## NPARSEC: NTT PARallaxes of Southern Extremely Cool objects

**This is production line astronomy on a large scale. ESO is investing a large amount of NTT time and we are all investing a large amount of our time. We must therefore have the telescope working all the time – you must be as efficient and professional as possible, so as to make that happen. We must obtain the highest quality astrometric data possible – which is not harder than doing regular imaging, but does require more care.**

### p2pp details USER: RSMART, for PW ask Ricky, Directory: NPARSEC

Contacts: Ricky Smart, +4hr, smart@oato.inaf.it, skype: stayoutoftherain, mobile: +393405542976.
Chris Tinney, UNSW, Australia -8hr, c.tinney@unsw.edu.au, skype: cgtinney.

## NPARSEC CHECKLIST / QUICK INSTALLATION GUIDE

- Have you loaded the latest .obx files into p2pp?
- Have you done daytime calibrations: Darks using NPARSEC_DARK.obx) and Dome flats using NPARSEC_SpecialDomeFlats_J.obx?
- Have you imported the NPARSEC_observingsheets.csv into a spreadsheet viewer?
- Have you decided on first targets? On the first night of a double night if the wind is not a problem observe low declination objects on the second night everything else.
- At sunset have the TO start refresh *as soon as possible* at 1s when counts  10000 run NPARSEC_Skyflat_Evening.obx
- Open skype with Ricky
- If the night looks iffy look over the Backup taregts
- At sunrise have the TO refresh at 10s when counts  1000 run NPARSEC_Skyflat_Morning.obx

## Working at the NTT

- Arrive early on the first night to read all this material and familiarise yourself with NTT observing. At 16:00 on the first day they should give you a run down of Gasgano, upload the obx's and setup calibrations.

- We have three calibrations with obx's in Calibrationobx:

  A dome flat: NPARSEC_SpecialDomeFlats_J.obx

  Darks: NPARSEC_DARK.obx

  A sky flat: NPARSEC_Skyflat.obx to be run in the evening and the morning.

- Import the current NPARSEC OBs (obx files) into the P2PP library for the current run. On the P2PP workstation there is a NPARSEC directory with old directories, start from the obx files we provide do not use the old ones. An easy way to upload is from the p2pp computer scp the obx's from your machine.

- The NTT has an active mirror – you need to monitor image quality and if there is evidence for it deteriorating, then ask for an Image Analysis. You may also need to do this if you move the telescope over a large ZD from one target to the next, or if the temperature changes dramatically during the night.

- **Do not increase the exposure times (DIT) of individual images above 30s.** If it ls cloudy and you believe, after looking at the interim image or based on previous images, more exposure time will be needed at most repeat the dither sequence of nine images. Increasing the exposure times means we also have to take corresponding darks and probably the sky will saturate during the exposure making the images practically useless.

- **WARNING: The NTT is an alt-az telescope it cannot observe within a few degrees of the zenith. So you cannot observe targets at $\delta$=$-$26-$-$32 degrees as they cross the meridian. Plan accordingly. They are marked with an X in the targetlist. From the ESO webpage: Never, ever point or observe within 5deg from the Zenith (dec -32 to -26, HA 00:10:00)**

## Observing Strategies - The Bullet Point Summary

- Use the file NPARSEC_observingsheets.csv open in a spreadsheet program (e.g. excel) to plan and track the night. The paper copy of the targets attached here is only provided as support, the .csv maybe more uptodate.
- Plan your observing so the telescope is working all the time!
- Plan to observe the whole target list over two nights. The list has been prepared so that you should be able to observe all targets observerable once over a clear two night observing block. You can then repeat those observations on the second block starting 3 nights later.
- Optimise the NTT's image quality .... if you see evidence for the NTT images being poor, then ask the TO to do an Image Analysis after you have slewed to the next target. This can take up to 20 minutes, but if it improves the image quality is well worth it! THis is usually only useful when the seeing is better than 1".
- Priorities: One way to plan your program is to try and keep to a given declination range as this helps the NTT keep image quality. Unfortunately the stars have not helped this and you will have to jump about in declination a bit. However, if on the first night you try to concentrate on objects at declinations greater than around -10 then on the second night do the rest you will probably be doing as well as you can. Note that if the wind is high then often it is difficult to observe in the north, this means if the wind is high ( 15km/s) on the first night perhaps change things by doing the southern declinations on the first night. After the above the priorities should follow the following:

  [•] Try to observe targets within ±15 minutes of their nominated **Target ST**. It is better to drop an object on one night (and try to make it up on the next) than to "fit it in" and then observe everything else on that night 30m late!

  [•] Match targets to observing conditions. Good seeing do faint targets, poor seeing or clouds do bright targets.

  [•] When left with no other selection use the priority column.

  [•] Try to minimise huge dome+telescope rotations from north to south.
- You can start observing 40-60 minutes before astronomical twilight in the evening, and go to 40-60 minutes after astronomical twilight in the morning.
- Tips for the TO

  It is quicker if the TO plots a little box at 420,420 (the statistics box) this makes the move-to-position very fast for them.

  The TO can have the program going on automatic, that is the telescope automatically starts the next selected obx when one has finished. This means you have to be careful about highlighting the obx but it saves you sitting around waiting for the current exposure to finish,

  The move-to-position of the object does not have to be very precise, we have a dither box of 50 or so pixels so being precise here is not important.

  When trying to locate the target note that the coordinates on the console of the TO are *very* good.
- Rough total observing block time:

  [•] 60s×9 OBs take 15 minutes to run

  [•] 120s×9 OBs take 23 minutes to run

  [•] 120s×18 OBs take 42 minutes to run

  [•] 120s×27 OBs take 61 minutes to run
- Contact Ricky (or Chris) in advance and during your run.

## Executing the OBs

OBs (the obx files) get executed in the usual way – select one in P2PP and tell the TO it is ready to execute. He/she will grab it into BOB and start it. The telescope will slew to the target, and then make a small offset. Once it has moved a pop-up will appear saying "At Offset Position, Store Fixed Pattern and hit OK" (or some such), when the image has stabilised on the terminal of the TO (or you) will hit the "Store Fixed Pattern" and "Remove Fixed Pattern" buttons. The telescope will move back to the start position, and you should see a clean positive and negative image of your field.

You now have to identify the target on the Finding Chart, and tell the TO to "Please Move that to pixel 420,420 please". They will then do this, and the actual science observations will start. Hopefully at this point you will look at the TCS and find that the Sidereal Time is exactly the Target ST for the object's observations to start at! In any case, log the actual ST the observations started at in your observing log.

Once a few dither exposures have been done, use 'Pick Object' on the terminal of Gasgano Skycat to estimate seeing, and fill this value in on your log sheet.

## Some General Hints on IR Observing

**Quick-look examination of images :** the sky background in the near infrared is much higher than in the optical, and as a result the pixel- to-pixel variations in detector response can create a 'noise' background that can make detecting faint stars almost impossible.

A commonly used trick to obviate this is to take pairs of images (with the telescope moved in between) and subtract them. If the sky level is roughly constant between the two exposures, the -pixel-to-pixel sky noise will cancel, and make fainter objects visible.

This trick is used when doing acquisition with the RTD as part of the NPARSEC parallax observations, and you can do it with the Skycat display on the offline computer (via Gasgano) as well. Once an image is displayed in the Skycat window, go to 'File - Bias Image ...'. This produces a pop-up that enables you to select another image (eg. a different image in the same dither pattern) to subtract, and to turn subtraction on (and off).

**GASGANO :** on the data reduction computer can be used to make quick- look reductions of a dithered set of data for an object.
To start gasgano:

- In the xterm write "gasgano" or select from desktop menu
- From "File" pull down menu select "Preferences" and check that the "Classification Rule file:" is set to "SOFI.rul" (right now "/home/quality/gasgano/config/SOFI.rul"but that may change) click "ok" a failed window may come up but ignore it
- From "File" pull down menu select "Add/Remove files", then "Add File", go up two levels (click twice the first icon to left of "Look in" box) select directory "data" then "raw" and todays date "YYYY-MM-DD", , do the same for "data/reduction", finally click "add file"
- In open window select tonight and select "Auto Display" to open the image viewer

Gasgano will load all the files in that directory, and display them in a tree format. If during exposure you want to see how things are going select a a group of observations and send them to be analysed by the data reduction recipe "sofi_image_jitter". After each observation is finished the program makes a pipeline reduction for you called r.SOFI.....0000.fits, this is what you should look at to see if things went well.

If the image in skycat does not update you have to close the sofi_image_jitter and reselect the frames.

## Observing Strategies - Background

**Differential Astrometry:** Astrometric observing is **all** about keeping everything the same for every observation of every target from run to run, **apart** from the motion of the target star (which we hope to measure). In particular, we want the instrument to be as close to the same as we can arrange, and to be looking through the same 'wedge' of atmosphere. So each object has a **Target Sidereal Time, or Target ST** that corresponds to the sidereal time at which the observations of that target started on the first few observing runs. If we observe that target starting at that **Target ST** ($\pm 15$ m) on every run, then SOFI will be at the same rotator angle (and so see the same gravity vector), and the differential refraction effects will be close to identical at all epochs.

We also use a 'Move to Pixel' acquisition for each target, so that it is placed as close as possible to the same pixel **(420,420)** on every run.

One complication here is that being a alt-az telescope, the NTT cannot observe within a few degrees of the pole. So you cannot observe targets at $\delta = -25$-$-35$ degrees as they cross the meridian. For these targets, observations must either *complete* 10 minutes before HA=$-$0:10, or start after HA=+0:10. The **Target ST**s for these objects have bee set accordingly. **But beware you don't start one of these objects a bit late *before* it crosses the meridian and so hit the zenith distance limit by mistake.**

Also, swinging the NTT from a target north of the zenith, to one south of the zenith involves rotating the whole dome and telescope almost 180 degrees in azimuth .... which takes several minutes. So try to plan observations to minimise those large swings.

**Chasing the Meridian:** As a general rule, we aim to observe the target list as close to the meridian as possible. Observing time near the meridian is therefore just as valuable as the total number of hours available during the night. You have to schedule observations so they happen during the best "window of opportunity" as they pass through the hour angle that corresponds to their **Target ST**. This means observations involve trying to bang out targets one after another as they near the meridian – or more precisely come within $\pm 15$ m of their **Target ST**. It is therefore strongly recommended to plan targets several objects ahead, so that you can achieve this goal.

If you are 'running behind' chasing the **Target ST** (say because you lost 10 minutes to an instrument problem), then it is better to drop an object (and hopefully pick it up on the next night) and jump to the next one so that all subsequent objects are hit "on the nail".

**Adjusting to Conditions:** In your planning of the coming targets, you should also think about the observing conditions. If seeing is worse than median (and especially if worse than 1.2-1.3") then you are better getting data on (a) brighter targets, and (b) less distant targets – save the best seeing conditions (and so best S/N and best astrometry) for the fainter targets (if J>17.5) and the early T and late L dwarfs with d>40 pc.

**NTT Image Quality:** The NTT has a meniscus mirror, and so it needs to continually adjust the figure of the mirror to ensure you get good images. When this is working well, the NTT will produce images that track (or are better than) the seeing coming from the DIMM. However, to achieve this, the mirror must be figured correctly to start with, which is done by doing an "Image Analysis" to correct the wavefronts coming from the mirror. This will *always* be done first thing each night, and may often have to be redone several times during the night. If you see that the NTT's images are significantly worse than the DIMM, OR if they look weird (elongated, chromatic, or even triangular) then the Image Analysis needs to be redone. Ask the TO to do one when you move to the next target.

Image Analysis can take up to 10 minutes .... but is worth doing if you have a good reason to believe there is a problem with the mirror. Image Analysis can't correct for bad seeing (of course) and will not work in very bad seeing or cloud.

**Target Distribution on Sky:** We have "holes" in the RA distribution of targets at 6-7h and 17-19h (due to the Galactic plane). We have tried to set up the **Target ST**s so they take advantage of this, but there will still be gaps. You can fill these with additional observations of objects observed

In some cases we have too many targets clumped in one RA range. Obviously, these can be "shared" over subsequent nights. However, in some ranges the list is still overly full, and to the **Target ST** is set so that some of these objects are planned to be observed up to an hour away from the meridian. For these objects, please take extra care to try and hit the **Target ST** as closely as possible for the begining of the observation. NB This comment was included at the begining, it is still valid but now the splitting of objects in declination takes precedence and tends to organize your night for you.

**Observation Length:** The OBs have been set up to acquire either 60s×9 = 9 mins, 120s×9 = 18 mins, 120s×18 = 36 mins, or 120s×27 = 54 mins depending on the object brightness. However, there are overheads associated with detector reads, telescope offsets between observations, slews to targets and acquisition of targets onto the nominated pixel. To help you plan your observing you should use the above time +6 minutes for the total average time it will take from initiating a new OB, to the time you are ready to initiate the next one. Try to hit the **Target ST** at the start of the next observation.

## NPARSEC FAQ

- **At twilights why don't you go as far as possible out of meridian to get the setting or rising targets?**
  The NPARSEC targets are pretty well distributed, chasing targets is always at a cost to those in meridian. While it is sometimes worthwhile to catch an object before it sets or anticipate an object as it is rising this should only be done when the main targets have good coverage on that particular run. It should not be done instead of a second image on a high priority target. Another minus to chasing targets at sunset is that you will be pointing towards the sun, e.g. a bright background.

- **Is the seeing limit for switching to backup spectrascopic observations ( 2-2.3 arcseconds) hard.**
  No, it requires judgement, I would always start with parallax observations and if the seeing is bad know that the weight of the observation will be much less than a good night. If you do not have any observations of a target in a given 4 night run and it is the 3rd or 4th then it maybe worth while.

- **It is strange that a 18.01 (or 17.01) object has a 54 (or 36) minute exposure while a 17.99 (or 16.99) object has a 36 (or 18) minute exposure, why is this?**
  Each exposure requires the combination of 9 images, part of the reduction process requires that we have darks that are the same length as one of the 9 images hence we make 3, 10, 20 and 30s darks and can only make observations in unit of 9 times those numbers. So whay don't we do darks of 3,4,5,6.... - well bottom line some integerisation of the exposure time makes things simplier and having the magnitude range divided into 4 is already quite a sampling. For the longer 54min exposures you can often stop after the first two sets, e.g. 36 minutes.

- **Whats the maximum number of targets that can be done?**
  This is not a very fair question, during the winter with no interuptions, good seeing, doing just brightish objects, it would be possible to observe 50-60 targets but this cannot be compared to a summer night where the observer does also faint targets. A better question what is the lowest overhead: on some nights being on the ball, doing similar dec targets, with "Auto request OBs" on and "Run all OBs" on you can cut the overhead down from 7 minutes to 2-3 minutes. Also using up to civil twilight times can give up to 3-4 more targets a night.

-

## BACKUP PROGRAM

Because of the high background, high per observation precision goal, and the dithering nature of IR observing it is much less resilient to high seeing than optical observing. There is an opinion that if the seeing is bad in the optical you can still get almost the same positional precision by just increasing the exposure time. Right or wrong in the IR this is much more complicated and we feel that if the seeing is over 2.2-2.3" it is better to switch to a spectroscopic backup program. This has obviously be decided on a case by case basis, if there are bright targets with short exposure times then they are less effect by bad seeing, also if you have had a good night already then spending less time on imaging and more on spectra is more justified. If you have not had any observations then even a low precision point is better than no point. You should always begin the night with imaging, e.g. parallax observations, if the seeing is bad and you think it is best to go to spectra please contact me. Having said that the over all procedure is described below.

Example backup obx's are in the backup sub-directory of the NPARSEC directory. They basically spend anything up to an hour doing a blue spectra of objects that we have listed as worthy of spectral followup. After each target a nearby standard must be observed and in the notes of the obx we have listed a few possible candidates.

The actual carrying out of the observation is quite simple but there are a few pitfuls for people not used to spectroscopy:

- Go to the google docs and see what targets are still listed as needing spectra. Choose some thing that is going to be reasonably close to meridian in the time you will need it.
- Make sure you understand what star is the target. Have a good clear finding chart printed out. The target's magnitude and your experience todate should tell you how complicated it is going to be to identify the target. Remember you are going to have to see and put the target in the slit. It is not like the imaging where so long as the rough field is OK you're get the target. You will only get the spectra of the object you put in the slit.
- Decide before hand which is the standard star you are going to use, locate the targets and the standards obx in the p2p. All of this should be done before during the parallax observations or during the day.
- If the seeing is really bad, ¿3", you may want to go to the larger slit in the obx, the TO should be able to help you.
- When you have done all the above you can start thinking about the actual observation.
- Now select the target obx and the TO will take a short exposure. Identify the star, be sure it is the right one. Ask the TO to save a image of the field when he has moved the star to the slit position so we can always check after the fact. Once you are sure the exposure can start.
- Start thinking if you haven't already about the next target.
- Once a few dithers have been taken use Gasgano to take a look at the result. You should be starting to see the targets spectra forming.
- Again if the seeing or transparency is bad you may need to ask the TO to take some extra dithers.
- Once the target is done you can go to the standard. This is easier as it is very bright. It should be observed with the same slit and resolution as the target which it is by default but if you manually change the target then manually change also the standard.
- Update the google docs putting whatever comments you feel are required.

Every so often do another parallax target, perhaps concentrating on the bright ones with short exposure times, do not assume the dim seeing values are valid for the NTT.

```
P: Priority 4=Tinney2003, 5=manually dropped, 6->9=low->high. ST: Mean Siderial time todate.
T: Exposure time of sequence. J: apparent J band mag
SPT: Spectral types from infrared spectroscopy. d: photometric distance
0,1: approximately the number of nights in 2010...2011
--Name-STHH.mm-N-P-T---J----SPT--d---0--1--2-HH-MM-SS.ss--DD-MM-SS.s---Full Name--
0024n00U 23.33 1 9 61 18.16  4.5 55  3  3  3  0 24 22.94   0 22 47.9  ULASJ002422.94+002247.9
0034n05T  0.45 1 8 25 15.53  6.5 11  2  6  2  0 34 51.57   5 23  5.0   2MASSJ00345157+0523050
0050s33T  1.06 2 8 25 15.93    7 11  2  7  2  0 50 19.94 -33 22 40.2   2MASSJ00501994-3322402
0136n09M  1.19 1 9 16 13.45  2.5  6  1  6  2  1 36 56.62   9 33 47.3  IPMSJ013656.57+093347.3
0138s03W  1.32 1 9 25 16.39   3p 25  1  5  2  1 38 36.59  -3 22 21.3 WISEPJ013836.59-032221.2
0148s72W  1.36 2 9 61 18.96  9.5  8  2  5  2  1 48  7.25 -72  2 58.7 WISEPJ014807.25-720258.7
0203s01S  1.54 1 9 25 16.86  9.5 21  2  5  3  2  3 33.18  -1  8 11.9  SDSSJ020333.26-010812.5
0223s29W  2.50 2 9 43 17.10    8 12  1  4  2  2 23 22.34 -29 32 58.2 WISEPJ022322.34-293258.2
0247s16S  2.20 2 8 43 17.19 2+/- 36  3  5  2  2 47 49.78 -16 31 13.2  SDSSJ024749.90-163112.6
0254n02W  2.20 1 8 25 16.55    8  9  0  4  2  2 54  9.45   2 23 59.1 WISEPJ025409.45+022359.1
--Name-STHH.mm-N-P-T---J----SPT--d---0--1--2-HH-MM-SS.ss--DD-MM-SS.s---Full Name--
0255s47D  3.21 2 9 16 13.25    9  4  0  8  1  2 55  3.57 -47  0 50.9        DENIS-PJ0255-4700
0310n16T  3.01 1 9 25 16.02    9 15  5  6  1  3 10 59.86  16 48 15.5    2MASSWJ0310599+164816
0325n04S  3.31 2 7 25 16.25  5.5 20  4  5  1  3 25 53.22   4 25 40.6  SDSSJ032553.17+042540.1
0329n04u  3.31 1 6 43 17.05    5 31  2  5  1  3 29 20.22   4 30 24.5          ulasj0329+0430
0348s60T  4.20 2 8 25 15.32    7  8  4  5  0  3 48  7.72 -60 22 27.0   2MASSJ03480772-6022270
0407n15T  4.00 1 7 25 16.06    5 20  5  5  0  4  7  8.85  15 14 56.5   2MASSJ04070885+1514565
0415s09T  4.25 2 9 25 15.69    8  6  4  5  2  4 15 19.54  -9 35  6.6    2MASSIJ0415195-093506
0423s04S  4.43 1 6 16 14.47    0  9  0  6  3  4 23 48.58  -4 14  3.5 SDSSpJ042348.57-041403.5
0510s42T  4.51 2 7 25 16.22    5 21  3  9  2  5 10 35.24 -42  8 14.7   2MASSJ05103520-4208140
0516s04T  5.09 1 8 25 15.98  5.5 18  5  9  2  5 16  9.45  -4 45 49.9   2MASSJ05160945-0445499
--Name-STHH.mm-N-P-T---J----SPT--d---0--1--2-HH-MM-SS.ss--DD-MM-SS.s---Full Name--
0518s28T  5.41 2 9 25 15.98   1p 19  4  8  1  5 18 59.95 -28 28 37.2   2MASSJ05185995-2828372
0528s33W  5.51 2 9 25 16.67   8: 10  2  8  2  5 28 44.51 -33  8 24.0 WISEPJ052844.51-330823.9
0542s16W  5.30 1 9 25 15.60 7-8:  8  2 10  2  5 42 31.27 -16 28 29.2 WISEPJ054231.27-162829.1
0559s14T  6.11 1 7 16 13.80  4.5  7  3  6  4  5 59 19.14 -14  4 48.8   2MASSJ05591914-1404488
0611s04W  6.18 1 9 25 15.49    0 14  3  8  4  6 11 35.13  -4 10 24.0 WISEPJ061135.13-041024.0
0612s30W  6.46 2 9 43 17.10   8: 12  2  7  4  6 12 13.89 -30 36 12.9 WISEPJ061213.89-303612.9
0623s04W  6.17 1 9 43 17.50    8 14  1  6  5  6 23  9.93  -4 56 24.6 WISEPJ062309.93-045624.6
0627s11W  6.46 2 9 25 15.49    7  9  2  9  2  6 27 20.07 -11 14 28.9 WISEPJ062720.07-111428.8
0727n17T  7.20 1 8 25 15.60    7 10  1  7  5  7 27 18.24  17 10  1.2    2MASSIJ0727182+171001
0729s39T  7.42 1 9 25 15.92 8pec  7  2  9  4  7 29  0.02 -39 54  4.4   2MASSJ07290002-3954043
--Name-STHH.mm-N-P-T---J----SPT--d---0--1--2-HH-MM-SS.ss--DD-MM-SS.s---Full Name--
0751s76W  7.51 2 8 61 19.34    9 16  0  3  4  7 51  8.79 -76 34 49.6 WISEPJ075108.79-763449.6
0817s61D  8.08 2 7 16 13.61    6  5  0  7  2  8 17 30.01 -61 55 15.8     DENISJ081730.0-615520
0819s03W  8.07 1 9 16 14.99    4 13  3  9  5  8 19 58.05  -3 35 29.0 WISEPJ081958.05-033529.0
0820n10S  7.52 1 9 25 16.98 9.5+ 22  3  6  5  8 20 30.13  10 37 37.2  SDSSJ082030.12+103737.0
0830n01S  8.21 2 8 25 16.29  4.5 23  3  6  4  8 30 48.78   1 28 31.1  SDSSJ083048.80+012831.1
0926n07U  8.56 1 7 43 17.48  3.5 41  1  5  4  9 26 24.76   7 11 40.7  ULASJ092624.76+071140.7
0939s24T  9.06 2 9 25 15.98    8  7  2  5  7  9 39 35.48 -24 48 27.9   2MASSJ09393548-2448279
0949s15T  9.35 2 8 25 16.15    2 21  2  4  7  9 49  8.60 -15 45 48.5   2MASSJ09490860-1545485
0950n01u  9.43 1 6 43 17.99    8 18  3  7  5  9 50 47.28   1 17 34.3          ulasj0950+0117
1007s45T 10.04 2 8 25 15.65    5 16  1  4  7 10  7 33.69 -45 55 14.7   2MASSJ10073369-4555147
--Name-STHH.mm-N-P-T---J----SPT--d---0--1--2-HH-MM-SS.ss--DD-MM-SS.s---Full Name--
1030n02S 10.27 1 9 25 16.89 9.5+ 21  1  8  9 10 30 26.78   2 13  5.7  SDSSJ103026.78+021306.4
1048n09S 10.48 1 8 25 16.59  2.5 27  0  6  8 10 48 29.26   9 19 37.3  SDSSJ104829.21+091937.8
1110n01S 11.09 1 7 25 16.34  5.5 21  0  7  6 11 10 10.01   1 16 13.0 SDSSpJ111010.01+011613.1
1114s26T 11.32 2 8 25 15.86  7.5  9  0  5  7 11 14 51.33 -26 18 23.5   2MASSJ11145133-2618235
1122s35T 11.27 2 9 25 15.02    2 12  0  5  8 11 22  8.26 -35 12 36.3   2MASSJ11220826-3512363
```

```
1157n06S 11.42 1 9 25 16.93  1.5 30  0  7  6 11 57  0.49   6 11  5.2  SDSSJ115700.50+061105.2
1157n09U 11.44 1 8 25 16.81  2.5 30  0  6  6 11 57 59.04   9 22  0.7  ULASJ115759.04+092200.7
1202n09U 12.05 1 7 25 16.71    5 27  0  5  5 12  2 57.05   9  1 58.8  ULASJ120257.05+090158.8
1207n02S 12.17 1 9 25 15.58    0 15  0  7  6 12  7 47.17   2 44 24.9  SDSSJ120747.17+024424.8
1209s10T 12.21 2 8 25 15.91    3 20  0  7  8 12  9 56.13 -10  4  0.8   2MASSJ12095613-1004008
--Name-STHH.mm-N-P-T---J----SPT--d---0--1--2-HH-MM-SS.ss--DD-MM-SS.s---Full Name--
1215s34T 12.43 2 8 25 16.24  4.5 22  0  6 10 12 15 44.32 -34 20 59.5   2MASSJ12154432-3420591
1300n12u 13.01 2 9 25 16.71  8.5  7  0  4  8 13  0 41.73  12 21 14.7          ulasj1300+1221
1311n01W 13.02 1 9 61 19.16   9: 15  0  0 10 13 11  6.24   1 22 52.4 WISEPJ131106.24+012252.4
1402n08S 14.00 1 9 25 16.84  1.5 29  0  6 11 14  2 55.64   8  0 55.3  SDSSJ140255.66+080055.2
1404s31T 13.48 2 9 25 15.58  2.5 17  0  5  8 14  4 49.41 -31 59 33.1   2MASSJ14044941-3159329
1459n08U 14.36 1 7 43 17.98  4.5 50  0  4  7 14 59 35.25   8 57 51.2  ULASJ145935.25+085751.2
1504n10S 14.26 1 6 43 17.03    7 19  0  5  6 15  4 11.56  10 27 19.5  SDSSJ150411.63+102718.4
1511n06S 14.58 2 9 25 16.02 0+/- 18  0  4  6 15 11 14.66   6  7 43.1  SDSSJ151114.66+060742.9
1521n01S 15.30 2 8 25 16.40   2: 24  0  5  5 15 21  3.27   1 31 42.6  SDSSJ152103.24+013142.7
1553n15T 16.13 1 6 25 15.82    7 11  0  5  6 15 53  2.28  15 32 36.9    2MASSIJ1553022+153236
--Name-STHH.mm-N-P-T---J----SPT--d---0--1--2-HH-MM-SS.ss--DD-MM-SS.s---Full Name--
1615n13T 16.00 1 7 25 16.35    6 19  0  5  6 16 15  4.13  13 40  7.9   2MASSJ16150413+1340079
1617n18W 16.22 1 9 43 17.66    8 15  0  2  7 16 17  5.75  18  7 14.0 WISEPJ161705.75+180714.0
1630n08S 16.46 2 7 25 16.40  5.5 21  0  7  4 16 30 22.95   8 18 22.1  SDSSJ163022.92+081822.0
1741n25W 17.19 2 7 25 16.45    9  4  0  5  5 17 41 24.26  25 53 19.5          WISEPJ1741+2553
1750n17S 17.34 1 8 25 16.34  3.5 24  0  8  5 17 50 32.93  17 59  4.2 SDSSpJ175032.96+175903.9
1812n27W 17.46 1 7 61 18.19  8.5 14  0  3  4 18 12 10.85  27 21 44.3 WISEPJ181210.85+272144.3
1821n14T 18.33 1 6 16 13.43  4.5 10  0  2  5 18 21 28.15  14 14  1.0   2MASSJ18212815+1414010
1828s48T 18.03 2 8 25 15.18  5.5 12  2  6  6 18 28 35.72 -48 49  4.6   2MASSJ18283572-4849046
1934s21C 18.51 2 7 43 17.90  3.5 50  3  6  4 19 34 30.40 -21 42 21.0      CFBDSJ193430-214221
1936s55T 19.32 2 6 16 14.49    5 15  0  5  8 19 36  1.87 -55  2 32.2   2MASSJ19360187-5502322
--Name-STHH.mm-N-P-T---J----SPT--d---0--1--2-HH-MM-SS.ss--DD-MM-SS.s---Full Name--
2018s74W 19.36 2 6 43 17.11    7 20  0  6  6 20 18 24.98 -74 23 26.1 WISEPJ201824.98-742326.1
2043s15S 20.33 1 9 25 16.62    9 20  3  6  3 20 43 17.69 -15 51  3.1  SDSSJ204317.69-155103.4
2047s07S 20.15 1 9 25 16.95   0: 28  2  5  5 20 47 49.59  -7 18 17.6  SDSSJ204749.61-071818.3
2052s16S 20.54 2 6 25 16.33 1+/- 22  3  5  4 20 52 35.15 -16  9 30.8  SDSSJ205235.31-160929.8
2124n01S 21.11 1 8 25 16.03    5 19  3  5  5 21 24 13.87   0 59 59.9  SDSSJ212413.89+010000.3
2139n02T 21.24 1 9 25 15.26  1.5 14  2  3  4 21 39 26.77   2 20 22.7   2MASSJ21392676+0220226
2151s48T 21.36 2 9 25 15.73    4 18  2  4  3 21 51 38.39 -48 53 54.2   2MASSJ21513839-4853542
2154s10T 21.51 2 8 25 16.42  4.5 24  2  5  4 21 54 24.94 -10 23  2.2   2MASSJ21542494-1023022
2228s43T 22.40 2 7 25 15.66    6 14  3  5  3 22 28 28.89 -43 10 26.2   2MASSJ22282889-4310262
2229n01U 22.13 1 7 43 17.88  2.5 49  3  4  4 22 29 58.30   1  2 17.2  ULASJ222958.30+010217.2
--Name-STHH.mm-N-P-T---J----SPT--d---0--1--2-HH-MM-SS.ss--DD-MM-SS.s---Full Name--
2239n16W 22.23 1 9 25 16.08    3 21  0  3  5 22 39 37.55  16 17 16.2 WISEPJ223937.55+161716.2
2325s41W 22.45 2 9 61 19.75    9 20  0  5  2 23 25 19.54 -41  5 34.9 WISEPJ232519.54-410534.9
2331s47T 23.03 2 6 25 15.66    5 16  3  3  3 23 31 23.78 -47 18 27.4   2MASSJ23312378-4718274
2342n08u 23.22 1 8 25 16.37  6.5 17  4  4  5 23 42 28.97   8 56 20.1          ulasj2342+0856
2356s15T  0.22 1 6 25 15.82  5.5 16  2  5  1 23 56 54.77 -15 53 11.1    2MASSIJ2356547-155310
```