Kitt Peak National Observatory
Status and Plans 2006

Buell T. Jannuzi

(Acting Director KPNO)
Notes Regarding this Presentation

The slides that follow were taken from presentations made by Dr. George Jacoby (WIYN Director), Dr. Jeremy Mould (NOAO Director), Richard Green (Past KPNO Director), Dr. Ron Probst (NEWFIRM Project Scientist), and Buell Jannuzi (Acting Director KPNO). Together they were used by Jannuzi for his presentation to the October 2006 meeting of the NOAO User’s Committee. The talk did not cover all the details you might see on these slides. Similarly, not all the items covered by the oral presentation are included in these slides. Buell T. Jannuzi
An Interesting Year of Challenges…(Situation Normal)
While Outstanding Science Continuing to be Produced …
Change in Leadership and staffing of KPNO…led us to
  Fill Open Positions …
Decrease in NOAO capabilities (decrease in MIP), flat budget for NOAO,
  increasing obligations, deficit to make up from FY05, led us to
  Look for cost savings…
  Look to Secure Partnerships …
VERITAS Project, led us to work to improve relations with Tohono O’odham
  Nation …
Continued Growth of Tucson requires we continue to represent our Interests
  with Outdoor Lighting issues in Pima County and Tucson …
Telescope Operations: Mayall 4m, 2.1m and small telescopes, and WIYN
  FY07 -- Year of new instruments, QUOTA, WHIRC, Hydra, and NEWFIRM
KPNO Contributions to Basic Science Research and Education.

Education -- PAEO Nightly Observing Program; out reach to Tohono O’odham (community college; middle and high schools); TLRBSE; NSF REU.

Science -- FY04, 157 publications; FY05, 154 publications; FY06 > 150 publications; More than 25 Ph.D. projects (travel costing us $25K)


*Constraining the Evolution of the Ionizing Background and the Epoch of Reionization with z~6 Quasars. II. A Sample of 19 Quasars* -- Fan et al., AJ, 132, 117.


*Discovery of two young brown dwarfs in an eclipsing binary system* -- Stassun et al., Nature, 440, 311 (0.9m).


And completion of several NOAO survey programs...examples


Change in Leadership not only staff changes…
Staffing Changes since last report
Left…
Judy Prosser retired after 18 years of service.
One facilities position retirement.
Gene McDougall transitioned from KPNO OA to WIYN engineer.
(Richard Green, John Glaspey, and Scott Bulau)

New…
Karen Butler, new OA for 4m and WIYN
Kathleen Robles, 10% time, in training to be back-up for Joanne Hudson
Two trainees in facilities
AND new detector engineer, Maureen Ellis, starting in November
We have managed to reduce our operating costs. Increased charge for room/food to make revenue/cost neutral.

Adjusted JUF method of calculation to provide stability and allow minimum preventative maintenance.

Reduced KPNO Mountain Electricity Consumption by 10%, Mayall by 20%, but rising gas/electricity costs mean only part of this saving results in lower monetary costs. (Mayall electric bill approximately $40K for FY06)
Partnerships have helped KPNO

Instruments -- Flamingos, ET, IRMOS, WHIRC, OPTIC, ONIS (TIFKAM), QUOTA, ODI, and NEWFIRM

Operations -- WIYN, and now Clemson
University of Maryland Will be renewing for Three more years!

Instrumentation Partner NEWFIRM, now QUOTA/ODI 20% share Mayall 4m

Fear the Turtle

Fear the Turtle.
Partners for 2006-2009, 10% share
In Mayall 4m (time trades possible)

President James Barker
Our Would Be Tenant: VERITAS

FY06 Update

– NSF, DOE, with consultation by KPNO, in negotiations with Tohono O’odham Legislative Council and chief Executive (Chairwomen Juan-Saunders).
– Mitigation proposal does include finite lifetime for astronomical activities on Kitt Peak.
– Current status: Site prep completed in Horseshoe Canyon, foundations built, telescopes being tested off-site.
– Environmental Assessment and Cultural Assessment Completed.
– Waiting for go ahead to complete project. Decision anticipated very soon.
Kitt Peak Still a Great Site
All the reasons it was picked originally still are true:

Located in Southern Arizona
Clear Skies
Good Seeing
About 90 minutes from Tucson Airport

Infrastructure Supports 22 Telescopes
Growth of Stray Light must be managed to Maintain Dark Sky Access

- Work of Massey and Foltz showed that stray light at zenith of Kitt Peak grew by 15-20% over the 1990s decade in which Pima County population grew by ~40%.
- Stray light contribution toward Tucson and Phoenix horizons grew faster.
- Zenith sky now like that of Palomar in the 1970s, when it was considered a premiere dark site. Measurements continue.

Jannuzi serves on Outdoor Lighting Code Committee, involved in intra-agency conference on importance of the night-skies, the AAS committee on this topic, and was involved in the negotiation of the settlement between Pima County and Clear Channel Outdoor (Bill Board lighting will now obey the law.)
KPNO Operations

Operations stretched, but still of high quality.

E.g., First half of FY06, time lost to technical problems:
4m   1.5%        much better than last year
WIYN 3.1%
2.1m  2.9%

Time lost due to weather, approximately 25%.

Road work and other basic infrastructure work completed.
QUOTA and ODI

QUOTA (2006) → “Quad Orthogonal Transfer Array”
8K x 8K prototype to test new CCDs, controllers, software, filters, shutter
Uses 4 OTAs – each is 4Kx4K

ODI (2009) → 32K x 32K Array -- Uses 64 OTAs
Diagonal ~22.5 inches; Corrector ~26 inches diam
The WIYN One Degree Imager

Daniel Harbeck
UW Madison/WIYN
ODI Project Scientist
CCD Controller: NOAO Monsoon

- A controller for ODI:
  - 512 channel controller, 2 sec read out time goal
  - provide guiding capability
  - Capable of reading out an OTA, demonstration of closed-loop guiding pending, but appears feasible.
Interference Test Result

- Quota SDSS r’ filter tested at KPNO 4m + Mosaic
- photometry is well behaved
- some ghosting around bright stars - filter or 4m corrector?
- very flat after polishing, <4 lambda
- 18 lambda dome in first version
Timeline

- August 2/3 2006: ODI PDR
- Fall 2006: Quota commissioning as an static imager
- Winter 2006: Quota commissioning with OTA functionality
- Spring 2007: ODI CDR
- Spring 2007: continued QUOTA upgrades
- Quota becomes the standard imager at WIYN
- Summer 2009: ODI commissioning.

- Initial filter set to be SDSS g’ r’ i’ z’ Y (?)
- KPNO Mosaic camera filters can be used! 20+ filters available.
Summary

• QUOTA/ODI will add unique imaging capabilities to the WIYN partners - including community access through NOAO.
• Focussed on high image quality - active tip/tilt correction over 1° field of view
• QUOTA will become available this winter
• ODI will be available in 3rd Q 2009
  • be prepared to receive 500GBytes of data per night.
  • Users will require data reduction facilities.

• ODI is not just another wide field imager:
  • F/6.3 beam allows effective use of narrow band filters. cf.
    • PanStarrs: f/4, dedicated survey
    • LSST: f/1.25, dedicated survey
    • VISTA: f/3.25
  • ODI is not a survey - time available for individual programs; larger efficiency if coordinated programs can share data sets.
WIYN High-Resolution IR Camera
- PI: Margaret Meixner at STScI
- 2K x 2K HgCdTe array with 0.09”/pixel for WTTM
- Tip/tilt should frequently yield diffraction-limited images
- Just granted ~$400K from STScI DDRF
- NSF ATI proposal being submitted for balance with Ed Churchwell (U Wis), Pat Knezek, and Don Figer as co-I’s.
- NOAO will contribute a monsoon controller and a starter 1K array.
- Plan for a 2-year project.
- The image of NGC7027 from NIRIM on WIYN shows H$_2$ in red, [Fe II] in green, and Br $\gamma$ in blue.
<table>
<thead>
<tr>
<th>WIYN Image (rapid guiding correction)</th>
<th>Hubble Image</th>
</tr>
</thead>
</table>

![Images](image_url)
WIYN 0.9m will have new HDI -- Half Degree Imager
Thanks to the NSF PREST program.
A lot of what we have always done is still very important.

Yunnan 2.4m Mirror after being coated by KPNO
Mayall 4 m Telescope

WIYN 3.5 m
From the first “System” Workshop:

Deep wide-field infrared imaging capability is needed to identify targets for high spatial/spectral resolution instruments on modern 4-10 m telescopes, public and private.

The NEWFIRM program is NOAO’s response to this community priority.
NEWFIRM Program Status

Presented to COMAND
19 September 2006
Ron Probst

David Sprayberry will update you tomorrow....
Bringing arrays coplanar
Telescope preparations

• Kitt Peak engineering group
• Instrument handling and operations
  – Handling/shipping cart
  – New cage bottom
  – He compressor definition, plumbing, wiring, cooling
    (compressors being purchased by University of Maryland)
  – Cass focus prep, cable wrap, mirror cell tapping
• Work formally organized as set of small projects
  – Reviewed weekly by KP Acting Director and staff
• Progress on schedule for January first light
Welcome to the KPNO Projects Meeting Web Pages

Welcome to the KPNO Project Web pages. These pages are always going to be under construction as we work together to use them as a means of communication regarding the many projects we are undertaking together. However, as we start-up this process, the pages will be changing very rapidly and we ask for your patience as we refine the organization and look of the pages. Your suggestions for improvements very welcome. Send suggestions to Buell (jannuzi@noao.edu) and Dan (deklund@noao.edu).

Eventually we will take advantage of the easy editability of these pages to have many people help update and edit the content, but for now, please refrain from editing these web pages until after you have talked to Dan Eklund or Buell Jannuzi for instructions and guidelines on what you may add/edit in terms of content.
Commissioning and SV

- Three, approximately 2 week runs
  - Late January, late March, late May
- January: mostly engineering test, characterization
  - Determine performance figures (March 31 proposal deadline)
  - SV proof-of-concept, test pipeline structures
- March: verify rework, begin SV in earnest
  - Subset of January engineering tests
  - Mostly extragalactic science
- May: pound on SV projects!
  - Galactic and extragalactic targets accessible
SV Requirements

• Test principal system modes to demanding levels
• Deliver data sets that are meaningfully complete, and with both immediate and archival value
• Begin payback to investors
• Advertise instrument capabilities
• Engage internal and external participants
• Meet constraints of time and schedule
SV Projects Strawman Plan

- Orion broadband/narrowband minisurvey, 10 hrs
  - contingent on January engineering tests

- Deep broadband extragalactic field, 30 hrs
  - Field TBD: Groth strip, NDWS Bootes, COSMOS, GOODS

- Hi-z Ly$\alpha$ search, 10 hours
  - Possible fields include LALA field within NDWS Bootes, GOODS, etc..

- $\rho$ Oph J H K$_S$ survey, 8 hrs
  - 1.5 hr/night x 5 nights

- Galactic Ring NB survey, 20 hrs

- Other suggestions, lower priority
  - NDWS Bootes field in H band
  - Deep J, K in ChaMP field
  - Time series search for WD + BD, BD + BD binaries
  - Time series search for Cepheids in M31
<table>
<thead>
<tr>
<th>Project Title</th>
<th>Principal Investigator*</th>
<th>Time Allocation</th>
<th>Brief Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orion A narrowband mini-survey</td>
<td>(Bally)</td>
<td>10 hours January</td>
<td>J H Ks + 1.64 [Fe II], 2.12 H2, 2.17 Br γ in four NEWFIRM pointings</td>
</tr>
<tr>
<td>Deep broadband extragalactic field</td>
<td>Veilleux</td>
<td>30 hours March, May</td>
<td>Deep J, Ks; Two pointings (four, if only one filter used); field TBD; EGS, COSMOS, GOODS?</td>
</tr>
<tr>
<td>Deep Ly α search at z = 7.7</td>
<td>Veilleux</td>
<td>10 hours March, May</td>
<td>One pointing with R=800 filter pair; field TBD, LALA or GOODS</td>
</tr>
<tr>
<td>Broadband survey of rho Oph dark cloud</td>
<td>Probst</td>
<td>8 hours May</td>
<td>J H Ks mosaic of 1 sq deg core of ρ Oph cloud + shallow survey of “streamers”</td>
</tr>
<tr>
<td>Galactic Ring narrowband mini-survey</td>
<td>(Bally)</td>
<td>20 hours May</td>
<td>J H Ks + 1.64 [Fe II], 2.12 H2, 2.17 Br γ in four NEWFIRM pointings, 29.5 &lt; l &lt; 31.5, b =0.0</td>
</tr>
<tr>
<td>Completion of NDWFS Bootes field</td>
<td>(Jannuzi)</td>
<td>15 hours? March, May</td>
<td>Complete the H band data set for this NOAO Survey program. Explore airglow variation effects in H filter.</td>
</tr>
<tr>
<td>Search for WD-BD and BD-BD binaries</td>
<td>Howell</td>
<td>8 hours March or May</td>
<td>Time series data set to detect eclipsing binaries and other variable objects. Choose a convenient field from the Faint Sky Variability Survey.</td>
</tr>
</tbody>
</table>

*PI name in parentheses indicates tentative, subject to change
Forward look to science operations

Three phases
- Science verification observations (Spring 2007)
- Early science projects (Fall 2007)
- Full-up survey science programs (2008?)

How to achieve
- Science value, immediately and in archived data
- Appropriate community involvement
- Phasing with proposal deadlines
- Phasing with instrument performance data
- Segue from KPNO to CTIO
Early science: Fall 2007

- Competitive through *normal* proposal process
- Science driven
- Extra weight for survey style aspects
  - Significant, different primary and ancillary science
  - Potential long term value of archived data
  - Proof of concept for larger efforts
- Only limited performance info at proposal time
- Announce instrument configurations in advance
  - Narrowband filter availability
- Pre-assign significant blocks of telescope time
  - Two or three bright runs
- PI-style execution—no queue observing
Survey science: Spring 2008(?) +

- Competitive through *survey* proposal process
- Balance scale and creativity
  - Complement UKIDSS, VISTA, Gemini approaches
  - Appropriate to US community and system of facilities
- Verification science performance available
- Announce instrument configurations in advance
- Pre-assign significant blocks of telescope time
- Potential for team-supported queue observing
- Proposals can leverage segue from KPNO to CTIO
- **Probably needs significant expansion of 4-m time committed for survey programs**
Constraints for KPNO of the future:

1.) Must respect our obligations to the Tohono O’odham. Respect for l’olkam, the Nation, and its people.
Constraints for KPNO of the future:

2.) Will have to exist within the constraints of the NSF’s implementation plan for whatever the Senior Review Recommends.
Constraints for KPNO of the future:

3.) Must honor existing agreements or permanently weaken the ability of KPNO and NOAO to create meaningful partnerships required for GSMT, LST, and other facilities of the future.

(WIYN, WIYN 0.9m, “ET”, IRMOS, FLAMINGOS, Maryland, Clemson …)

Several current budget subsidies also depend on partnerships (e.g. $50K a year from WIYN to help cover cost of Mechanical Engineer are going away by 2008, and will cause increase in operation costs).
Constraints for KPNO of the future:

4.) For at least the next five years, will have a less capable partner in NOAO than we have had in the past.

Even if we are presented with no cuts, the flat funding profile anticipated before the senior review is taking us to a less capable parent organization.

MIP, DPP, and other divisions of NOAO that provide fractional FTEs, unique skills, might not be as available, increasing KPNO’s cost-per-task.
Constraints for KPNO of the future:

5.) Continue to provide joint infrastructure for tenant observatories.

Columbia, Dartmouth, University of Michigan, Ohio State, Ohio U., (MDM, 2 telescopes); WIYN 3.5m, WIYN 0.9m (10 partners); Calypso; Western Kentucky University, PSI, Villanova U., Fayetteville Statue U., South Carolina State U., RCT; NSO (3); NRAO; Case Western; University of Arizona, Steward Observatory (4); SARA, Florida Institute of Technology, East Tennessee State, Florida International, U. of Georgia, Valdosta State U., and Clemson U.; WHAM; public observing program (4), and maybe VERITAS.