May 2003 – Astronomy Abroad: American Southwest Itinerary

May 1 – Thursday
Class Day
1:00pm – 3:50pm
   Hand out new syllabus
   Talk about Cosmos reading – sign up sheet (make copies when filled in)
   Talk about Final Project
   Lecture:
       Right Ascension and Declination
       Local Sidereal Time
       Magnitude Scale
   Go over star charts show RA, Dec, Magnitude and type of objects.

8:00pm Observing from campus, learn about telescope.

Hand out Tyson Scientific Method article for discussion May 2nd at dinner.
Bring flashlights tomorrow.

May 2 – Friday
Pick up 15-person Van
4:00pm Meet Duke Hall for drive to dinner at my house.
Discuss Tyson article on scientific method.
Stargazing in Angelus Oaks.
Assignment for Sunday: Cosmos 1

May 3 – Saturday
11:00am Meet at Duke Hall.
Check equipment.
Check room in van.
4 – Sunday
9:00am - Meet at Duke Hall
Drive to Tucson: ~7 hours
Discuss Cosmos 1 – Assign Cosmos 2 for Wednesday
Lodging Tucson: **Four Points Sheraton** (1900 E. Speedway, 520-327-7341)

Location:
May 5 – Monday

9:00am Leave for KPNO (get lunch on way to KPNO). Arrive Visitor Center by 11:00am
Contact: NOAO E/PO Officer Robert Wilson
(phone en route: 520-318-8726 or 8732, office 8440; email: rwilson@noao.edu)
Tour McMath-Pierce Solar Observatory:
Contact: Claude Plymate (phone: 520-318-8168, email: plymate@noao.edu)

I have arranged for your group to eat dinner in the cafeteria; the cost
will be $10.00 per person. There are places along the way where you could
pick up lunch or just buy it in town before leaving. A noon tour of the
4-meter should be possible. The only real question about that telescope is
whether we can get on the floor. I am working on that but can't promise
anything. But even if we don't get on the floor, they can still see the
telescope. I would say arrive about 11:00. We can go straight to the 4-m,
have a leisurely lunch, see the 2.1-m, do some solar observing on the
16-inch (weather permitting), visit the McMath-Pierce (by 2:30), and have dinner at
4:30. We could use the time between dinner and WIYN to get your equipment
set up. Does this sound reasonable given your schedule?

6:00 Set up at WIYN/0.9m parking lot.
6:30 Tour WIYN Observatory
Contact: Liese van Zee (email: vanzee@astro.indiana.edu)
7:07pm - Sunset at WIYN. Stargazing from WIYN/0.9m parking lot.

Driving Directions: Kitt Peak is 56 miles southwest of Tucson via State Route 86 on the
Tohono O'Odham Reservation. Allow 90 minutes of drive time from Tucson. Take I-10
to I-19 South (see note below). Less than 1 mile is Ajo Way/Hwy 86 (Exit 99). Take this
exit West (right). Proceed past Ryan Airfield and Three Points. Continue until Junction
386 (Kitt Peak turnoff). Turn left onto 386. The Kitt Peak Visitor Center is located at the
summit (12 miles).

Note: I-10/I-19 construction -- It looks like you can take Campbell to 22nd Street, turn
west on 22nd street, cross under I10, whereup 22nd Street becomes Starr Pass Blvd.
Then you can either turn left onto Mission Road or the next major left onto La Cholla
Blvd. Both of these intersect the Ajo Highway (Route 86).

Assigned Reading for Tuesday: Sun and thermal radiation
Sun and Moon Data for 5 May 2003, Tucson AZ

The following information is provided for Tucson, Pima County, Arizona (longitude W110.9, latitude N32.2):

**SUN**
- Begin civil twilight       5:08 a.m.
- Sunrise                          5:34 a.m.
- Sun transit                   12:20 p.m.
- Sunset                           7:07 p.m.
- End civil twilight          7:34 p.m.

**MOON**
- Moonset                    10:20 p.m. on preceding day
- Moonrise                    8:19 a.m.
- Moon transit               3:46 p.m.
- Moonset                   11:14 p.m.
- Moonrise                   9:10 a.m. on following day

Phase of the Moon on 5 May: waxing crescent with 16% of the Moon's visible disk illuminated.

**Sunrise and set position**

<table>
<thead>
<tr>
<th>Mountain Standard Time</th>
<th>Altitude</th>
<th>Azimuth (E of N)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>h  m</td>
<td>o</td>
</tr>
<tr>
<td>05:34</td>
<td>rise</td>
<td>70.5</td>
</tr>
<tr>
<td>19:07</td>
<td>set</td>
<td>290.0</td>
</tr>
</tbody>
</table>

**Moonrise and set position**

<table>
<thead>
<tr>
<th>Mountain Standard Time</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>h  m</td>
<td>o</td>
</tr>
<tr>
<td>08:19</td>
<td>rise</td>
<td>59.0</td>
</tr>
<tr>
<td>23:14</td>
<td>set</td>
<td>301.0</td>
</tr>
</tbody>
</table>

Magnetic Declination (MD) for Tucson = 11 degrees (East)
Magnetic Direction = True Direction - MD
May 6 – Tuesday
The Sun and GONG

10:30 am - 12:00 noon GONG presentation (Sudol)
DMAC Conference Room

(lunch break)

01:00 pm - 02:00 pm ATST presentation (Hill)
Science Conference Room

02:00 pm - 04:00 pm field trip to GONG shelter, solar observing with Tyler's telescope at the GONG farm

Mercury transit?
Assigned Reading for Thursday: Impact hazards and Io
May 7 – Wednesday
Saguaro National Monument (West)

10:00 am - Day hike at Saguaro. Bring lunch and dinner.
*Discuss Cosmos 2 – Assign Cosmos 6 for Thursday*
6:00 pm – Set up at Sus Picnic Area on Bajada Loop Drive.
  - Have dinner. Loop closes at sunset (no gate), but we will need to drive van out and park at entrance to loop.

Carry equipment out to van when done.

*Assigned Reading for Friday: Galaxies and electromagnetic spectrum*
Sun and Moon Data for 7 May 2003 Tucson AZ

Mountain Standard Time

SUN
Begin civil twilight  5:06 a.m.
Sunrise  5:32 a.m.
Sun transit  12:20 p.m.
Sunset  7:09 p.m.
End civil twilight  7:35 p.m.

MOON
Moonrise  9:10 a.m. on preceding day
Moonset  12:06 a.m.
Moonrise  10:07 a.m.
Moon transit  5:32 p.m.
Moonset  12:52 a.m. on following day

Phase of the Moon on 7 May: waxing crescent with 33% of the Moon's visible disk illuminated.

Sunrise and set position
Mountain Standard Time
Altitude  Azimuth
(E of N)
h  m  o
05:32  rise  69.2
19:09  set  290.9

Moonrise and set position
Mountain Standard Time
Altitude  Azimuth
(E of N)
h  m  o
10:07  rise  59.0
24:52  set  301.0

Magnetic Declination (MD) for Tucson = 11 degrees (East)
Magnetic Direction = True Direction - MD
May 8 – Thursday
Planetary Day
10:00am Jay Melosh
   Impact Cratering
   Gould/Simpson Building – Geology.
   Conference room on the ninth floor of the Gould/Simpson building, just down the hall from my office.

Lunch

12:45 Jani Radebaugh (LPL) – Geology (same room as morning)
   Io Volcanism

Discuss Cosmos 6 – Assign Cosmos 3 for Sunday
May 9 – Friday
Galaxy Day
Contact: JD Smith, Steward Obs.

Noon lunch.

Steward Observatory Room 450 1:00 – 3:00pm
1:00pm J.D. Smith – SIRTF galaxies
2:00pm Betsy Barton Gillespie – Colliding galaxies

Free Night

May 10 – Saturday
Free Day.
May 11 – Sunday
*Mother’s Day – call mother*
12:00pm Leave Tucson for Kartchner Caverns
Kartchner Caverns (520-586-2283)
   Arrive by 2:30 pm
   Tour 3:40 pm

**Directions**
The park is located nine miles south
of I-10 exit 302, off State Hwy 90.

Lodging Benson: **Super 8 Motel** (855 N Ocatillo Rd, I-10 exit 304, just north, 520-586-1530)

Do Laundry (Sat night or Sun morning)

*Discuss Cosmos 3 – Assign Cosmos 4 for Monday*
May 12 – Monday
9:00 am Leave Benson, AZ for Socorro, NM ~5 hours (+Lose 1 hour)


Driving: I-10E to Demming NM, Hwy 26 NE to Hatch, I-25 N to Socorro
*Discuss Cosmos 4 – Assign Cosmos 7 for Wednesday*

In Socorro: AJ recommends “El Sombrero”

May 13 – Tuesday
VLA Contact: Robyn Harrison
Go to VLA HQ in morning.
  * Talk by somebody about latest results.
  * Minerological Museum

Tour of array in afternoon.
Sun and Moon Data for Tuesday 13 May 2003  MDT

The following information is provided for Magdalena, Socorro County, New Mexico (longitude W107.2, latitude N34.1):

**SUN**
- Begin civil twilight: 5:41 a.m.
- Sunrise: 6:09 a.m.
- Sun transit: 1:05 p.m.
- Sunset: 8:02 p.m.
- End civil twilight: 8:30 p.m.

**MOON**
- Moonrise: 4:15 p.m. on preceding day
- Moonset: 4:37 a.m.
- Moonrise: 5:26 p.m.
- Moon transit: 11:22 p.m.
- Moonset: 5:10 a.m. on following day

Phase of the Moon on 13 May: waxing gibbous with 91% of the Moon's disk lit.

**Sunrise and set position**

<table>
<thead>
<tr>
<th>Mountain Daylight Time</th>
<th>Altitude (E of N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>h  m</td>
<td>o</td>
</tr>
<tr>
<td>06:09</td>
<td>rise 67.2</td>
</tr>
<tr>
<td>20:02</td>
<td>set 293.7</td>
</tr>
</tbody>
</table>

**Moonrise and set position**

<table>
<thead>
<tr>
<th>Mountain Daylight Time</th>
<th>Altitude (E of N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>h  m</td>
<td>o</td>
</tr>
<tr>
<td>17:26</td>
<td>rise 96.7</td>
</tr>
<tr>
<td>05:10 fd</td>
<td>set 267.0</td>
</tr>
</tbody>
</table>

**Magnetic Declination (MD) for Socorro = 10 degrees (East)**

Magnetic Direction = True Direction - MD
May 14 – Wednesday
9:00 am Leave Socorro, NM for Chaco Culture National Monument (arrive by 5:00pm).

Albuquerque for lunch and camping supplies and food.
   Lunch: AJ recommends “Cervantes” on corner of Gibson and San Pedro.

Discuss Cosmos 7 – Assign Cosmos 9 for Friday

Popular Outdoor Outfitters
4900 Cutler Ave NE #D, ABQ NM 87110

Assigned reading for Thursday: Chapter on Celestial Orientation
Chaco Canyon
Chaco park staff: 505-786-7014 x 221

<table>
<thead>
<tr>
<th>DIRECTIONS</th>
<th>DISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start out going West on ABEYTA AVE toward I-25 BL N/N CALIFORNIA ST/US-60 E.</td>
<td>0.05 miles</td>
</tr>
<tr>
<td>Turn RIGHT onto I-25 BL N/N CALIFORNIA ST/US-60 E.</td>
<td>1.05 miles</td>
</tr>
<tr>
<td>Merge onto I-25 N.</td>
<td>91.94 miles</td>
</tr>
<tr>
<td>Take the NM-44 W/NM-165 E exit- exit number 242- toward RIO RANCHO/PLACITAS.</td>
<td>0.24 miles</td>
</tr>
<tr>
<td>Take the ramp toward BERNALILLO/RIO RANCHO/FARMINGTON.</td>
<td>0.04 miles</td>
</tr>
<tr>
<td>Turn LEFT onto NM-44 W.</td>
<td>115.82 miles</td>
</tr>
</tbody>
</table>

**Total Estimated Time:**
4 hours, 16 minutes

**Total Distance:** 209.15 miles

May 15 – Thursday
Free hike
Be back at campsite for 4:30pm dinner. Leave for ruins 6:30pm. Bring snacks.
Lunar eclipse

May 16 – Friday
Get new campsite.
Hike to Penasco Blanco pictograph – *Discuss Cosmos 9 – Assign Cosmos 8 for Sunday*
Sun and Moon Data for Wednesday 14 May 2003, ~Chaco Canyon

Mountain Daylight Time

**SUN**
- Begin civil twilight: 5:37 a.m.
- Sunrise: 6:06 a.m.
- Sun transit: 1:09 p.m.
- Sunset: 8:12 p.m.
- End civil twilight: 8:41 p.m.

**MOON**
- Moonrise: 5:31 p.m. on preceding day
- Moonset: 5:11 a.m.
- Moonrise: 6:46 p.m.
- Moon transit: 12:20 a.m. on following day
- Moonset: 5:46 a.m. on following day

Phase of the Moon on 14 May: waxing gibbous with 97% of the Moon's visible disk illuminated.

**Sunrise and set position**

Mountain Daylight Time

<table>
<thead>
<tr>
<th>Altitude</th>
<th>Azimuth (E of N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>h m</td>
<td>o</td>
</tr>
<tr>
<td>06:06</td>
<td>rise 65.7</td>
</tr>
<tr>
<td>20:12</td>
<td>set 294.0</td>
</tr>
</tbody>
</table>

**Moonrise and set position**

Mountain Daylight Time

<table>
<thead>
<tr>
<th>Altitude</th>
<th>Azimuth (E of N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>h m</td>
<td>o</td>
</tr>
<tr>
<td>18:46</td>
<td>rise 105.3</td>
</tr>
<tr>
<td>05:46 nd</td>
<td>set 250.9</td>
</tr>
</tbody>
</table>

**Magnetic Declination (MD) for Chaco = 13 degrees (East)**

Magnetic Direction = True Direction - MD
Sun and Moon Data for Thurs. 15 May 2003, Chaco Canyon

Mountain Daylight Time

**SUN**
- Begin civil twilight: 5:37 a.m.
- Sunrise: 6:05 a.m.
- Sun transit: 1:09 p.m.
- Sunset: 8:13 p.m.
- End civil twilight: 8:42 p.m.

**Sunrise and set position**

<table>
<thead>
<tr>
<th>Mountain Daylight Time</th>
<th>Altitude</th>
<th>Azimuth (E of N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>h  m</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>06:05</td>
<td>rise</td>
<td>65.5</td>
</tr>
<tr>
<td>20:13</td>
<td>set</td>
<td>295.0</td>
</tr>
</tbody>
</table>

**Total Lunar Eclipse: Lunar Position**

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
<th>h  m</th>
<th>Azimuth</th>
<th>Altitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moonrise</td>
<td>2003 May 15</td>
<td>20:04</td>
<td>113.2</td>
<td>----</td>
</tr>
<tr>
<td>Moon enters totality</td>
<td>2003 May 15</td>
<td>21:13.7</td>
<td>124.1</td>
<td>10.9</td>
</tr>
<tr>
<td>Middle of eclipse</td>
<td>2003 May 15</td>
<td>21:40.1</td>
<td>128.7</td>
<td>14.9</td>
</tr>
<tr>
<td>Moon leaves totality</td>
<td>2003 May 15</td>
<td>22:06.4</td>
<td>133.6</td>
<td>18.7</td>
</tr>
<tr>
<td>Moon leaves umbra</td>
<td>2003 May 15</td>
<td>23:17.4</td>
<td>148.7</td>
<td>27.1</td>
</tr>
<tr>
<td>Moon leaves penumbra</td>
<td>2003 May 16</td>
<td>00:14.8</td>
<td>162.9</td>
<td>31.5</td>
</tr>
<tr>
<td>Moonset</td>
<td>2003 May 16</td>
<td>06:25</td>
<td>244.1</td>
<td>----</td>
</tr>
</tbody>
</table>

Magnetic Declination (MD) for Chaco = 13 degrees (East)
Magnetic Direction = True Direction - MD

**Lenses, field of view, and size of moon disk**

<table>
<thead>
<tr>
<th>Film</th>
<th>Lens</th>
<th>f.o.v.</th>
<th>Moon D. 4x6</th>
<th>Moon D. 8x10</th>
<th>Moon D. 10x16</th>
</tr>
</thead>
<tbody>
<tr>
<td>35mm</td>
<td>28mm</td>
<td>46 x 65 deg.</td>
<td>1mm</td>
<td>2mm</td>
<td>2.5mm</td>
</tr>
<tr>
<td>30</td>
<td>50</td>
<td>30 x 40</td>
<td>1.7</td>
<td>3.4</td>
<td>5.4</td>
</tr>
<tr>
<td>120mm</td>
<td>35mm</td>
<td>62 x 76</td>
<td>1</td>
<td>1.7</td>
<td>2.5</td>
</tr>
<tr>
<td>120</td>
<td>80</td>
<td>29 x 40</td>
<td>2.2</td>
<td>3.7</td>
<td>5.5</td>
</tr>
<tr>
<td>120</td>
<td>105</td>
<td>23 x 29</td>
<td>3</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>120</td>
<td>210</td>
<td>11 x 15</td>
<td>5.4</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>120</td>
<td>420</td>
<td>6 x 7.5</td>
<td>11</td>
<td>18</td>
<td>27</td>
</tr>
</tbody>
</table>
Sun and Moon Data for Friday 16 May 2003, Chaco Canyon

Mountain Daylight Time

**SUN**
- Begin civil twilight: 5:36 a.m.
- Sunrise: 6:05 a.m.
- Sun transit: 1:09 p.m.
- Sunset: 8:14 p.m.
- End civil twilight: 8:43 p.m.

**MOON**
- Moonrise: 8:04 p.m. on preceding day
- Moon transit: 1:18 a.m.
- Moonset: 6:25 a.m.
- Moonrise: 9:21 p.m.
- Moonset: 7:12 a.m. on following day

Phase of the Moon on 16 May: waning gibbous with 99% of the Moon's visible disk illuminated.

**Sunrise and set position**

<table>
<thead>
<tr>
<th>Mountain Daylight Time</th>
<th>Altitude (E of N)</th>
<th>Azimuth</th>
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</thead>
<tbody>
<tr>
<td>h m</td>
<td></td>
<td>o</td>
</tr>
<tr>
<td>06:05</td>
<td>rise</td>
<td>65.3</td>
</tr>
<tr>
<td>20:14</td>
<td>set</td>
<td>295.1</td>
</tr>
</tbody>
</table>

**Moonrise and set position**

<table>
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<tr>
<th>Mountain Daylight Time</th>
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</tr>
</thead>
<tbody>
<tr>
<td>h m</td>
<td></td>
<td>o</td>
</tr>
<tr>
<td>06:25</td>
<td>set</td>
<td>244.0</td>
</tr>
<tr>
<td>21:21</td>
<td>rise</td>
<td>118.9</td>
</tr>
</tbody>
</table>

**Magnetic Declination (MD) for Chaco = 13 degrees (East)**
Magnetic Direction = True Direction - MD
May 17 – Saturday
9:00am Leave Chaco for Monument Valley (must arrive by 7:00pm)

Lodging: Mitten View Campground (435-727-5870)
Reservation: Nordgren

Assigned reading for Monday: the Outer Solar System (Pluto and Comets)

<table>
<thead>
<tr>
<th>DIRECTIONS</th>
<th>DISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Start out going North on US-550 N/NM-44 N toward CR-7600.</td>
<td>35.95 miles</td>
</tr>
<tr>
<td>2: Turn LEFT onto US-64/W BROADWAY AVE. Continue to follow US-64 W.</td>
<td>11.21 miles</td>
</tr>
<tr>
<td>3: Turn SLIGHT RIGHT onto E BROADWAY/US-64 BR W. Continue to follow US-64 BR W.</td>
<td>0.91 miles</td>
</tr>
<tr>
<td>4: US-64 BR W becomes US-64 N.</td>
<td>29.71 miles</td>
</tr>
<tr>
<td>5: Turn RIGHT onto US-64/NM-504.</td>
<td>26.07 miles</td>
</tr>
<tr>
<td>6: US-64/NM-504 becomes US-160.</td>
<td>28.22 miles</td>
</tr>
<tr>
<td>7: Turn RIGHT onto US-191.</td>
<td>26.44 miles</td>
</tr>
<tr>
<td>8: Turn LEFT onto US-163/UT-163.</td>
<td>41.03 miles</td>
</tr>
<tr>
<td>9: Turn RIGHT onto OLJETO RD.</td>
<td>0.85 miles</td>
</tr>
</tbody>
</table>

**Total Estimated Time:** 5 hours, 42 minutes

**Total Distance:** 200.39 miles
Sun and Moon Data for Friday 17 May 2003, Monument Valley

Mountain Daylight Time

**SUN**
- Begin civil twilight: 5:43 a.m.
- Sunrise: 6:12 a.m.
- Sun transit: 1:17 p.m.
- Sunset: 8:23 p.m.
- End civil twilight: 8:52 p.m.

**MOON**
- Moonrise: 9:30 p.m. on preceding day
- Moon transit: 2:28 a.m.
- Moonset: 7:21 a.m.
- Moonrise: 10:44 p.m.
- Moonset: 8:16 a.m. on following day

Phase of the Moon on 17 May: waning gibbous with 96% of the Moon's visible disk illuminated.

**Sunrise and set position**

<table>
<thead>
<tr>
<th>Mountain Daylight Time</th>
<th>Altitude</th>
<th>Azimuth (E of N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>06:12 rise</td>
<td></td>
<td>64.6</td>
</tr>
<tr>
<td>20:23 set</td>
<td></td>
<td>295.5</td>
</tr>
</tbody>
</table>

**Moonrise and set position**

<table>
<thead>
<tr>
<th>Mountain Daylight Time</th>
<th>Altitude</th>
<th>Azimuth (E of N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:21 set</td>
<td></td>
<td>239.0</td>
</tr>
<tr>
<td>22:44 rise</td>
<td></td>
<td>123.0</td>
</tr>
</tbody>
</table>

Magnetic Declination (MD) for Monument Valley = 12 degrees (East)

Magnetic Direction = True Direction - MD
May 18 – Sunday
9:00am Drive Monument Valley loop drive.
12:00noon Leave Monument Valley for Flagstaff AZ (gain hour off Navajo reservation)
~5 hours driving time

Lodging: Du Beau Hostel (1-800-398-7112, 19 West Phoenix Street)
May 18 – May 29

Discuss Cosmos 8 – Assign Cosmos 5 for Tuesday
Assigned reading for Tuesday: Mars

May 19 – Monday
Lowell Observatory
10:00am Slipher Room, Topic: Pluto – KBOs and the outer solar system
Contact: Will Grundy at Lowell

May 20 – Tuesday
USGS
10:00am Mars and Martian Glaciers
Contact: Jeff Kargel

Discuss Cosmos 5 – Assign Cosmos 10 for Friday
Assigned reading for Wednesday: Stars

Present idea of final project (proposed object) – discuss over dinner

May 21 – Wednesday
10:00am Tour of NPOI
2:00 pm Talk by Tyler Nordgren at NOFS

May 22 – Thursday
Lowell Observatory
Deidre Hunter – Galaxies

May 23 – Friday
Final Projects due at 9:00am
9:00am Leave for Grand Canyon
Discuss Cosmos 10 – Assign Cosmos 11-12 for Sunday, Monday or Tuesday nights
Watch sunset
Stargaze from south rim or closer back to Flagstaff
Sun and Moon Data for 23 May 2003 Flagstaff AZ ~Grand Canyon

Mountain Standard Time

**SUN**
- Begin civil twilight: 4:49 a.m.
- Sunrise: 5:17 a.m.
- Sun transit: 12:23 p.m.
- Sunset: 7:30 p.m.
- End civil twilight: 7:58 p.m.

**MOON**
- Moonset: 11:46 a.m. on preceding day
- Moonrise: 1:45 a.m.
- Moon transit: 7:13 a.m.
- Moonset: 12:47 p.m.
- Moonrise: 2:12 a.m. on following day

Phase of the Moon on 23 May: waning crescent with 42% of the Moon's visible disk illuminated.

### Sunrise and set position

<table>
<thead>
<tr>
<th>Mountain Standard Time</th>
<th>Altitude (E of N)</th>
<th>Azimuth</th>
</tr>
</thead>
<tbody>
<tr>
<td>h  m</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>05:17      rise</td>
<td>63.6</td>
<td></td>
</tr>
<tr>
<td>19:30      set</td>
<td>296.3</td>
<td></td>
</tr>
</tbody>
</table>

### Moonrise and set position

<table>
<thead>
<tr>
<th>Mountain Standard Time</th>
<th>Altitude (E of N)</th>
<th>Azimuth</th>
</tr>
</thead>
<tbody>
<tr>
<td>h  m</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>12:47      set</td>
<td>255.5</td>
<td></td>
</tr>
<tr>
<td>2:12        rise</td>
<td>101.0</td>
<td></td>
</tr>
</tbody>
</table>

**Magnetic Declination (MD) for Flagstaff = 12 degrees (East)**

**Magnetic Direction = True Direction – MD**
May 24 – Saturday
11:00am Leave for Meteor Crater
Saturday night Free night

May 25 – Sunday
Free day
Observing Night 1
*Discuss Cosmos 11-12 – Assign Cosmos 13 Wednesday*

May 26 – Monday
Free day
Observing Night 2
*Discuss Cosmos 11-12 – Assign Cosmos 13 Wednesday*

May 27 – Tuesday
Free day
Observing Night 3
*Discuss Cosmos 11-12 – Assign Cosmos 13 Wednesday*

May 28 – Wednesday
11:00 am Leave Flagstaff for University of Redlands (~7 hours)
*Discuss Cosmos 13*