SOAR as part of the O/IR "System"

R. Chris Smith

16-19 May 2011, SOAR Sci Symposium, Brazil

What is a “System”

- Dictionary definition: System
  - An assemblage or combination of things or parts forming a complex or unitary whole

- In Astronomy
  - The combination of public and private telescopes and instrumentation that provides access to a wide range of capabilities to enable the broadest possible spectrum of scientific investigation
  - Includes balance over both *apertures* and *instrumentation*to meet the needs of the particular astronomical community

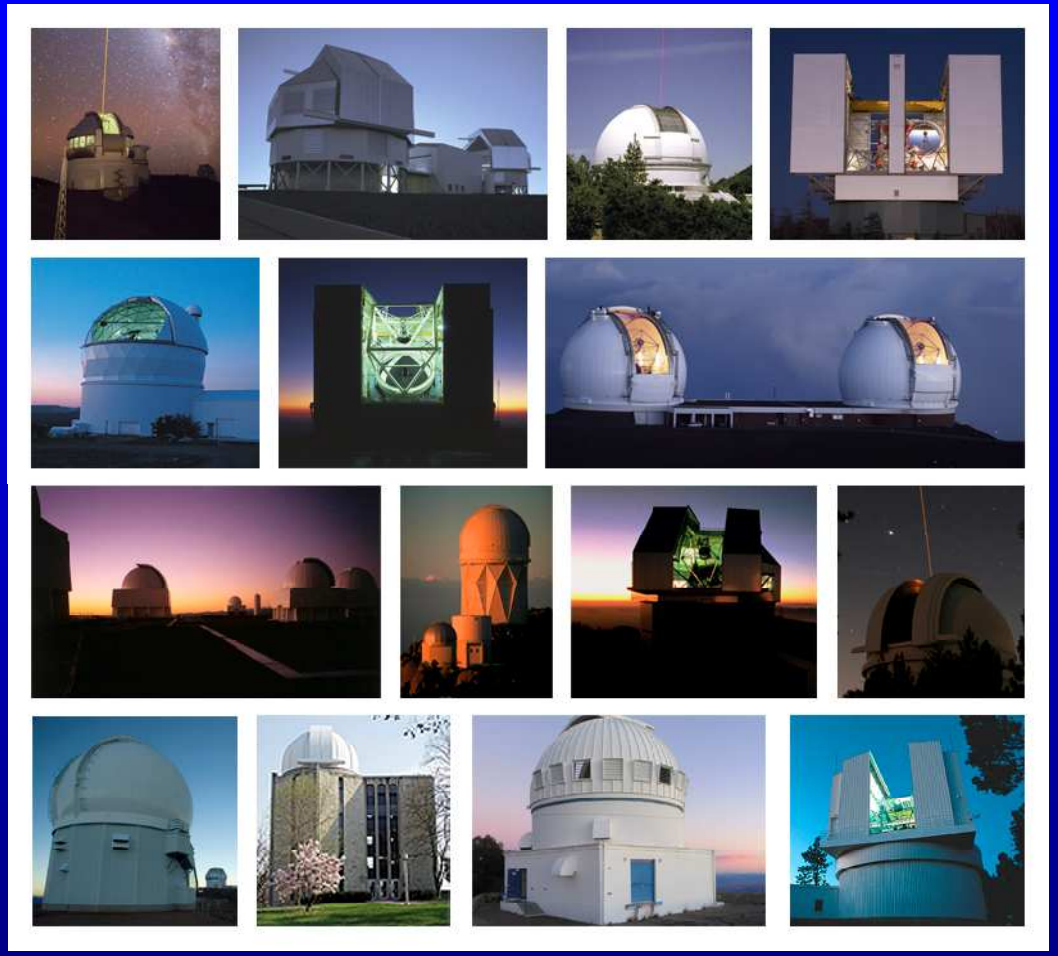
Example

U.S. Ground-basedOptical-Infrared System

Large Facilities in the OIR System

GTC (via Florida)
Keck (1, 2)
Large Binocular Telescope
SALT (through US partners)
Hobby-Eberly
Gemini (North, South)
Magellan (Baade, Clay)
MMT

Palomar (Hale)
SOAR
NOAO (Mayall, Blanco)
Discovery Channel (2012)
AEOS
WIYN
ARC
Shane
IRTF



LSST, GSMT are future flagship System facilities

Focus on Southern Hemisphere

- Large System facilities available through NOAO
  - Gemini South 8m
  - Magellan 6.5m x 2
  - SOAR 4.1m
  - Blanco 4m
- Smaller System facilities
  - CTIO 1.5m, 1.3m, 1.0m, 0.9m
  - Run in collaboration with “SMARTS” Consortium
    - Small & Medium Aperture Research Telescope System

All facilities available, either through partnerships, time trades (guaranteed time) or “open skies”

Optimizing the System ~1990s

- With given apertures, need to carefully consider how to optimize instrumentation capabilities across facilities

- In ~1993, with Gemini & SOAR on the horizon, CTIO tried to develop an optimized plan for local large apertures (Blanco, Gemini, & SOAR)
  - Blanco strengths: wide field, prime focus access
  - SOAR strengths: narrow field, high image IQ, blue response
  - Gemini strengths: narrow field, high image IQ, red response, depth

Optimization Plan ~2000

- Blanco
  - MOSAIC II, wide field optical imager
  - ISPI, wide field IR imager
  - Hydra, wide field fiber spectrograph
  - RC Spectrograph (only until Goodman completed)
  - Echelle Spectrograph decommissioned
- SOAR
  - 1st generation instrument suite taking advantage of high IQ (SOI, OSIRIS, Goodman, Spartan, SIFS)
- Gemini
  - Instrument suite taking advantage of IR response and (of course) large aperture (inc. GMOS)

Optimization @ Small Apertures

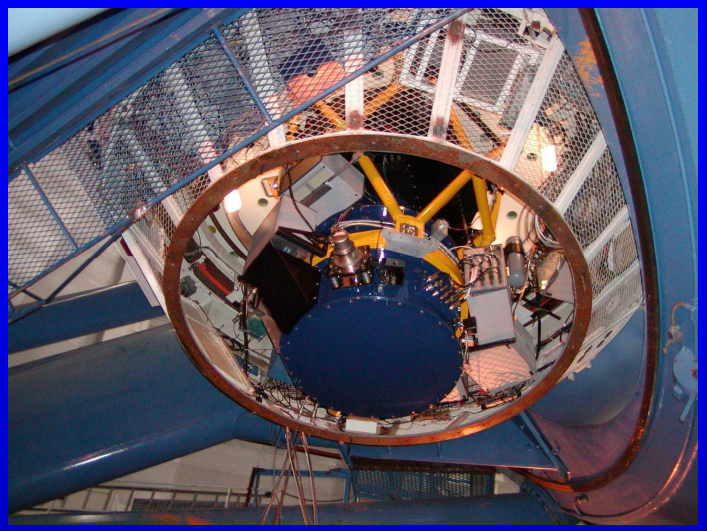
- SMARTS:
  - Consortium of partners, OPEN to new members
  - Funding: diverse sources (Univs, Grants, Govts, etc)

- SMARTS optimization: no instrument changes
  - CTIO 1.5m: Low+High Resspectrographs, Service
    - Including CHIRON, R~80,000, range 420-870 nm
  - CTIO 1.3m: Simultaneous Opt/IR imager, Service Obs
  - CTIO 1.0m: Optical Imager, Classical Obs
  - CTIO 0.9m: Optical Imager, ½ Service, ½ Classical

Ongoing Optimization ~2012

- Blanco
  - Wider field IR capability: NEWFIRM
  - Wider field Optical capability: DECam
  - Improved wide field fiber spectroscopy: Hydra upgrade
  - Additional single object spectroscopy (optical, IR?)
- SOAR
  - Higher resolution optical imaging (SAM AO)
  - High resolution spectroscopy (STELLES)
  - Additional capabilities (Goodman, BTFI, etc.)
- Gemini
  - Higher resolution IR imaging (NICI, MCAO)

NEWFIRM



– The NOAO Extremely Wide Field IRImager
  - Project Scientist: Ron Probst

– An imager with…
  - Wide FOV: 28x28 arcmin
  - Near IR sensitivity: 1-2.5 microns, high throughput & QE
  - Sub-arcsecond resolution (0.4 arcsec/pixel)
  - Software support: both Pipeline reduction and IRAF package

– Moves back and forth from KPNO & CTIO

NEWFIRM

– The NOAO I

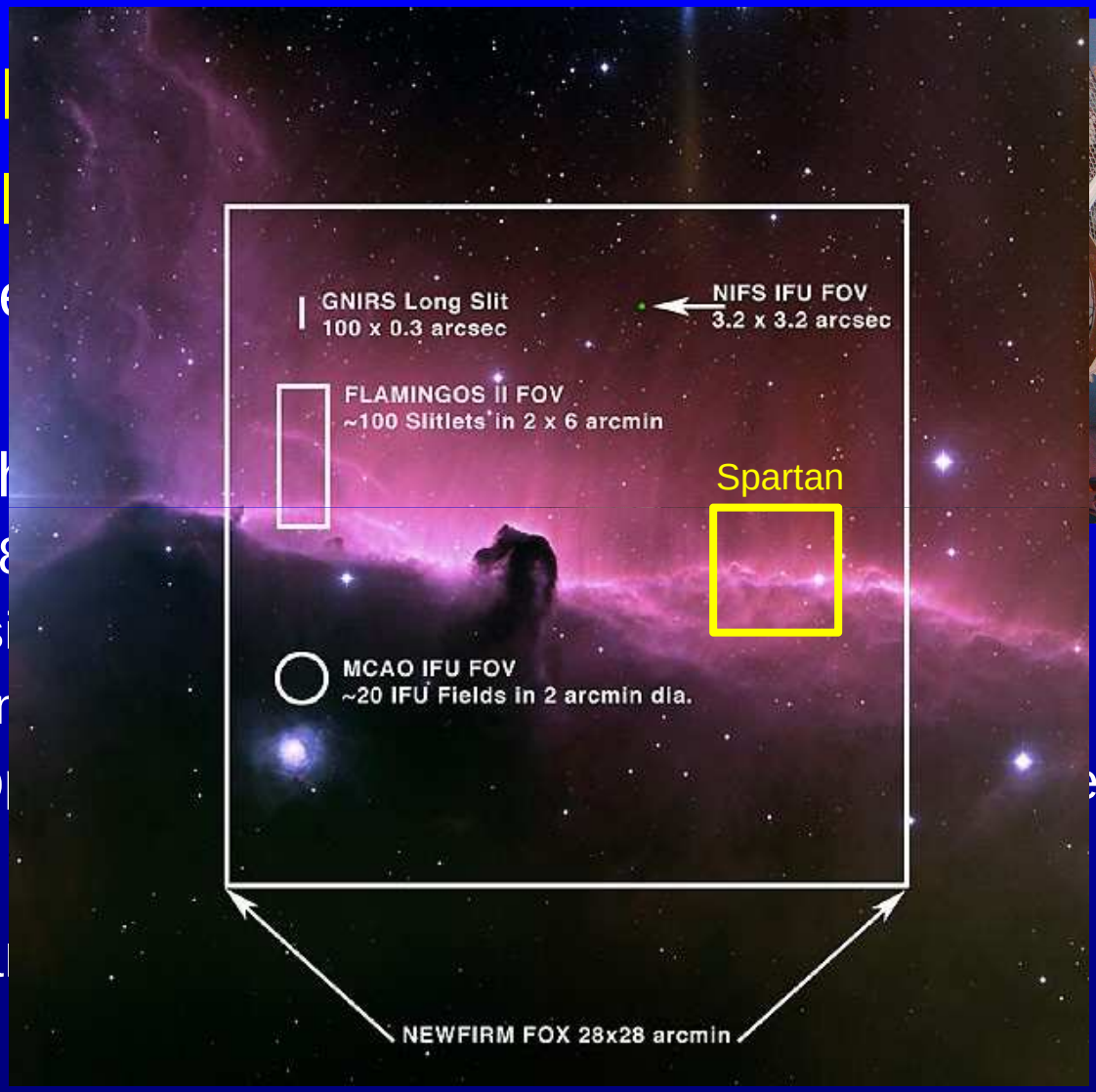
Wide Field IRI

- Project Scie

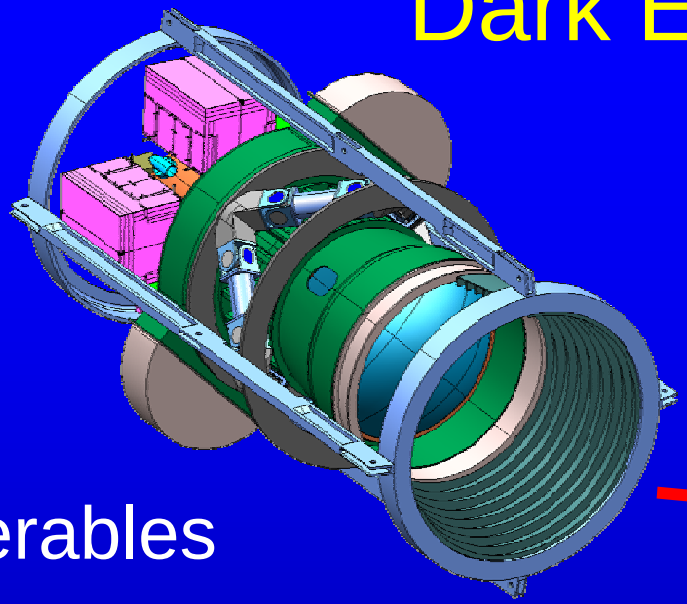
– An imager with

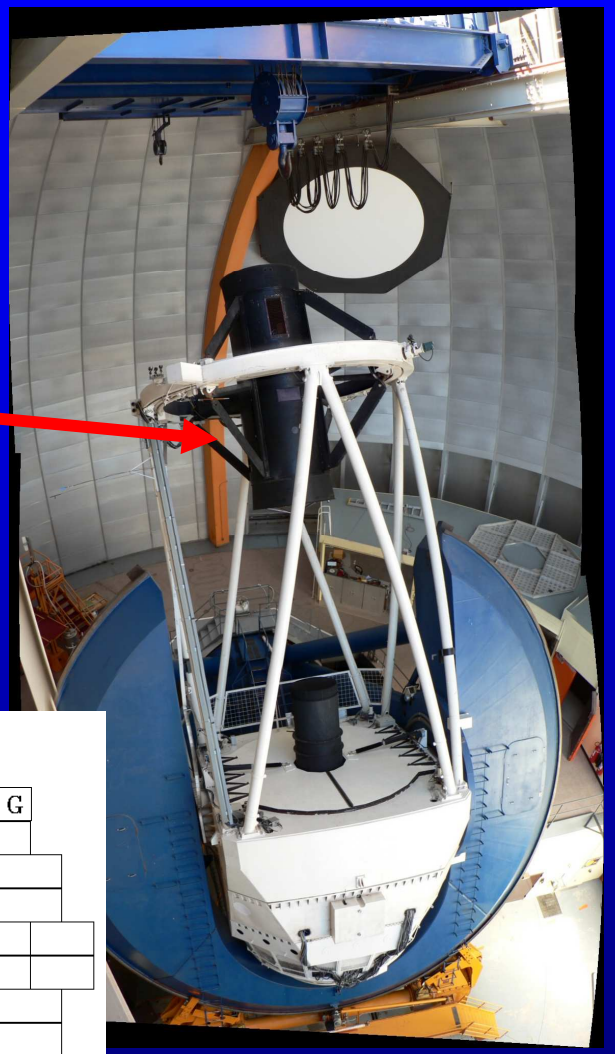
- Wide FOV: 28
- Near IR sensi
- Sub-arcsecor
- Software supp

– Moves back a

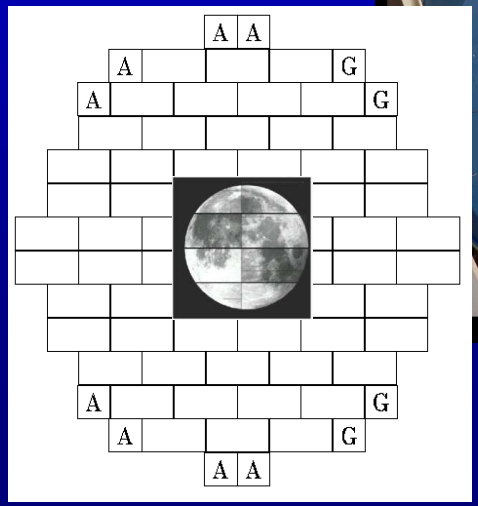


Dark Energy Camera





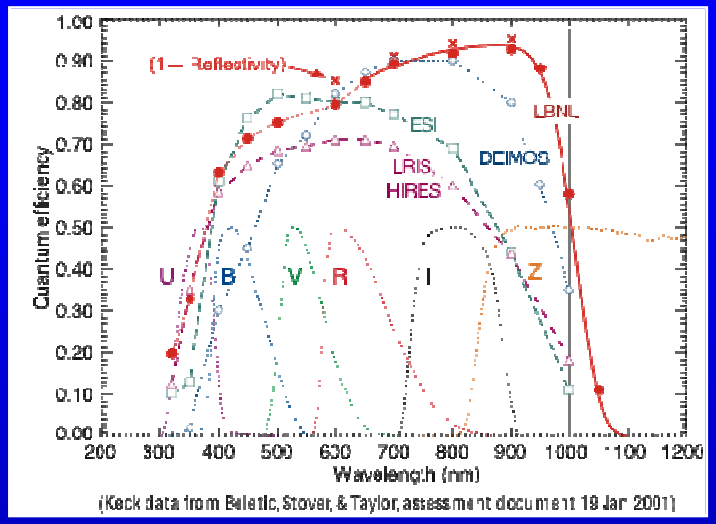
- Two Deliverables
  - DECam imager
    - 570 megapixel camera, 62 2Kx4K + 12 2Kx2K
    - 2.2 deg FOV (diam)
    - grizy filters
  - Community Pipeline

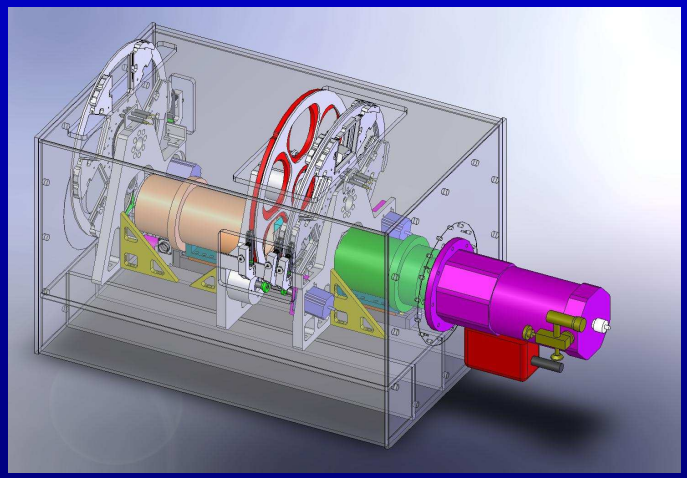


ReSTAR

Hydra+ & COSMOS

Optical Spectrographs





- Hydra+
- New CCD+Controller
- Red Sensitive CCD
- Planned Nod & Shuffle mode

- COSMOS
- Partnership with OSU
- Imaging optical spectrometer
- $R \leq 3000$, 10 arcmin FOV, MOS
- 5 gratings at once (RC: 1)
- Throughput: ~ 40% (RC ~ 17%)
- Planned Nod & Shuffle in Red
- First light (Blanco): 2012

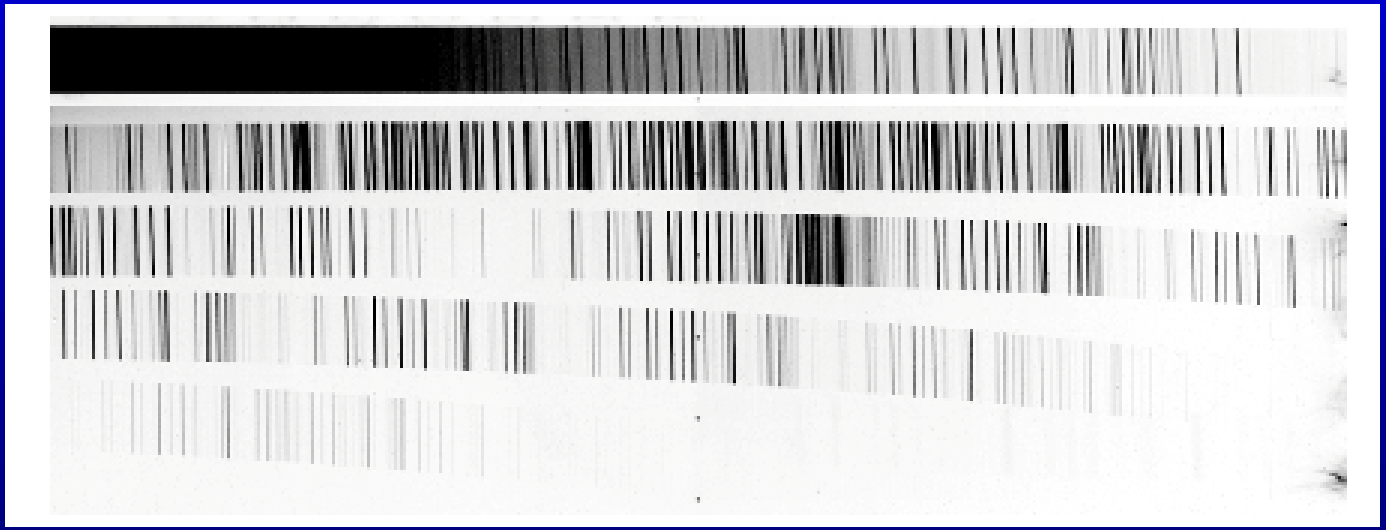
ReSTAR

TripleSpec

New near-IR spectrometer

- *R*~ 3000 (1” slit), 0.9 <λ< 2.4 micron spectrograph
- Fixed-format, cross-dispersed, 5 orders at once
- Partnership with Cornell University, delivery goal: 2014
  - Cornell built Hale 200-in version, this is copy

Sky spectrum, TripleSpec, Palomar Hale 200-in



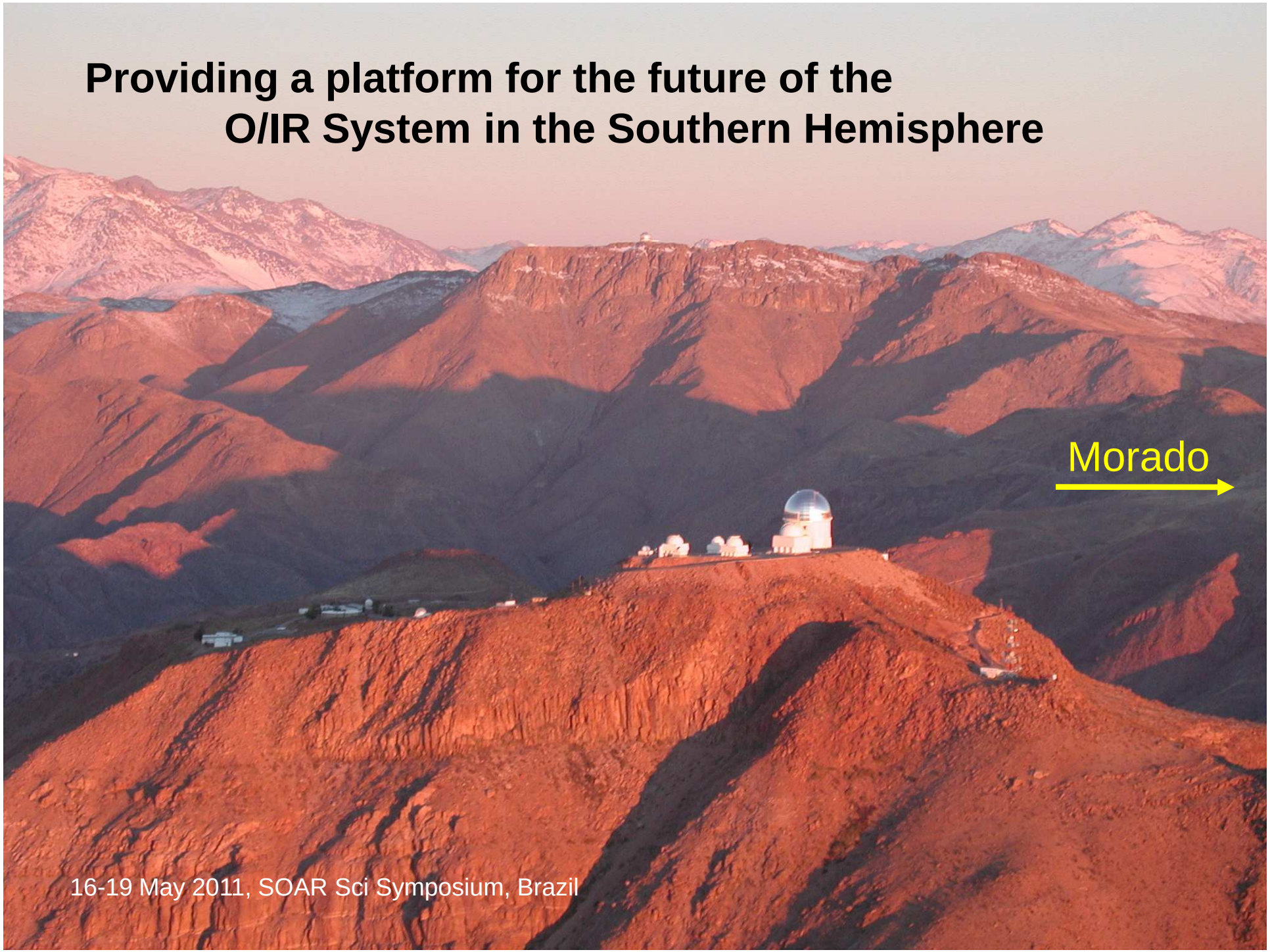
Future: LSST

- Preparations
  - First dedicated NOAO/LSST staff member on the ground in La Serena (Jeff Barr)
  - Telescope controls team: finishing Blanco, upgrading SOAR, and preparing LSST system
  - Site preparation
    - Taking mountaintop off now…

RE-Optimization ~2020

- LSST timeline
  - "Construction" [funding] starting in ~2014
  - First light in ~2018
  - Full operations in ~2020
- Need to completely rethink the balance of instrumentation on across 4 large apertures
- Need to address the new science areas
  - Particularly TIME DOMAIN
  - SURVEY followup projects
- Work together with partners to achieve optimization across various "Systems"

Providing a platform for the future of the O/IR System in the Southern Hemisphere



16-19 May 2011, SOAR Sci Symposium, Brazil