESCOPE

BRT

search

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Submit A Request To The Telescope

Part 1 - What to observe

Object Type	Not yet selected, click change >>>	
Object ID	Not yet selected, click change >>>	
Object Name	Not yet selected, click change >>>	Change

Part 2 - Telescope selection

Telescope Type	Auto select	
Telescope ID	Auto select	
Telescope Name	Auto select	

Part 3 - Other Information

Filter selection	Not selected yet	
Exposure Time	Not selected yet	
Dark Frame	Not selected yet	
Job comments	None	

Submit request Clear request

Обработка астрофотографии

Выбор объекта из предложенного списка или ввод его координат

The screenshot shows the website for the Bradford Robotic Telescope. At the top left, it says 'BRADFORD ROBOTIC TELESCOPE' and features a logo with the letters 'BRT' and three dots. A search bar is located at the top right with the text 'search'. On the left side, there is a navigation menu with the following items: 'Welcome - Hello alexwolf', 'Your Menu', 'Your Requests', 'Log out', 'Main Menu', 'Main page', 'System status', 'Real time data', 'Weather', 'Image gallery', 'Information', 'Photo galleries', 'Webcams', 'Statistics', 'Forums', 'Project news', and 'Contact us'. The main content area is titled 'Object Type Selection' and contains the instruction 'Choose a type of object to observe:'. Below this, there is a list of object types, each with a 'Select...' button: 'A constellation', 'The Moon or a planet in our solar system', 'A well known galaxy, nebula or cluster', 'A Messier object', 'An SAO Catalogue object', 'An NGC Catalogue object', 'An IC Catalogue object', 'Specify RA and DEC coordinates', and 'Other objects'. A 'Back' button is located at the bottom left of the main content area.

BRADFORD ROBOTIC TELESCOPE

Object Type Selection

Choose a type of object to observe:

- A constellation
- The Moon or a planet in our solar system
- A well known galaxy, nebula or cluster
- A Messier object
- An SAO Catalogue object
- An NGC Catalogue object
- An IC Catalogue object
- Specify RA and DEC coordinates
- Other objects

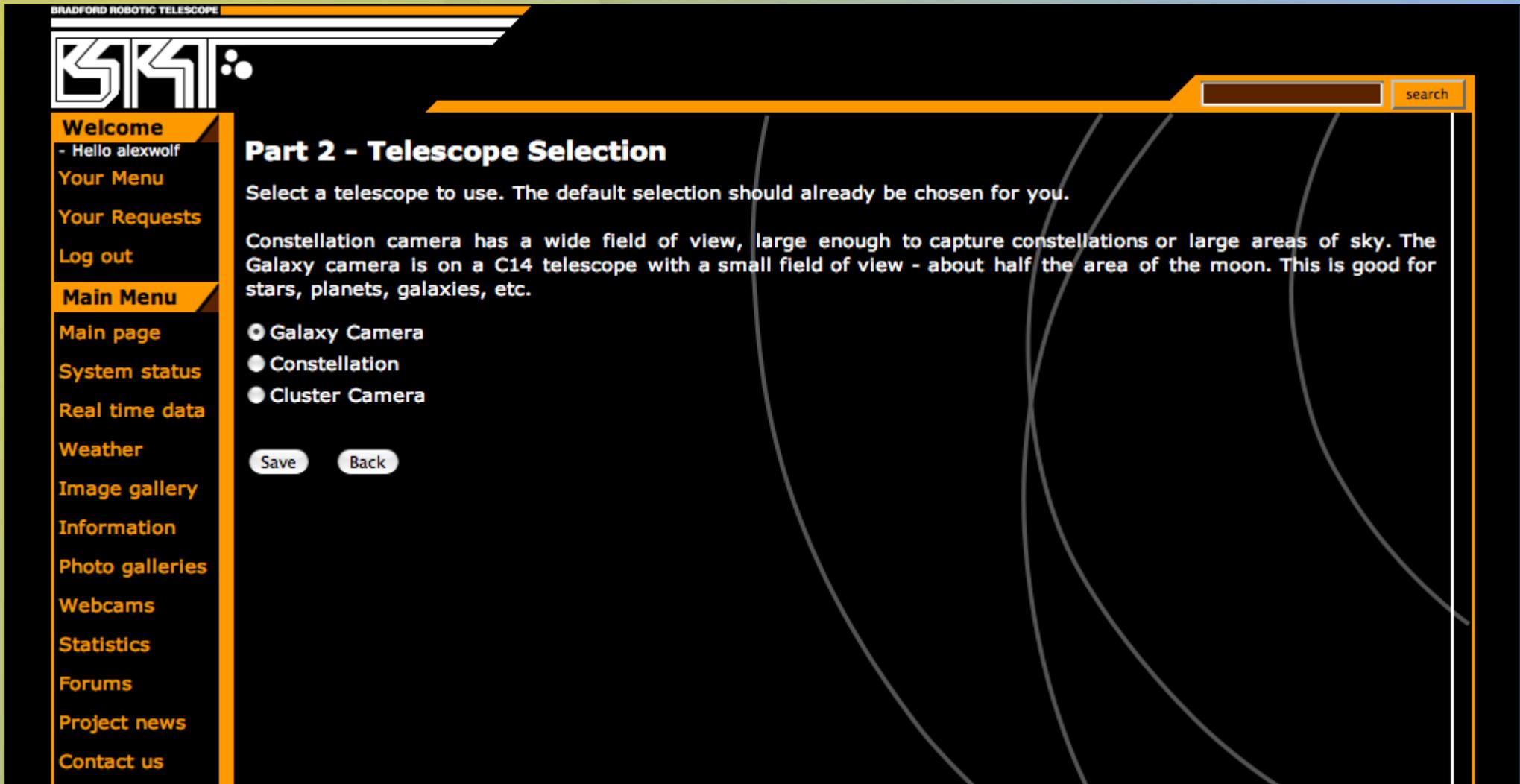
Обработка астрофотографии

Выбор объекта из каталога Мессье

●	31	Andromeda	The Andromeda Galaxy
●	32	Andromeda	Satellite galaxy of Andromeda
●	33	Triangulum	The Triangulum Galaxy
●	34	Perseus	
●	35	Gemini	
●	36	Auriga	
●	37	Auriga	
●	38	Auriga	
●	39	Cygnus	
●	40	Ursa Major	Winecke 4
●	41	Canis Major	
○	42	Orion	The Great Orion Nebula
●	43	Orion	Part of the Orion Nebula, de Mairan's Nebula
●	44	Cancer	Praesepe, The Beehive Cluster
●	45	Taurus	The Pleiades
●	46	Puppis	
●	47	Puppis	
●	48	Hydra	
●	49	Virgo	
●	50	Monoceros	
●	51	Canes Venatici	The Whirlpool Galaxy
●	52	Cassiopeia	

Обработка астрофотографии

Выбор камеры на BRT



The screenshot shows the website interface for the Bradford Robotic Telescope (BRT). The page is titled "Part 2 - Telescope Selection". The left sidebar contains a navigation menu with the following items: Welcome, Your Menu, Your Requests, Log out, Main Menu, Main page, System status, Real time data, Weather, Image gallery, Information, Photo galleries, Webcams, Statistics, Forums, Project news, and Contact us. The main content area displays the following text:

Part 2 - Telescope Selection

Select a telescope to use. The default selection should already be chosen for you.

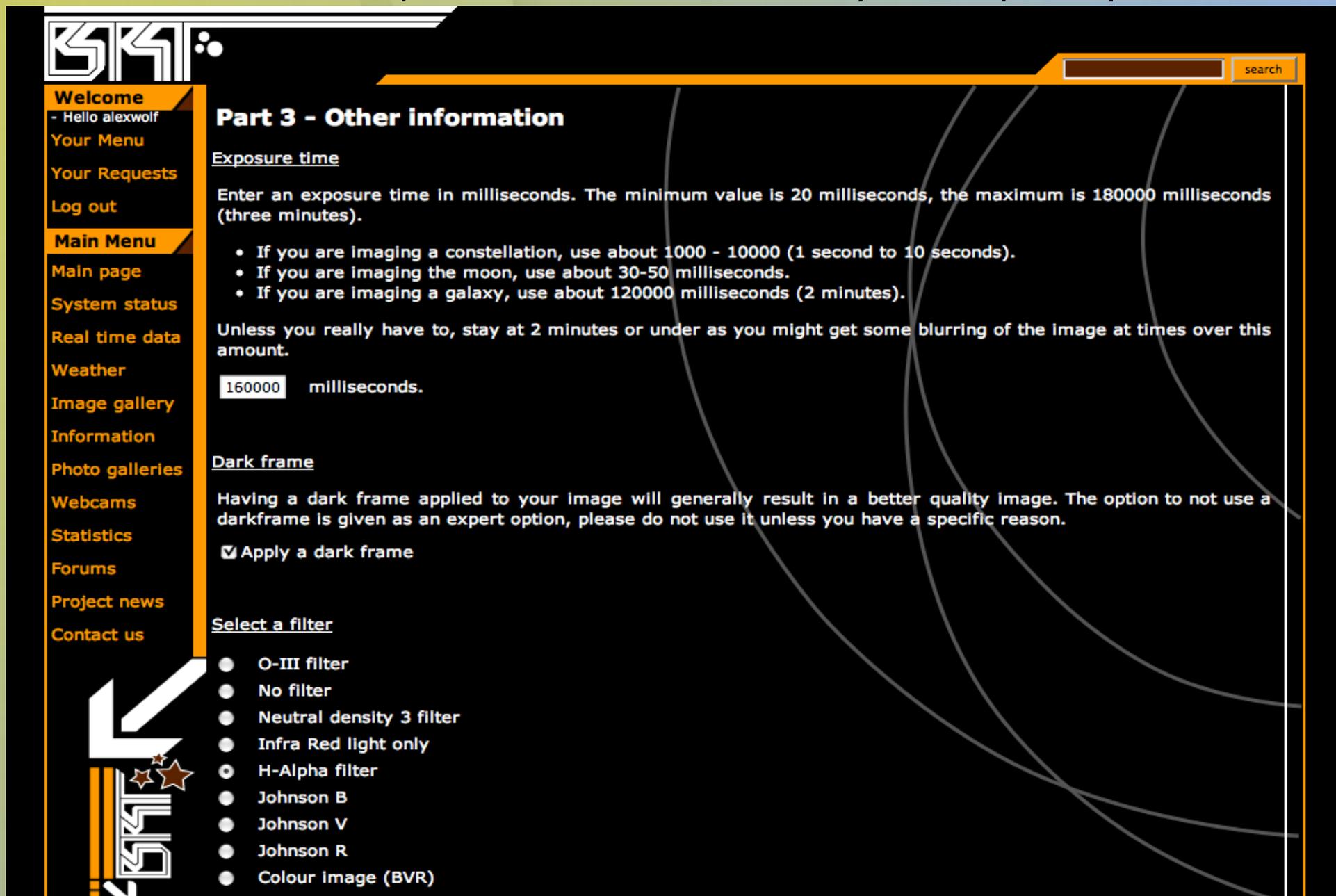
Constellation camera has a wide field of view, large enough to capture constellations or large areas of sky. The Galaxy camera is on a C14 telescope with a small field of view - about half the area of the moon. This is good for stars, planets, galaxies, etc.

Galaxy Camera
 Constellation
 Cluster Camera

Save Back

Обработка астрофотографии

Задание выдержки снимка и используемых фильтров



Part 3 - Other information

Exposure time

Enter an exposure time in milliseconds. The minimum value is 20 milliseconds, the maximum is 180000 milliseconds (three minutes).

- If you are imaging a constellation, use about 1000 - 10000 (1 second to 10 seconds).
- If you are imaging the moon, use about 30-50 milliseconds.
- If you are imaging a galaxy, use about 120000 milliseconds (2 minutes).

Unless you really have to, stay at 2 minutes or under as you might get some blurring of the image at times over this amount.

milliseconds.

Dark frame

Having a dark frame applied to your image will generally result in a better quality image. The option to not use a darkframe is given as an expert option, please do not use it unless you have a specific reason.

Apply a dark frame

Select a filter

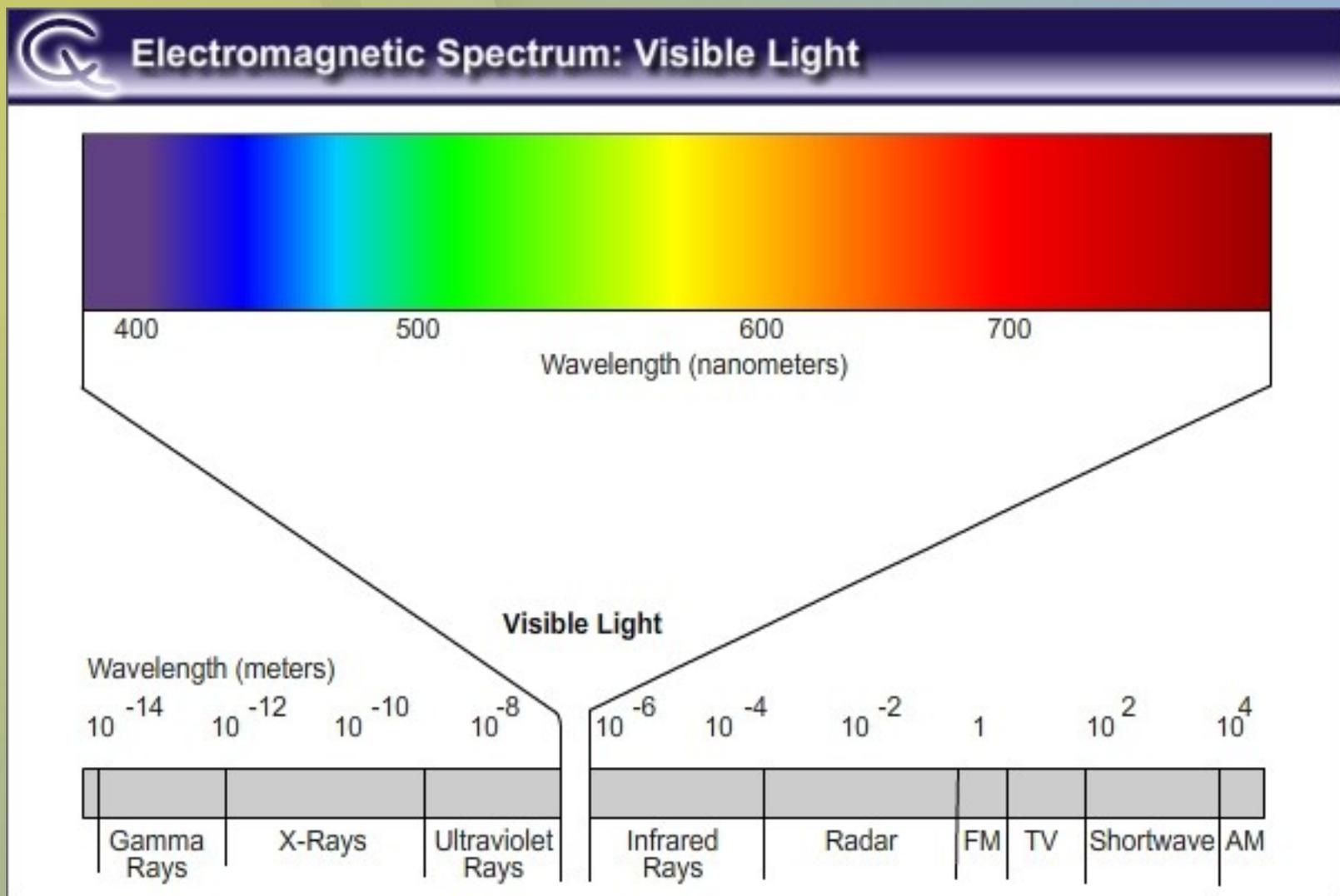
- O-III filter
- No filter
- Neutral density 3 filter
- Infra Red light only
- H-Alpha filter
- Johnson B
- Johnson V
- Johnson R
- Colour Image (BVR)

Navigation Sidebar:

- Welcome
- Hello alexwolf
- Your Menu
- Your Requests
- Log out
- Main Menu
- Main page
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- Contact us

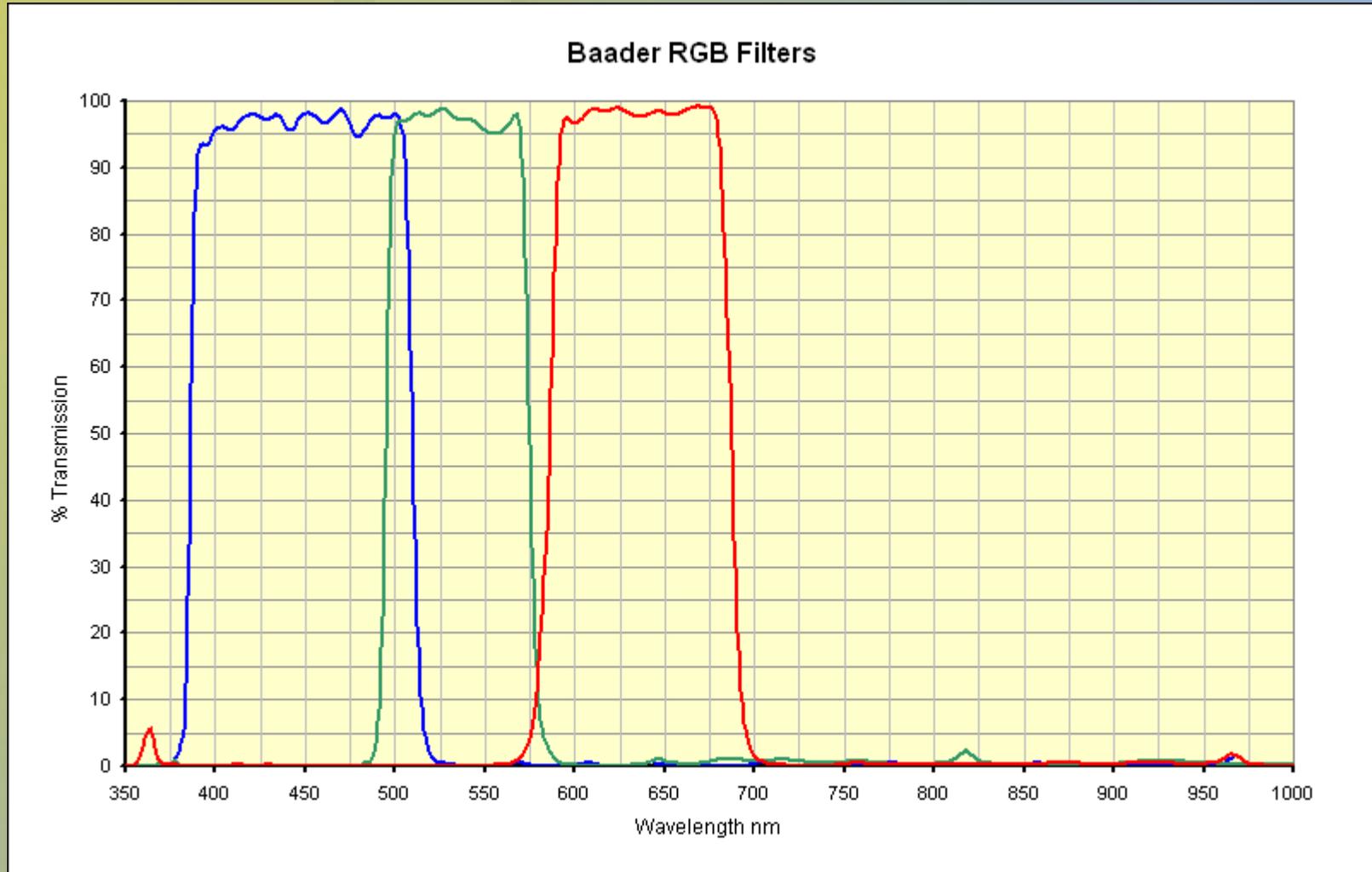
Обработка астрофотографии

Длины волн лучей видимого спектра



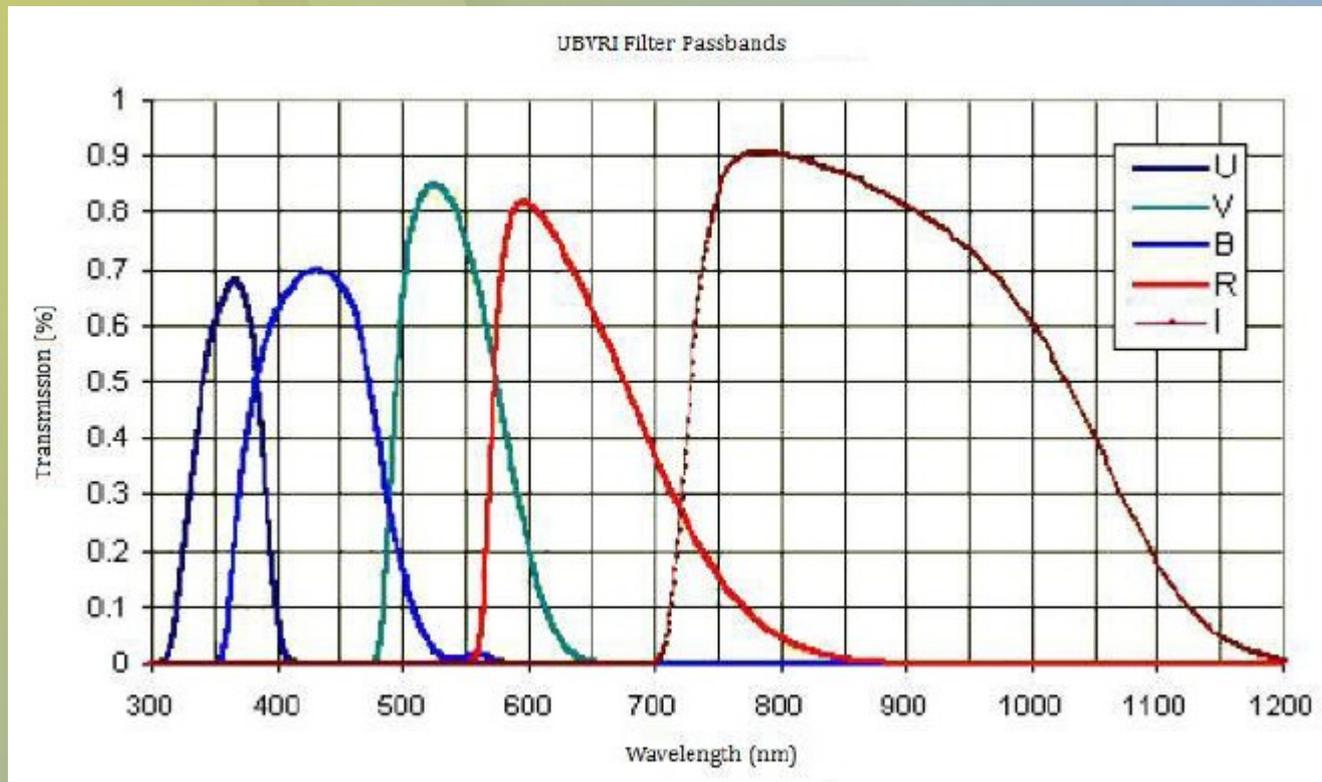
Обработка астрофотографии

Полосы пропускания цветных фотографических фильтров (RGB)



Обработка астрофотографии

Полосы пропускания цветных фотометрических фильтров (BVR)



Обработка астрофотографии

Обработка M82, полученной на Bradford Robotic Telescope 10 сент.

The screenshot shows the Bradford Robotic Telescope (BRT) website interface. The top navigation bar includes the BRT logo and a search box. A left sidebar contains a 'Main Menu' with links to various site features. The main content area is titled 'Your Request' and displays details for request R214250, which is for observing the Cigar Galaxy (M82). Below this, the 'View Image' section offers four different ways to view the image: JPEG, Java Applet, 3D FITS file, and 3x 2D FITS file zip.

BRADFORD ROBOTIC TELESCOPE

BRT

search

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Your Request

Request ID	R214250
Job ID	J111365
Object Type	MESSIER
Object ID	82
Object Name	The Cigar Galaxy
Exposure Time	120000 ms
Filter Type	Colour
Dark frame	Instant
Site Name	Tenerife
Telescope Type Name	Galaxy
Telescope Name	Galaxy Camera
Request Time	03:23 on Friday 10 September 2010 (02:23:03 UTC)
Completion Time	06:25 on Friday 10 September 2010 (05:25:21 UTC)
Comments	
Status	Complete

View Image

Choose a way of seeing your image. If you are unsure, choose one of the first two options, JPEG or Java Applet.

JPEG See the image in your browser. Quick and easy, but may not show the best results.

Java Applet Use a Java applet to play with the image settings to bring out the object.

3D FITS file Download image as a FITS file. You will need FITS viewing software on your computer to use this file. If the observation is a colour observation, the file will be a 3 dimensional data set.

3x 2D FITS file zip Same as above, except you get a zip file containing 3 2D FITS files for software that doesn't understand 3D FITS data.

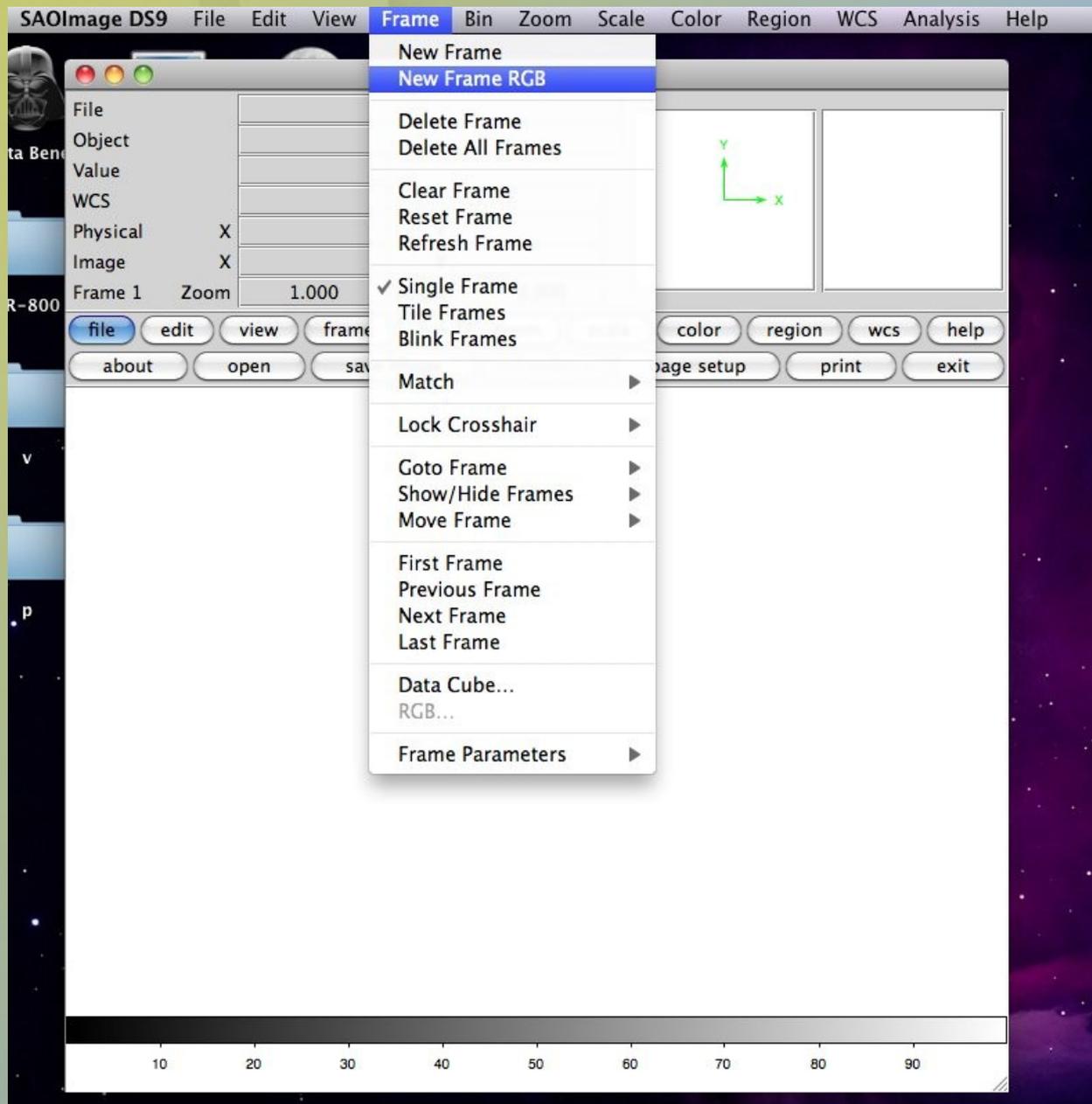
Обработка астрофотографии

Снимок M82 в JPEG, без обработки



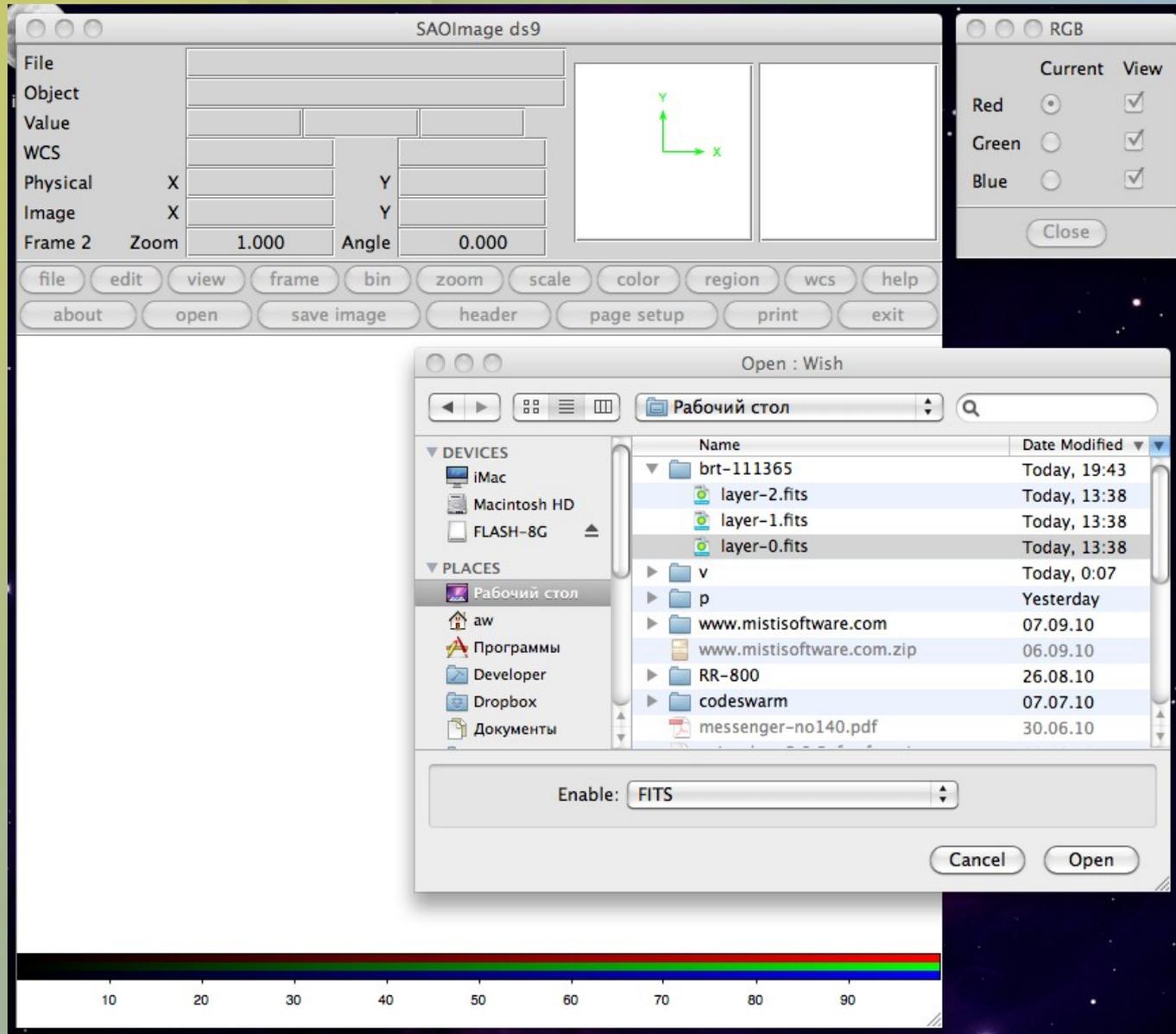
Обработка астрофотографии

Создаем в SAOImage DS9 RGB-фрейм и...



Обработка астрофотографии

...открываем в нём файлы как цветные каналы.



Обработка астрофотографии

Красный канал с линейным распределением цвета

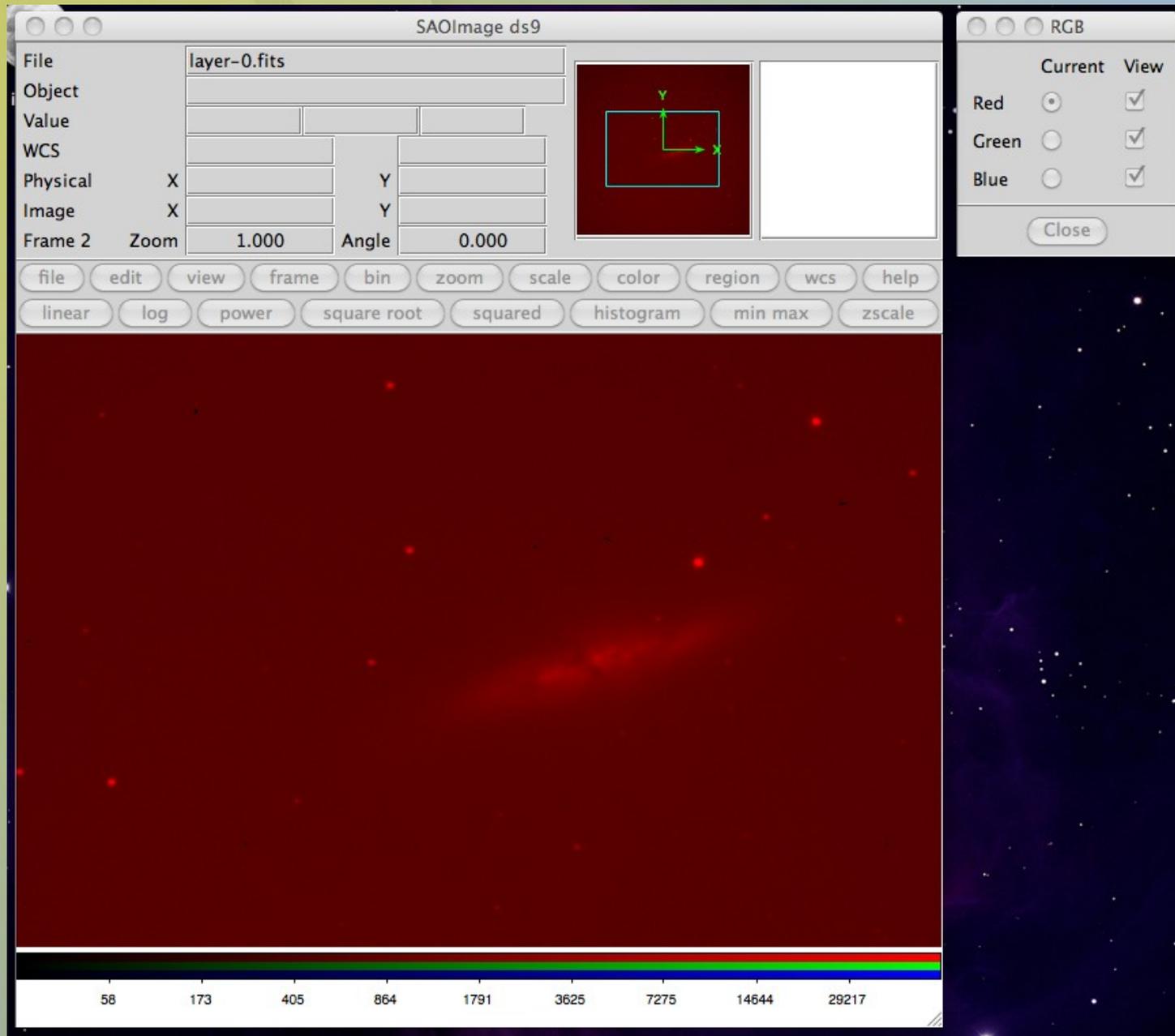
The image shows a screenshot of the SAOImage ds9 software interface. The main window, titled "SAOImage ds9", displays a large astronomical image with a red channel. The image shows a dark field with several bright red stars. A green box highlights a region of interest in the upper left quadrant, with a green crosshair indicating the center. The interface includes a menu bar with options like "file", "edit", "view", "frame", "bin", "zoom", "scale", "color", "region", "wcs", and "help". Below the menu bar are several buttons for image processing: "linear", "log", "power", "square root", "squared", "histogram", "min max", and "zscale". The "linear" button is currently selected. The status bar at the bottom shows pixel coordinates: 5812, 11624, 17494, 23306, 29175, 34987, 40799, 46669, and 52481. To the right of the main window is a smaller window titled "RGB" with a "Close" button. This window has a "Current" column and a "View" column. The "View" column has checkboxes for "Red", "Green", and "Blue", all of which are checked.

File	layer-0.fits			
Object				
Value	503			
WCS				
Physical X	861.000	Y	518.000	
Image X	861.000	Y	518.000	
Frame 2	Zoom	1.000	Angle	0.000

	Current	View
Red	<input checked="" type="radio"/>	<input checked="" type="checkbox"/>
Green	<input type="radio"/>	<input checked="" type="checkbox"/>
Blue	<input type="radio"/>	<input checked="" type="checkbox"/>

Обработка астрофотографии

Красный канал с логарифмическим распределением цвета



Обработка астрофотографии

Красный канал с power-распределением цвета

The screenshot displays the SAOImage ds9 software interface. The main window, titled "SAOImage ds9", shows a large black image with a few red stars. A green box highlights a region of interest, and a green crosshair is visible. The interface includes a menu bar with options like "file", "edit", "view", "frame", "bin", "zoom", "scale", "color", "region", "wcs", and "help". Below the menu bar are buttons for "linear", "log", "power", "square root", "squared", "histogram", "min max", and "zscale". The "power" button is highlighted, indicating the current color distribution. The status bar at the bottom shows pixel coordinates: 38921, 44729, 48164, 50578, 52469, 53999, 55294, 56427, and 57416.

On the right side, there is a panel titled "RGB" with a "Close" button. It has a table for color selection:

	Current	View
Red	<input checked="" type="radio"/>	<input checked="" type="checkbox"/>
Green	<input type="radio"/>	<input checked="" type="checkbox"/>
Blue	<input type="radio"/>	<input checked="" type="checkbox"/>

Обработка астрофотографии

Красный канал с квадратным распределением цвета

The image shows the SAOImage ds9 software interface. The main window displays a dark astronomical image with a few bright spots. A small inset window shows a green square with a coordinate system (X and Y axes). The interface includes a menu bar (File, Object, Value, WCS, Physical, Image, Frame 2, Zoom, Angle) and a toolbar with various processing options (file, edit, view, frame, bin, zoom, scale, color, region, wcs, help, linear, log, power, square root, squared, histogram, min max, zscale). A color calibration panel on the right is titled 'RGB' and shows the 'Current' and 'View' settings for Red, Green, and Blue channels. The 'View' checkboxes for Red, Green, and Blue are all checked. A 'Close' button is located below the color calibration panel. At the bottom of the main window, there is a color calibration bar with numerical values: 18407, 26031, 31934, 36859, 41240, 45161, 48768, 52158, 55311.

Channel	Current	View
Red	<input checked="" type="radio"/>	<input checked="" type="checkbox"/>
Green	<input type="radio"/>	<input checked="" type="checkbox"/>
Blue	<input type="radio"/>	<input checked="" type="checkbox"/>

Обработка астрофотографии

Красный канал с квадратичным распределением цвета

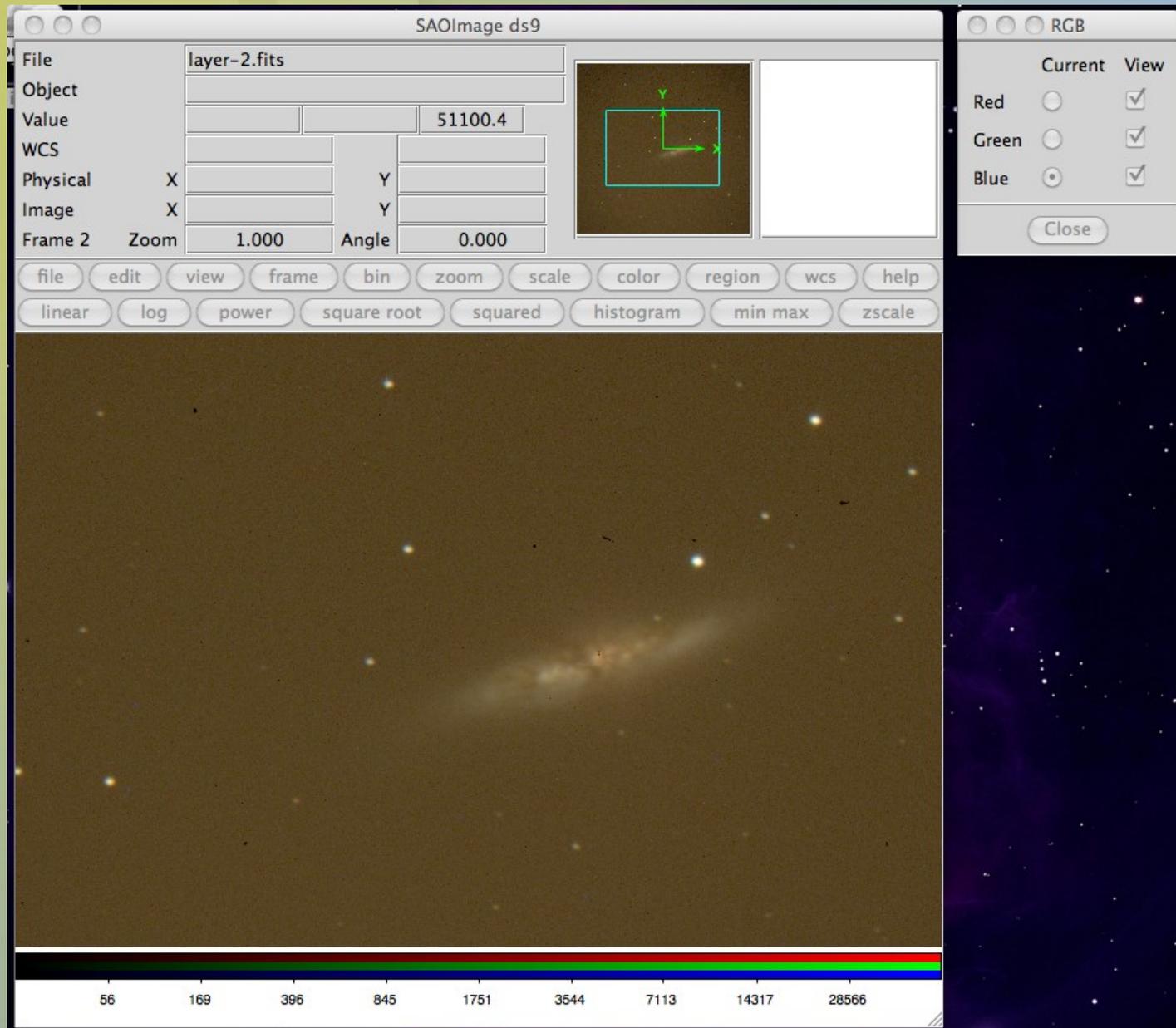
The screenshot displays the SAOImage ds9 interface. The main window shows a dark astronomical image with a red channel selected. A color calibration bar is visible at the bottom, with numerical values: 580, 2318, 5250, 9318, 14602, 20999, 28556, 37362, 47248. The interface includes a menu bar with options like file, edit, view, frame, bin, zoom, scale, color, region, wcs, help, and a toolbar with various processing options like linear, log, power, square root, squared, histogram, min max, and zscale. A metadata panel on the left shows details for 'layer-0.fits', including Object, Value (465), WCS, Physical X (846.000), Y (324.000), Image X (846.000), Y (324.000), Frame 2, Zoom (1.000), and Angle (0.000). A small inset window shows a green square with a coordinate system. A separate window on the right shows the RGB color calibration settings, with Red, Green, and Blue channels all checked under the 'View' column.

File	layer-0.fits	
Object		
Value	465	
WCS		
Physical	X: 846.000	Y: 324.000
Image	X: 846.000	Y: 324.000
Frame 2	Zoom: 1.000	Angle: 0.000

	Current	View
Red	<input type="radio"/>	<input checked="" type="checkbox"/>
Green	<input type="radio"/>	<input checked="" type="checkbox"/>
Blue	<input type="radio"/>	<input checked="" type="checkbox"/>

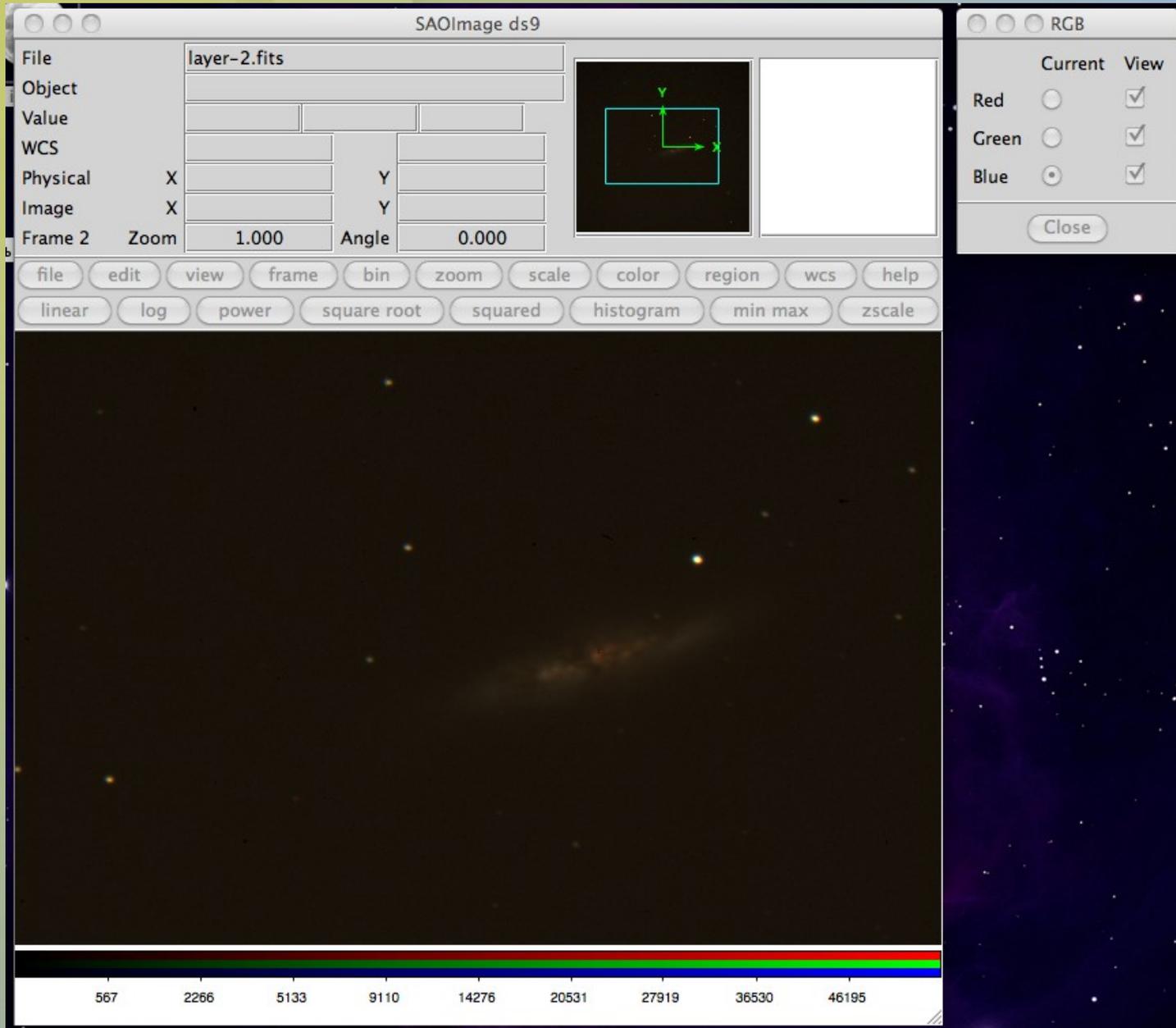
Обработка астрофотографии

Цветное изображение с логарифмическим распределением цвета



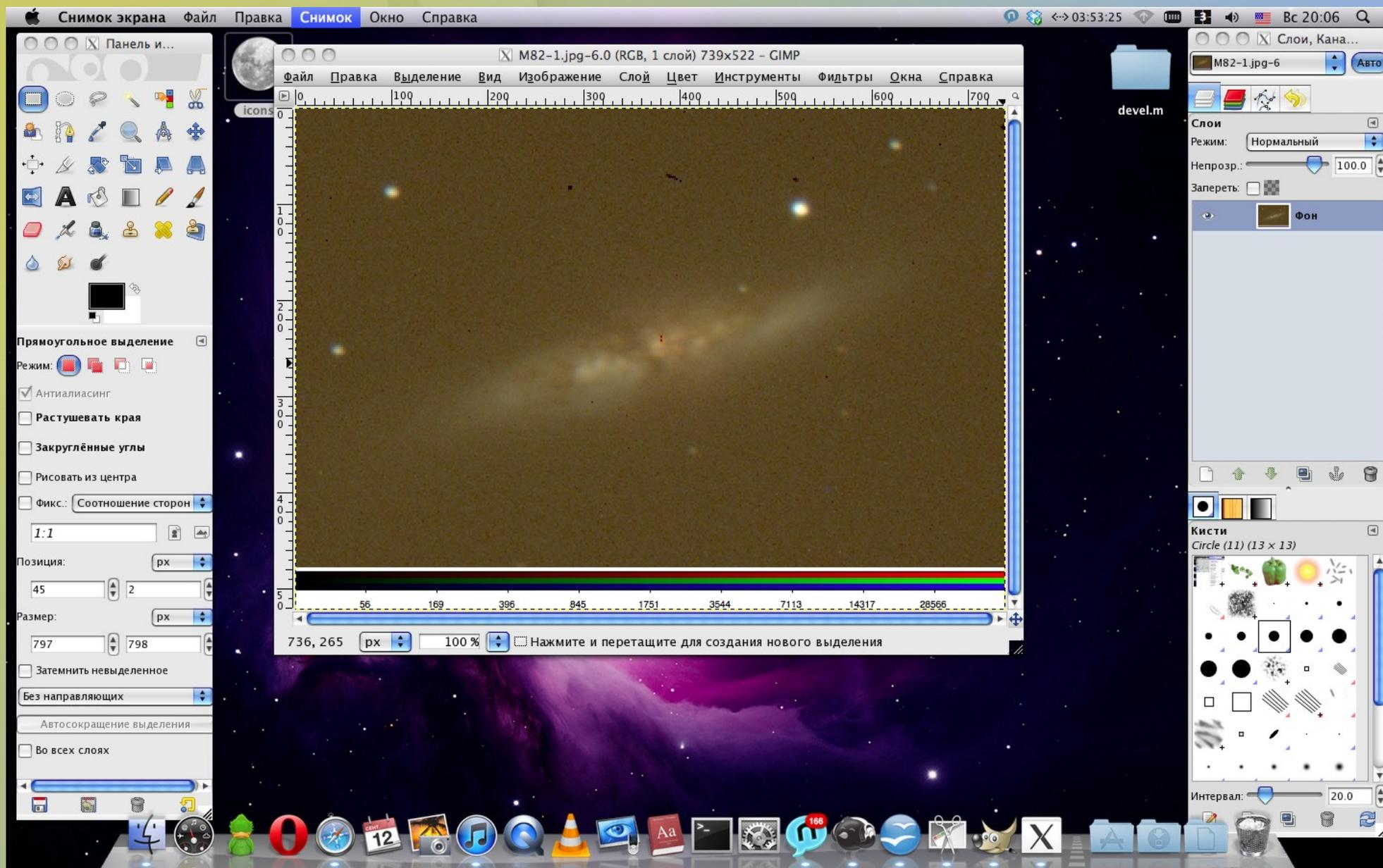
Обработка астрофотографии

Цветное изображение с квадратичным распределением цвета



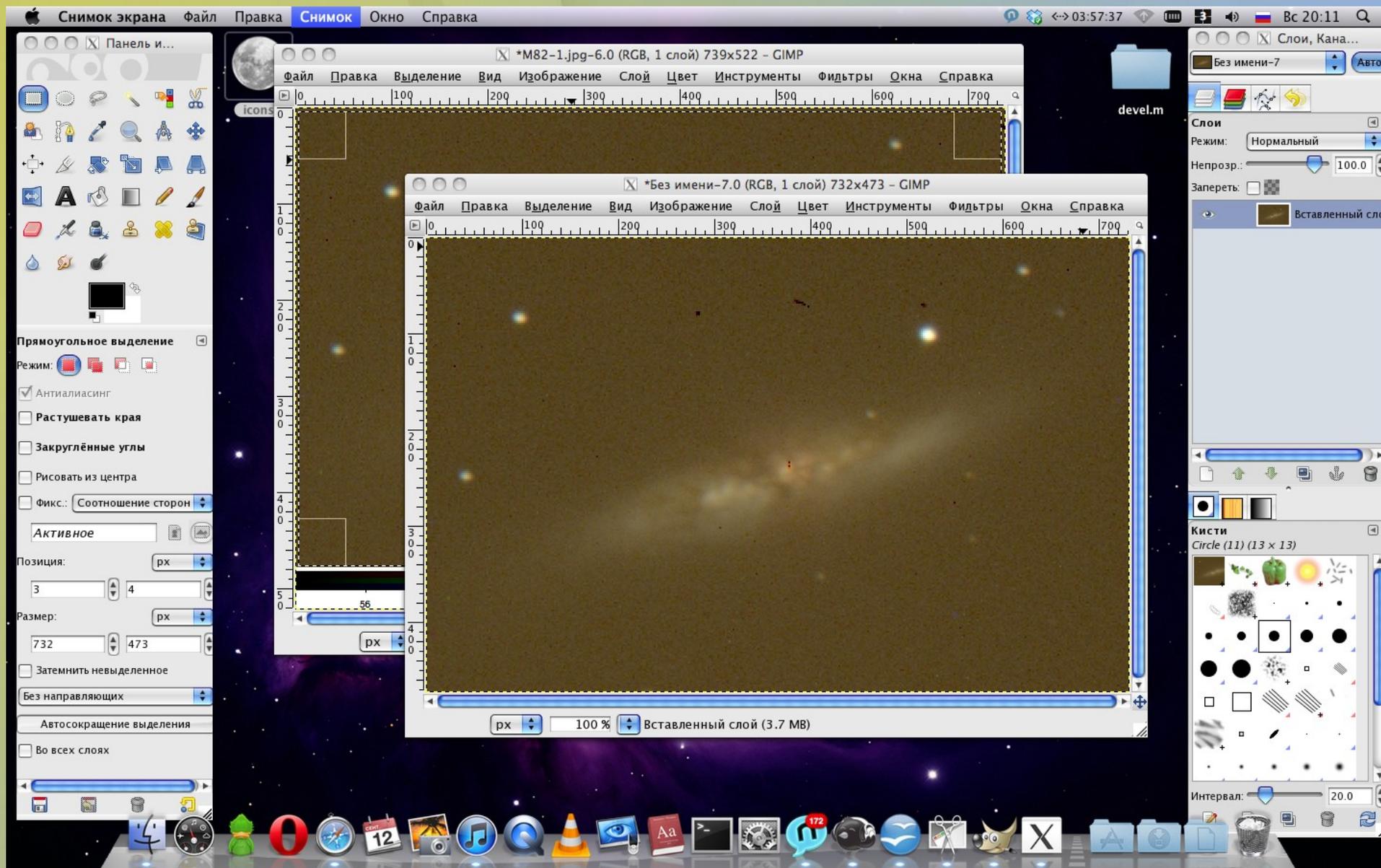
Обработка астрофотографии

Открываем экспортированное из DS9 цветное изображение с логарифмическим распределением цвета в GIMP



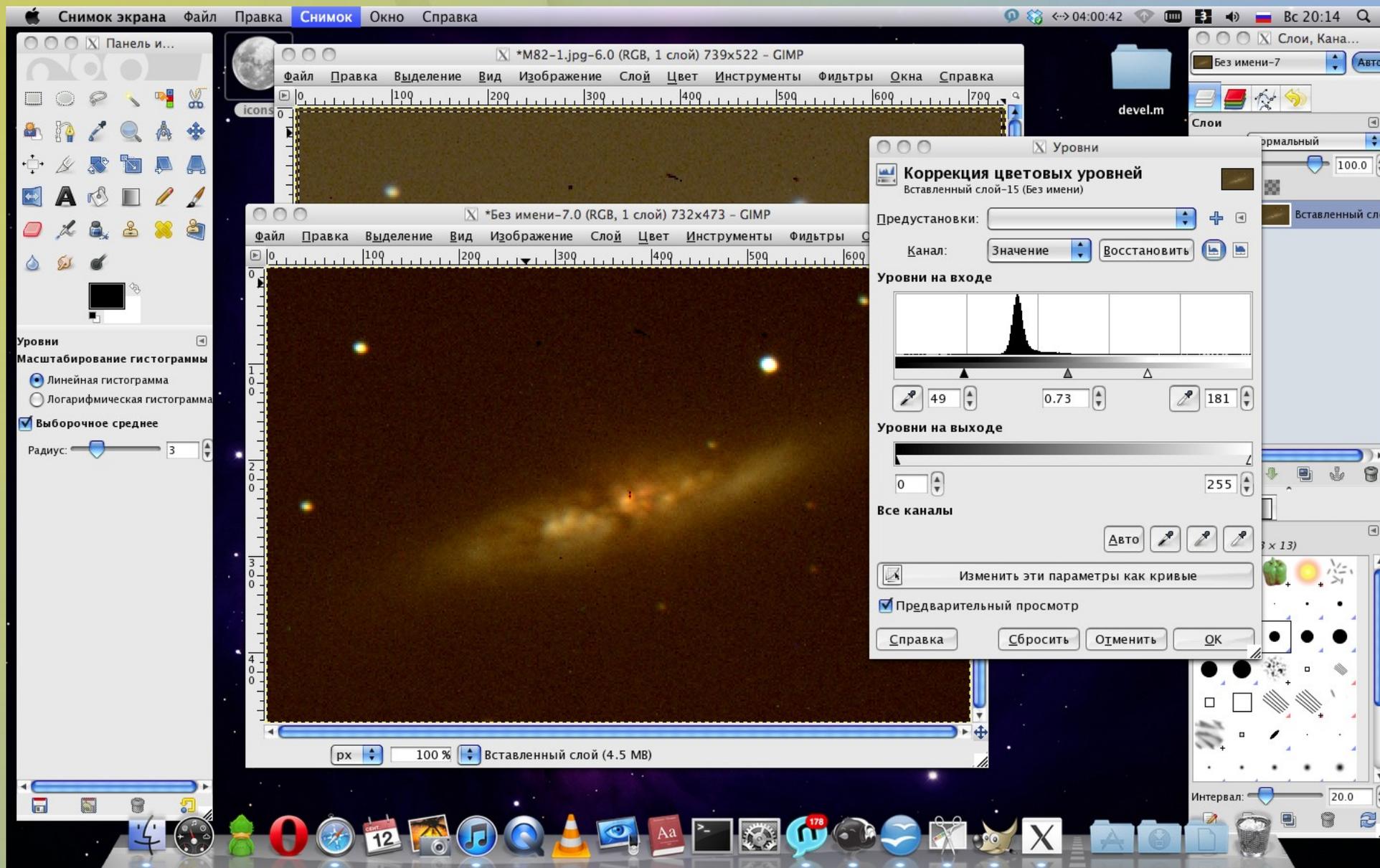
Обработка астрофотографии

Выделяем интересующую нас область снимка и создаем из неё новое изображение для последующей коррекции



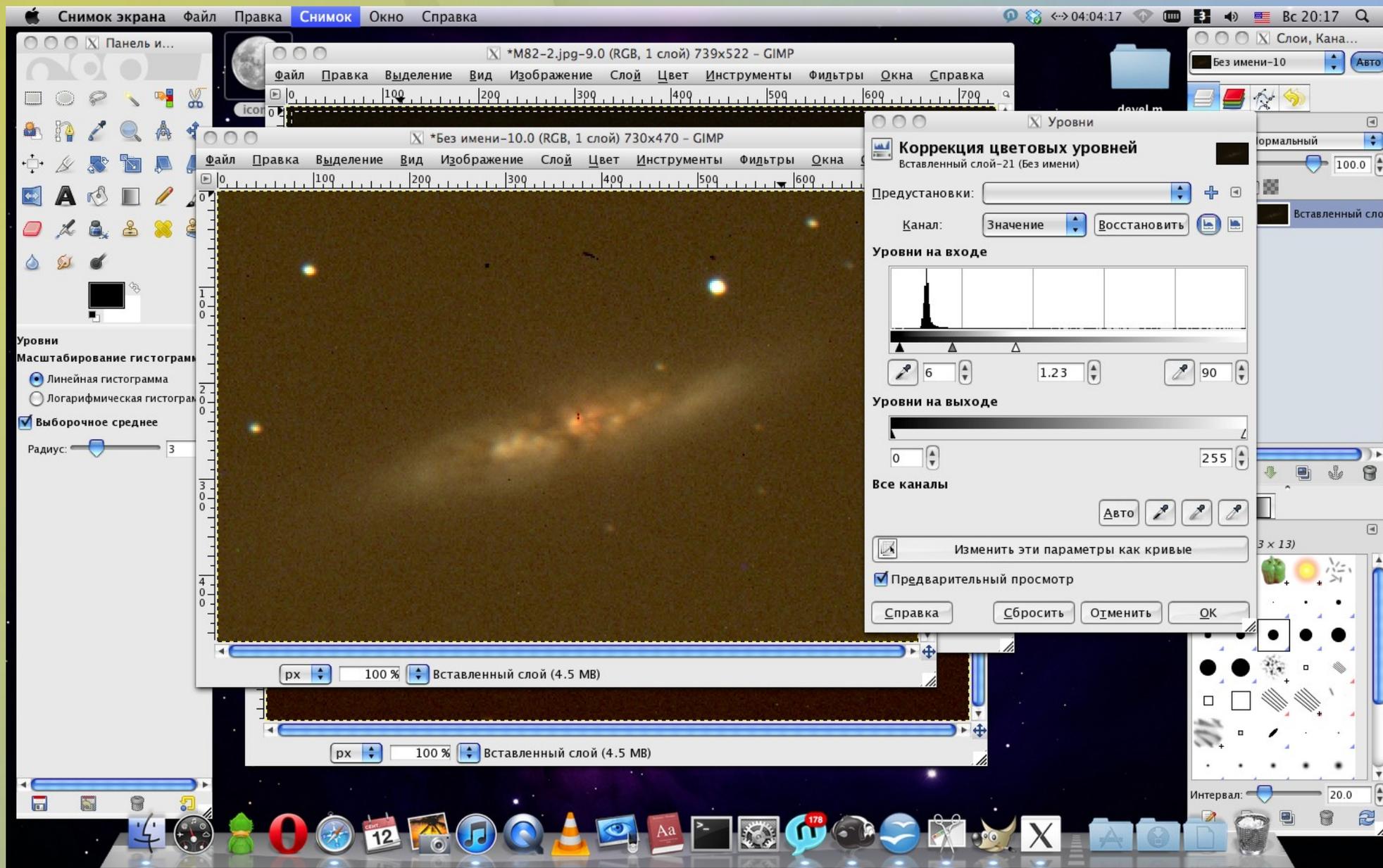
Обработка астрофотографии

Коррекция уровней нового снимка



Обработка астрофотографии

Проводим операции в GIMP для цветного снимка с квадратичным распределением цвета, аналогичные только что сделанным



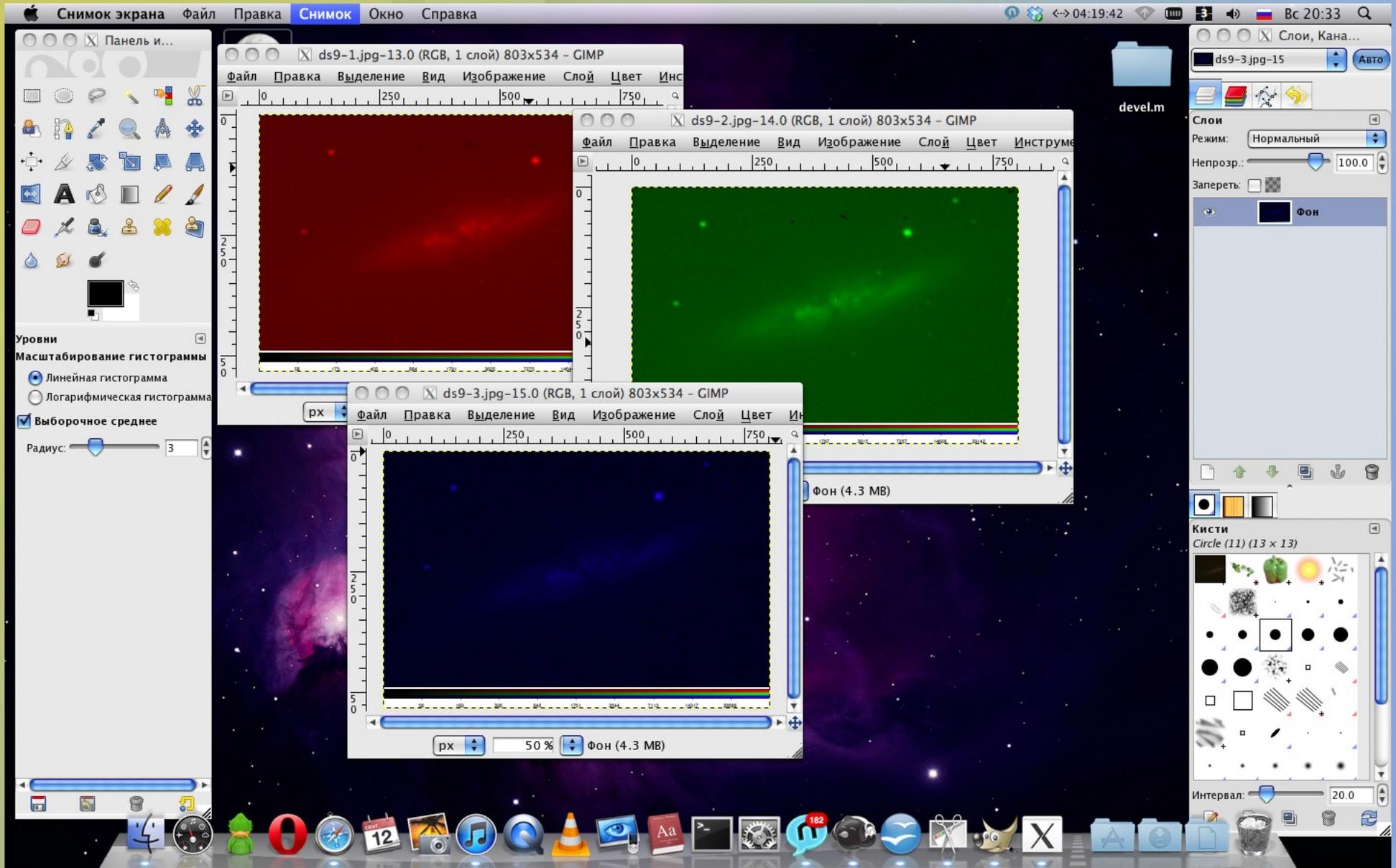
Обработка астрофотографии

Сведение цветowych слоёв можно делать в GIMP, а не в SAOImage DS9!

Для этого экспортируем каждый из „поканальных“ FITS-изображений в JPEG-файлы, затем открываем их в GIMP и создаем в нём „слоёное“ изображение.

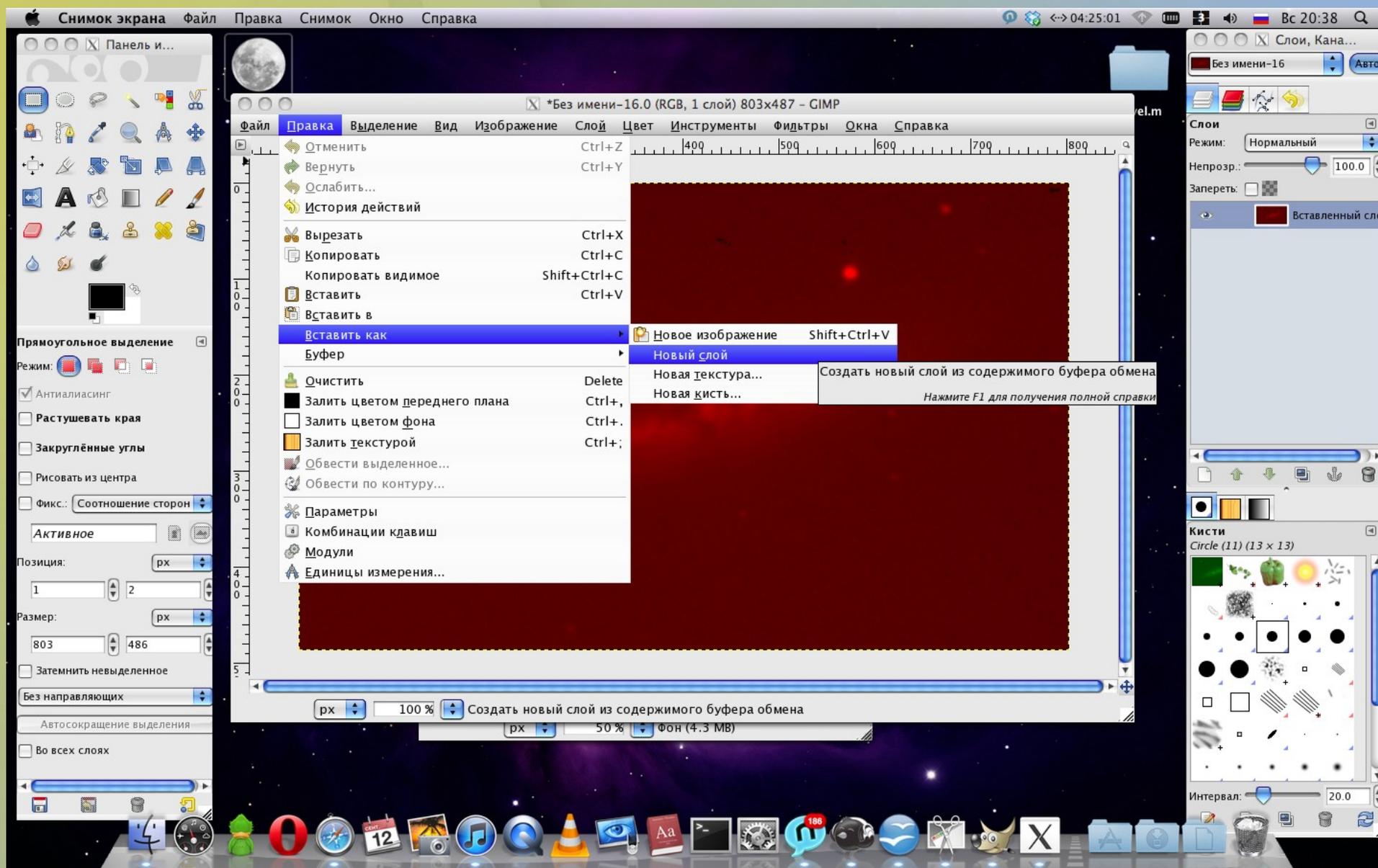
Обработка астрофотографии

Открытые в GIMP пофайловые „цветовые каналы” из DS9



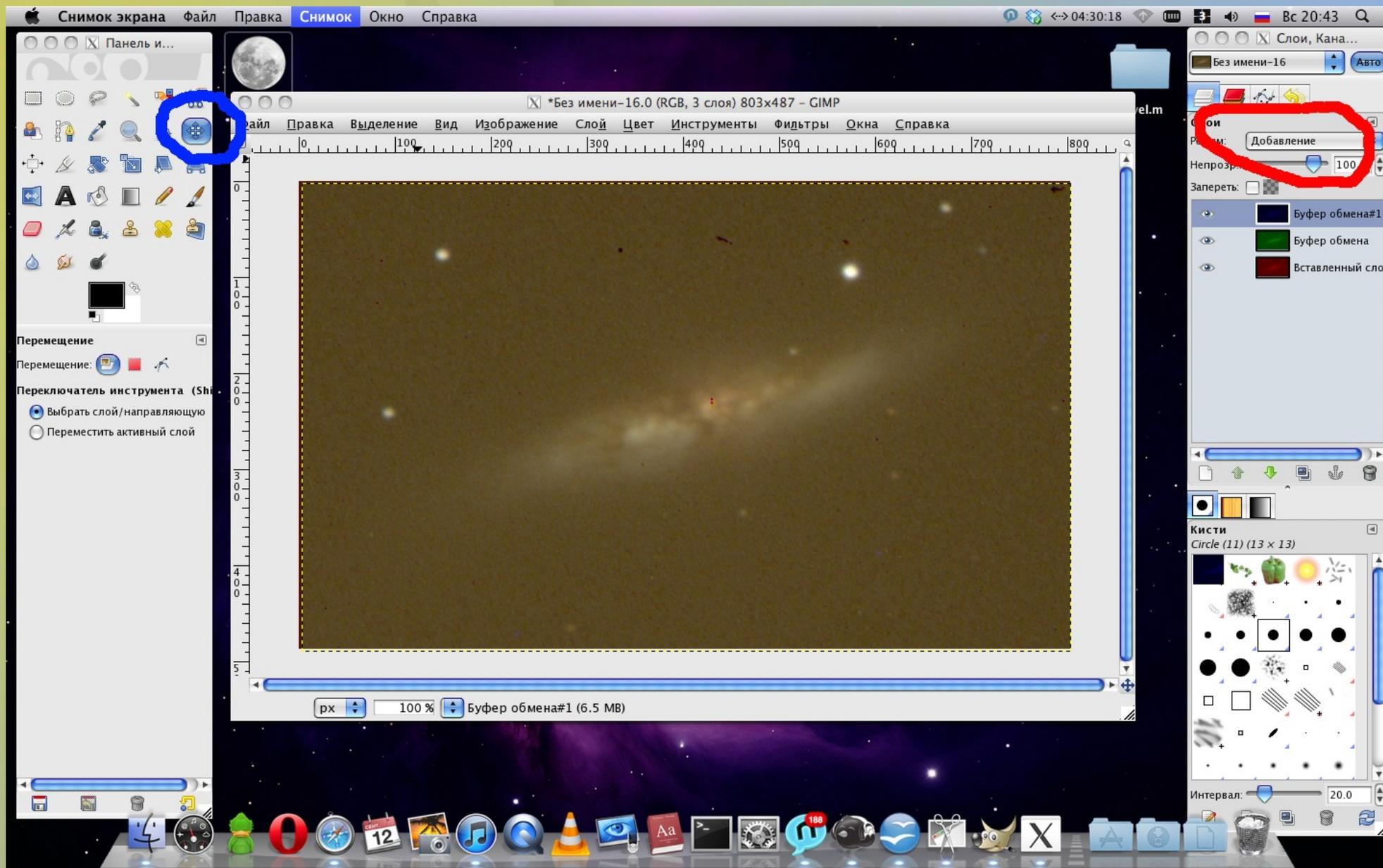
Обработка астрофотографии

Делаем изображение с красным каналом корневым, после чего вставляем в него другие „канальные изображения“ как слои



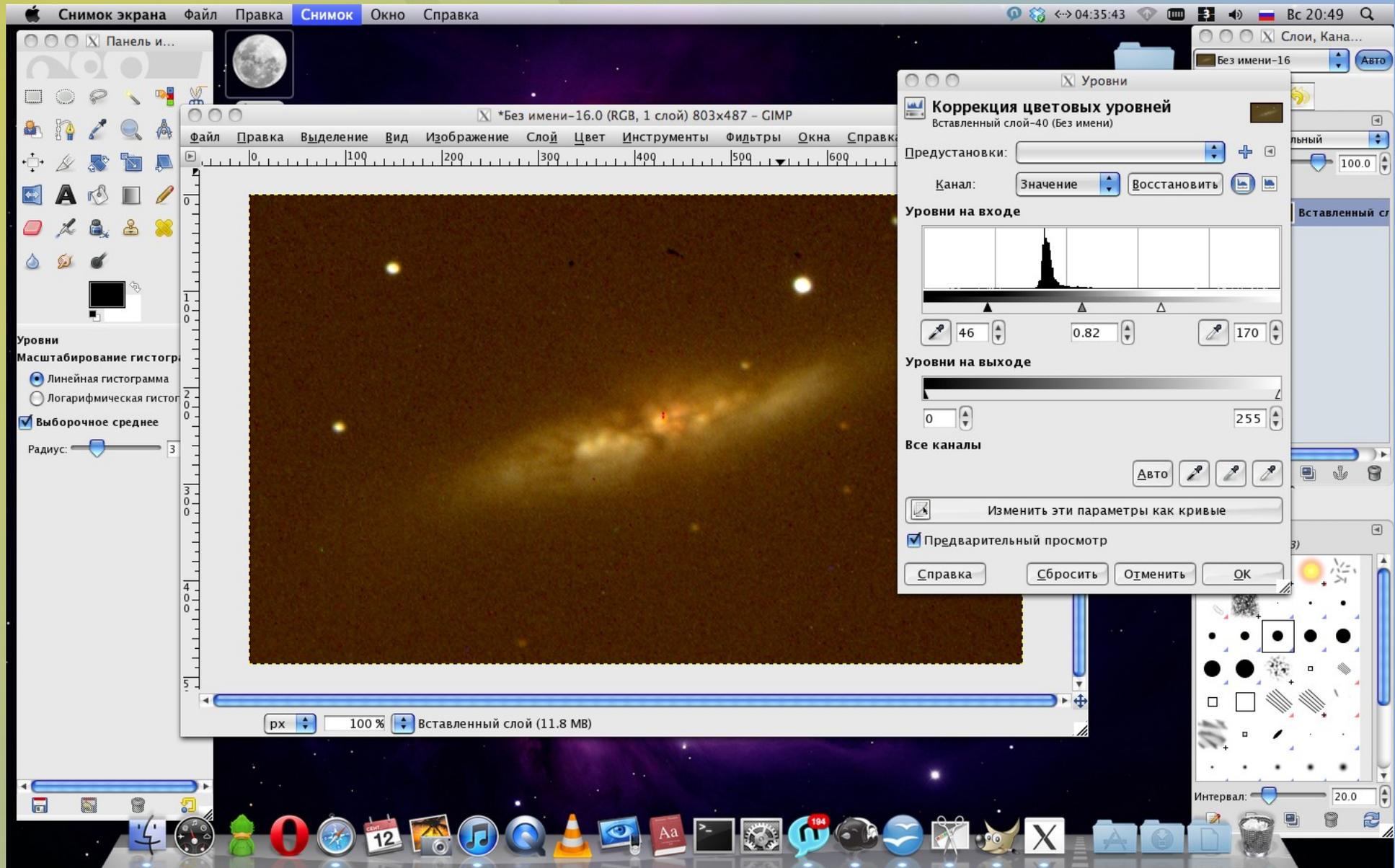
Обработка астрофотографии

Режим наложения у „зеленого“ и „синего“ слоя ставим *Добавление* и совмещаем слои так, чтобы звезды разных „каналов“ совпадали



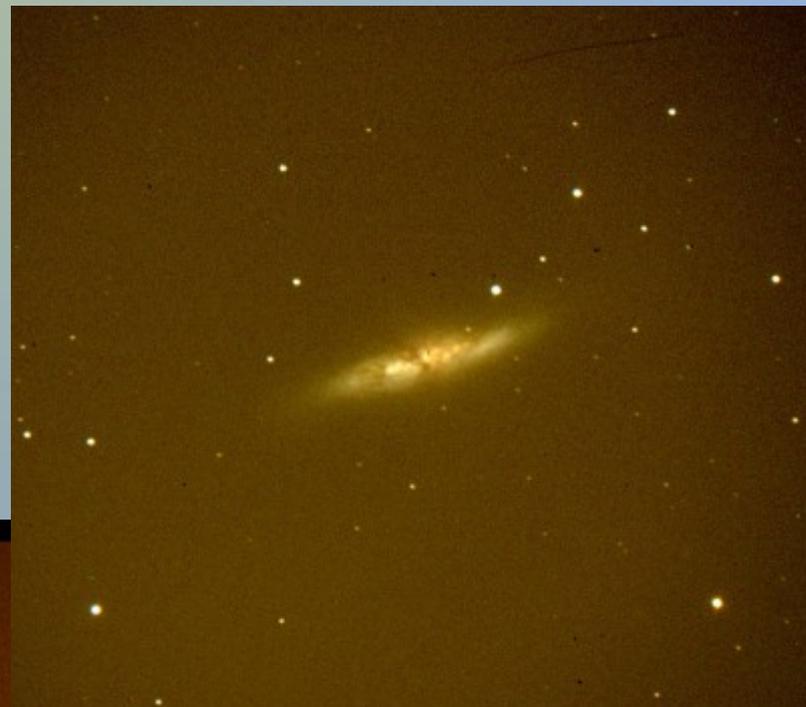
Обработка астрофотографии

Сводим изображение и корректируем уровни



Обработка астрофотографии

Результаты обработки фотографии („до” и „после”)



Обработка астрофотографии

М 17, до обработки, JPEG получен автосложением на BRT



Обработка астрофотографии

М 17, после обработки в SAOImage DS9 и GIMP



Обработка астрофотографии

Результаты обработки фотографии („до” и „после”)



Спасибо за внимание!

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