**Lecture 4: Finding things on the sky**

* 1. Finding things on the sky
     1. First task: is it observable?
     2. Planning a path to a star
  2. Review of principles
     1. You can always use something like Starry Night to determine observability
     2. But a few simple principles will suffice
     3. First, remember what magnitudes are naked eye, binoculars, telescope visible
     4. Second, calculate how high it will get in the sky: Altitude at transit is 90 - | Dec - Lat |
     5. Third, remember how to calculate LST, and compare to RA
     6. RA at midnight standard time changes throughout year
     7. 12h on Mar 21, 18h on Jun 21, 0h on Sep 23, 6h on Dec 21
     8. 2 h per month, or 4 min per day
     9. Difficult to observe things at large HA, particularly if altitude at transit is low
  3. Edmund charts for observability
     1. Example: El nath. a star in Auriga
     2. These charts are set up for 8pm local standard time
     3. Basically, at 8pm on each date, LST = RA
     4. This tells you what is transiting, or near to (in this case mid February)
     5. Things with in a few hours are likely to still be in the sky
     6. Though less so the further south you go
     7. For area near pole, use circular layout
     8. At latitudes like ours, many of these stars are circumpolar: Lat - (90-Dec) > 0
     9. Same principle
     10. Let’s do some examples
  4. Northern cap
     1. On what date will I be able to go outside at 9pm standard time and see Caph directly above Polaris
     2. Caph is at 00:09+59:08
     3. Minimum altitude it reaches is 41 - (90-59) = 12 deg
     4. Maximum altitude it reaches is 90 - |41-59| = 72
     5. 00h transits at midnight on Sep 23
     6. As year goes on it will transit earlier and earlier
     7. Each month by 2h
     8. So it will transit 3h earlier, at 9pm, 1 1/2 months later
     9. Say near Nov 7
     10. For 00:09 we add two days (4 min per day), bringing our estimate to Nov 9
     11. Let’s consult the Edmund atlas
     12. The dates are set up for 8pm standard time, so we look for Caph and subtract an hour
     13. 23h 09m transits at 8pm around Nov 6, so on that date 00h 09m transits at 9pm
     14. We’re within 3 days in our estimate, which is good enough for our accuracy
     15. Of course, a program like Starry Night would calculate it exactly
     16. But you want to be able to do it quickly, or even in your head
  5. Lower declinations
     1. On what date can we go outside and see M46 at 07:46-14:48 transiting at 3 am?
     2. First, note that it will be low on the sky: 90 - |41+15| = 34 deg altitude at max
     3. If 08h is transiting at 3am, 5h is transiting at midnight
     4. So let’s estimate from Dec 21, when 6h transits at midnight
     5. 2h per month, so 15 days earlier is what we want: Dec 6
     6. On Dec 6, 5h transits at midnight, so 8h transits at 3am
     7. But M46 is 14m earlier (07h 46m), or about 3 days
     8. So Dec 3 is the date at which M46 will transit at 3am
     9. The Edmund Atlas is not so useful in this case, since it is geared to 8pm
     10. But let’s try: at 8pm on Mar 16 or so, M46 transits
     11. That is 7h from 3am, so we need to go 7h earlier in the year, or 3 1/2 months
     12. That’s about Dec 1. Again, good agreement.
  6. Actually finding the object on the sky
     1. Great, so you know when some star will be easy to see on the sky
     2. Once you are out there, how to you find it?
     3. First, find North, using Big Dipper or Casseopia to find Polaris, that will orient you
     4. Next, take note of constellations and bright stars nearby to orient you.
     5. E.g. in this case you can see Orion, and know to look to its left
     6. That’s usually not going to be good enough
     7. There is Sirius, and Procyon
  7. If you are trying to find something bright with binoculars or through telescope finder
     1. That might be good enough
     2. Eg this is a typical binocular FOV
     3. Sweep this “left”: look for this pattern, and follow this line
     4. A few FOVs over if you are sweeping carefully you may see M46
     5. This requires practice, practice, practice
     6. And yet, still won’t necessarily be good enough for faint things
     7. Fainter objects require a more detailed plan
  8. Finding an object with Alt-Az
     1. On an alt-az telescope, the best thing to do is to map out a specific plan
     2. At each step note a distinct pattern of stars
     3. Requires fainter star charts than Edmund (available, e.g., in Peterson)
     4. It is quite hard to recognize these patterns in fact: requires practice!
     5. But this process helps you study the star field ahead of time, which is crucial
     6. Remember that in finder scope image is flipped!!
  9. Finding an object with Equatorial
     1. On an equatorial telescope that is aligned, you can dial NS and EW accurately
     2. So the strategy there is to offset from a an easy to recognize object
     3. E.g. Sirius is at 06:44-16:36
     4. Dial 1h2m East, 2 deg 12 arcmin N
     5. Again, take the time to study the star field you are aiming for at each step
  10. From the finder to the eyepiece
      1. When you are trying to find a faint object, not always obvious in finder
      2. Use the widest FOV (longest focal length) eyepiece available at first
      3. Much smaller than finder still!
      4. At the start of your observations, you probably want to make sure it is calibrated
      5. Usually, you won’t have sufficient charts to identify all faint stars in FOV
      6. Need to key off ones visible in finder to make sure you are centered
      7. Once you have aligned the object (and are tracking) you can swap in smaller eyepiece
      8. With luck, you will do all this in a later lab