

# Observational Astronomy & Data Reduction

Lecture 3:  
Planning your Observing Night

**EVERYONE, GO TO:**

<https://tinyurl.com/ISYA2018-ObservationalAstro>

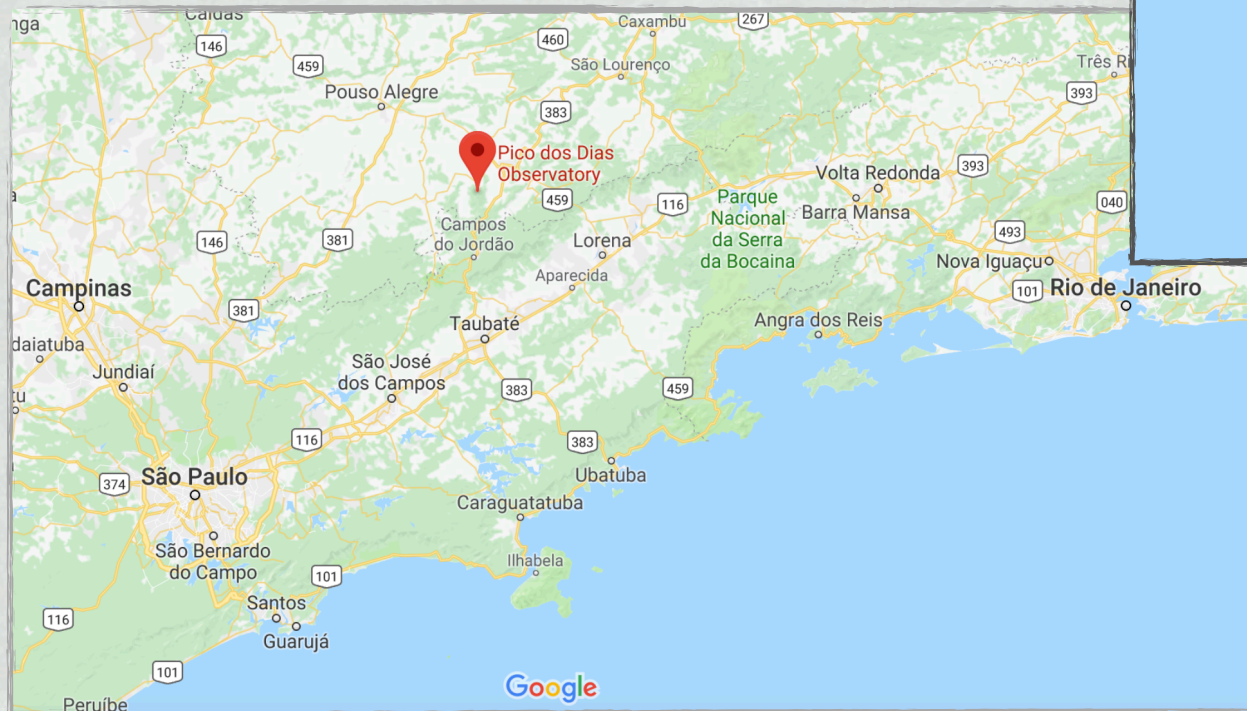


Karín Menéndez-Delmestre  
Observatório do Valongo

# Remote Observing @ Observatório Pico dos Dias

## Localização

- Minas Gerais, Brazil
  - ~350 km from Rio de Janeiro
  - ~250km from São Paulo
- $22.5344^{\circ}$  S,  $45.5825^{\circ}$  W

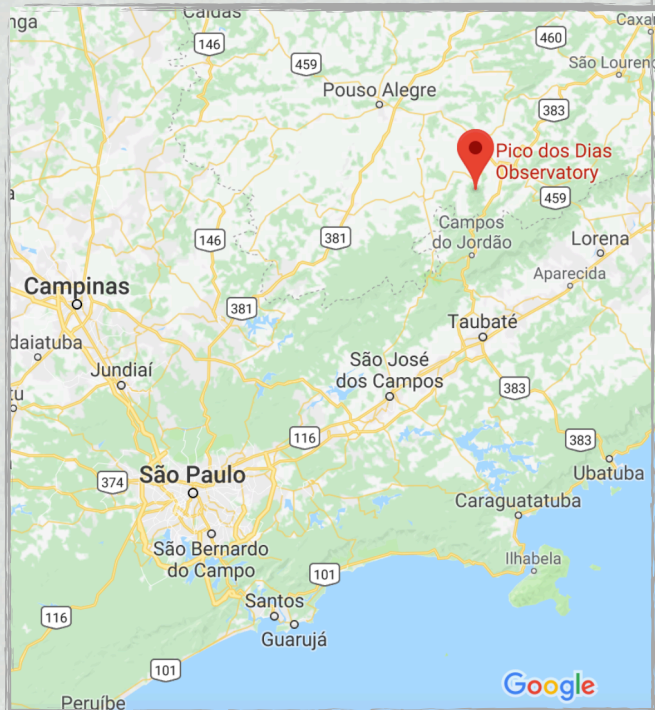




# Remote Observing @ Observatório Pico dos Dias

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# Remote Observing with the Perkin-Elmer 1.6m Telescope



<http://www.nitmantiqueira.org.br/portal/index.php/noticias/1195-lna-fecha-acordo-com-instituicao-da-russia-para-monitorar-lixo-espacial>



# Remote Observing with the Perkin-Elmer 1.6m Telescope



## General Properties

- Cassegrain telescope
  - Ritchey-Chrétien variation
  - @ Cassegrain focus:  $f/10$

## Instrument

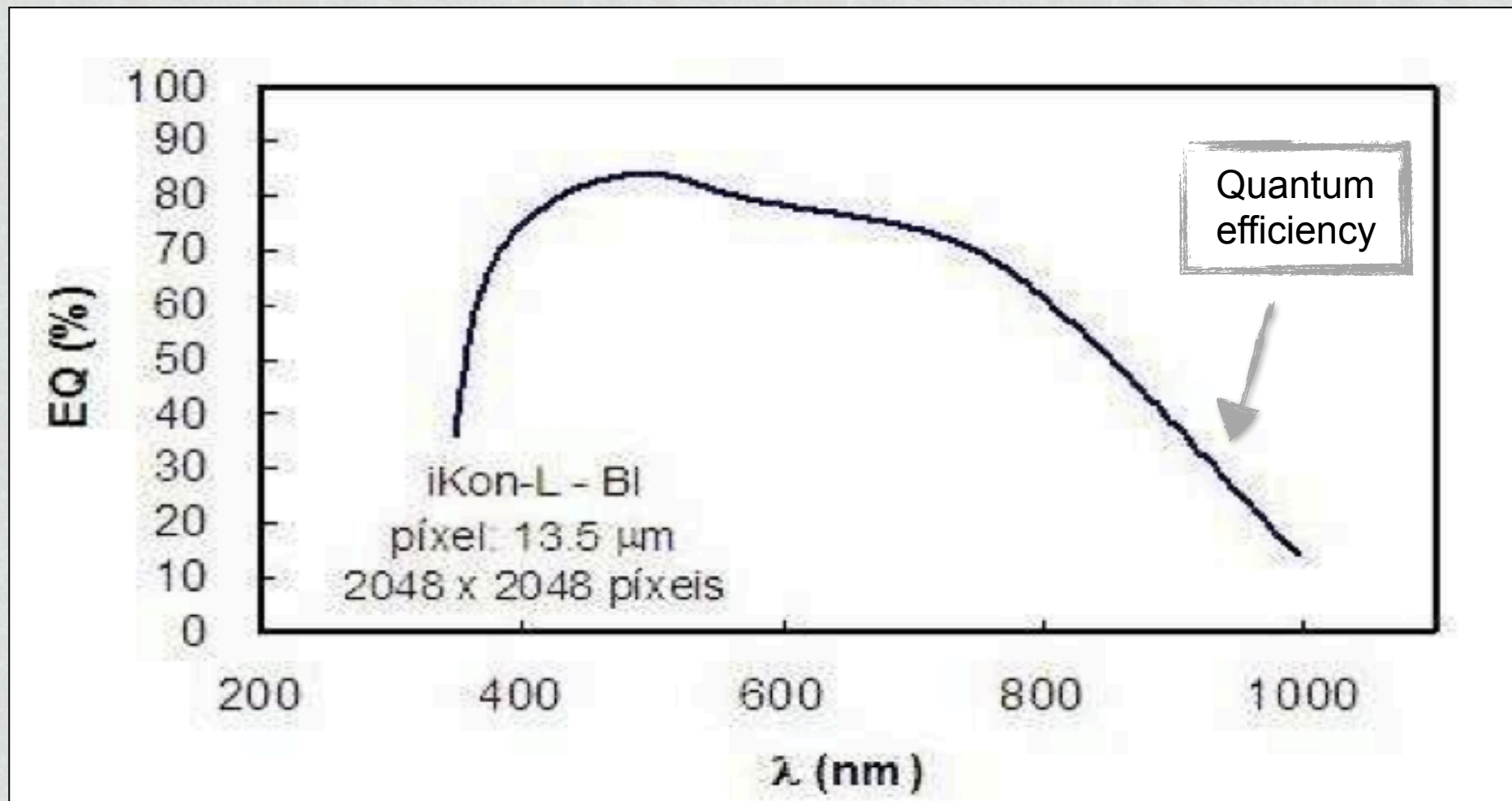
- Direct Camera with IKON CCD
  - CCD: 2048 pix x 2048 pix
  - Pixel size:  $13.5\mu\text{m} \times 13.5\mu\text{m}$ 
    - $0.18''/\text{pix}$
    - From:  $h = \theta_{\text{radians}} F$
  - FOV:  $\sim 6' \times 6'$ 
    - from:  $\theta_a \times \theta_b = (a \times b) / F^2$



# Imaging with the Direct Cam on the PE/1.6m Telescope

## Filters

- Up to 6 filters can be placed on the filter wheel

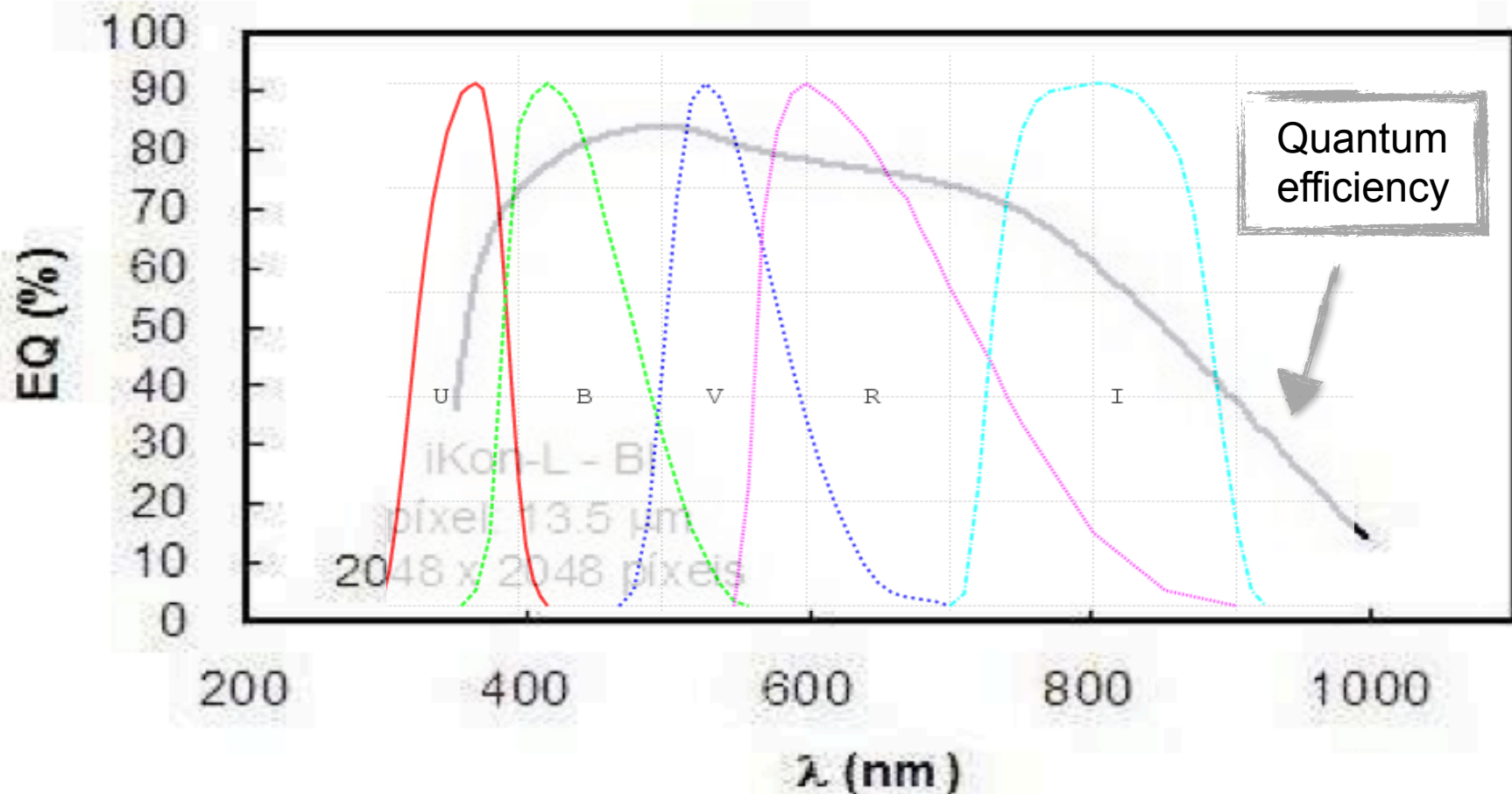




# Imaging with the Direct Cam on the PE/1.6m Telescope

## Filters

- Up to 6 filters can be placed on the filter wheel





- Go to the LNA official website: <http://www.lna.br/opd/opd.html>


BRASIL

Serviços

Simplifique!

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Legislación

Canais de informação





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Gemini

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CFHT

Instrumentação

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Anúncios

Chamada para propostas

Servidor para processamento on-line das observações

mais antigos...

Informações gerais

Localização

Telescópios

Instrumentos e detectores

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Histórico das noites observadas

Formulário de pedido de tempo

Formulário de avaliação de dados:

Projetos comuns

Projetos de longo prazo

Câmera AllSky

Estação meteorológica

Visitas de escolas e grupos

Desde 22 de abril de 1980, o Observatório do Pico dos Dias colabora de forma contínua para o desenvolvimento científico e tecnológico do Brasil, atendendo ativamente à comunidade astronômica nacional no suporte às suas atividades científicas e de formação avançada.

Última atualização: 29/05/2015  
Comentários e Sugestões: [webmast@lna.br](mailto:webmast@lna.br)



- Let's see what the (current) weather conditions are like

[Estacao Meteorologica](#)

[Sensor de nuvens](#)

[AllSky I](#)

[AllSky II](#)

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[Boletim](#)

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## O P D - Estação Meteorológica

Brasopolis-MG    Altitude: 1864 m    Latitude: 22° 32' 04" S Longitude: 45° 34' 57" W  
Data: 12/07/18 - 11:05 UTC: 12/07/18 - 14:05 Amanhecer: 6:42    Por do sol: 17:33    Lua: New Moon

**CAMERA ALLSKY - OPD**

UTC: 12/July/2018 14:12:33

Aguardando o início das Imagens da noite . . .



Imagem da Via Láctea, destacando-se a Lua cheia(esquerda) e a cúpula do Telescópio de 1,60 m (LNA, 2008)

Imagem exibida em [765x510] pxs , original em : [1628x1236] pxs



- Let's see what the (current) weather conditions are like
- We'll be using the 1.6m Perkin-Elmer (PE) Telescope

## O P D - Estação Meteorológica

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### Condições climáticas



[PE - 1,60m](#)

[IAG - BC 0,6m](#)

### S U M A R I O S

**Atual**

**Anterior**

[Mensal \(NOAAMO\)](#) [Mensal \(NOAAPRMO\)](#)

[Anual \(NOAAYR\)](#) [Anual \(NOAAPRYR\)](#)

[Ultimos 2 dias](#)

[Dados do Mês](#)

[Previsão do tempo](#)

- Let's see what the (current) weather conditions are like
- We'll be using the 1.6m Perkin-Elmer (PE) Telescope

[Estacao Meteorologica](#)

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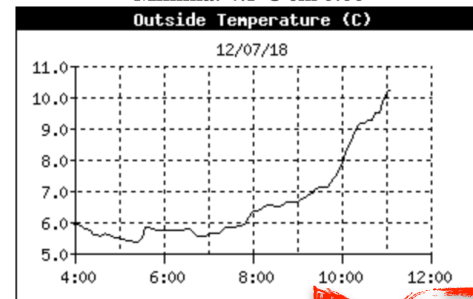
### TEMPERATURA

**Externa 1,60m**

**Atual : 10.2 °C**

**Máxima: 10.2°C em 11:00**

**Mínima: 4.1°C em 0:00**

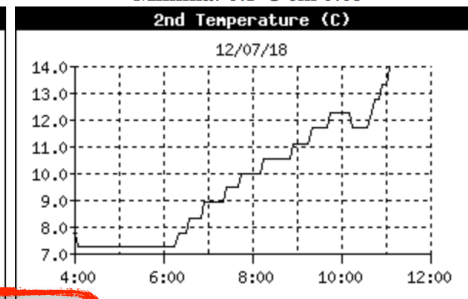


**Interna - Cúpula 1,60 m**

**Atual : 13.9°C**

**Máxima: 13.9°C em 11:02**

**Mínima: 6.1°C em 0:03**



**Humidity**

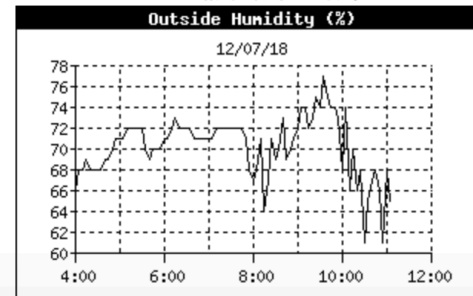
**UMIDADE**

**Externa 1,60m**

**Atual: 63%**

**Máxima: 85% em 0:00**

**Mínima: 61% em 10:29**

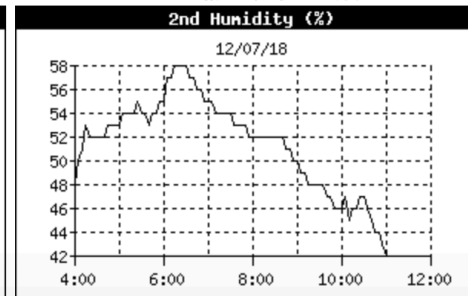


**Interna - Cúpula 1,60 m**

**Atual: 41%**

**Máxima: 66% em 0:00**

**Mínima: 41% em 11:07**



**Max humidity: ~95%**  
**Max Wind: 70km/h**



# CLASSROOM WORK

Group 1

- Important times during your observing night:

- Sunset
- twilight

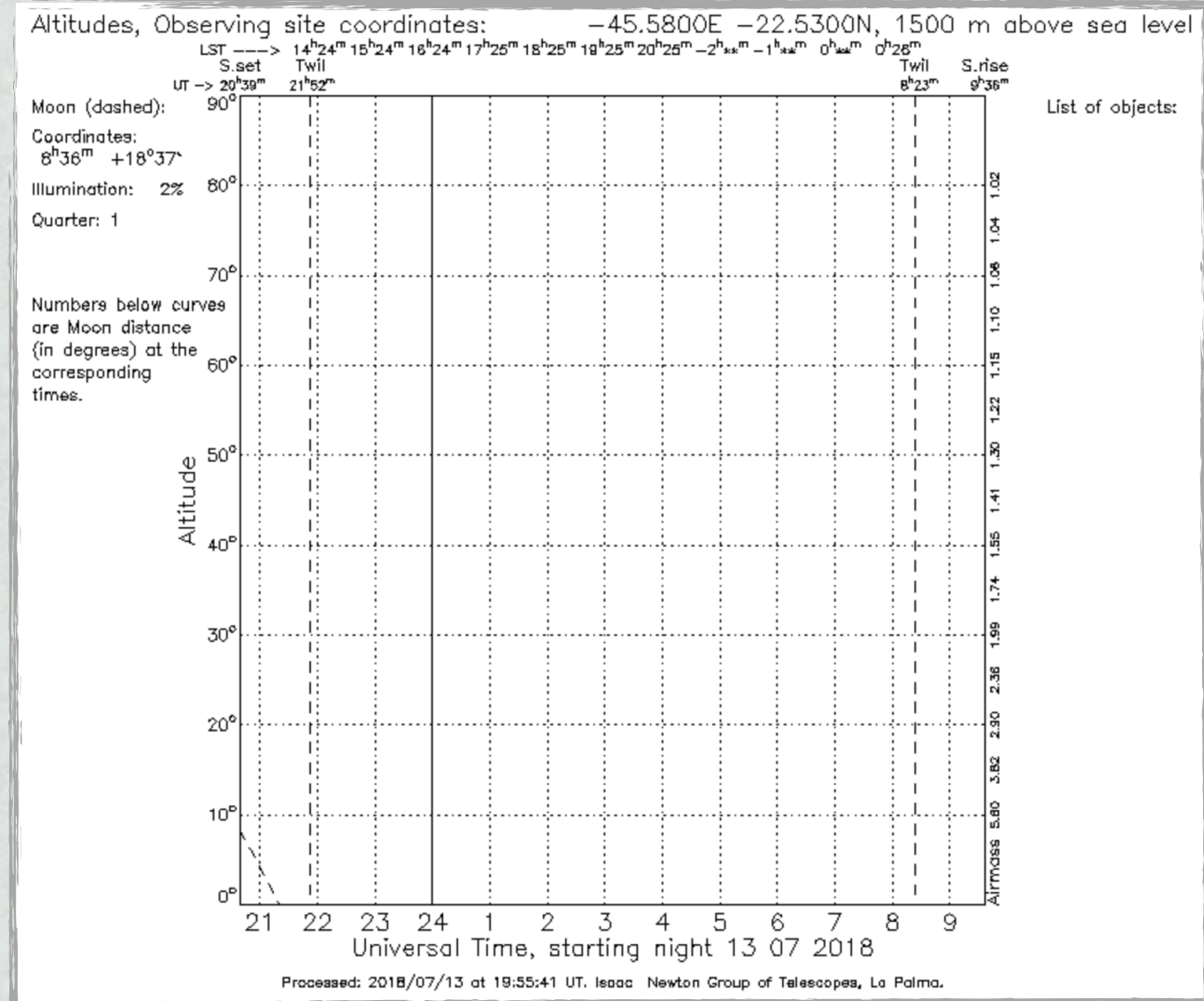
Go to:

<http://catserver.ing.iac.es/staralt/>

**OPD:**  
longitude latitude:  
**-45.58 -22.53**

Also:

<https://www.timeanddate.com/astronomy/@3460834>



# CLASSROOM WORK

## Group 1

- Important times during your observing night:

- Sunset
- twilight

21:52  
(UT time)

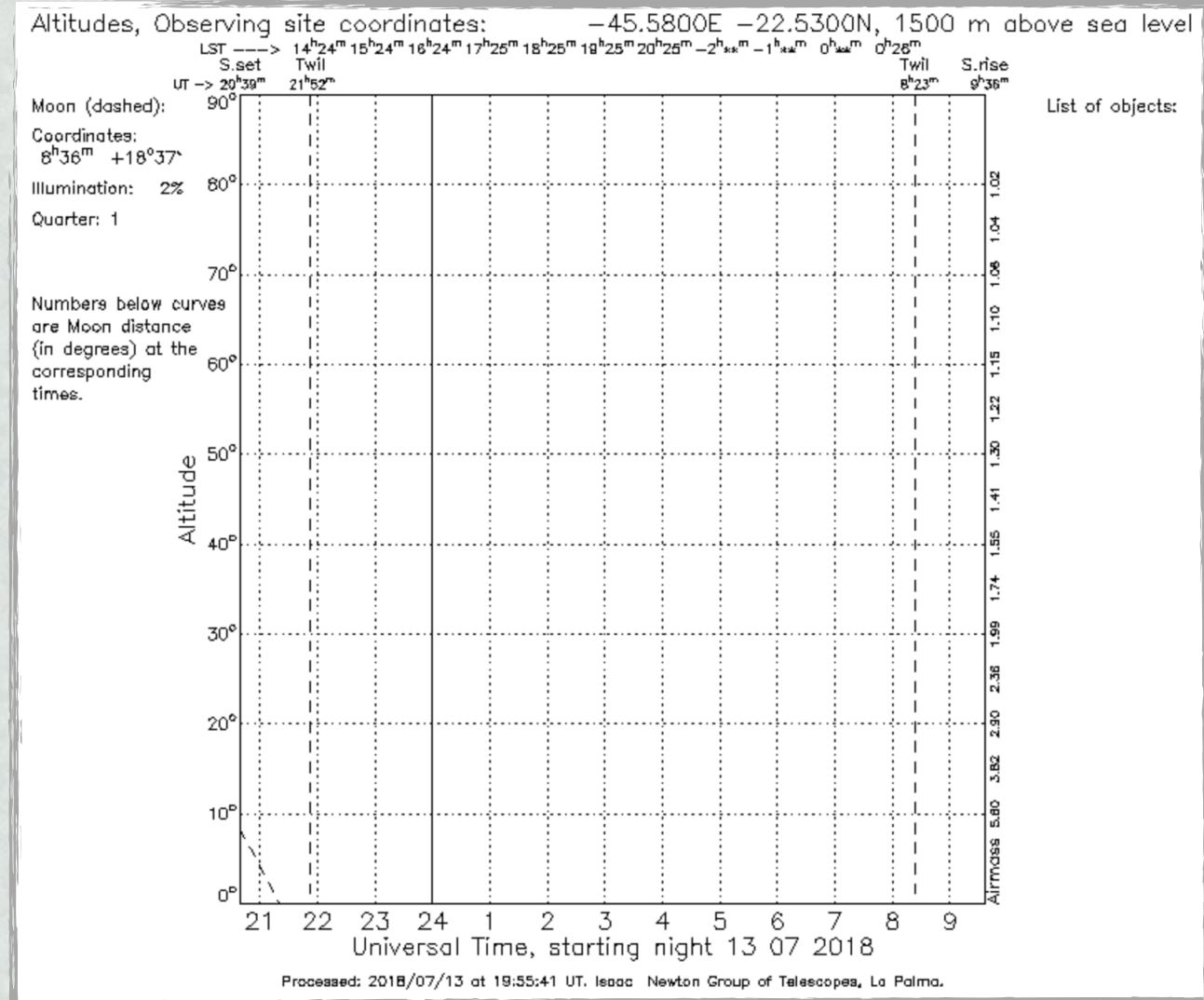
Go to:

<http://catserver.ing.iac.es/staralt/>

OPD:  
longitude latitude:  
-45.58 -22.53

**Also:**

[https://  
www.timeanddate.com/  
astronomy/@3460834](https://www.timeanddate.com/astronomy/@3460834)





# CLASSROOM WORK

Group 1

- Important times during your observing night:

- Sunset
- twilight

21:52  
(UT time)

Go to:

What time is it?

Current local time in  
Itajubá, Brazil

Fri, 13. July 2018

**10:17:46** a.m.

Time Zone: UTC-3

[America/Sao\\_Paulo](#)

Universal Time Coordinated GMT / UTC	UTC-3
Daylight Saving Time DST	UTC-2
Standard Time	UTC-3

[Currently in use](#)

What time is it?

Current local time in  
Socorro, Colombia

Fri, 13. July 2018

**08:17:46** a.m.

[HTML](#)

Time Zone: UTC-5

[America/Bogota](#)

Universal Time Coordinated GMT / UTC	UTC-5
Daylight Saving Time DST	<a href="#">There are rules for this</a>

universal time current time

[All](#) [Images](#) [News](#) [Maps](#) [Videos](#) [More](#) [Settings](#) [Tools](#)

About 217,000,000 results (0.58 seconds)

**1:17 PM**

Friday, July 13, 2018  
Coordinated Universal Time (UTC)

→ 16:52  
(Socorro time)

# CLASSROOM WORK

Group 2

- Object selection

- Science:  
Micro-variable AGNs  
(Romero+99):  
<https://aas.aanda.org/articles/aas/pdf/1999/06/ds8028.pdf>
- Consider:
  - ▶ coordinates
    - B1950 → J2000  
<https://ned.ipac.caltech.edu/forms/calculator.html>
  - ▶ airmass
    - <http://catserver.ing.iac.es/staralt/>

Table 1. Observed AGNs

Object	$\alpha_{1950.0}$	$\delta_{1950.0}$	$z$	$m_V$	Type
0537 – 441	05 37 21.1	–44 06 45.0	0.894	16.48	RBL
0637 – 752	06 37 23.25	–75 13 38.2	0.651	15.75	RLQ
1034 – 293	10 34 55.9	–29 18 27.0	0.312	16.46	RLQ
1101 – 232	11 01 11.1	–23 13 20.0	0.186	16.55	XBL
1120 – 272	11 20 34.2	–27 13 35.0	0.389	16.80	RQQ
1125 – 305	11 25 04.0	–30 28 14.0	0.673	16.30	RQQ
1127 – 145	11 27 35.6	–14 32 54.0	1.187	16.90	RLQ
1144 – 379	11 44 30.9	–37 55 31.0	1.048	16.20	RBL
1157 – 299	11 57 10.0	–29 55 10.0	0.207	16.40	RQQ
1244 – 255	12 44 06.7	–25 31 25.0	0.638	17.41	RLQ
1256 – 229	12 56 27.6	–22 54 28.0	?	17.30	RBL
1349 – 439	13 49 52.5	–43 57 55.0	?	16.37	RBL
1510 – 089	15 10 08.9	–08 54 48.0	0.360	16.54	RLQ
1519 – 273	15 19 37.3	–27 19 30.0	?	17.70	RBL
2005 – 489	20 05 46.6	–48 58 43.0	0.071	13.40	RBL
2155 – 304	21 55 58.3	–30 27 54.0	0.116	13.09	XBL
2200 – 181	22 00 27.0	–18 16 14.0	1.160	15.30	RQQ
2254 – 204	22 54 00.5	–20 27 43.0	?	16.60	RBL
2316 – 423	23 16 20.9	–42 23 14.0	0.055	16.00	XBL
2340 – 469	23 40 34.2	–46 56 42.0	1.970	16.40	RQQ
2341 – 444	23 41 08.2	–44 23 58.0	1.900	16.50	RQQ
2344 – 465	23 44 02.3	–46 29 10.0	1.890	16.40	RQQ
2347 – 437	23 47 57.5	–43 42 31.0	2.900	16.30	RQQ



# CLASSROOM WORK

Group 2

- **Object selection**

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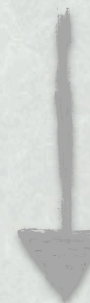
- Consider:

- ▶ coordinates

- B1950 → J2000  
<https://ned.ipac.caltech.edu/forms/calculator.html>

Remember? RA range available in the night sky for this time of the year!

RA: 15h → 23h



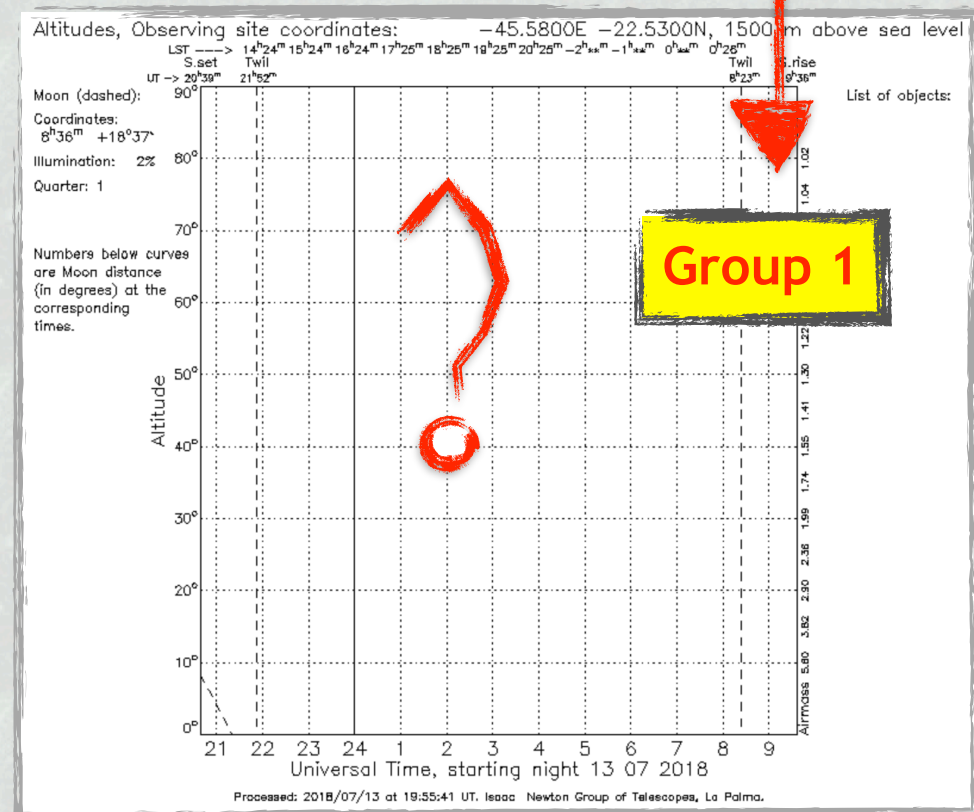
1510 - 089	15 10 08.9	-08 54 48.0	0.360	16.54	RLQ
1519 - 273	15 19 37.3	-27 19 30.0	?	17.70	RBL
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2340 - 469	23 40 34.2	-46 56 42.0	1.970	16.40	RQQ
2341 - 444	23 41 08.2	-44 23 58.0	1.900	16.50	RQQ
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# CLASSROOM WORK

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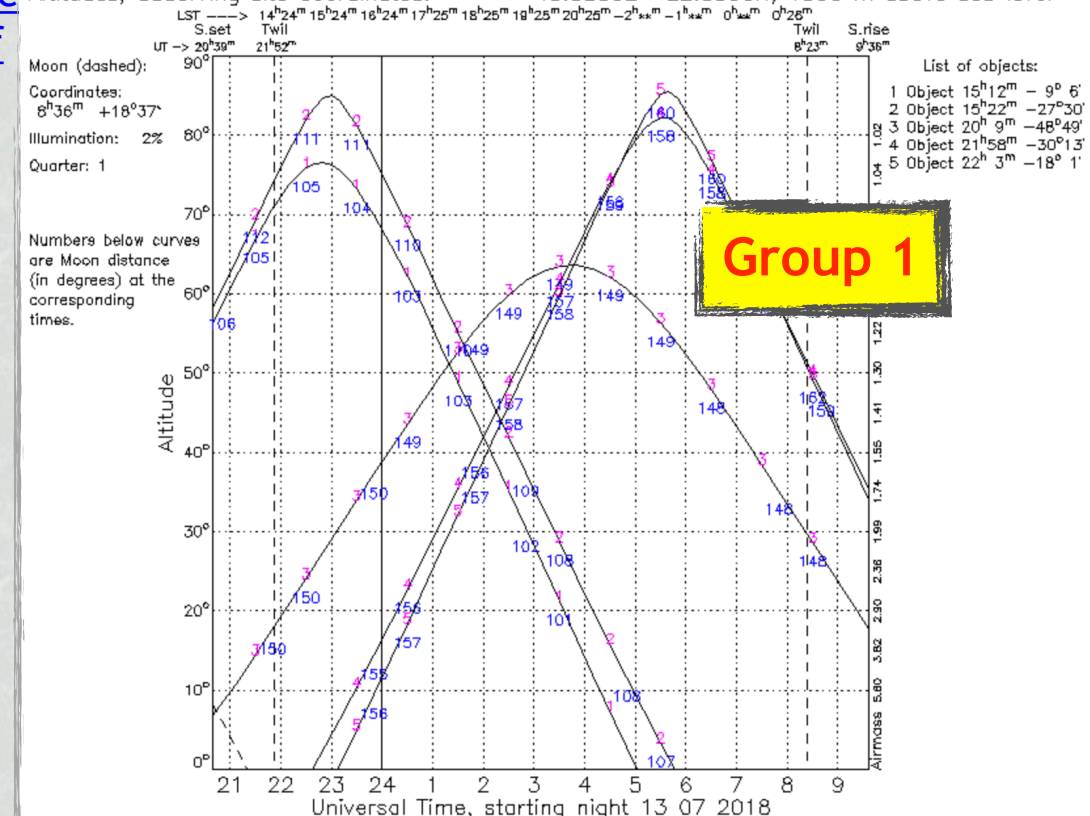
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2155 - 304	21 55 58.3	-30 27 54.0	0.116	13.09
2200 - 181	22 00 27.0	-18 16 14.0	1.160	15.30

Altitudes, Observing site coordinates: -45.5800E -22.5300N, 1500 m above sea level



# CLASSROOM WORK

Groups 3, 4

- Finder charts
  - IRSA (<http://irsa.ipac.caltech.edu/applications/finderchart/>)

The screenshot shows the IRSA Finder Chart web interface. The top navigation bar includes the IRSA logo and links for DATA SETS, SEARCH, TOOLS, and HELP. A 'Login' link is on the right. Below the navigation bar, there are buttons for 'Search', 'Catalogs', and 'Help', and a 'Background Monitor' button with a notification icon. The main content area is titled 'Finder Chart' and has two tabs: 'Single Position' (selected) and 'Multiple Positions'. The 'Single Position' tab contains a form with the following fields and options:

- Name or Position:** A text input field with a dropdown menu set to 'Try NED then Simbad'. Below it, examples are listed: 'm81', 'ngc 13', '12.34 34.89', '46.53 -0.251 gal', '19h17m32s 11d58m02s equ j2000', and '12.3 8.5 b1950'.
- Image Size:** A text input field with '300' and a dropdown menu set to 'arcsecond'.
- Display Size:** Radio buttons for 'Small', 'Medium' (selected), and 'Large'.
- Select Images:** Checkboxes for 'DSS', 'SDSS (DR7)', '2MASS (allsky)', 'WISE (AllWISE)', 'Spitzer (SEIP)', 'AKARI', and 'IRAS (IRIS)'. All are checked except 'IRAS (IRIS)'.
- Search Corresponding Catalog(s):** Radio buttons for 'Yes' (selected) and 'No'.
- Search within the image boundary:** Radio buttons for 'Search within the image boundary' and 'Search radius (arcsec)' (selected).
- SDSS (DR10):** A text input field with '5'.
- 2MASS (PSC):** A text input field with '5'.
- WISE (AllWISE):** A text input field with '5'.
- Spitzer (SEIP):** A text input field with '5'.
- AKARI:** A text input field with '5'.
- One to one match:** A checkbox that is unchecked.
- Image Search Options:** A link to expand more options.

At the bottom of the form are 'Search' and 'Cancel' buttons, and a help icon (?) on the right.



# CLASSROOM WORK

Groups 3, 4

- Finder charts

**Finder Chart**

**Single Position** **Multiple Positions**

Name or Position:

228.210547, -9.100079 Equ J2000 or

Image Size:

Display Size: ☐ Small ☒ Medium ☐ Large

Select Images: ☒ DSS ☒ SDSS (DR7) ☐ 2MASS (allsky) ☐ WISE (AllWISE) ☐ Spitzer (SEIP) ☒ GALEX ☐ IRAS (IRIS)

Search Corresponding Catalog(s): ☒ Yes ☐ No

☐ Search within the image boundary

☒ Search radius (arcsec)

SDSS (DR10):

☐ One to one match

► Image Search Options

**Target**

**Size of output image**

**Select database where to look for images**

**GO!**

# CLASSROOM WORK

Groups 3, 4

- Finder charts
  - IRSA (<http://irsa.ipac.caltech.edu/applications/finderchart/>)

The screenshot shows the IRSA Finder Chart web application. At the top, the IRSA logo is on the left, and navigation links for 'IRSA', 'DATA SETS', and 'SEARCH' are in the center. On the right, the coordinates 'EQ-J2000: 15h12m38.48s, Image Pixel: 246.1, 176.5' are displayed. Below the navigation links are buttons for 'Search', 'Catalogs', and 'Help'. A toolbar with various icons for zooming, panning, and other functions is located below the buttons. A red arrow points from the 'Shift image so that N is up' text box to the compass icon in the toolbar. Another red arrow points from the 'Show compass on image' text box to the compass icon. Below the toolbar, the target information is shown: 'Target= 15h12m50.53s -9d06m00.3s Equ J2000; Image Size=0.1333 deg; Sources=DSS,SDSS'. Below this is a row of five thumbnail images. The first thumbnail is labeled 'DSS poss1\_blue: 1955-05-19' and has a red arrow pointing to it from the 'Download a PDF of the finder' text box. Above the thumbnails is a 'Download' button and a checkbox for 'WCS Match' (checked) and 'Target Match' (unchecked). Below the thumbnails, the text 'No SDSS data available.' is displayed.

IRSA | DATA SETS | SEARCH

EQ-J2000: 15h12m38.48s, Image Pixel: 246.1, 176.5

Search | Catalogs | Help

Target= 15h12m50.53s -9d06m00.3s Equ J2000; Image Size=0.1333 deg; Sources=DSS,SDSS

Download | WCS Match | Target Match

DSS poss1\_blue: 1955-05-19 | DSS poss1\_red: 1955-05-19 | DSS poss2ukstu\_blue: 1981-05-03 | DSS poss2ukstu\_red: 1991-03-19 | DSS poss2ukstu\_ir: 1997-04-28

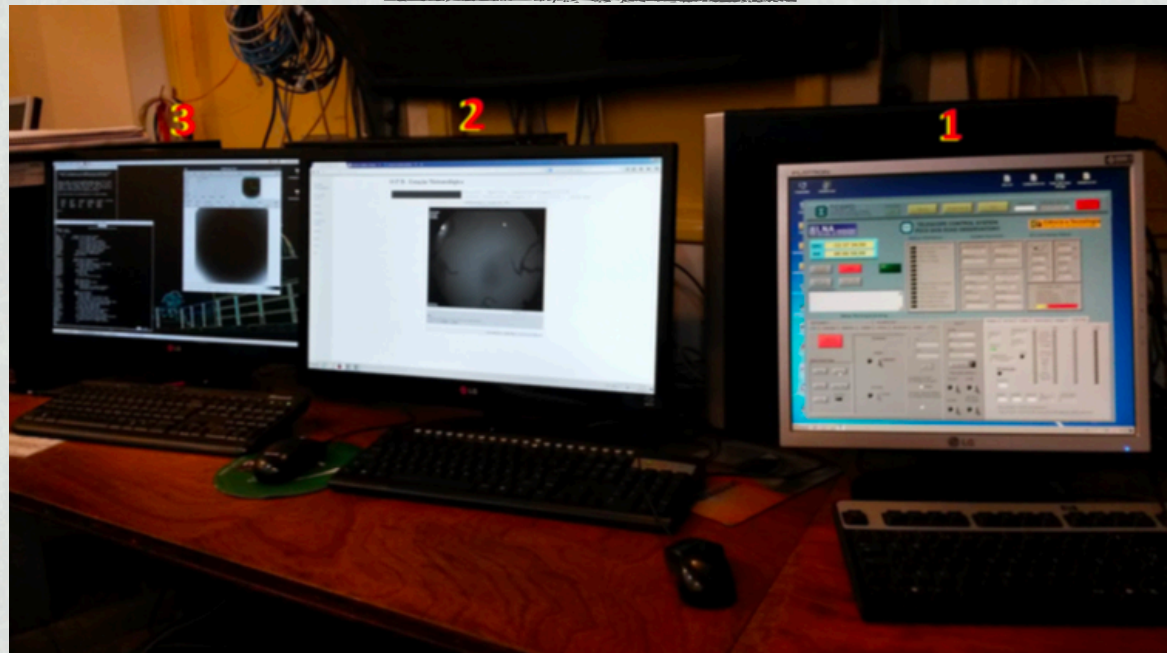
No SDSS data available.



# Remote Observing

- We will be virtually connected to the 3 main computers necessary for observing at OPD:
  - #1: TCSP software
    - ▶ Telescope Control System Pico dos Dias Observatory
    - ▶ Controls telescope
  - #2: OPDAcquisition
    - ▶ Setup for upcoming image
  - #3: real-time data manipulation with IRAF, ds9

Groups 7, 8, 9



# Remote Observing – before the night starts I.

## Prior to observing:

- Create the night's directory where data will be written to
- **Load object list** and make sure that it is properly read
  - ▶ *Hint:* download one of the catalogs already present (e.g., BSC) and edit it – this way you make sure to get the format correctly!
  - ▶ **Double-check that coordinates are correct!**
- **Create a log file** – an excel sheet is a good option!
  - ▶ You will write up what each produced file is about, in real time!
  - ▶ Very valuable as header information is prone to (sleepy-)human-made errors!
  - ▶ **Define who is responsible for it!**

\* Observatory guidelines make some recommendations in terms of # of frames (to get a representative “master” after median-combining the individual frames):

<http://www.lna.br/opd/instrum/camara/camara.html>



# Remote Observing – before the night starts I.

## Prior to observing:

- ~~Create the night's directory where data will be written to (DONE!)~~
- ~~Load object list and make sure that it is properly read (DONE!)~~
  - ▶ ~~Hint: download one of the catalogs already present (e.g., BSC) and edit it — this way you make sure to get the format correctly!~~
  - ▶ Double-check that coordinates are correct! **Groups 5**
- ~~Create a log file — an excel sheet is a good option! (DONE!)~~
  - ▶ You will write up what each produced file is about, in real time!
  - ▶ Very valuable as header information is prone to (sleepy-)human-made errors!
  - ▶ Define who is responsible for it! **Groups 6**

# Remote Observing – before the night starts II.

## Prior to observing: Calibration images

**Groups 7, 8, 9**

- Bias (25 frames)\*
  - Always execute one, check the counts (make sure it's all good) and only then execute the rest
    - ▶ Check counts on computer #3 (real-time data manipulation with IRAF, ds9)
    - ▶ Avoid saturation, stay under 60% saturation (~65K counts)
  - Make an entry on your logsheet
- Flats (15 frames per filter)\*:
  - B-band (~5s) w. medium lamp
  - I-band (~5s) w. weak lamp
- darks (11 frames per exposure time)
  - Will likely need for: 5s, 300s

\* Observatory guidelines make some recommendations in terms of # of frames (to get a representative “master” after median-combining the individual frames):

<http://www.lna.br/opd/instrum/camara/camara.html>

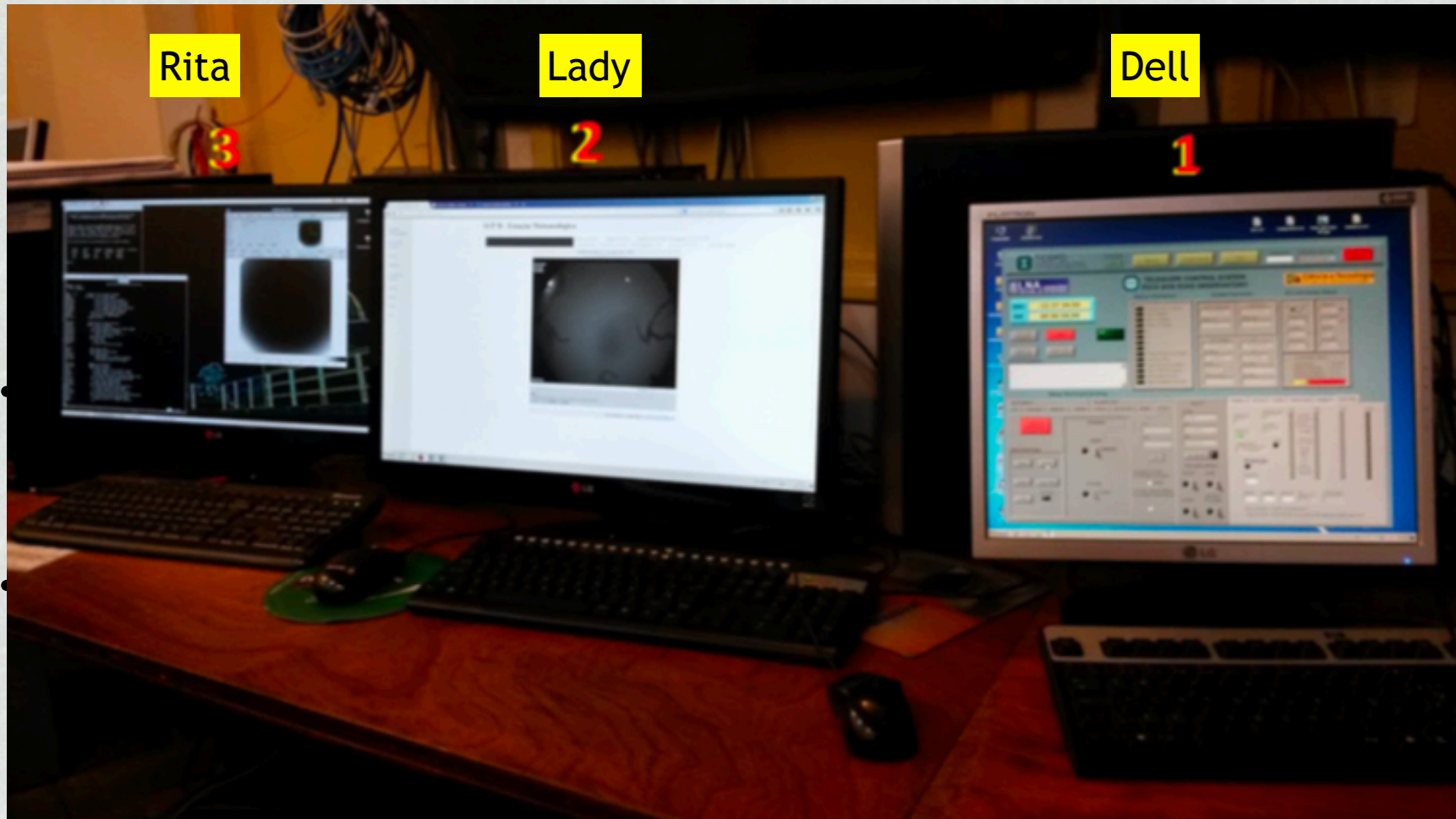


# Remote Observing – before the night starts II.

## Prior to observing: Calibration images

- Bias (25 frames)\*

Groups 7, 8, 9



# Remote Observing — once the night starts

- Global pointing

Groups 8, 9, 7

- Choose a bright star, place it at the center of the detector
- This sets the global pointing for the night.



# Remote Observing — once the night starts

**Groups 9, 7, 8**

- Global pointing
- **Point telescope to 1st science target**
  - ▶ To do this: choose object in target list, precess!
  - ▶ Move telescope
  - Short exposure (~30s) to recognise field
  - Field recognition (use your finder chart!)
  - Offset to place science target close to center
    - ▶ +ve offsets towards East & North
    - ▶ Remember: you move the telescope, not the sky!

# Remote Observing – once the night starts

- Global pointing
- Point telescope to 1st science target
- **Start exposing on target**
  - 300s/exposure
    - ▶ Check counts, verify that we are not saturating on science target, nor on (many) nearby stars
      - We need field stars for additional flux calibration!
  - Go through filters of interest (B, I)
  - Dither!
  - Repeat sequence

## Dither Pattern

	$\Delta\text{RA}$	$\Delta\text{Dec}$
pos1*	0	0
pos2	+5"	+10"
pos3	-10"	+5"
pos4	-5"	-10"
* default where telescope places target		





# Remote Observing — once the night starts

- Global pointing
- Point telescope to 1st science target
- Start exposing on target
  - 300s/exposure
  - Go through filter wheel (B, I)
  - Dither
  - Repeat!
- **Standard star**
  - Choose according to magnitude, airmass (to approximately match that of your science target)
  - ~2 short exposures
    - ▶ Verify that the star has not saturated
- 2nd science target... and so on, always sticking a standard star in between to play it safe!

# IRAF & ds9 – the very basics

- Here in Socorro:
  - Open a terminal and go to `/home/isya/IRAF`
  - Open ds9 from the terminal (i.e., type “ds9 &”)
  - On the terminal’s command line, type “ecl”
    - ▶ You’re in the IRAF environment!
      - Note: Little hiccup: we’ll have to open images directly using the pull-down menus from ds9
- Once on IRAF, common routines you’ll use (also on remote computer!)
  - *imstat* <file>
    - ▶ Get basic statistic on the image/region
  - *display* <file> <frame>
  - *imexamine* <file>
    - ▶ e.g., quickly check radial/surface profiles (<r>, <s>) of sources
  - *imarith* <file1> <file2> <operation> <output\_file>
  - *imcombine*

Note: for help in any iraf routine, type “help <routine>” on iraf command line



# IRAF & ds9 – the very basics

- To use IRAF routines:
  - directly on *iraf* command line by inputting the routine name and main input parameters
  - Explicitly open the parameter list by typing “epar <routine>” on the *iraf* command line.