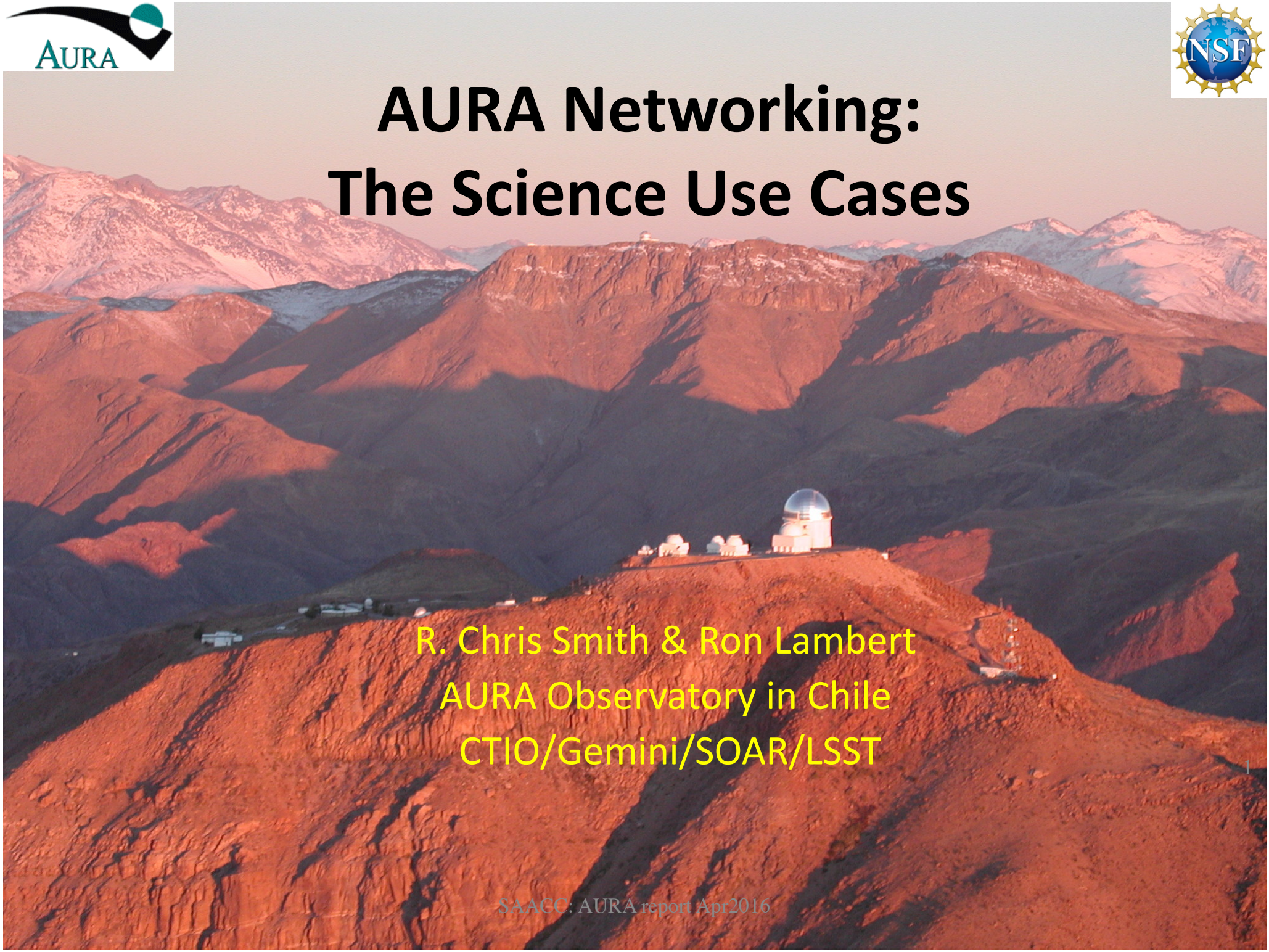

AURA Networking: The Science Use Cases

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AURA Observatory in Chile
CTIO/Gemini/SOAR/LSST

AURA Backbone Users & Use

- Large users
  - NOAO/CTIO (DECam!)
  - Gemini (Remote ops!)
  - SOAR (Remote observing)
  - **LSST (under construction)**
  - Carnegie (La Serena)
  - NRAO/ALMA (Santiago)
  - GMT (pending)
- Smaller Users
  - SMARTS
  - PROMPT (x8 now)
  - GONG
  - ALO
  - WHAM
  - LCOGTN
  - KASI/KMTnet
  - ASAS-SN
  - mEarth (Harvard)
  - “EvryScope”/Prompt
  - T80S (Brazil)

Key Use Case #1: Data Transfer

- Big Cameras, Big Data
  - NOW: DECam producing ~500Gb to 1TB/night
  - Near-real time reduction and analysis
    - Has moved from “goal” to “requirement”
    - Science example: Gravity Wave outburst detection
  - FUTURE: LSST!
- Small telescopes, Big Data
  - KASI/KMTnet 1.6m w/ four 9Kx9K CCDs
  - Evryscope & ASAS-SN covering whole sky with multiple mega-pixel cameras

Key Use Case #2: Remote Observing

- SOAR
  - MSU, UNC are almost always remote
  - Brazilian and NOAO remote observations becoming more common
- Gemini
  - Over-the-shoulder observing offered
  - Mtn-base critical: no one in dome at night
- CTIO
  - DECam remote observing under development
- SARA
  - Fully remote: mtn to user critical

Key Use Case #3: Robotic Telescopes

- Network connection critical
  - PROMPT has been doing it for years
  - LCOGTN with active (every 15 min) rescheduling
  - ASAS-SN with rapid alerts of SNe discovered

- Likely to become more common with LSST follow-up opportunities

Key Use Case #4: Coordination

- **Real-time** communication and coordination is critical in transient follow-up
  - Target of Opportunity observing (ToO)
  - E.g., Gemini can get on target within minutes, and data is available in archive within minutes of being taken
- **Scientific importance** growing for all observatories
  - Opportunities for Gravity Wave follow-up
  - "Uncommon" transients identified by LSST

Key Use Case #5: Data Access

- Archives are the starting point for a growing fraction astronomical research

- Key assets in Chile
  - ALMA archives for users
    - Chilean site under consideration
  - LSST Data Access Center
    - To host data products in La Serena

Key Use Case #6: Distributed Processing & Analysis

- ALMA
  - Analysis @ JAO, distribution to ARCs, advanced data products produced, sent back to JAO
- DES
  - Basic analysis at NCSA, advanced data products produced in Brazil, sent back to NCSA
- LSST
  - Data sent to NCSA (US) and IN2P3 (France)
  - Joint analysis, results redistributed

The SCIENCE: GW170817

- AUGUST 17, 2017
  - Detection by LIGO & VIRGO @ 12:41 UT
  - Detection by Fermi Gamma-ray Space Telescope, then SWIFT

- Worldwide alert for optical/IR/radio followup
- Chilean facilities led discovery and followup
  - IN REAL TIME

GW170817

- Multiple detections at AURA
  - PROMPT5 @ CTIO, 23:46 UT
  - DECam @ CTIO, 00:05 UT
  - LCOGT @ CTIO??, 00:15 UT
- Extensive immediate follow up
  - Gemini
  - SOAR
  - Photometry with telescopes above

GW170817

- Discovery made possible by NETWORKS
  - Alerts going out, being received
  - Remote coordination of observations
  - Immediate data transfer & reduction at remote sites
  - Remote coordination of follow-ups
- Of course, the HUMAN networks are key
  - High-quality connectivity isn't just about data, it's about linking scientists all of the world in real time to achieve "the impossible"