

Observation Plan of M101 with JPCam at JST250

Observation Plan of M101

This is an example of a project aimed at observing M101 using the J-PAS strategy (same depth and bands) in order to get familiar with the use of the JPCam Observing Tools. These tools are the JPCam Exposure Time Calculator (JETC)¹ and the JPCam Observing Planner (JOP)². M101 is already being observed within the J-PAS project, so this only serves as an example.

We aim to observe M101, a large nearby galaxy, following the J-PAS strategy. The observation plan consists of:

- 4 exposures of 60 seconds each in T1, T2, and T3, dithered by 0.236 degrees, with a binning of 2x2 in dark time.
- 2x4 exposures of 60 seconds each in T4, dithered by 0.236 degrees, with a binning of 2x2 in grey time.
- 4x4 exposures of 30 seconds each in T5, dithered by 0.236 degrees, without binning, in bright time.

All observations are planned for dark nights. The 4 exposures dithered pattern is shown in Fig. 1.

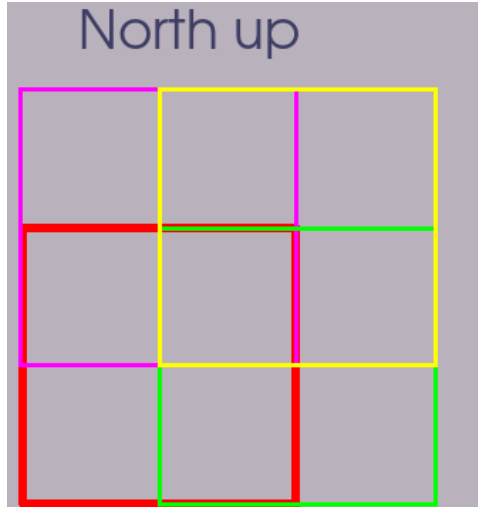


Figure 1: A very basic sketch illustrating the dithering pattern applied (the useful area of a single CCD is shown). Each color represents the FoV of the CCD on the sky for each of the 4 exposures.

JPCam ETC

Let's start by estimating the signal and noise using the JETC. For the T1, T2, and T3 trays, we obtained a signal-to-noise ratio (SNR) ranging from approximately 3.5 to 13 per pixel for a surface brightness magnitude of 22 mag/arcsec² (M101 is an extended object). We used an input spectrum of a starburst

¹<https://www.cefca.es/jop/>

²<https://www.cefca.es/jop/plan/field.html>

galaxy with little dust attenuation, normalized the continuum to the J0520 band, dark sky brightness, and chose a binning of 2. We show the inputs and the outputs for this configuration in Fig 2.

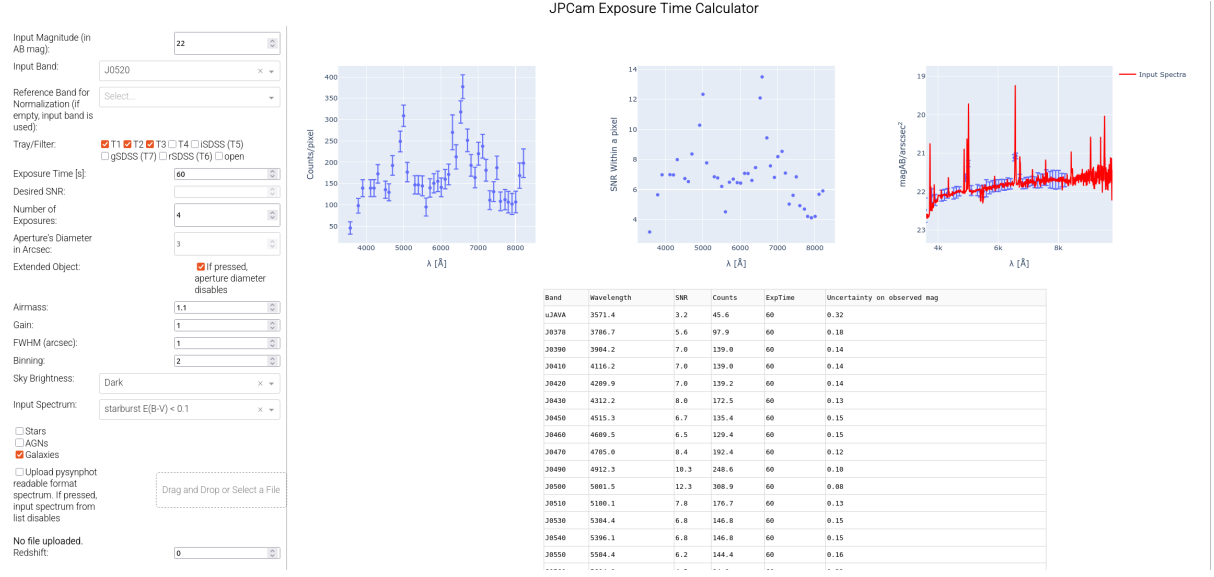


Figure 2: JETC for T1, T2, and T3 specifications.

For T4, we used 8 exposures of 60 seconds each in grey sky brightness and obtained an SNR ranging between 4 and 9 per pixel. The other input parameters remained the same as T1, T2, and T3. We show the inputs and the outputs for this configuration in Fig 3.

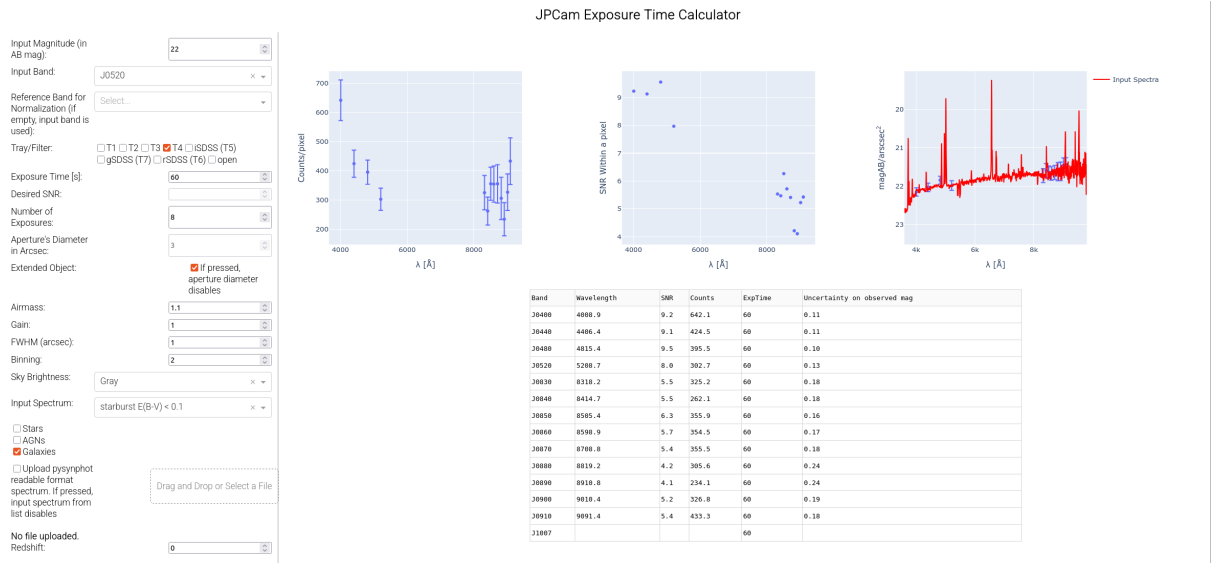


Figure 3: JETC for T4 specifications.

For iSDSS (T5), we used 16 exposures of 30 seconds each in bright sky brightness and obtained an SNR of 4 per pixel. The binning was set to 1, with an input magnitude of 23.4 mag/arcsec², and the other input parameters remained the same as for T1, T2, T3, and T4. We show the inputs and the outputs for this configuration in Fig 4.

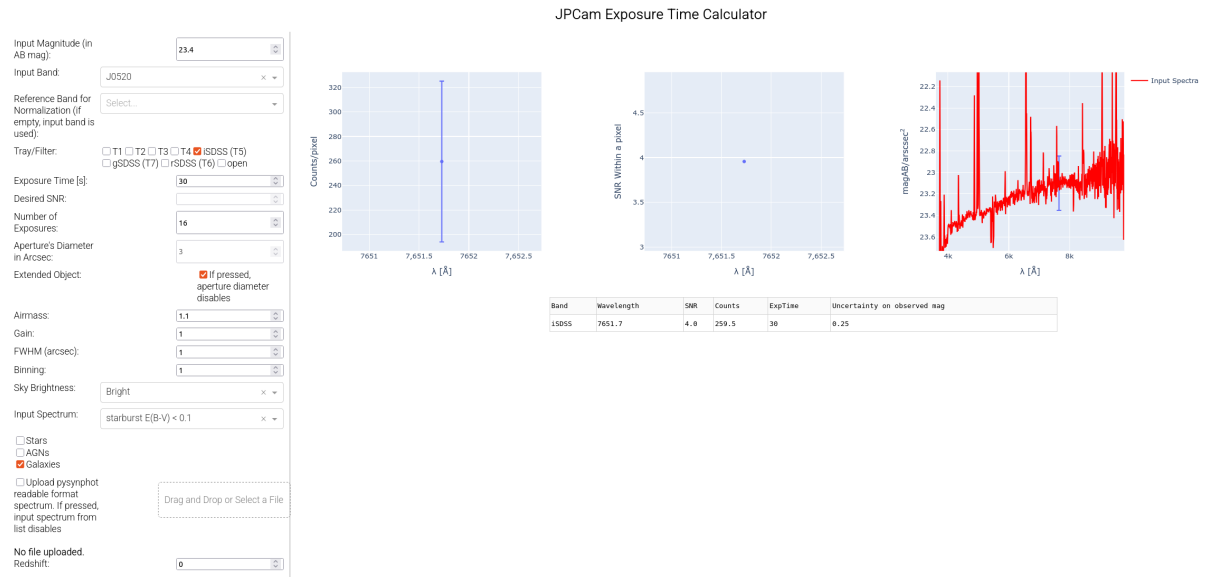


Figure 4: JETC for T5 specifications.

JPCam Observing Planner

Having obtained the SNR for the desired input magnitudes, we proceed to plan the pointings for the field containing M101. Suppose we want to cover 5 deg^2 centered on M101. We start with the *Narrowband Strategy* in order to plan the pointings with T1, T2, T3, and T4. We can use the *Narrowband Strategy* area coverage versus NxN mosaic plot from the JOP help document (and shown here in Fig. 5) to get a first-order approximation of the number of pointings needed.

Looking at Fig. 5, we would need 9×9 pointings to cover approximately 5 deg^2 . We can use the JPCam observing planner (JOP). Go to the JOP (<https://www.cefca.es/jop/plan/field.html>) and generate the pointings and effective field of view. In this tool we set $NP_x = NP_y = 9$ and input the central coordinates: $RA = 210.802267$, $Dec = 54.34895$. We name the field prefix after the galaxy, M101, choose Tray 1 (T1) with all filters selected, and deselect the official colors to achieve better color contrast. We center the pointings on JPCam and choose the recommended dither shift (default setting). We show the inputs and the outputs for this configuration of the JOP in Fig 6.

The number of pointings to be used in the Observing Time Application Platform appears in red. This number, 81, will be used to estimate the total time of the project and in the J-ETC Project Total Time estimation. In this case, the number of pointings for T1 is $9 \cdot 9 = 81$. The area common to all filters is 4.86 deg^2 , shown as a grey square. This area represents the full-depth region, visited in all 4 dithers. A larger area is covered at shallower depths at the borders, and also by individual or different combinations of filters. Filters can be selected or deselected based on user preference.

For T2, T3, and T4, the number of pointings remains the same to obtain the same area (*Narrowband Strategy*). However, for T5 with the iSDSS filter, we use the *Broadband Strategy* where just 1 pointing is sufficient, as we can cover approximately 6.28 deg^2 at $Dec = 0$ degrees. This pointing contains already 4 pointings optimized to fill the gaps between the JPCam CCDs, which is managed internally by the planner. In case the user does not want that the coverage of the gaps is managed internally, the “No gaps (T567)” checkbox can be selected. Using the JPCam observing planner, we set $NP_x = NP_y = 1$ and input the central coordinates: $RA = 210.802267$, $Dec = 54.34895$. The field prefix remains “M101”, and we choose Tray 5 (T5 T6 T7 option) with the recommended dither shift (default setting). We show the inputs and the outputs for this configuration of the JOP in Fig 7. In this case, the total number of pointing for T5 is $1 \cdot 1 = 1$.

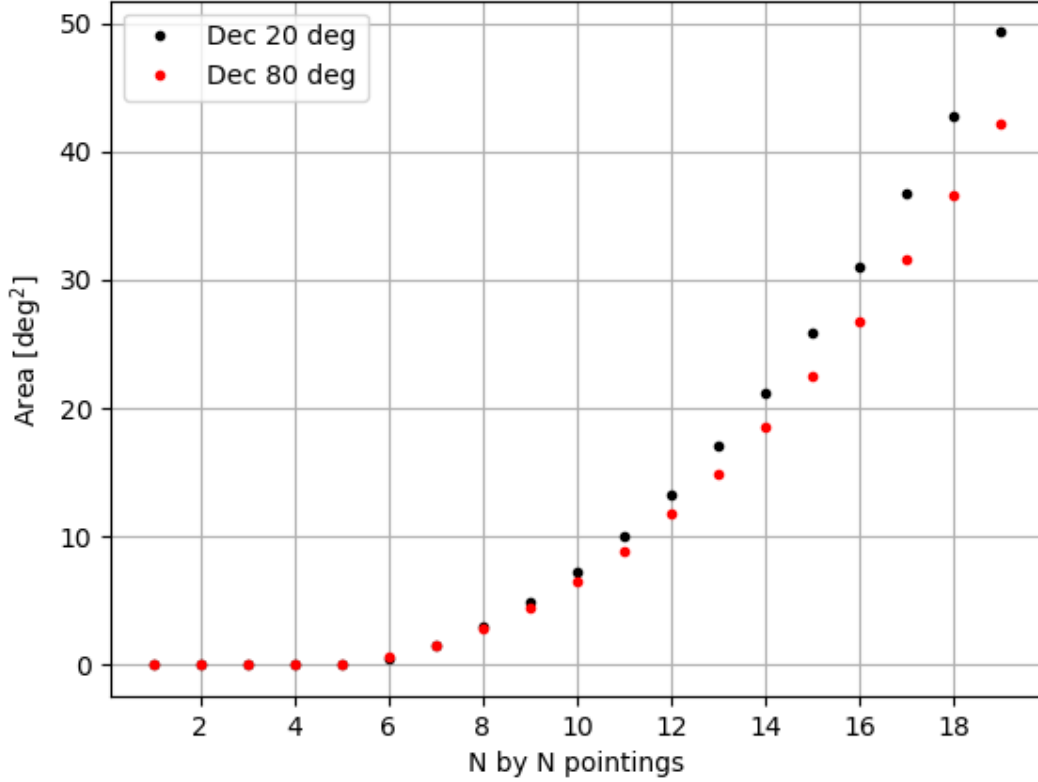


Figure 5: Common area covered by all the filters in the *Narrowband Strategy* versus the number of pointings per dimension, N , in a squared mosaic.

Download and Further Exploration

In both strategies, it is possible to download the list of pointings as a CSV file for further exploration, which is needed in phase 2 of accepted proposals. You can also download the regions covered by all filters (*Narrowband Strategy*) or the region covered by the only filter in the tray (*Broadband Strategy*) in DS9 region format. Additionally, a set of DS9 region files with the individual coverage area for each selected filter can be downloaded (in narrowband strategy). This is particularly useful for overlaying regions onto the field image using DS9, as illustrated in Fig. 8. It helps verify whether your area of interest falls within the proposed JPCam observation.

Project total time

Once we have the exposure times for each tray and the number of pointings, we can estimate the total number of hours requested for this proposal using the JETC. A specific tool is available in the JETC to estimate the “Project Total Time”. We show in Fig. 9 the needed inputs of the project defined in this document to observe M101. N . Points is the total number of pointings for each Tray i . This value is that appearing in red in the JOP tool. ExpTime T_i is the individual exposure time for the Tray i . Exp is the number of exposures/dithers.

We show in Fig. 9 the needed inputs of the project defined in this document to observe M101. The output in the case of our proposal for M101 is that the required total time is 48.45 hours to complete the project.



GENERATE POINTINGS

Field data

Field prefix:

RA:

Dec:

Tray

Tray:

Filters:

☒ J0620	☒ J0610	☒ J0600	☒ J0590
☒ J0490	☒ J0450	☒ J0580	☒ J0570
☒ J0410	☒ uJAVA	☒ J0560	☒ J0550
☒ J0540	☒ J0530		

Colors: ☐ Official

Area

Center at:

NPx (1-20):

NPy (1-20):

Dither:

Dither shift:

The number of pointings to be used in the OAJ Observing Time Application Platform is **81**.

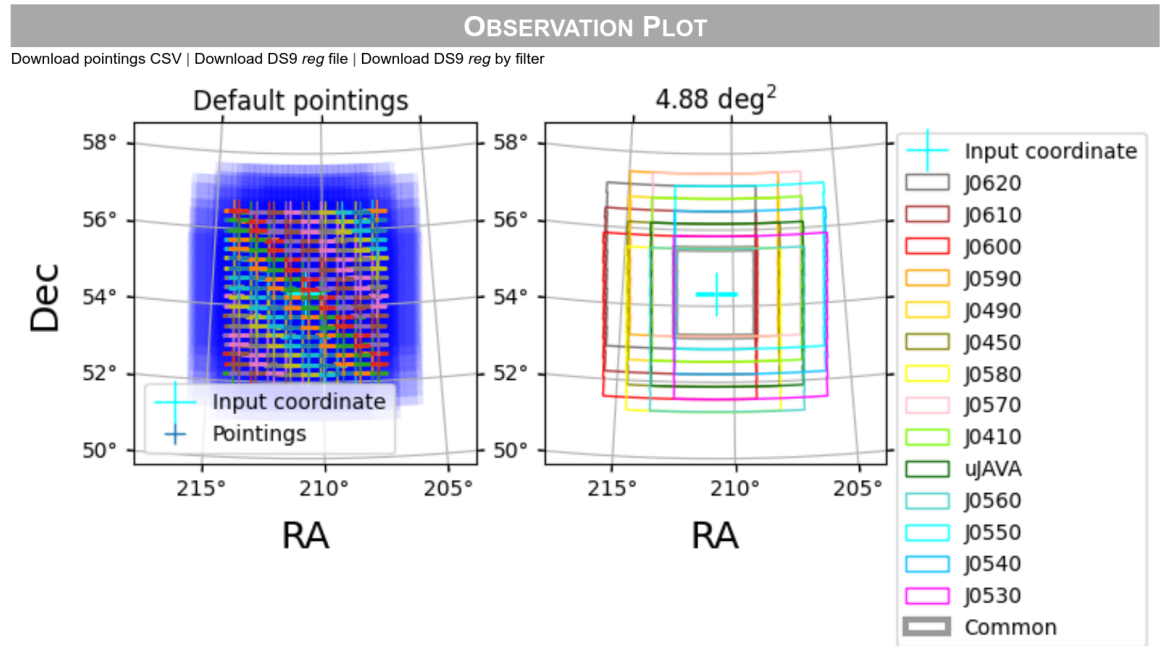


Figure 6: JOP for T1, T2, T3, and T4 specifications.



GENERATE POINTINGS



Field data

Field prefix:
 RA:
 Dec:

Tray

Tray:
 Filters:
 Colors: ☒ Official
 No cover gaps (T567) : ☐

Area

Center at:
 NPx (1-20):
 NPy (1-20):
 Dither:
 Dither shift:

[Compute](#)

The number of pointings to be used in the OAJ Observing Time Application Platform is 1.

OBSERVATION PLOT

[Download pointings CSV](#) | [Download DS9 reg file](#)

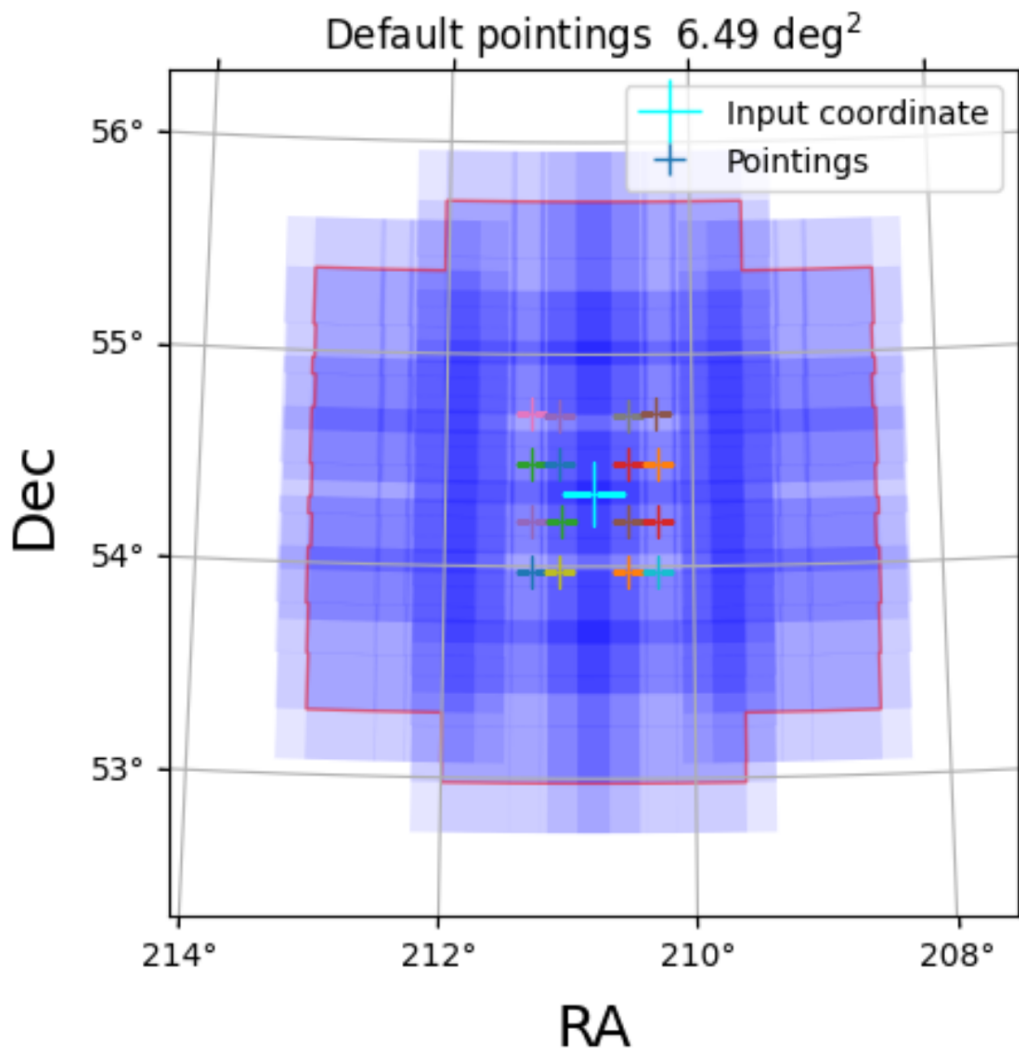


Figure 7: JOP for T5 specifications.

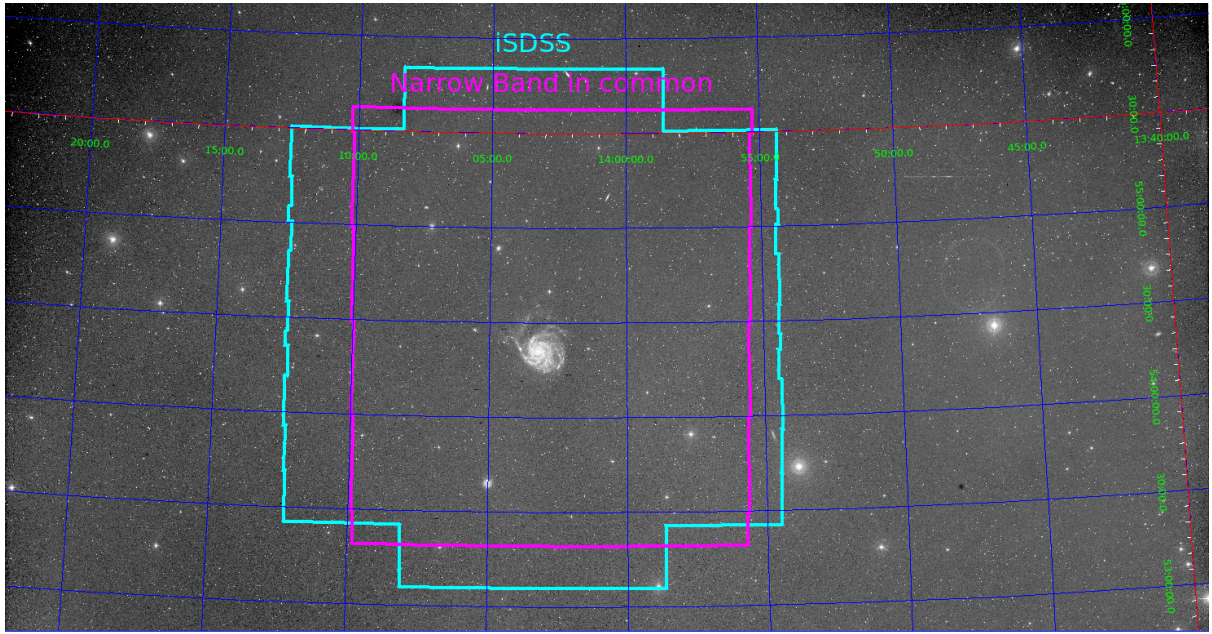


Figure 8: M101 image from Digital Sky Survey. Proposed regions to cover an area of 4.86 deg^2 with the narrowband filters, and 6.36 deg^2 with iSDSS, are shown in pink and cyan, respectively.

Calculate

Project Total Time

T1:

N. Points T1:

81

ExpTime T1 [s]:

60

N. Exp T1:

4

T2:

N. Points T2:

81

ExpTime T2 [s]:

60

N. Exp T2:

4

T3:

N. Points T3:

81

ExpTime T3 [s]:

60

N. Exp T3:

4

T4:

N. Points T4:

81

ExpTime T4 [s]:

60

N. Exp T4:

8

gSDSS (T7):

N. Points gSDSS:

0

ExpTime gSDSS [s]:

0

N. Exp gSDSS:

0

rSDSS (T6):

N. Points rSDSS:

0

ExpTime rSDSS [s]:

0

N. Exp rSDSS:

0

iSDSS (T5):

N. Points iSDSS:

1

ExpTime iSDSS [s]:

30

N. Exp iSDSS:

16

Open:

N. Points open:

0

ExpTime open [s]:

0

N. Exp open:

0

☐ NO Cover Gaps in T5, T6, T7, Open

Calculate total time

The total time for your project is: 48.45 h

Figure 9: JETC Project Total Time calculation.