INSTRUMENTS FOR AMATEUR RADIO ASTRONOMY

ARIES

CONTROL AND ACQUISITION SOFTWARE

OPERATING INSTRUCTIONS

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Chapter 1

Aries: software for all the *RAL10* receivers

Aries (Fig. 1.1) is an advanced and easy to use software for Personal Computer (PC), developed to handle the automatic acquisition and control of the Total-Power microwave receivers of the *RAL10* Series by *RadioAstroLab*. Conceived to optimize the "strenght" and the flexibility in the serial communication typical of the *RAL10* family, the software controls the operating parameters of the specific model used (*RAL10KIT*, *RAL10AP*, *RAL10*): with the style of a graphic recorder, *Aries* displays the trend of the measurements in time and files the informations achieved through several modes and formats.

With *Aries* it is possible to control in a simple and intuitive way all the parametres of a single receiver, or handle different and simultaneous measurement sessions carried out with more devices (also of the same kind) connected to a single PC: the communication control implemented in the *RAL10* instruments and the interface of *Aries* allow a very reliable managing of the communication, perfect even in applications that require continuous measurements for long time and in distant places not controlled by operators.

Conceived as a data acquisition system for amateur radio astronomy stations, *Aries* includes all you need to handle and display the observations measurements, with wide possibilities to set the graphic scales and to plan the operating parameters. The ability of automatic data recording and the possibility to set suitable alarm thresholds when events occur in the measured signal, make the *RAL10* + *Aries* system very versatile and practical, to be used successfully in many sectors.

You can use *Aries* without limitations of license and/or number of installations: highlightings on possible malfunctioning and advices for the optimization of the application will be appreciated. The program will always be provided for free with the instruments of the *RAL10* series: in any case, *RadioAstroLab* guarantees the support of the application, along with the improvements that simplify and optimize the performances.

Since the family of the *RAL10* receivers includes different models with different features and performances, some indications on the pictures and on the functions described in this document could slighlty differ from those effectively observed by the user: the "philosophy" of use of the program, simple and intuitive, remains still valid and easily deducible from the context.
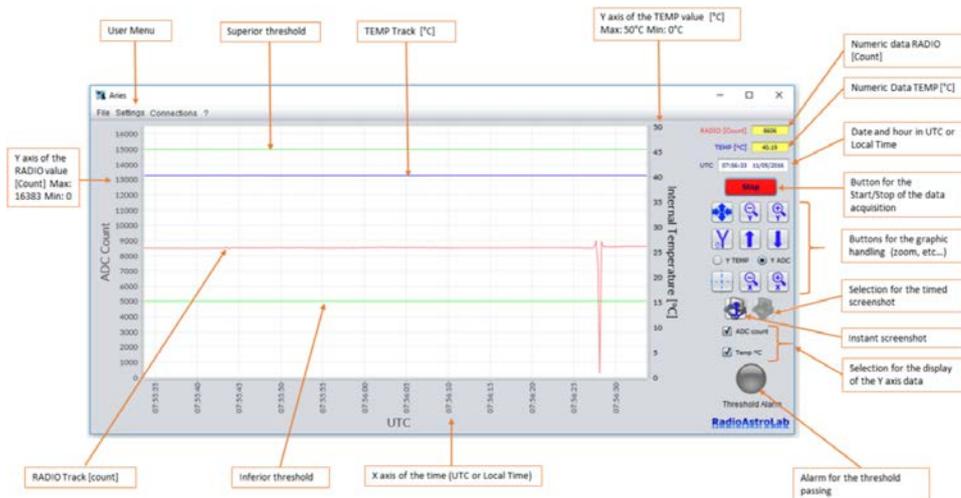
FIGURE 1.1: Main window of *Aries* software (the settings concern the receiver mod. *RAL10*).

Updated information about *Aries* can be found visiting the pages of our websites:

http://www.radioastrolab.it/
http://www.radioastrolab.com/.

In this document we will describe in detail the procedure of installation and the functionalities of *Aries*.

In the PIC. 1.1 you can see the main display and control consolle of the program: it is a graphic window that displays the trend in time of the acquised radiometric signal and, possibly, of other auxiliary signals managed by the specific receiver used, like the inner temperature of the instrument.

There are also the most frequently used commands for the handling of data acquisition, of graphic representation of the measurement and the automatic data recording.

Chapter 2

Installation of *Aries*

In this chapter we will describe how to install *Aries* on the most common platforms. If the computer is connected to the Internet, an alarm will be automatically displayed when a new version of the software is available to download (Figure 2.1): we suggest you to visit our web pages

http://www.radioastrolab.it/
http://www.radioastrolab.com/

to find the instructions for the download of the new version of the software and of the manual. Besides this advantage, for the following installation of *Aries* and its functioning no connection is needed.

2.1 Microsoft Windows environment

You can install *Aries* on *Microsoft Windows x86* and *Microsoft Windows x64* platforms (minimum requirements *Microsoft Windows Xp SP3*). For its proper functioning, the software requires the presence of the (JRE) 1.8 or higher, downloadable from

http://www.java.com/it/download/
http://www.java.com/en/download/

Before starting the installation procedure it is indispensable to verify this requirement.

ATTENTION: it is important to install the correct version of the Java Virtual Machine for x86 or x64 systems. If you install the JRE x86 on x64 systems the software may not work.

The installation procedure automatically provides the drivers needed to the functioning of the software with any receiver of the *RAL10* series.
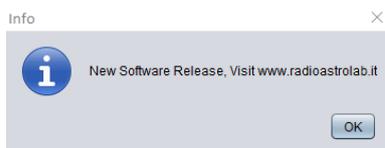
FIGURE 2.1: Message from *Aries* that informs the user about a new available version of the software (it appears only if the PC is connected to the Internet).

FIGURE 2.2: Installation of *Aries* for Microsoft Windows.
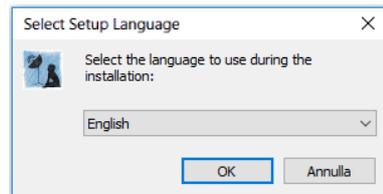
FIGURE 2.3: Choice of the language for the installation.

The installation program starts by selecting the icon shown in Fig. 2.2, waiting for the start window of the guided procedure. At the beginning the program will ask what language you wish to use for the installation.(Fig. 2.3).

ATTENTION: the choice of the language only concerns the installation procedure: *Aries***, for now, only provides English language.**

The folder where the software is installed will be indicated later (Fig. 2.4). The standard starting path is: `C:\ProgramFiles\Aries`. At least 8.5 MB of free space on the disk is required. Follow the suggestions (**Next >**) until you come to the installation window (Fig. 2.5). Start the installation by clicking on the **Install** button.

The installation procedure is very simple and intuitive, similar to that of most of the softwares around: the average user already has confidence with the various dialogue boxes of the installation program that show, step by step, the procedure phases. During the procedure the user will be asked, through a special dialogue box, if he wishes to install a desktop icon, useful to quickly start *Aries*.

Once the first step of the procedure is finished, there follows the automatic installation of the drivers needed for the serial communication with the receivers of the *RAL10* family. When the special dialogue box opens (Fig. 2.6) continue by clicking the **Extract** button to start the driver installation and go on with **Next** (Fig. 2.7) to complete the operation. If the operating system of the PC (Windows) should ask for the guided installation of the driver, do it as indicated by the installation program and wait for the system to finish the operation by signaling the event with the window shown in Fig. 2.8.

Once this operation is finished, the installation of *Aries* is completed (Fig. 2.9): we suggest to restart the PC to make the program operational.
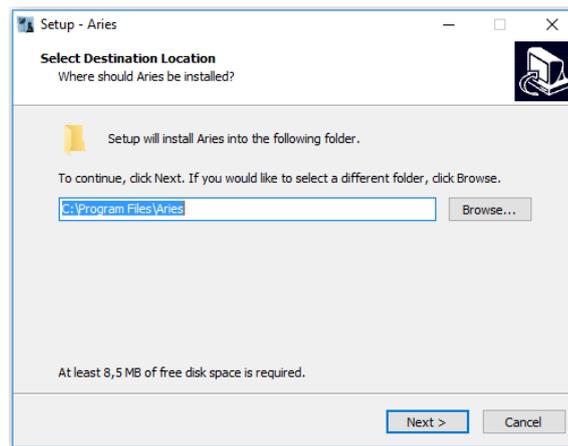
FIGURE 2.4: Selection of the installation folder.
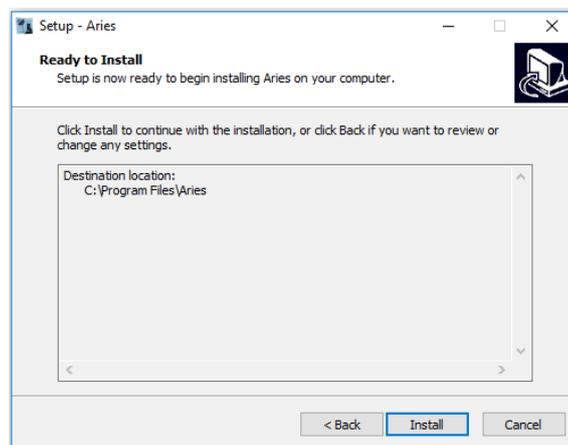
FIGURE 2.5: Lauch of the installation procedure.
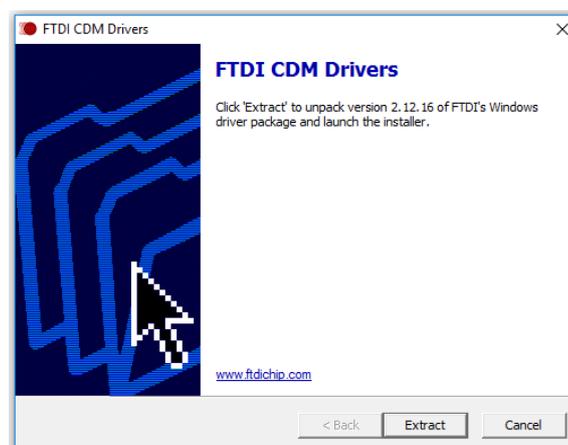
FIGURE 2.6: Installation of the drivers needed for the serial
communication with the receivers
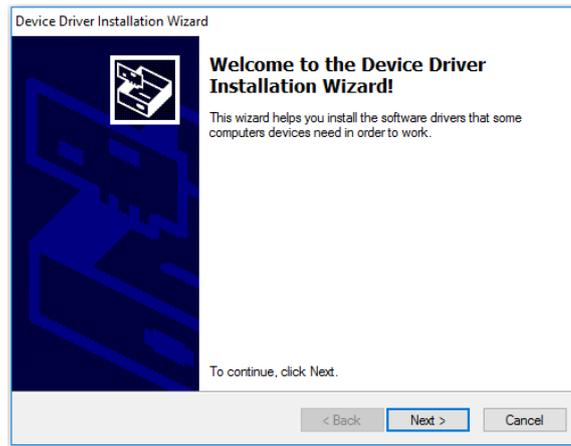
FIGURE 2.7: Guided installation of the communication drivers with the *RAL10* Series receivers.
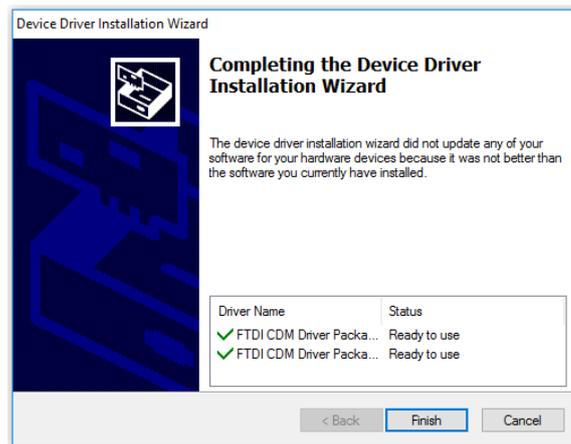
FIGURE 2.8: Installation of the drivers for the serial communication carried out successfully.
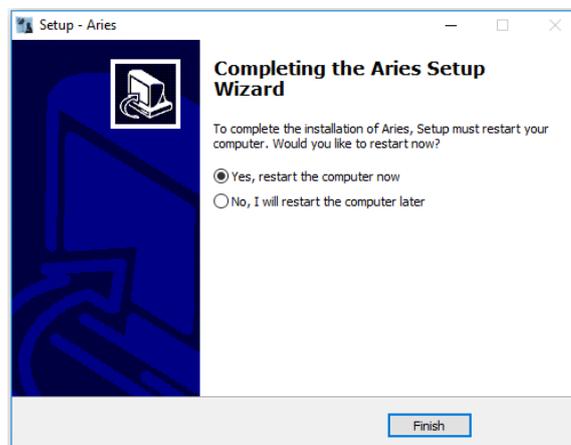
FIGURE 2.9: Installation of *Aries* completed.

2.2 Linux environment

In this paragraph we will describe how to use *Aries* on *Linux (Ubuntu, Linux mint, Gentoo, etc.) x86* and *x64* platforms. It is necessary that the machine has the version *OpenJDK 8* or higher, installable from the terminal by typing the command (es. *Ubuntu*):

```
$ sudo apt-get install openjdk-8-jre
```

After the installation of *OpenJDK* you can launch the file `Aries.run` inside the folder *Aries* previously extracted (Figure 2.10).
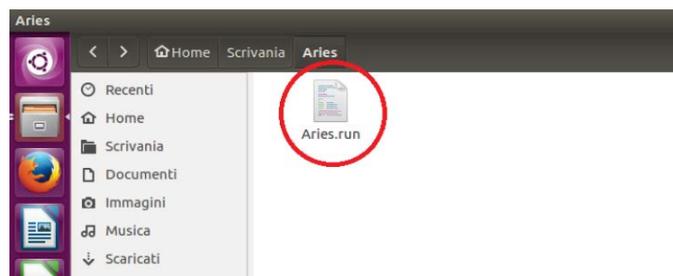
FIGURE 2.10: File `Aries.run` for *Linux* systems.
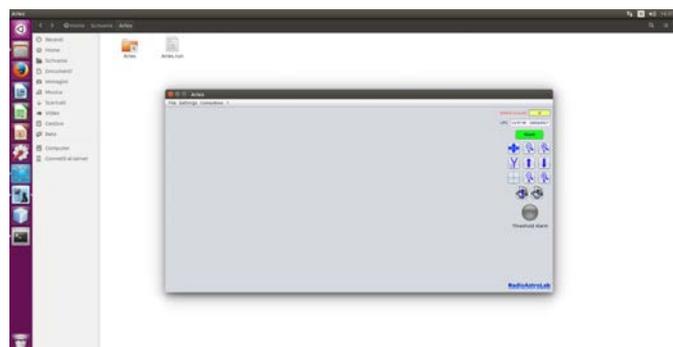
FIGURE 2.11: Launching of *Aries* in a *Linux (Ubuntu)* system.

For a correct visualization of system devices is very important to run *Aries* as an administrator: in this way there will be no problems when the system detects the device that connects to the specific receiver of the *RAL10* series. As *Linux* users know, *Sudo* is a program that allows the operating system administrators to run commands and programs as *root* (default username for the system administrator with maximum privileges), assigning only the essential privileges for the execution of individual commands. You will then need to type the following command *Sudo* in *Ubuntu*:

```
$ sudo ./Aries.run
```

Since *Aries* doesn't require an installation (it starts with a double *click* on the icon, as shown in Figure 2.11), within its folder will be created other key documents for the application to function: it is important not to modify the contents of these folders to not affect the operation of the program.

2.3   Mac OS X environment

In this section we will describe how to use *Aries* on *Mac OS (10.8 or higher)* platform. It is necessary that the machine has the *Java 8* or higher version installed, available for download from the following sites, after choosing the operating system *Mac OS*:

> https://www.java.com/it/download/manual.jsp
> https://www.java.com/en/download/manual.jsp

In case of difficulties in the installation of *Java* on the operating system *Mac OS* you should consult the official guide:

> https://www.java.com/it/download/help/mac_install.xml
> https://www.java.com/en/download/help/mac_install.xml

After the installation of *Java* you can launch the file `Aries.app` inside the folder *Aries* previously extracted (Figure 2.12). Since *Aries* doesn't require an installation (it starts with a double *click* on the icon, as shown in Figure 2.13), within its folder will be created other key documents for the application to function: it is important not to modify the contents of these folders to not affect the operation of the program.
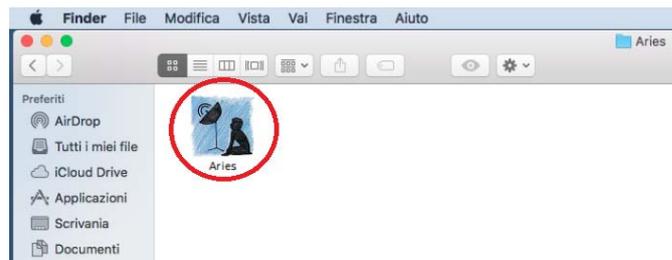
FIGURE 2.12: File `Aries.app` for *Mac OS* systems.
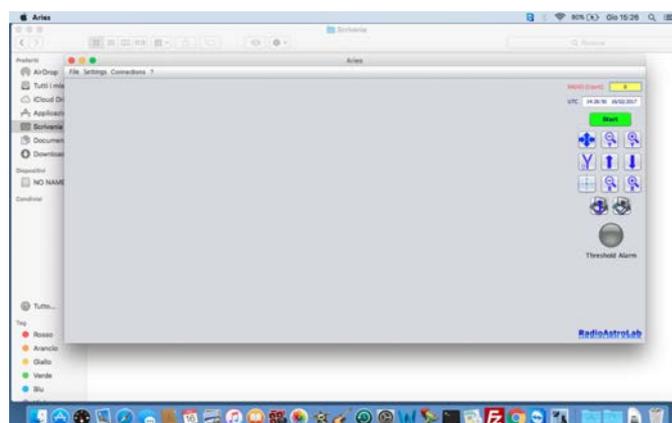
FIGURE 2.13: Launching of *Aries* in *Mac OS (El Capitan)*.

2.4 Raspbian environment (Raspberry PI)

In this paragraph we will describe how to use *Aries* on *Raspbian*, operating system based on official releases of *Debian* (one of the most famous distributions based on the *Linux* kernel) for the processor architecture *ARM (armhf)*, adapted for use on *Raspberry PI* board.

The *Raspberry PI* is defined as a "single board computer" which is a computer implemented on a single electronic board of low cost, small size and reduced power consumption. These features have made this device very popular among experimenters. The electronic board is equipped with a processor *ARM*, a RAM memory and a series of inputs and outputs with variable characteristics depending on the model used (for example *Raspberry PI 2, Raspberry PI 3 ...*).

FIGURE 2.14: *Raspberry PI 3* board.

To use *Aries* on *Raspbian* the *Java Virtual Machine (JRE) 1.8* or higher is required. Before starting the installation procedure it is essential to verify this requirement. In the last *Raspbian* distributions (typically intended for *Raspberry PI 3*) *Java* is an integral part of the system and does not need to be installed. To check for *Java*, run the command from the terminal:

```
$ java-version
```

If the print returns a *Java* version, it means it is present in the system. In case the version is present and it is inferior to 1.8 it is possible to update it with the command:

```
$ sudo apt-get update && sudo apt-get install oracle-java8-jdk
```

However, if the command for verifying the *Java* version returns an error, for example "Command not found", it means that *Java* is not present in the distribution, so download and install *Java* manually for the Raspian platform. Visit the following link:

```
hhttp://www.oracle.com/technetwork/java/javase/downloads/
jdk8-downloads-2133151.html
```

Select the download for *Java Platform (JDK) 8*, accept the terms of use and download the *jdk-8-linux-arm-vfp-hflt.tar.gz for Linux ARM v6 / v7 Hard Float ABI*. Copy the archive (.tar.gz) previously downloaded into the *Raspbian*

distribution (for example desktop), open the terminal and move the system path to the desktop with the command *cd*:

```
$ cd Desktop
```

When the system path is positioned on the desktop, from the terminal extract the tar.gz archive using the following command:

```
$ sudo tar zxvf jdk-8-linux-arm-vfp-hflt.tar.gz -C /opt
```

This will extract the archive to the *opt* folder (which normally contains all optional software) of the *raspbian* system. Set by default the *Java* version extracted for the *Raspbian* system with the following commands:

```
$ sudo update-alternatives -install /usr/bin/javac javac
/opt/jdk1.8.0/bin/javac 1$ sudo update-alternatives -install
/usr/bin/java java /opt/jdk1.8.0/bin/java 1$ sudo update-alternatives
-config javac $ sudo update-alternatives -config java
```

Check the version *Java* just installed with the commands:

```
$ java -version $ javac -version
```

Once you have installed *Java*, you can start the file `Aries_RPI.run` in the *Aries* folder previously extracted from the archive.
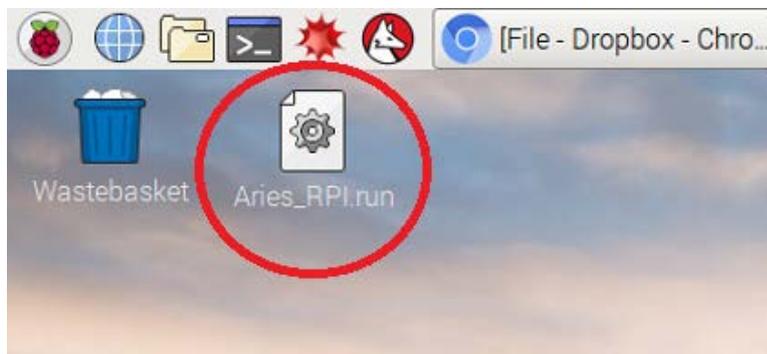
FIGURE 2.15: `Aries_RPI.run` file for *Raspian* system (*Raspberry PI 3*).

For proper display of system devices it is very important to run *Aries* as administrator: in this way there will not be any problems when the system detects the device that connects to the specific receiver of the *series RAL10*. As it is known to users *Linux*, *Sudo* is a program that allows operating system administrators to execute commands and programs as root (default username of the system administrator with maximum privileges), by assigning only the essential privileges for executing individual commands. You will then need to type the following Sudo command:

```
$ sudo ./Aries_RPI.run
```

Aries does not require an installation (it starts with a double click on the icon), within its folder will be created other documents necessary for
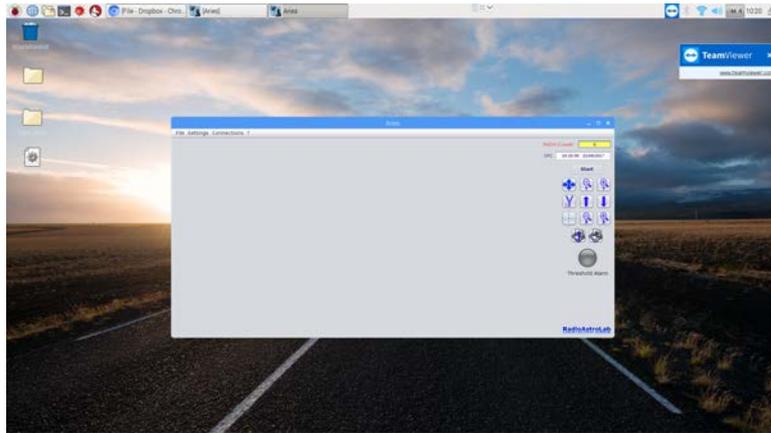
FIGURE 2.16: Starting *Aries* in a *Raspian* system (*Raspberry PI 3*).

the proper functioning of the application: it is important not to modify the content of these folders to not affect the operation of the program.
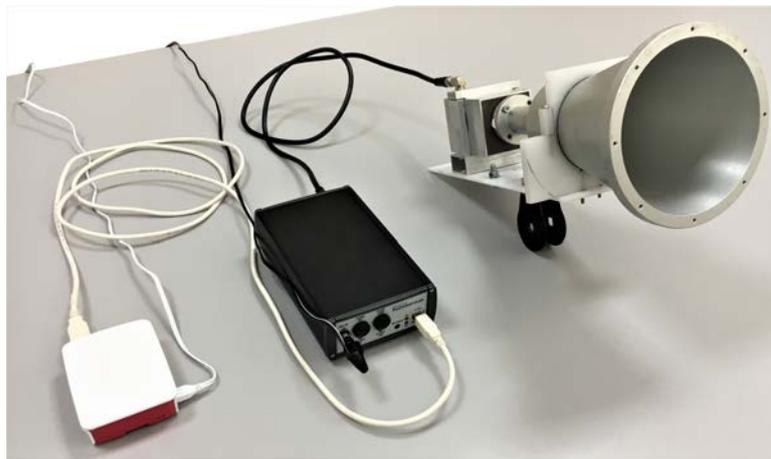
FIGURE 2.17: Working *Raspberry PI 3* with the *RAL10AP* receiver.

Chapter 3

How to launch *Aries*

Once the installation is over and the station computer (PC) has been restarted, it is possible to start working with *Aries*.

Before launching the program it is necessary to verify all the connections between the various components of the receiving station: please check that the coaxial cable coming from the antenna system is connected to the receiver's input, that the PC is connected to the receiver through the supplied USB cable and provide the electricity supply to the instrument. It is indispensable to refer to the instructions of the receiver used to know the details of the implementation and the requirements of each specific installation. Completed these checks, lauch *Aries*.

At every start, the program performs an automatic control to verify if, on the used PC, some instruments of the *RAL10* have already been set up and asks the serial peripheric for the possible presence of a particular receiver model. If the system detects a earlier set up device, *Aries* will try the connection.

In case no other device has been already used, *Aries* warns the user with a special message (Fig. 3.1): to start using the program it will be necessary to add a new device for the configuration.

WARNING: in this chapter we will describe the use of *Aries* in a *Microsoft Windows* system where the serial ports are identified by the term *COM x* (x is a progressive number). However, the procedure is similar also for the other environments (*Linux*, *Mac OS*): the important difference is in the name given by the operating system to the virtual serial port (on the *Linux* platform, for example, is used the description *ttyUSB0*).

It is possible to add a new device in the menu `Settings` (in chapter 4 the various entries of *Aries* menu are described), by choosing the entry `Add new device` (Fig. 3.2). The configuration will be carried out through a sequence of dialogue boxes: the first (Fig. 3.3) will ask to choose a device among those on the list (*RAL10* family of receivers - Fig. 3.4).

FIGURE 3.1: No receiver connected to the PC.

FIGURE 3.2: How to add a device for *Aries*.
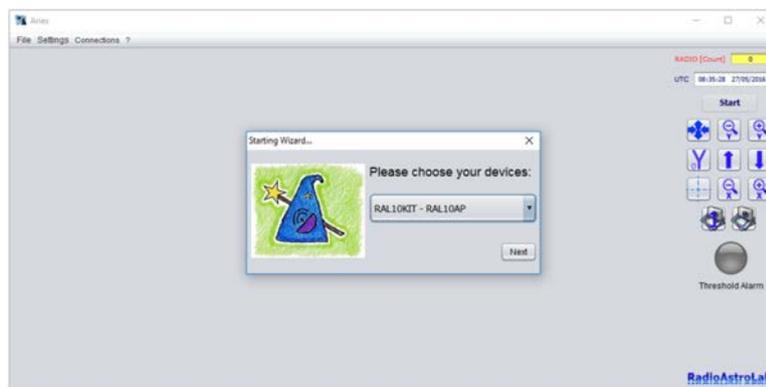
FIGURE 3.3: Window for the selection of the receiver.

Once a receiver has been selected (previously connected to the PC through an USB port and powered), it is possible to test the connection on the COM port associeted to it.

The operating system of the PC (Windows) automatically combines a virtual port COM (with a specific tracking number) to each receiver from the *RAL10* series connected through an available USB port. The COM serial port is emulated by the communication driver installed with the software, which acts as an interface between *Aries* and the receiver. The operation is successfull only if, after connecting the receiver to the USB port of the PC, the instrument is powered: at this point, the operating system Windows recognises and inserts the COM port associated to our receiver in the list of those already existing.

To activate the connection between *Aries* and the receiver, the user must select le corresponding COM port (Fig. 3.5), choosing from those available on the list in Fig. 3.6 (the example shows a *RAL10* receiver associated to the COM7 in *Windows*), then click on the **Connect** button: the connection will take place (Fig. 3.7) only if the right COM port for the specific receiver has been selected. Otherwise the program stops (**next** button disabled), or opens a message the signals the communication error. In any case, the user must repeat the connection attempt by selecting a different port among the available ones.

To test if the operating system Windows has effectively recognised the
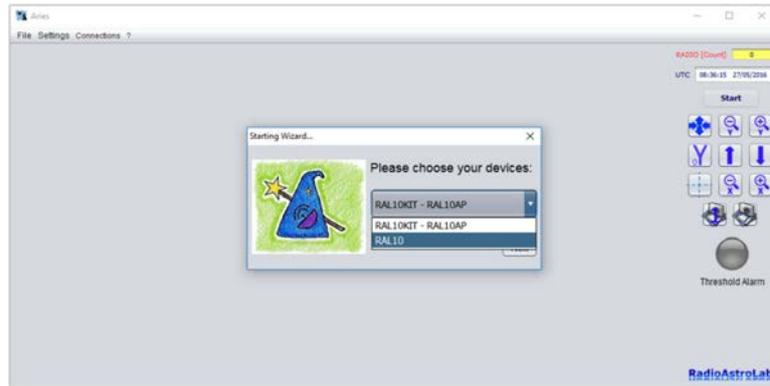
FIGURE 3.4: Choice among the available receiver models.
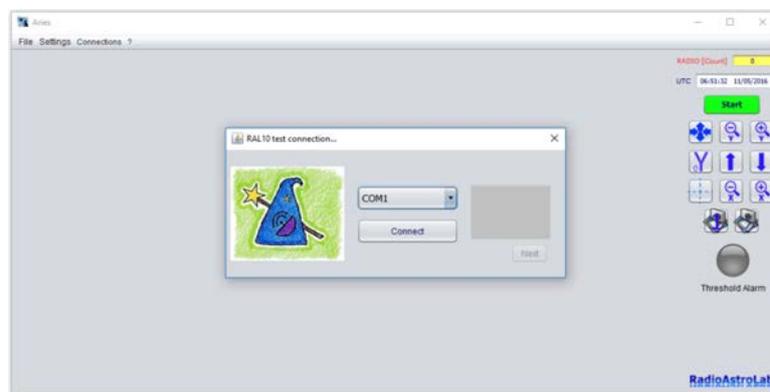
FIGURE 3.5: Selection of the serial COM port.

connection of a new device (the receiver) connected to a USB port, it is always possible to open the Windows component **Control panel > Device Manager**, expand the voice **Ports (COM e LPT)** and check which COM port (usually indicated as **USB Serial Port (COMxx)**, Fig. 3.8) has been added by the system after the receiver connection.

ATTENTION: every time you launch *Aries* after a receiver has been configured, the program automatically connects to that receiver which becomes the default device. A specific COM port has been associated to this device. If the default receiver is not connected to the USB port of the PC when the program is being launched, a message is displayed to signal a connection error.

Aries allows to add different receiver models of the *RAL10* series, since the user could use different instruments for different kind of measurements. The software automatically assigns the default role to the last device added (for example *RAL10*): *Aries* will automatically connect with it at the launching of the program. If you wish to operate with a different model of receiver, as long as it's been already added (for example *RAL10AP*), you only need to select it from the menu **Setting**, described in chapter 4 (Fig. 4.16). If you want to choose as default device one of the receivers on the list, you just have to select it: the program will update the default label (**DEF**) on the

FIGURE 3.6: Choice of the COM port used by the receiver among those available on the PC.

FIGURE 3.7: *Aries* is connected to the receiver through the selected COM port.
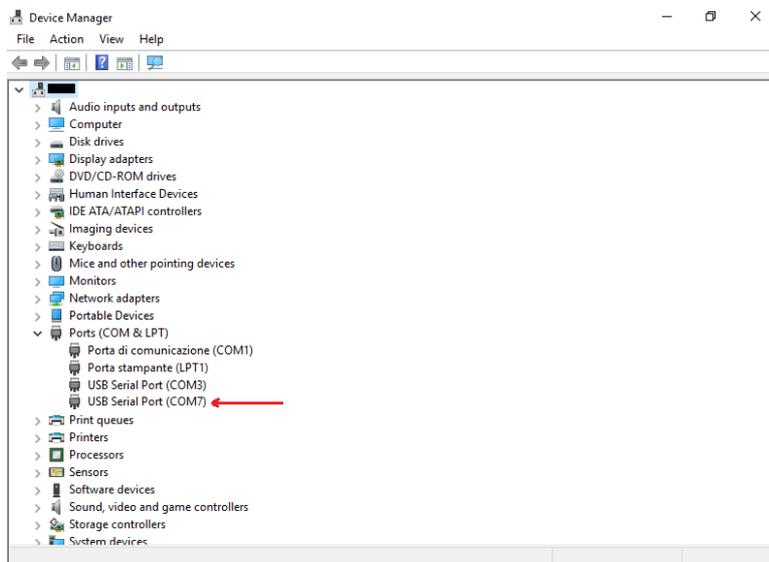
FIGURE 3.8: Test of the port used by the receiver through the Windows `Control Panel`
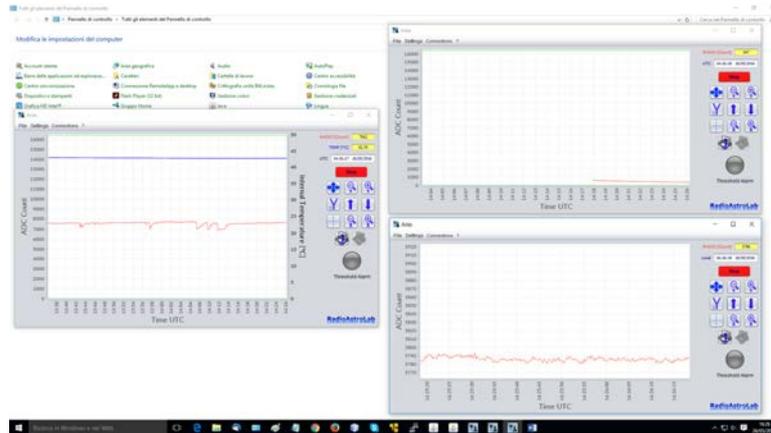
FIGURE 3.9: Simultaneous acquisition sessions with *Aries*.

FIGURE 3.10: Control window for the setting of the *RAL10*
receiver parameters.

chosen device.

You can also open simultaneously more sessions of *Aries* on the same computer (Fig. 3.9) so as to control and display graphically the measurement acquised by more receivers. This option is very useful when you carry out simultaneous measurement sessions with instruments optimised for different operating frequencies, polarizations and, in general, different antenna installations. Every *Aries* session operates indipendently from the others, each checking and handling the information coming from the specific receiver connected.

Once the connection of the receiver to the COM port is done, click the button **next** to complete di operation and move to the following parameters' setting (Fig. 3.10).

You can access to the **RAL10 Calibration...** windows that contains all the commands needed to set the instrument's parameters. In function of the model of receiver used, the parameters displayed on the calibration window will vary: in Fig. 3.10, for example, you can see the settings valid for the *RAL10* receiver.

The buttons for the setting of the polarization in reception are always
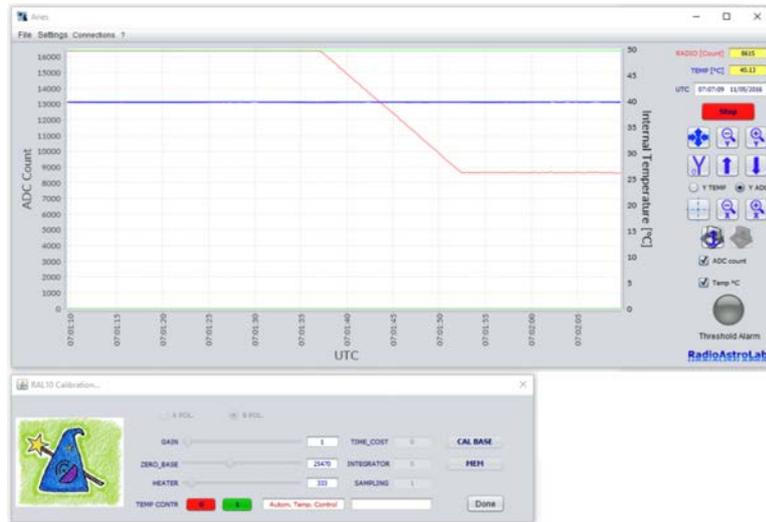
FIGURE 3.11: The radiometric signal (red track) is stable in the middle of the acquisition scale after the baseline calibration.

present **A POL.**, **B POL.**, as well as the cursors and the boxes for the setting of the post-detection gain **GAIN** and for the offset of the radiometric baseline **ZERO_BASE**, the boxes for the setting of the values of the measurement integration constants **TIME_COST** and **INTEGRATOR**. Moreover, it is also possible to select after how many samples received the measurment must be updated (**SAMPLING**) by setting the appropriate sampling period, which is the period of the signal integration, added to the one set before by the parameters **TIME_COST** and **INTEGRATOR**: the program will update the graphic track after the acquisition of the number of samples set, then it will calculate the average on the basis of that number.

If the *RAL10* receiver is connected, there will be the buttons for the abilitation/disabilitation of the automatic control that mantains constant the inner temperature of the receiver, the cursor and the connected box for the eventual manual setting of the heating element, the alarm boxes for the temperature excess.

The button **CAL BASE** activates the automatic calibration of the baseline (the so-called "reference zero") for the radiometric measurement.

It is possible to save in the non volatile internal memory the most important values of the operating parameters using the button **MEM**: in this way, every time the instrument is powered, the optimal operating conditions are restored, chosen after an appropriate calibration in function of the carachteristics of the receiving system and of the scenery observed.

ATTENTION: for details and depenings on the meaning of the operating parameters of the receivers and suggestions on their correct use please refer to the instruction manuals.

ATTENTION: the parameters values can be modified using the cursor (when present), or writing the numeric value in the specific editable box. It's important to push ENTER on the PC keyboard to confirm the new value.

Once the receiver settings are ready, you can close the window (or put it near the main window) and click the button **START** to lauch the data acquisition and the following graphic representation.

If the calibration of the radiometric baseline has been activated, wait until the signal is stabilized in proximity of the middle of the bar scale (Fig. 3.11).

Chapter 4

The functions of *Aries*

The main functions of *Aries* are to graphically represent (and record) the radiometric measurements acquired by the receiver connected to the PC and to check the operating parameters of the instrument.

The program essentially behaves like a graphic recorder: the variation of the data acquired is displayed in function of the time like a red-colored mobile track, represented in a rectangular diagram wher the abscissa is the time variable (expressed in Local Time or in UTC time) and the ordinate is the intensity of the signal expressed in acquisition relative units [ADC_count].

Since that, for now, in *Aries* you won't find the management of a calibration procedure for the radiometers of the *RAL10* series in absolute units of power of the received signal (this option will be implemented in the following version), the intensities of the radio signal are displayed on a range of relative counting units [ADC_count] of the inner analog-to-digital converter (the device that converts the analog signal acquired in the correspondant numeric signal displayed on the PC). This range varies from 0 to 16383, since the measurement resolution of the instrument is equal to 14 bit.

In function of the device connected (for example the receiver *RAL10*) it is possible to visualize also a further track (blue-colored) representing the inner temperature of the radiometer (thermostabilized), expressed in [°C] units.

Besides the graphic track, *Aries* also visualizes also the corresponding values of the measurements acquired (in the boxes in the upper right of the main window (Fig. 4.1), along with the date/hour information, settable in UTC format or in Local Time. If you use the *RAL10KIT* or *RAL10AP* receivers, you will not see the track of the inner temperature of the radiometer and the correspondig box with the numeric value.

Under the values labels you can see the button **START/STOP** (it changes from red to green and viceversa) used to start/stop the data acquisition from the receiver and the corresponding graphic representation. Before starting the acquisition of data, *Aries* will ask the user if he wishes to save
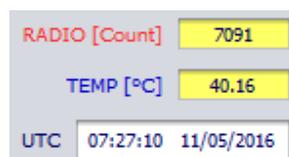
FIGURE 4.1: Labels with the windows for the numeric visualization of the data acquired.
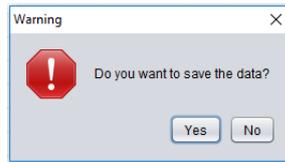
FIGURE 4.2: Notice for the request of data saving everytime
you start the acquisition by pushing the **START/STOP** but-
ton.
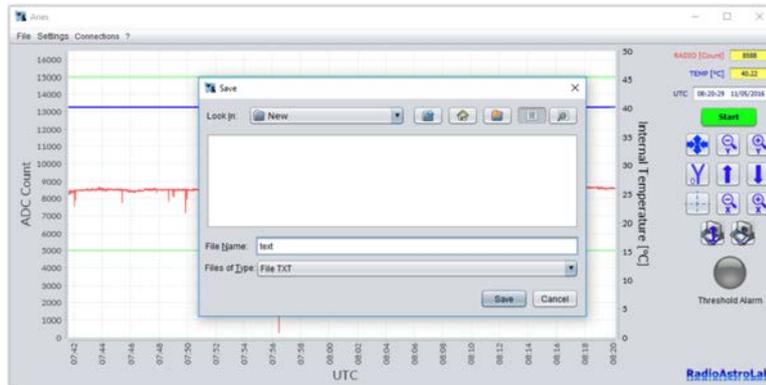
FIGURE 4.3: Data recording in text format (.TXT).

the measures in a text file representing the main recording format of the
radiometric data and of the instrument settings. The user will choose the
name and storage location of the file on the PC. Moreover, the software also
allows to record the measures in image format: the two buttons under the
Tracking button and the X axis zoom buttons are dedicated to the record-
ing of data in image format.

The picture Figure 4.4 shows an example of the format of a text file
recorded by the receiver *RAL10*: you can see a section of the header con-
taining the name of the receiver used, the values set for its parameters and
the starting date of the recording. The list below shows the temporal acqui-
sition instants of each sample of the quantities measured. The saving of the
samples acquired will go on until the acquisition is operating, and will stop
when the user ends the process.

To prevent overloads of the hard disk or any device used as non-volatile
memory (for example SD card in the *Raspberry PI*) with too frequent writes,
Aries will buffer the data obtained during one hour of acquisition, which
will be transferred to the text file chosen by the user. Each writing takes
place with a frequency of one hour.

You can also save, at pre-set time intervals, the graphic screens in image
format. When clicking the right button between the measurements record-
ing commands (the one with the camera - Fig. 4.5), *Aries* will open a dia-
logue box that allows to choose the folder in which to save the images, at
regular time intervals settable through the **Settings** menu (see the section
dedicated to the **Settings** menu voices for further information). Clicking
on the **Open** button you select the destination folder for the images: the but-
ton will turn red, confirming the activation of the storage procedure. As for

the recording of text files, you can't enable this feature when the acquisition is in progress (the button will be disabled). You can disable this feature by pressing the button again, and it will resume its original color.

```
RAL10
Sampling=1
Guad=1
Zero_base=23440
Time_const=0;
Integrator=4
Polarization=B
Date=8/2/2017

UTC RAD T(C)
01/12/2017 09:51:42.447 939 40.01
01/12/2017 09:51:42.656 941 40.01
01/12/2017 09:51:42.864 948 40.01
01/12/2017 09:51:43.085 937 40.01
01/12/2017 09:51:43.294 937 40.01
01/12/2017 09:51:43.513 938 40.01
01/12/2017 09:51:43.683 941 40.01
01/12/2017 09:51:43.888 942 40.01
01/12/2017 09:51:44.095 943 39.98
01/12/2017 09:51:44.314 940 40.01
01/12/2017 09:51:44.519 938 40.01
01/12/2017 09:51:44.718 937 40.01
01/12/2017 09:51:44.926 937 40.01
01/12/2017 09:51:45.134 938 40.01
01/12/2017 09:51:45.355 938 40.01
01/12/2017 09:51:45.562 939 40.01
01/12/2017 09:51:45.768 938 40.01
01/12/2017 09:51:45.977 947 40.01
01/12/2017 09:51:46.200 951 40.01
01/12/2017 09:51:46.404 948 40.01
01/12/2017 09:51:46.609 938 40.01
```

FIGURE 4.4: Example of a text file recorded by *Aries* (*RAL10*).

The center button (the camera icon with the number 1 overlapping - Fig. 4.6) is used to instantly record a picture of the graph screen (in .png format): you can choose the file name and its location in the PC. This feature is available in any time of execution of the program. When you stop the acquisition, the graphic contracts and shows the trend of the track at the launching of the program until the stopping moment, in order to display an overall picture of the measurement session. If you resume the acquisition of the measurements clicking on the **START** button, the previously displayed tracks will be cancelled and a new graphic will start: the software will ask to save a new text file with its path. The graphic recorder includes the zoom functions of the Y axis (radiometric track and inner temperature, if provided) and of the time axis X. On the Y axis (ordinate) is represented the radiometric signal acquired by the receiver. The limits of the range, as default, are set on the maximum value of range-bottom, corresponding to 16383 [ADC_count] and on the minimum value of range-start, corresponding to 0 [ADC_count]. These limits, superior and inferior, represent the measuring dynamics of the instrument.

Using the zoom buttons of the Y axis (highlighted in the upper part of Fig. 4.7) it is possible to increase or decrease its resolution. If, during this operation, the track disappears (upward or downward) from the display area, it is possible to use the arrow buttons to relocate the track on
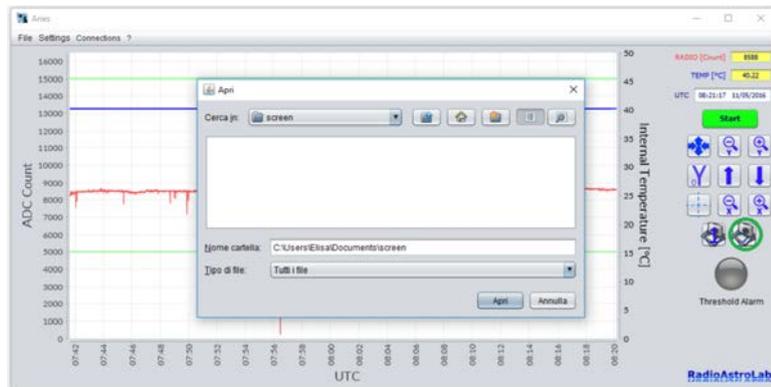
FIGURE 4.5: Automatic recording of the graphic screens in image format (screenshot).
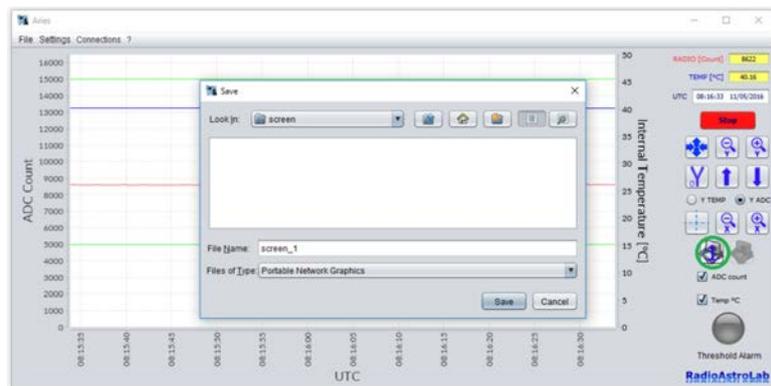
FIGURE 4.6: Recording of a single screen in image format.

FIGURE 4.7: Range settings for the graphical axes.

FIGURE 4.8: Commands for the selection of change of the ordinate range and the choice of visualization of the graphic tracks.

the graph in order to make it completely visible in all its dynamic excursion (basically, they are commands that allow the translation of the whole graphic track along the ordinate axis). If the receiver model provides the control of the inner temperature and its visualization, the temperature track can be seen as well (blue-colored). You won't be able to temporary modify the resolution of the radiometric track [ADC_count] and that of the inner temperature [°C]: you can choose the physical quantity to which apply the zoom commands by selecting the relative button in the boxes **Y TEMP** or **Y ADC** (Fig. 4.8). To restore the initial resolution of the Y axis (tha standard one with [Ymax = 16383] and [Ymin = 0]) you can use the **oY** button, while the upper button allows to automatically obtain the maximum resolution settable on the track.

By activating the check mark in the boxes for the abilitation of the graphic tracks (those upon the control light **Treshold Alarm** - Fig. 4.8) it is possible to activate the representations of the quantity desired.

Like for the Y axis, it is possible to zoom on the time axis (abscissa) using the dedicated buttons (Fig. 4.7) , thus modifying also the sliding speed of the track. The maximum speed (maximum zoom) settable is of sixty seconds per screen: the track will take a minute to cover all the graphic window. As we will see, in the **Settings** menu it will be possible to set the time format (in UTC or Local Time): the standard setting provides the representation in UTC format. For further information please refer to the section about the **Settings** menu voices.

By activating the **Tracking** button (represented by a dotted cross - Fig. 4.9) and positioning the cursor on a specific point of the track, you will see the numeric details (the values of the graphic coordinates) of that point (Fig. 4.10). When the function is activated, the dotted cross inside the button will be highlighted in red.

To check the signal sequence received during a measuring session, *Aries* offers the ability to set two control thresholds (upper and lower) that, if passed by the radiometric track (the red one), will trigger a visual alarm turning the **Treshold Alarm** spy red (Fig. 4.11) along with an sound alarm, if this option was previously set in the menu **Settings** (see the dedicated section). The thresholds are presented, in the graphic window,

FIGURE 4.9: **Tracking** function activated: it highlights the
coordinates of a point on the graphic track (button with the
red dotted cross).

FIGURE 4.10: Coordinates of a specific point of the track
highlighted with the **Tracking** function.

as two horizontal lines of green color.

Aries is designed to automatically reconnect when a temporary (and unexpected) interruption occurs in the serial communication line from the receiver to the PC. These problems can be frequent in some locations and are mainly caused by micro-interruptions or disturbances on the mains supply which turns off the receiver while the program is operating on a PC running on battery power (for example), or for any error associated with failure of the USB port detection by the operating system . When *Aries* detects an absence of communication with the receiver, it stops and restarts automatically maintaining the operating parameters set by the user and restoring a new serial connection to the receiver. This function is very useful when setting long automated measurement sessions in remote locations not manned by operators, possibly assisted remotely via internet: in these conditions it is important to maintain a high reliability in communication even in the presence of disorders or adverse conditions, minimizing data loss.
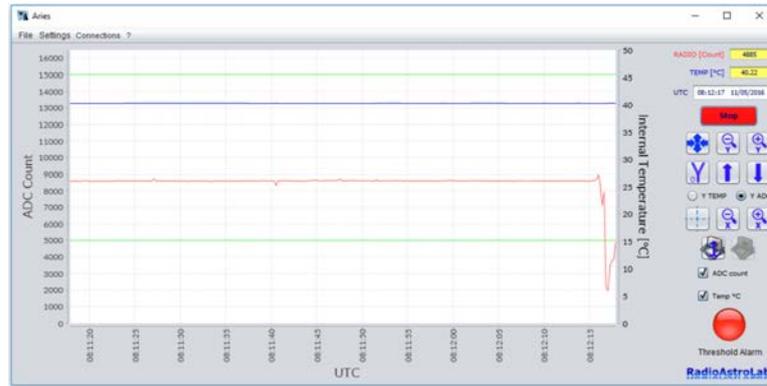
FIGURE 4.11: Alarm that alerts when the radiometric signal goes over the values of the pre-set thresholds (green horizontal lines on the graphic window).
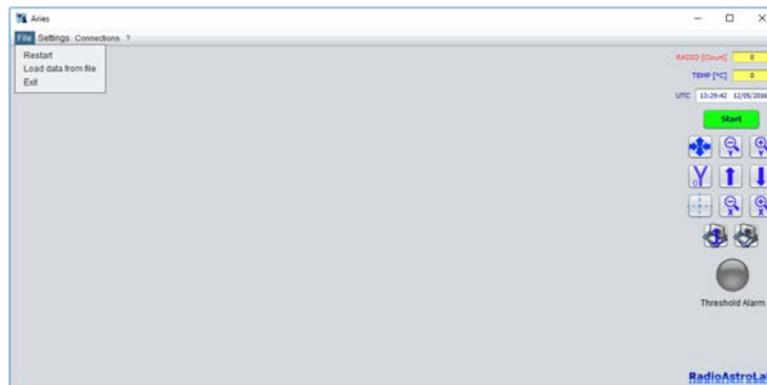
FIGURE 4.12: Components in the **File** menu.

4.1 Menu File

The menu **File** provides three voices (Fig. 4.12): **Restart**, **Load data from file**, and **Exit**.

The command **Restart** activates a new session of measurement acquisition starting the graphic window: the program looks as if it was launched just now.

Load data from file loads in the graphic window the data file saved by the user (Fig. 4.13): *Aries* displays the graph of the measurements based on the data in the file itself (Fig. 4.14).

Exit closes *Aries*.

4.2 Menu Settings

This menu includes the following voices (Fig. 4.15):

Add new device, adds a new device to the list of devices known by *Aries* through the procedure in chapter 3.

Manage devices, allows the user to handle one or more devices of the *RAL10* series with the corresponding settings of the parameters. The
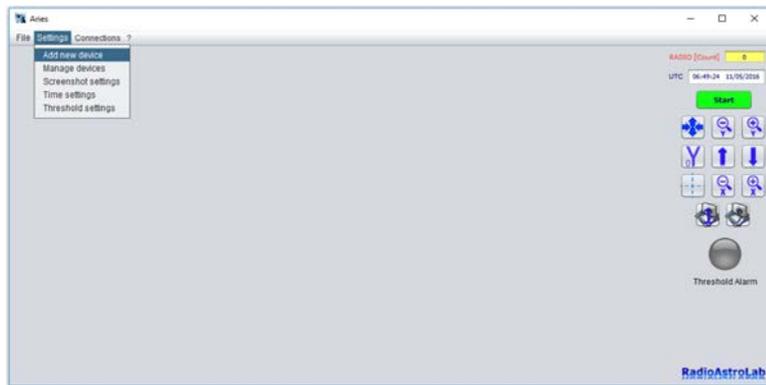
FIGURE 4.13: **Settings** menu voices.
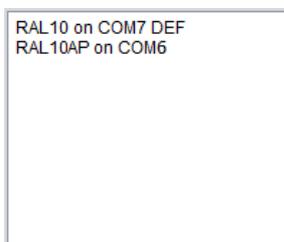
FIGURE 4.14: Selection of the receiver connected to *Aries*.

devices memorised in the PC and the default receiver with which you activate the connection at the launching of the program are highlighted. To change the default device you just have to select a different receiver among those on the list.

The default device will have the sign **DEF** beside the name (Fig. 4.16) and will be highlighted in the right label. The button **Delete Device** (Fig. 4.17) removes a device selected from the list, the button **Add New Device** (Fig. 4.17) adds a new device through the guided procedure in chapter 3 and the button **Edit Device settings** (Fig. 4.17) open the configuration window of the device shown in chapter 3.

Screenshot settings opens a window that will enable the user to set the saving frequency of the graphic screens (images) in seconds (fig. 4.19). The minimum frequency of recording selectable is a screenshot every 3 seconds, the maximum is a screenshot every 48 hours. The standard setting is a screenshot per hour. The chosen values must always be expresses in seconds.

Time settings modifies the visualization of date and hour (Fig. 4.20), choosing between UTC and Local Time. The standard setting of *Aries* refers to UTC time.

Threshold settings sets the superior and inferior threshold values that produce an alarm when the value of the radiometric measurement is over the superior threshold or lower than the inferior one (Fig. 4.21). The command also allows to enable the audible alarm and/or the automatic recording of a graphic screen (screenshot in image format) at the passing of the thresholds.
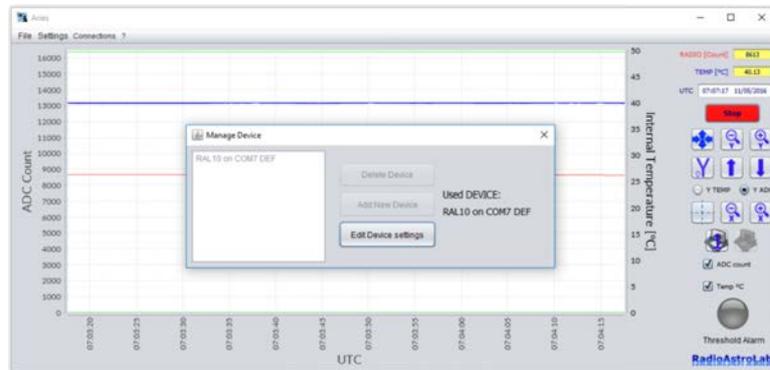
FIGURE 4.15: Window defining the receiver model selected
by *Aries*.
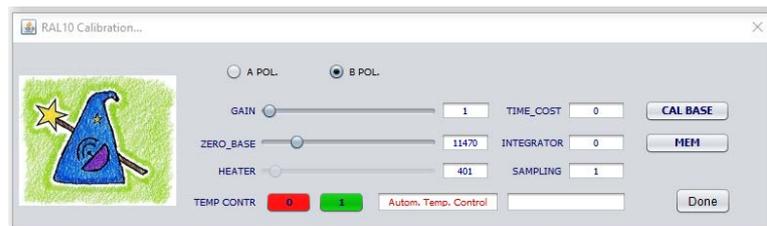
FIGURE 4.16: Configuration of the receiver parameters (de-
tails have been shown in chapter 3).
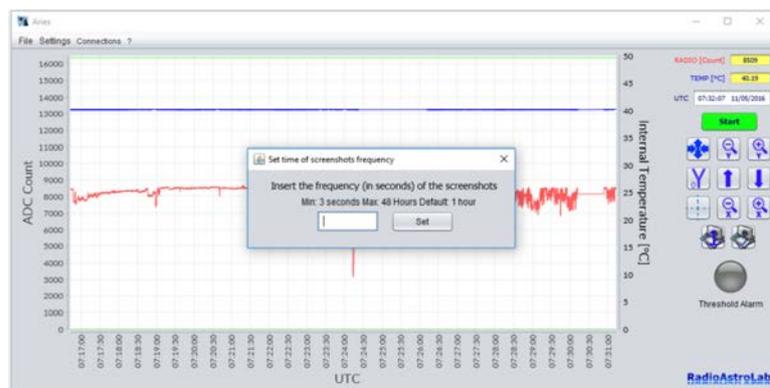
FIGURE 4.17: Setting of the recording frequency of the
graphic screens.

FIGURE 4.18: Setting of the date/hour format.
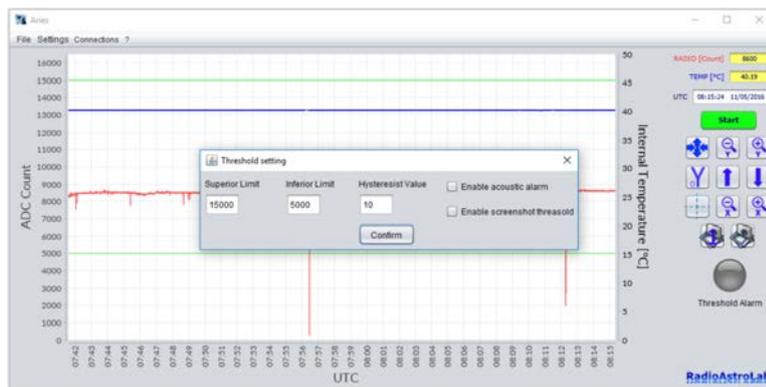
FIGURE 4.19: Setting of the threshold and hysteresis levels
for the acquisition alarm.
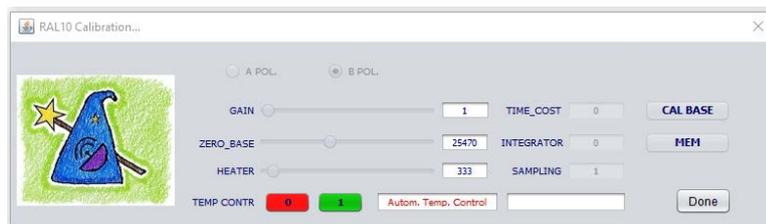
FIGURE 4.20: The configuration parameters of the receiver
are disabled during the acquisition of the measurements.
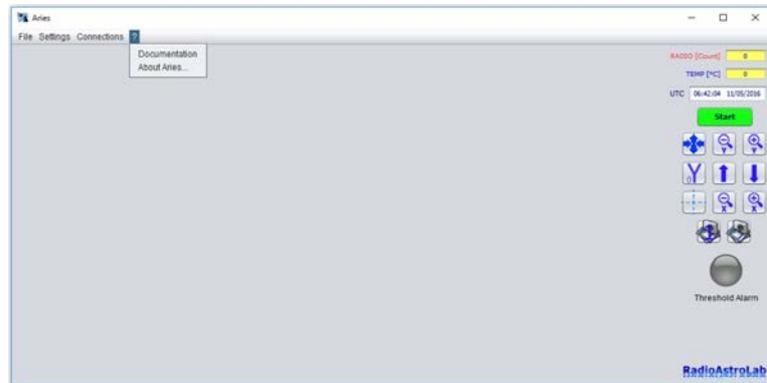
FIGURE 4.21: Menu with information about *Aries*.
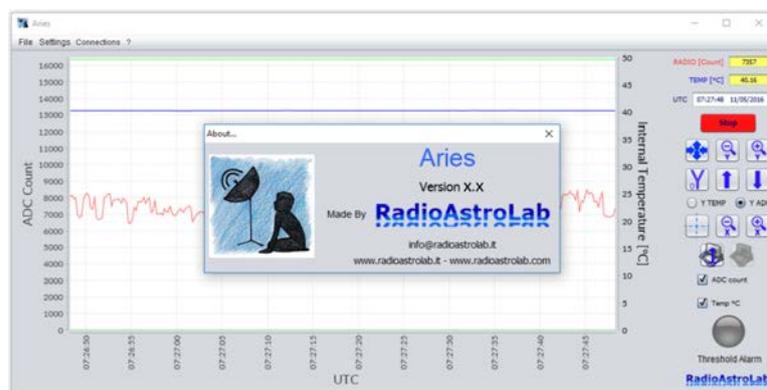
FIGURE 4.22: Information about *Aries*.

To activate unwanted activation of the alarm when the received signal fluctuates near the threshold values, a hysteresis value programmable by the user is provided.

The maximum value settable for the superior threshold is 16383 and it can't never be lower than the value set for the inferior threshold, also considering the hysteresis. The minimum value settable for the inferior threshold is 0. *Aries* will never accept threshold and hysteresis values that could create conflicts or ambiguities during the handling of an possible alarm event.

When the acquisition is activated, the voices of the **Settings** menu are disabled except for the **Manage devices** voice. During the acquisition also the commands for the setting of the parameters of the receiver inside the window **RAL10 Calibration...** are disabled (Fig. 4.22): however, you can always display possible variation in the parameters (as, for example, the **ZERO_BASE** value when the automatic calibration of the radiometric baseline is activated) for test and control purposes.

4.3 Menu Connections

This menu contains the entry **FTP images upload** which allows the user to upload screenshots (periodically) of the *Aries* graphics window, in image format (*.PNG*), on any server which has a *FTP protocol* (File Transfer Protocol). *FTP* is a data transfer protocol between a client (typically a local computer) and a server. This protocol is widely used for the management of websites.
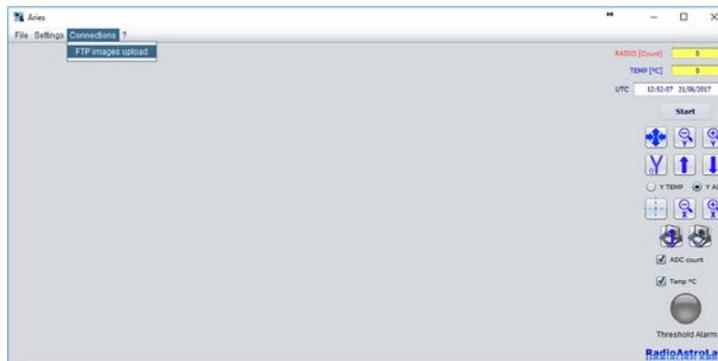
FIGURE 4.23: Menu Connections on *Aries*.

By entering the *FTP* access data to the server, the user must indicate the remote path on which he wants to load the images of *Aries*, with a fixed time frame. The updating periodicity can be set in the **Upgrade time frequency** box, confirming the value by pressing the "enter" key (the numerical value must be expressed in seconds). After entering the login data and choosing the remote path, press the **Start upload File** button to launch the automatic saves on the server at a fixed frequency. Access to this menu is only available when *Aries* data acquisition is stopped.

If the user does not set a name in the **Image file name (with .png)** box, *Aries* will use one by default (**screenshot_aries.png**), updating this file on the server with the periodicity set.
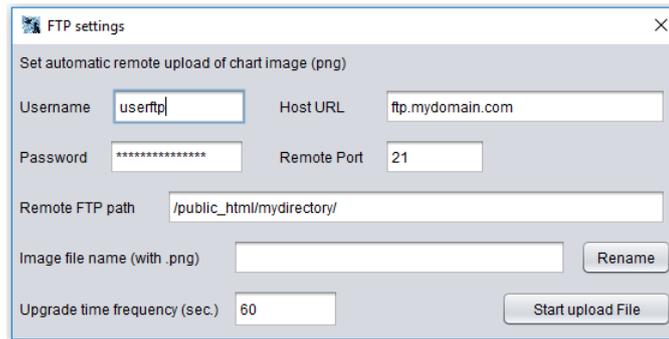
FIGURE 4.24: Connection setting window *FTP*.

4.4 Menu ?

This menu contains the information about the program (Fig. 4.23), and includes two voices: **Documentation** and **About**.

The voice **Documentation** opens a document in .PDF format containing *Aries* operating instructions (thi document) with all the information useful for the use of the software.

The voice **About** opens a dialogue box (Fig. 4.24) containing information on the software version. There are also indicated the website address and the email address of *RadioAstroLab* for eventual contacts.

We recommend to regularly visit the pages of our website *RadioAstroLab* to be updated on the latest news on the developing of new products, download updated versions of the software *Aries*, of the documentation about the program and about the receiver of the *RAL10* series.

Chapter 5

A macro to manage data

As explained in Chapter 4, the ability to save the measurements captured by the receivers of the *RAL10* series in a text file (.txt) is very useful, since it allows to import the recordings with a common electronic spreadsheet, normally available on a computer, and represent the data with high quality graphics, or process them for further analysis.

To simplify the work to the users we have created the spreadsheet with macro *ImportaDatiAries.xlsm*: this useful accessory, downloadable for free from our website pages, works on the platform *Microsoft Excel* (from version 2007 onwards) and it allows you to open and automatically import any documents (.txt) saved with *Aries*. To use *ImportaDatiAries.xlsm* is therefore necessary that your computer has been installed the program *Microsoft Excel*.

The Figure 5.1 shows the initial page of the spreadsheet *ImportaDatiAries.xlsm*.
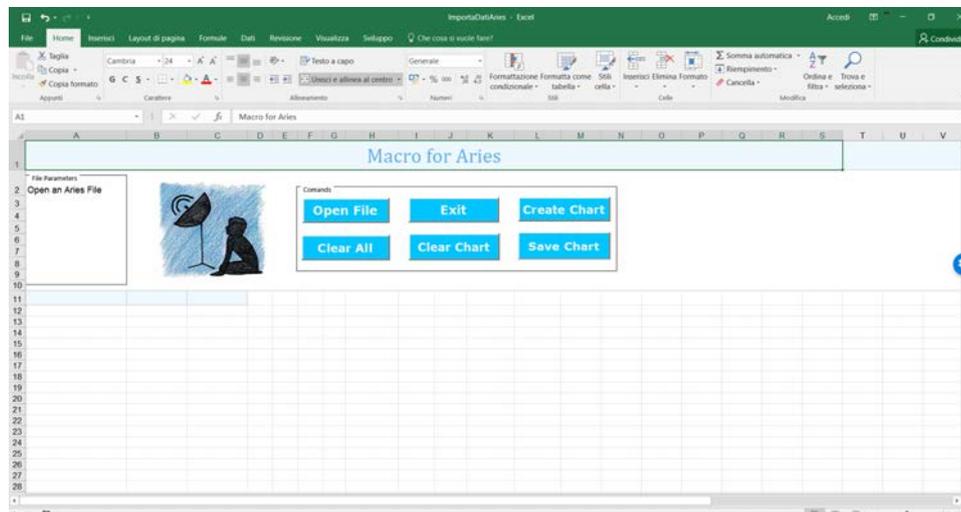
FIGURE 5.1: Initial page of *ImportaDatiAries.xlsm*.

The spreadsheet contains a macro (password protected) that will allow the user to manage the document data previously recorded using the following commands:

- *OPEN FILE*: is the document import command (.txt) generated by *Aries*. It opens a dialog box where the user chooses which document to use. An error dialog alerts the user if an invalid document was selected.
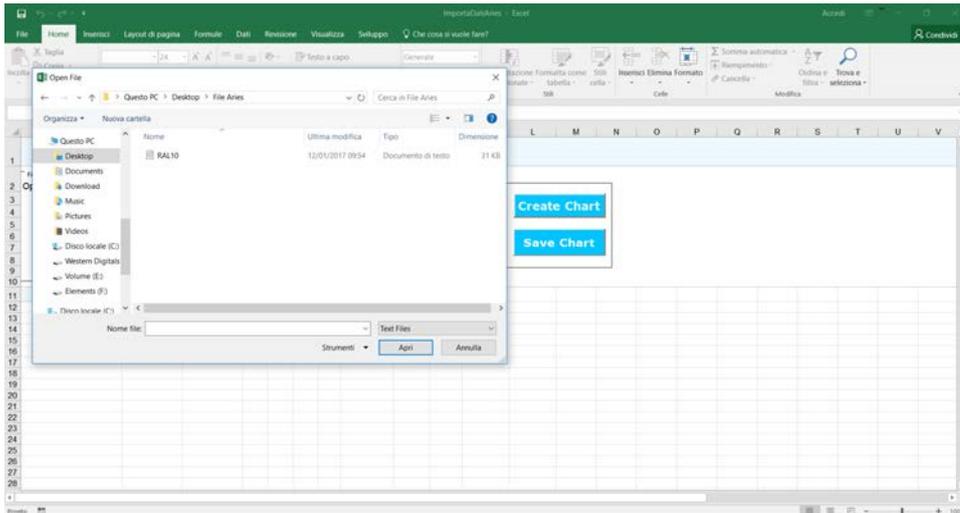
FIGURE 5.2: Import a document (.txt) generated by *Aries*.

The macro will import the data on the first columns of the spreadsheet (the number of columns depends on the receiver model used) and automatically will represent the measurements in a graphical format.

- *EXIT*: exits from the spreadsheet asking the user whether or not to save the imported data. Deletes previously created graphs.

- *CREATE CHART*: automatically creates graphs using the data present in the columns.

- *CLEAR ALL*: cleans the spreadsheet by deleting data in the columns and the previously created charts.

- *CLEAR CHART*: cleans the spreadsheet eliminating the present graphics, while keeping the data (previously imported) in columns.

- *SAVE CHART*: save charts as image format (.png). You can choose the name of the created images and, in the case of more graphics, an identification number will be added to the name chosen.
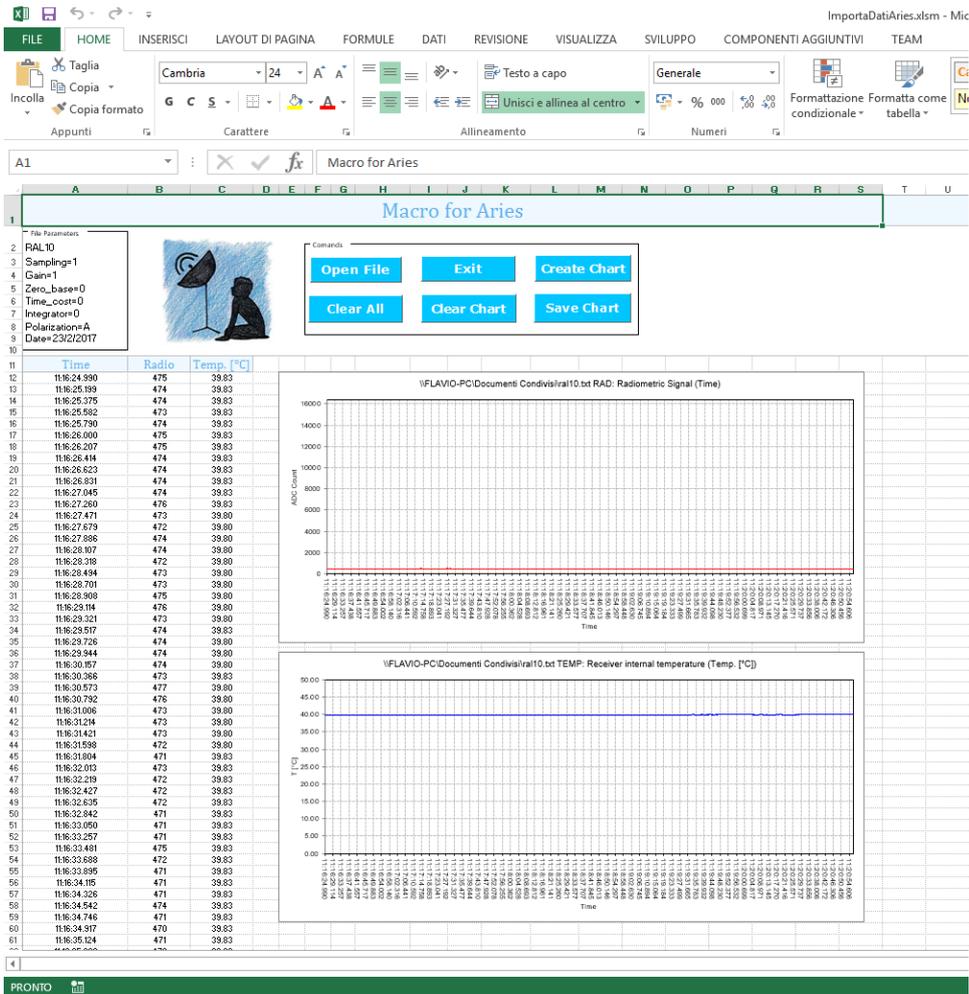
FIGURE 5.3: The document (.txt) with all the measures recorded with the *RAL10* receiver (example) was acquired successfully and the data of interest were represented.
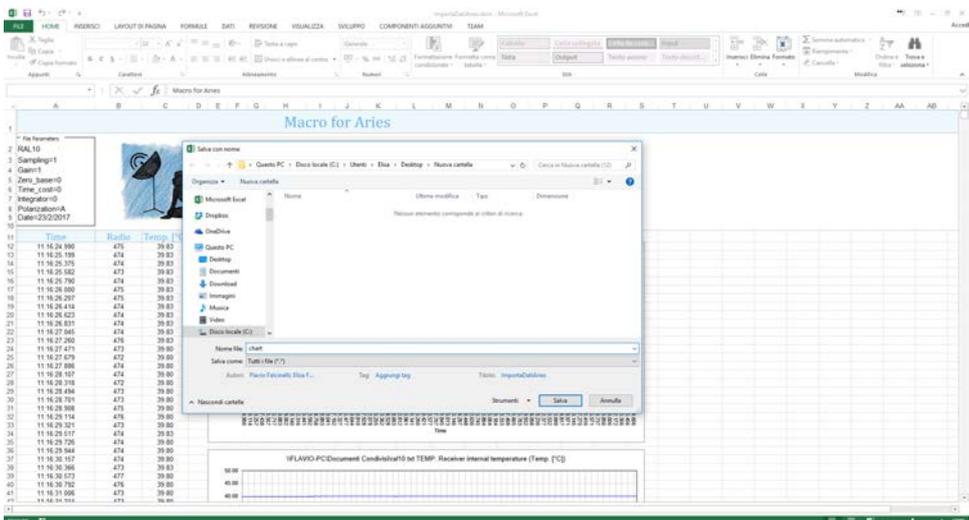
FIGURE 5.4: Dialog box for saving graphics images in (.png) format.

Appendix A

Automatic start of *Aries* on *Raspberry PI*

We will describe how to automatically launch the *Aries* software at the start (or reboot) of the *Raspberry PI* device, which is very useful when there is a fault of power supply followed by a subsequent reset. *Raspberry PI*, in fact, does not use mechanical keys to turn on (such as a PC) and will start automatically as soon as the electronic board is connected to a power source through the appropriate cable *micro USB* . You can set some commands so that, once you start the *Raspbian* operating system (the official *linux* distribution for *Raspberry PI*), *Aries* is executed automatically.

First you need to create a file called **startup.desktop** in the path **/etc/xdg/autostart**, then run this command from the terminal:

```
$ sudo gedit /etc/xdg/autostart/startup.desktop
```

a text editor will open, where you will edit and save the file you just created. It is necessary to insert the following lines of text:

```
[Desktop Entry]
Encoding=UTF−8
Type=Application
Name=nds
comment=
Exec=sudo /home/pi/Desktop/launch.sh
StartupNotify=false
Terminal=false
Hidden=−false
```

In the following line:

```
Exec=sudo /home/pi/Desktop/launch.sh
```

you set the path and file name that will contain the *bash* code to be executed once the operating system is started. The *bash* is a command interpreter that allows the user to communicate with the operating system through a set of predefined functions, or to execute programs and scripts (as in the case of the **launch.sh** file).

When done, save the file you just created and close the text editor.

Now you need to create the **launch.sh** file inside the **Desktop** folder (or where the user thinks it's best). The *bash* code inside it will allow *Aries* to

run automatically when the system starts. To create the **launch.sh** file, type
the following command on the terminal:

```
$ sudo gedit /home/pi/Desktop/launch.sh
```

This will open the text editor that will be used to edit the **launch.sh** file:

```
#!/bin/bash
cd /home/pi/Desktop
./Aries_RPI.run
```

Where the first instruction **cd /home/pi/Desktop** represents the setting
of the path where the *Aries* file is located (with the extension .run), then the
command **./Aries_RPI.run** is launched to start the program. *Aries* will start
automatically connecting to the serial port and will be configured with the
last settings used by the user. Save the file you just created, close the text
editor and restart the *Raspberry PI*.