WFMOS as a Pathfinder into the Future of Astronomy

Doug Simons

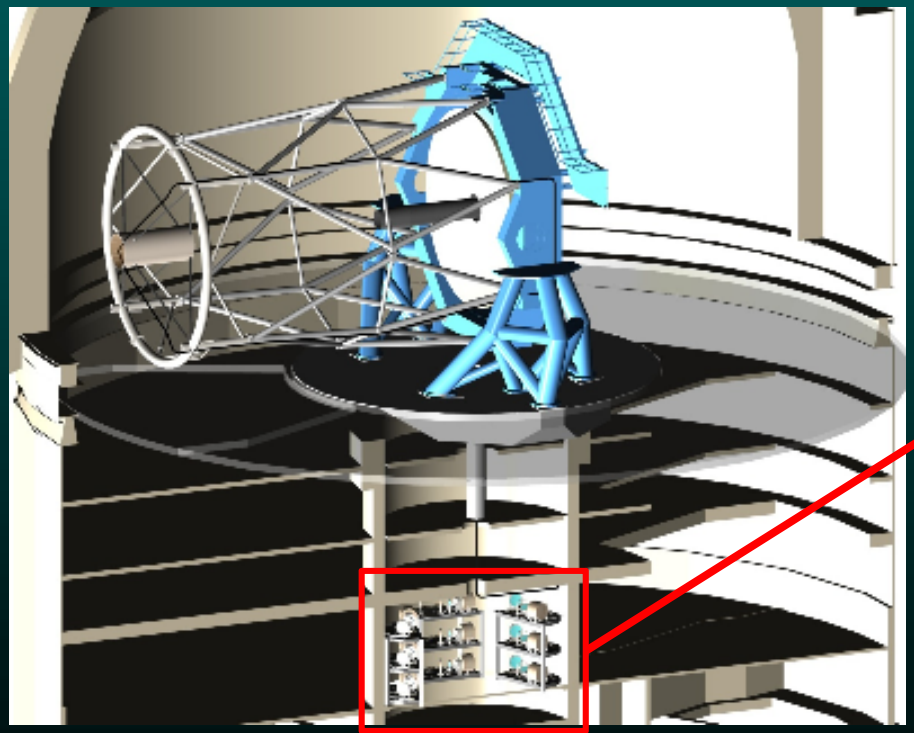
Director, Gem[illegible] Observatory

Many Slides, One "Story"

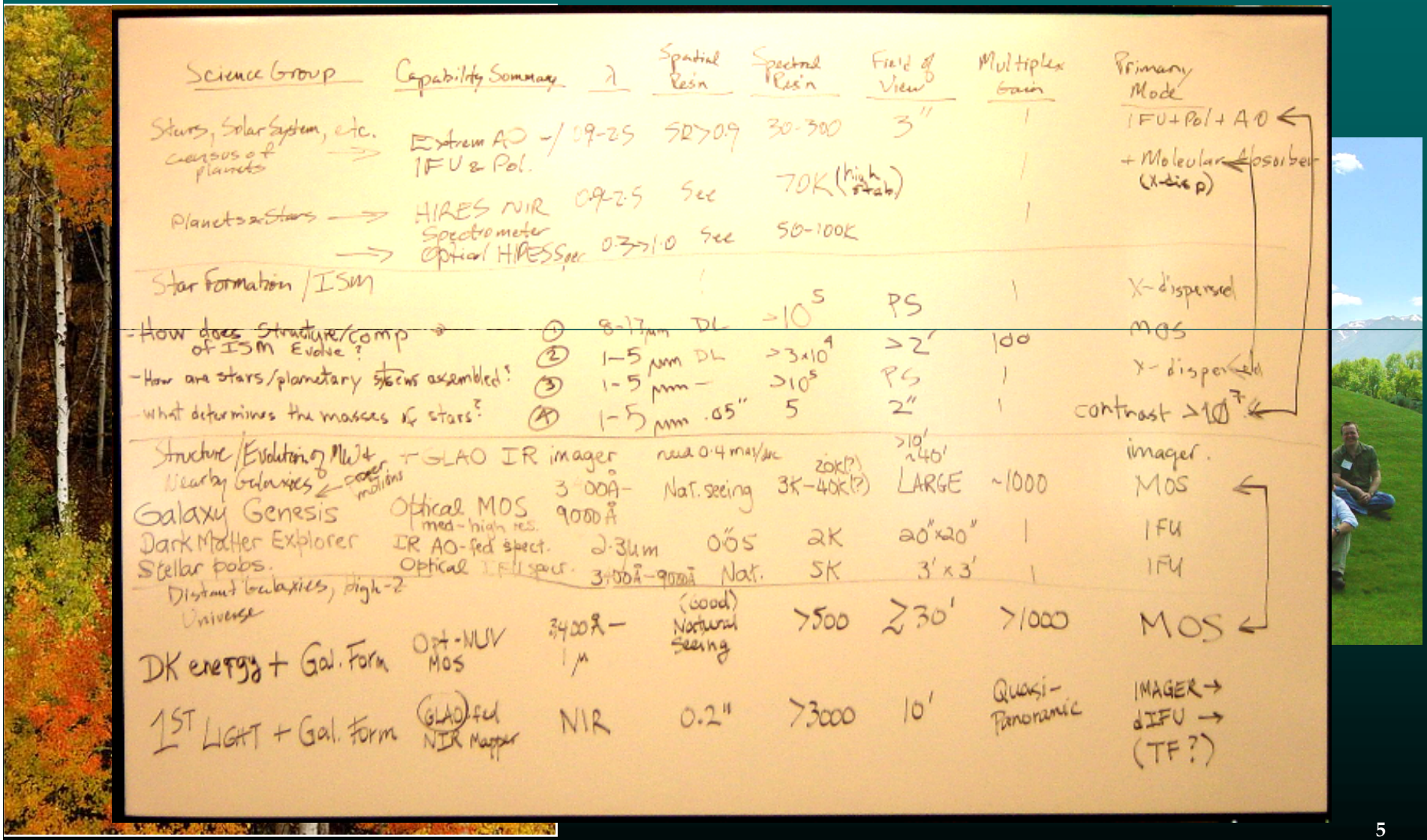
The Start of WFMOS

K.A.O.S.

Kilo-Aperture Optical Spectrograph



Onward to Aspen
(June 2003)



"Scientific Horizons…"

- **Matter**
  - How do
  - What is t
  - What is t
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- **Energy**
  - What is
  - How did
- **Life**
  - How con
    planets?
  - How do
  - How do
    blocks of

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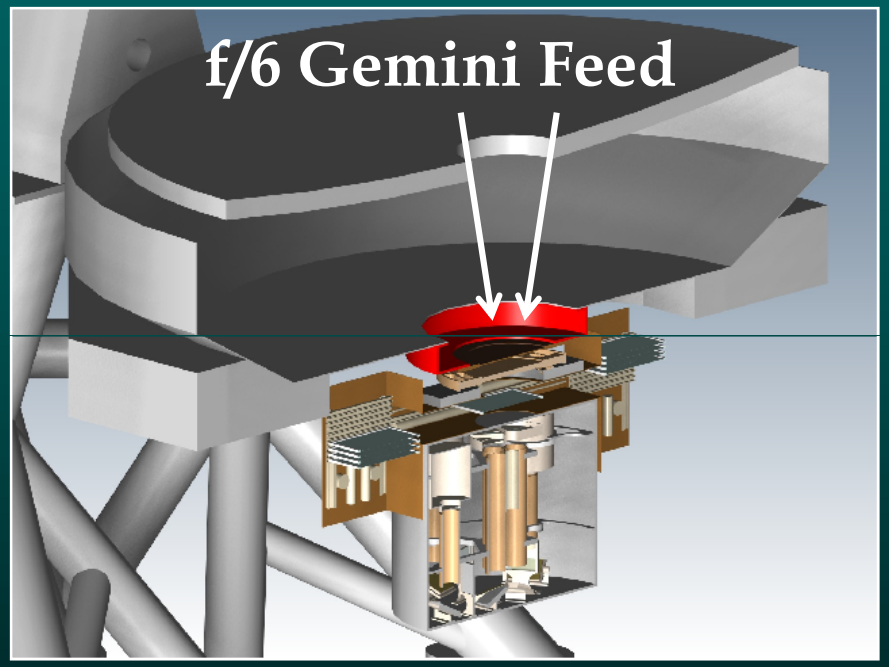
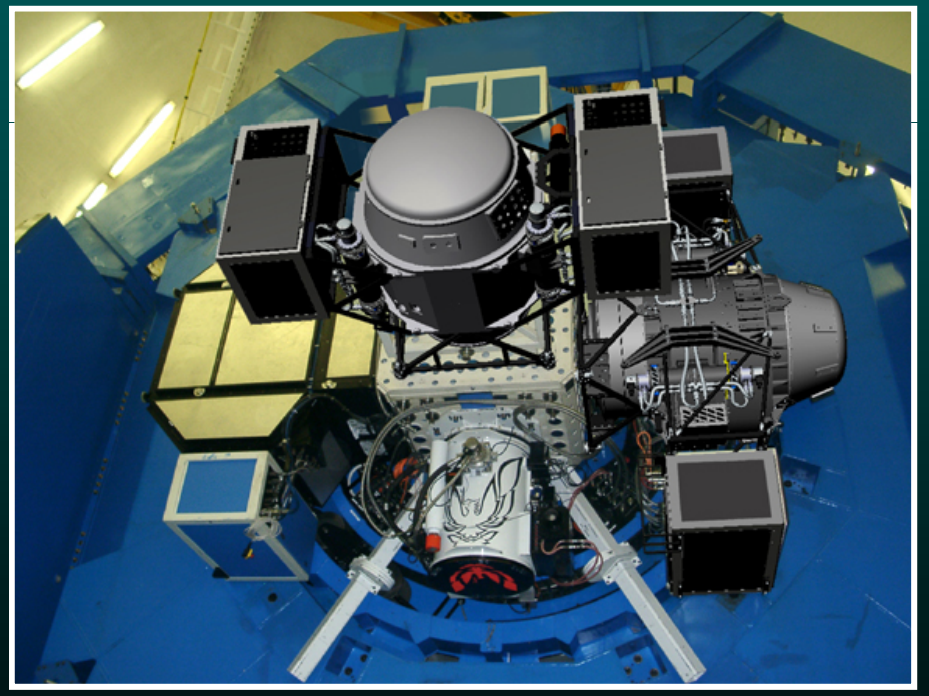
nical building

New Instrument Concepts Sprout from Aspen…

Wide Field Optical MOS Concept





HRNIRS Concept on up-looking port

First Aspen Cost Summary

New Instruments	Total Estimated Cost (USD)
Extreme AO Coronagraph	12,961,313
High Resolution NIR Spectrometer	17,260,000
High Resolution Optical Spectrometer	8,495,000
High Resolution MIR Spectrometer	20,481,250
MCAO fed NIR MOS	24,303,750
Wide Field Optical MOS	31,159,375
AO-fed NIR Spectrometer	14,876,625
IFU Optical Spectrometer	14,000,000
GLAO NIR Imager	14,139,375
GLAO NIR Spectrometer	21,592,500
Wide Field Fiber-Fed Optical MOS	31,977,125
New Facilities	
f/6 Telescope Configuration (1 telescope)	33,035,625
GLAO System including Adaptive Secondary	23,535,960

The WFMOS Breakthrough…

An important meal at Hale Pohaku

Assembling the Many Pieces of the WFMOS "Puzzle"

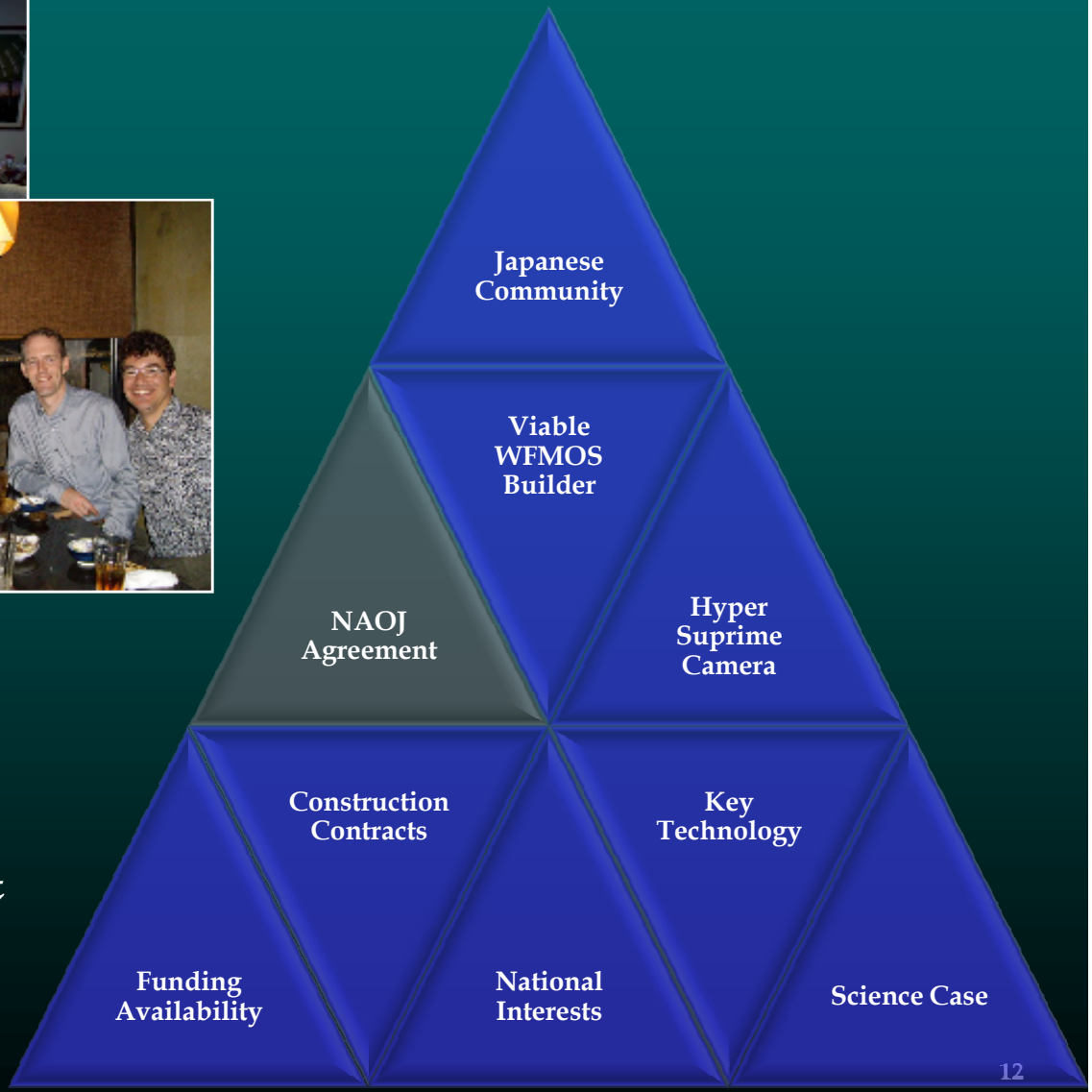
Assembling the Many Pieces of the WFMOS "Puzzle"

Chris Packham visited Tohoku, NAOJ, Tokyo, ISAS/JAXA, Hiroshima, Kobe, Kyoto to discuss Subaru/Gemini collaboration…

Attended 3 Annual Subaru User's Meetings

Assembling the Many Pieces of the WFMOS "Puzzle"

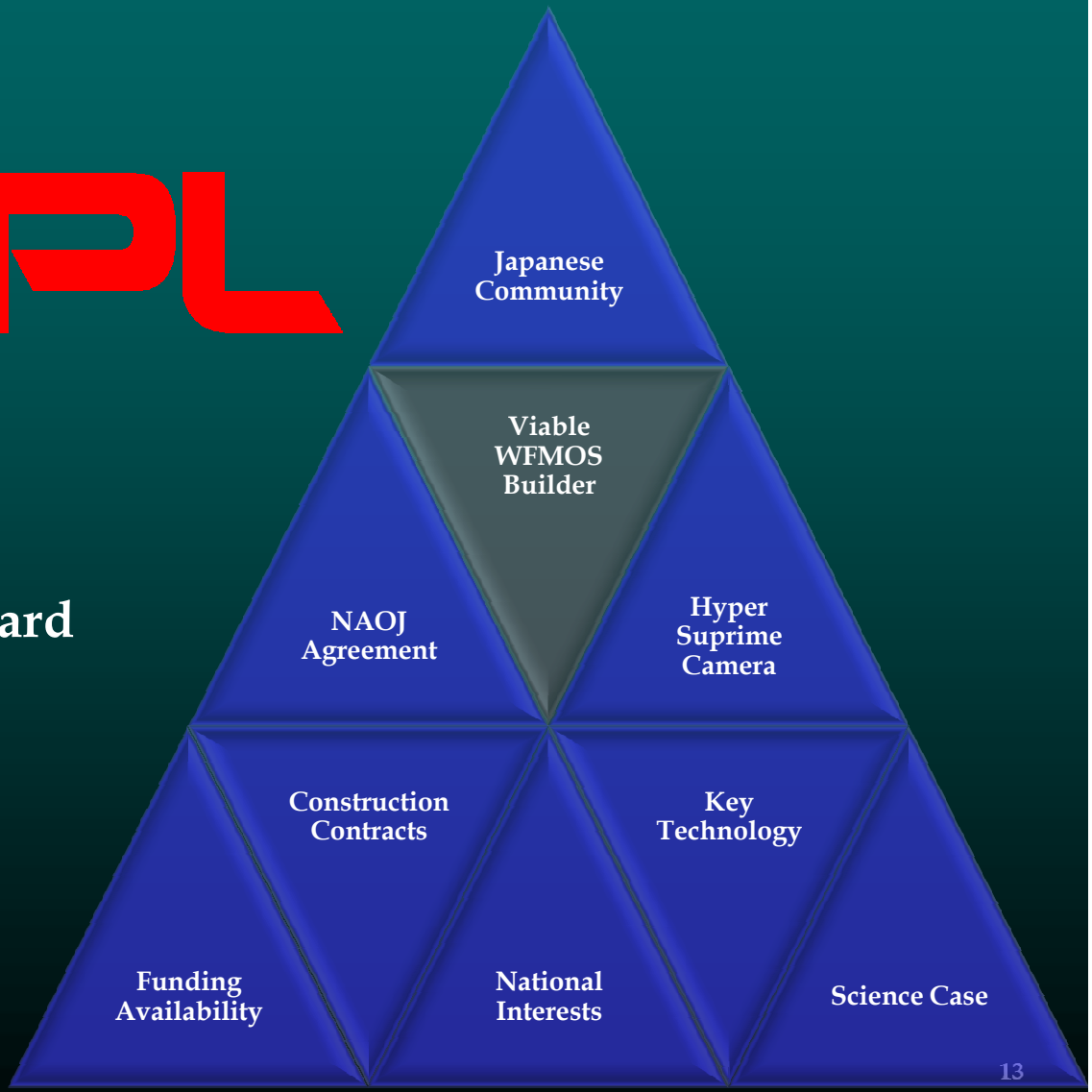
Over a dozen meetings in Hilo & Tokyo to negotiate the shared development/use of WFMOS…



Assembling the Many Pieces of the WFMOS "Puzzle"

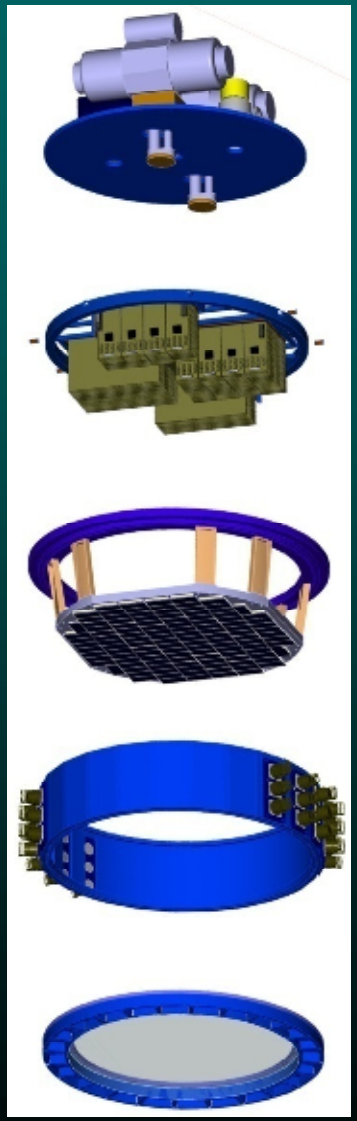
JPL & AAO Compete

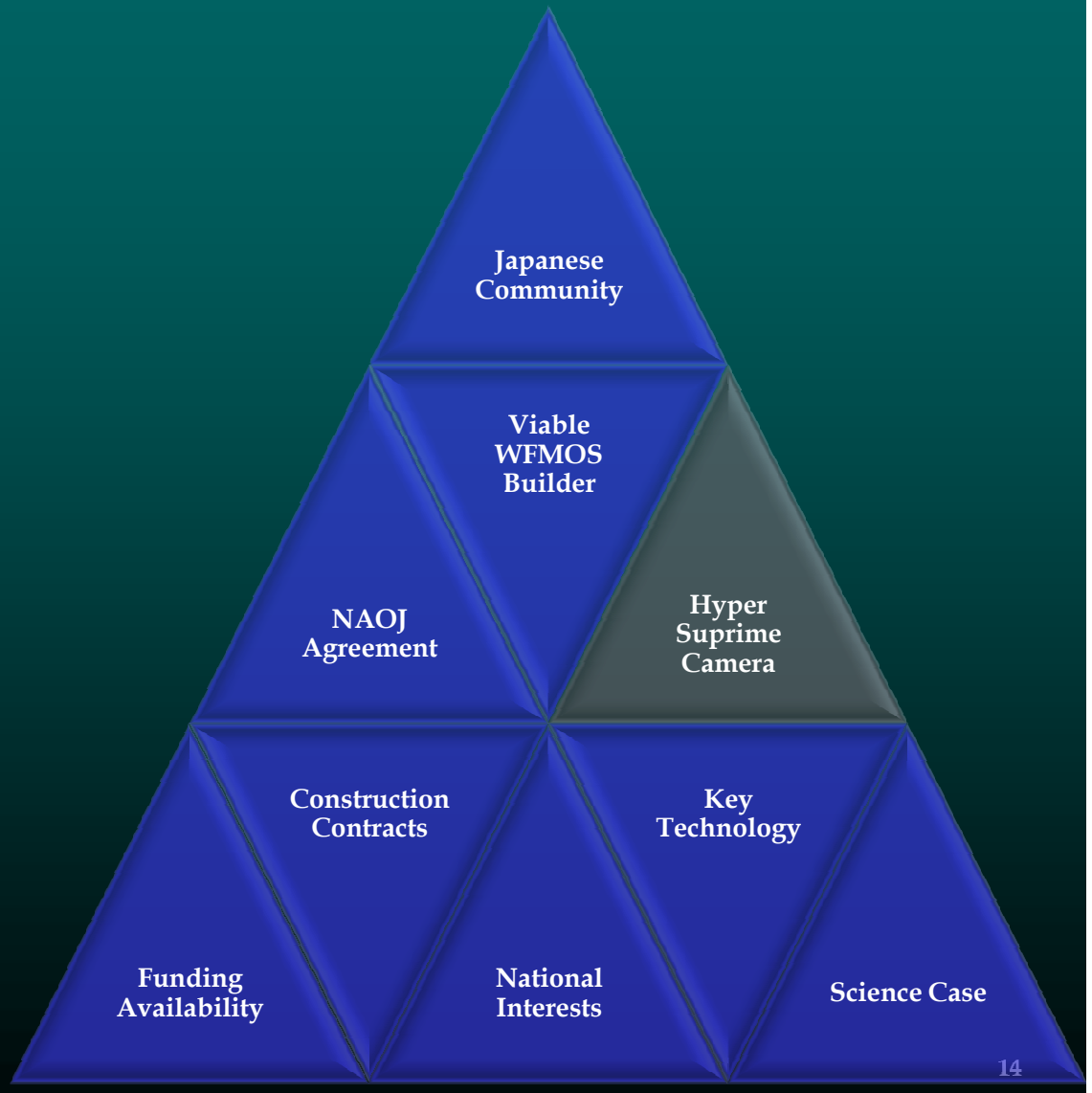
Recommend Going Forward with JPL Led Team



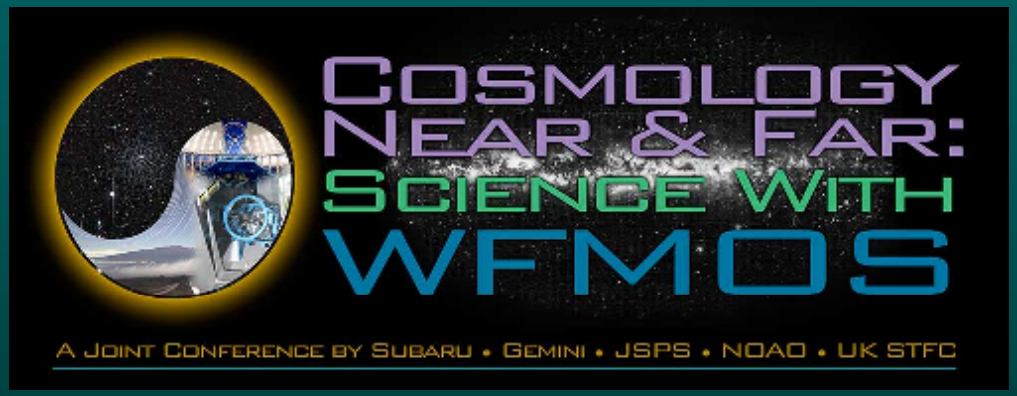
Assembling the Many Pieces of the WFMOS "Puzzle"

Hyper Suprime Camera Assembly

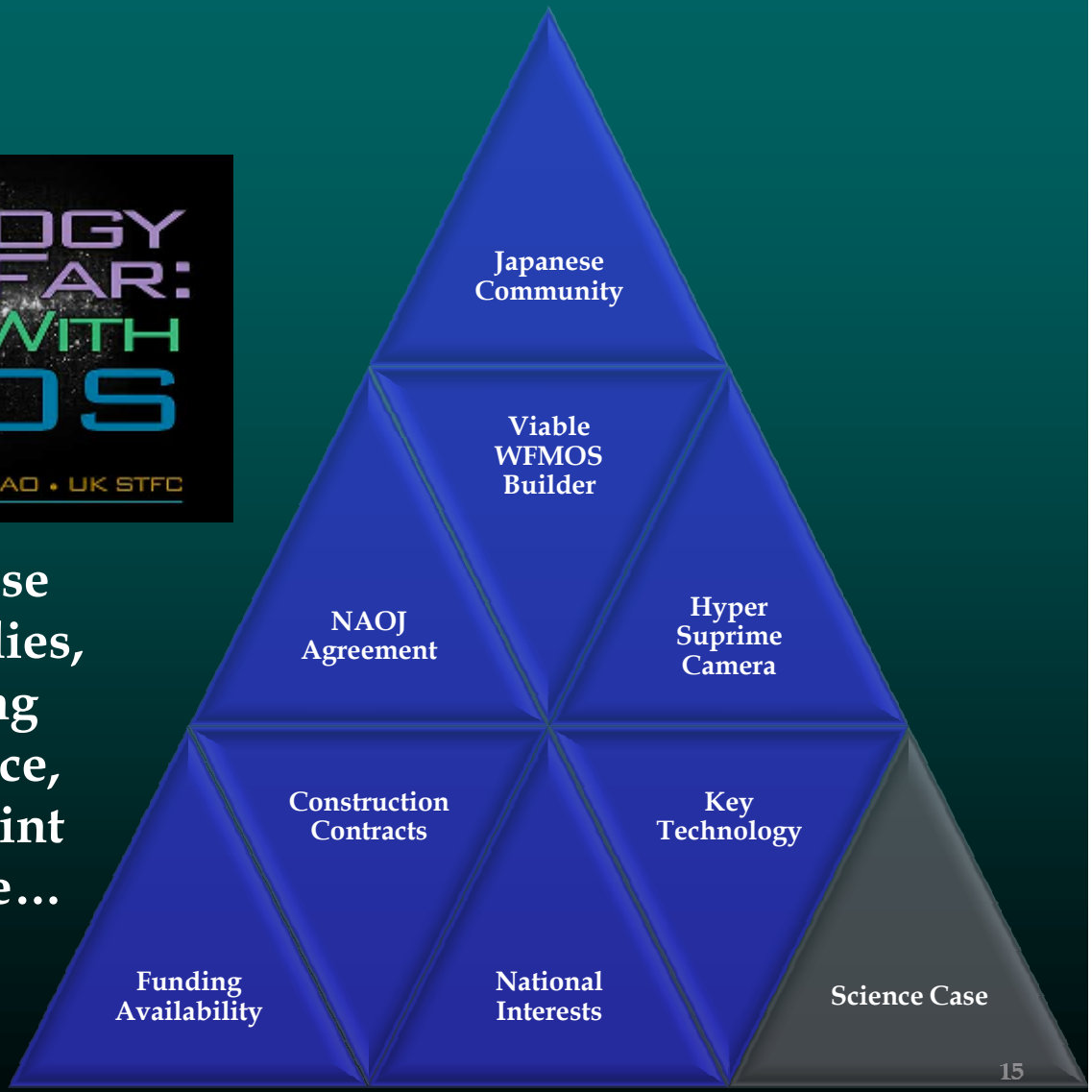




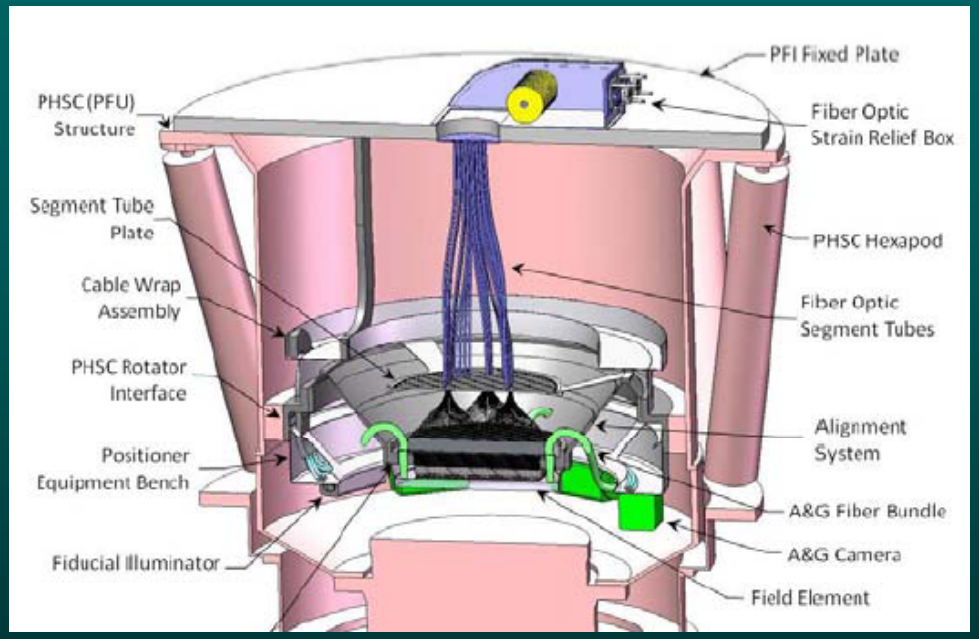
Assembling the Many Pieces of the WFMOS "Puzzle"



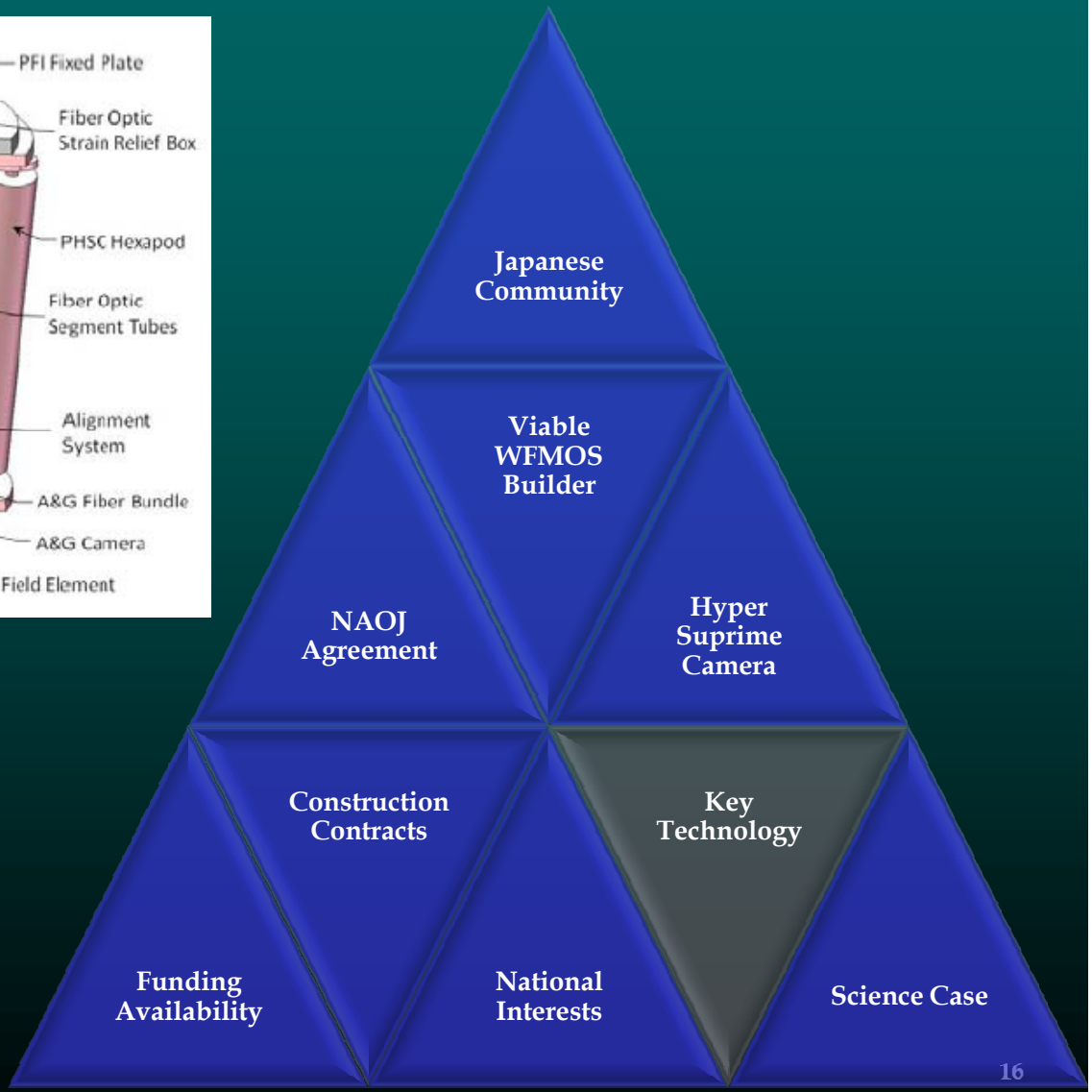
Robust WFMOS science case developed via 2 funded studies, 2009 Subaru User's Meeting dedicated to WFMOS science, and 2008 Gemini/Subaru joint WFMOS science conference…



Assembling the Many Pieces of the WFMOS "Puzzle"



Fiber Positioner



Assembling the Many Pieces of the WFMOS "Puzzle"

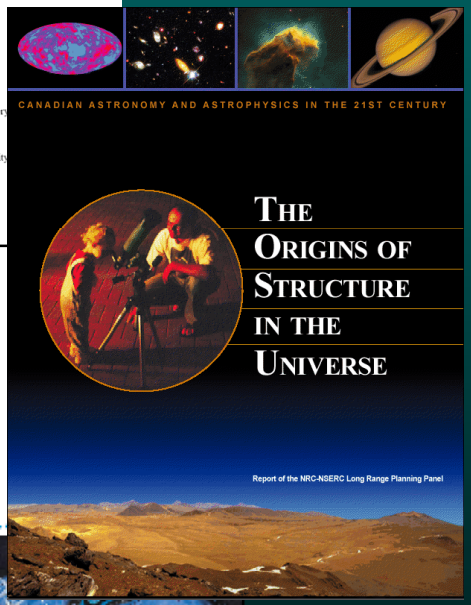

Final Report of the Committee
on
Access to Large Telescopes for Astronomical Instruction and Research
(ALTAIR)[1]

Submitted March 9, 2009

Committee Members
Daniel Eisenstein, University of Arizona
Heidi Hammel, Space Science Institute
Lynne Hillenbrand, California Institute of Technology
Christopher Johns-Krull, Rice University
David Koo, University of California at Santa Cruz
Nancy Levenson, University of Kentucky
Tom Matheson, National Optical Astronomy Observatory
Andrew McWilliam, Carnegie Observatories
John Monnier, University of Michigan
Joan Najita, (vice-chair) National Optical Astronomy Observatory
Lisa Prato, Lowell Observatory
Larry Ramsey, (chair) Penn State University
Seth Redfield, University of Texas at Austin, Wesleyan University
Tom Soifer, Spitzer Science Center

Liaisons and Observers
Tom Barnes, NSF observer
Michael Briley, NSF observer

Astro 2010



Canada

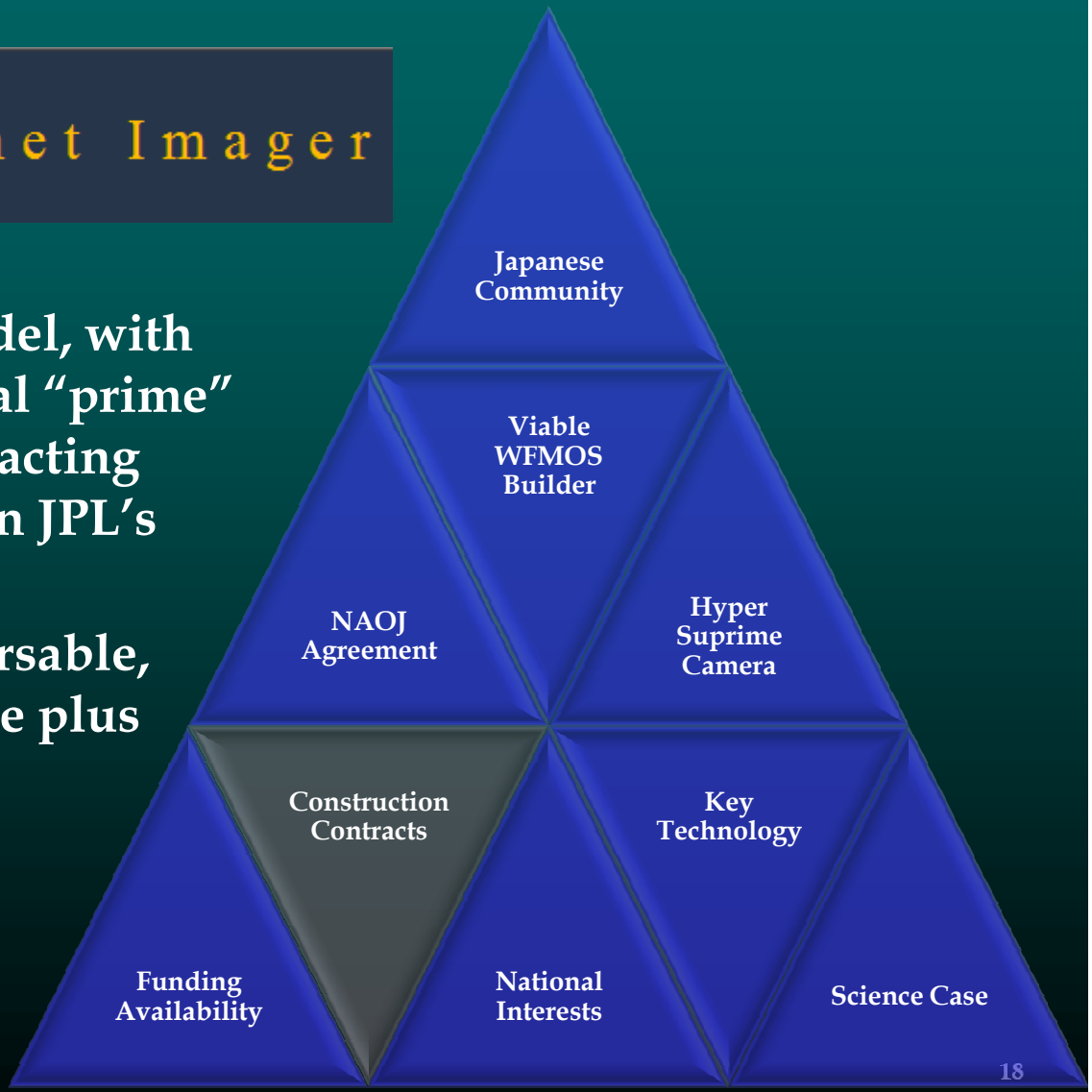
UK/Europe


Australia

Assembling the Many Pieces of the WFMOS "Puzzle"

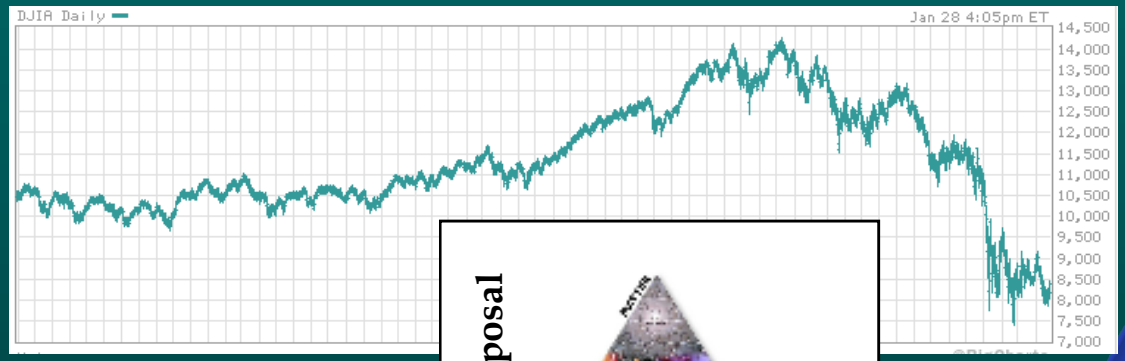
Gemini Planet Imager

- JPL proposing similar arrangement to GPI model, with JPL acting as a functional "prime" and Gemini direct contracting with other institutions in JPL's team
- JPL portion cost reimbursable, remainder are fixed price plus shared risk contingency

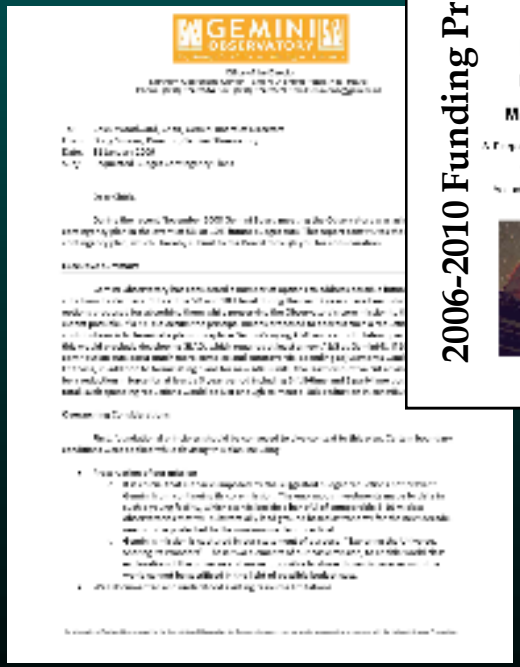


Assembling the Many Pieces of the WFMOS "Puzzle"

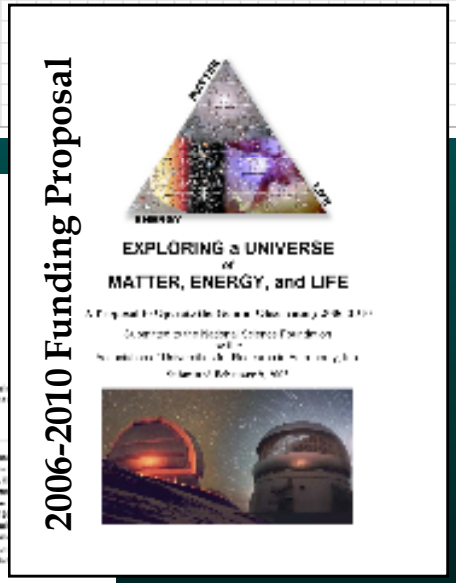
US Stock Market Performance Over Last 5 Years

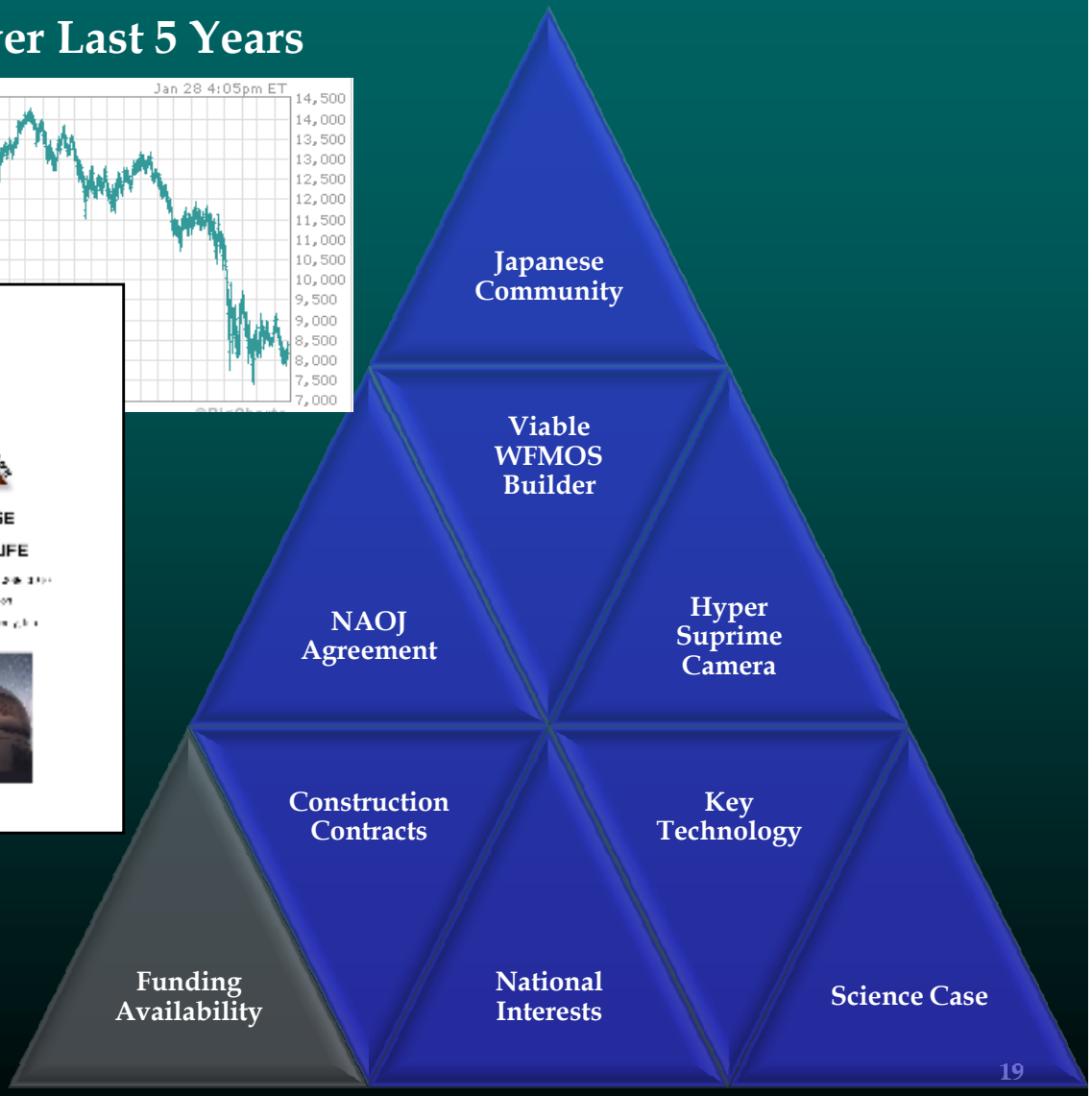


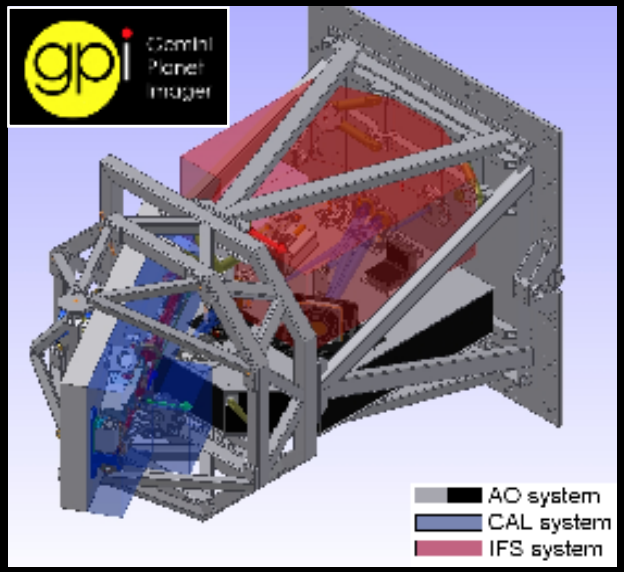
Gemini Contingency Plan



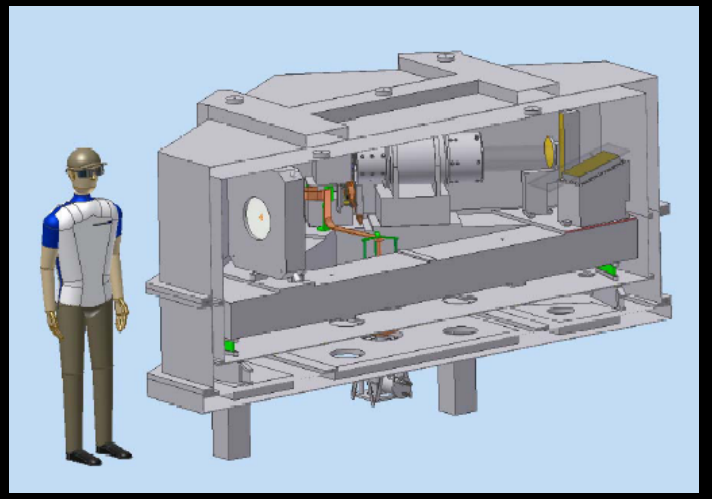
2006-2010 Funding Proposal





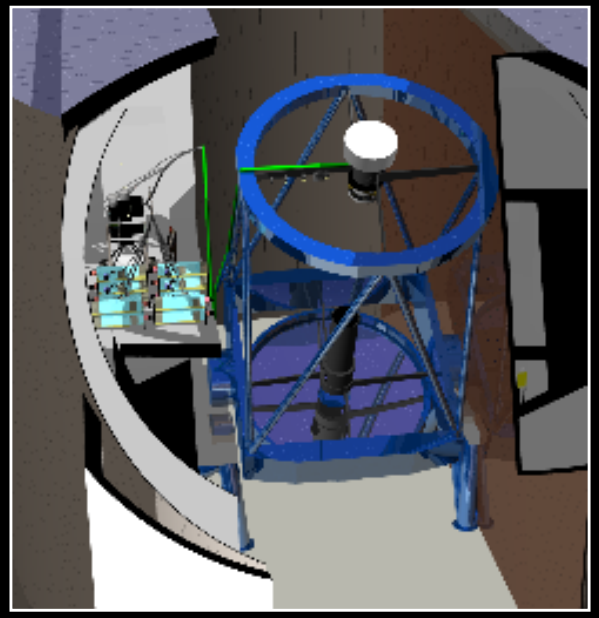


Gemini
Planet
Imager



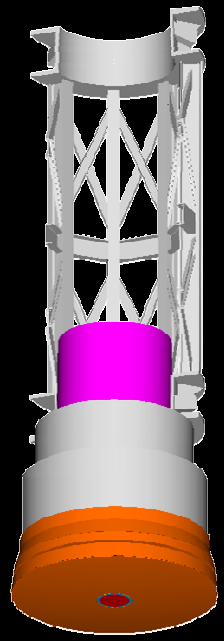
Precision
Radial
Velocity
Spectrometer

Aspen Instrument Program



Wide
Field
Multi-
Object
Spectrometer

Ground
Layer
Adaptive
Optics



From Gemini's Board of Directors Meeting (May 12-13)…

"The Board acknowledges receipt of the results of the WFMOS design studies in a report from the Observatory. The Board also acknowledges receipt of a draft of the Memorandum of Understanding between NAOJ and the Gemini Partnership describing the obligations and expectations of implementing and operating the WFMOS instrument on Subaru, the principles guiding the execution of WFMOS science (both campaign and PI driven) opportunities, and the mechanism for time exchange and access to the Gemini telescopes both North and South."

From Gemini's Board of Directors Meeting (May 12-13)…

"The Board recognizes there is strong science support in the Gemini community for the development of WFMOS, intense interest in developing an effective collaboration with NAOJ, and strong science motivation for the project. However, WFMOS has significantly increased in cost, and the Gemini Partnership can identify neither the necessary resources to proceed to WFMOS PDR, nor the totality of funds required in the out years to successfully complete the instrument. The Board regretfully terminates the WFMOS Aspen initiative.

The Board unequivocally endorses the GPI project as the completion of the Aspen program."

From Gemini's Board of Directors Meeting (May 12-13)…

"The Board wishes to express its deep appreciation for the extraordinary effort of the Gemini Observatory, our partner communities, as well as our colleagues at NAOJ. The Board does recognize the engagement between the Gemini partnership and NAOJ and the communities they represent as being enormously beneficial to the expanding international nature of astronomy, and more importantly, the development of strong friendship and aspiration for collaborations to advance science. The Board greatly values the developing scientific partnership between the Gemini and Subaru communities, as manifest in the first ever joint Gemini/Subaru science conference in May 2009, and remains open to exploring areas of mutual interest and benefit to further strengthen this partnership."

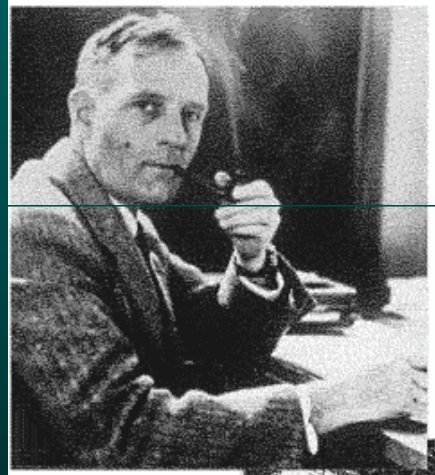
What Went Wrong?

- Aspen was a "blue sky" approach to developing a strategic plan
- Intent of Aspen was to -
  - Capitalize quickly on the investments made in new 8 m telescopes
  - Establish scientific legacy early for these facilities, before the era of JWST and ELT's
- Aspen produced instrument concepts that were vastly more expensive than the first generation of 8 – 10 m class instruments
  - A "moon shot" by previous instrument standards
- A $75M "planning budget" was established and "pay as you go" approached adopted rather than firm funding commitments
- In practice, funding provided~1/2 as fast as needed, which slowed down the program badly, yet astronomy moved on…
- Global economic crisis, combined by a Gemini Partnership that is in a state of transformation (International Agreement expiring), arrived at the worst possible time

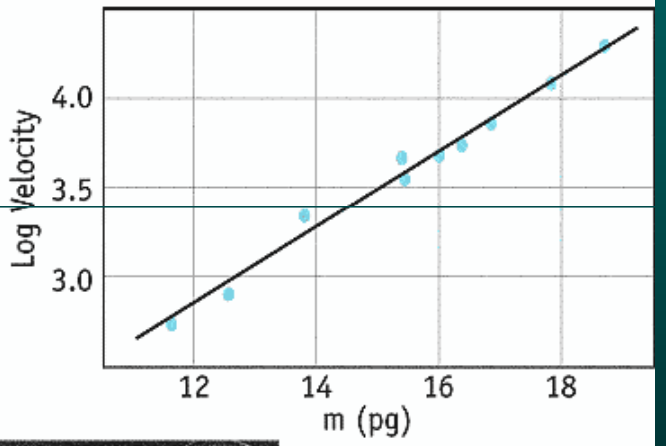
Collaboration

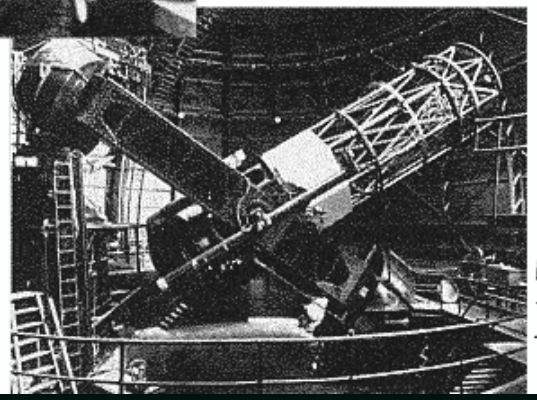
Gone are the Days…

Discovery of Expanding Universe



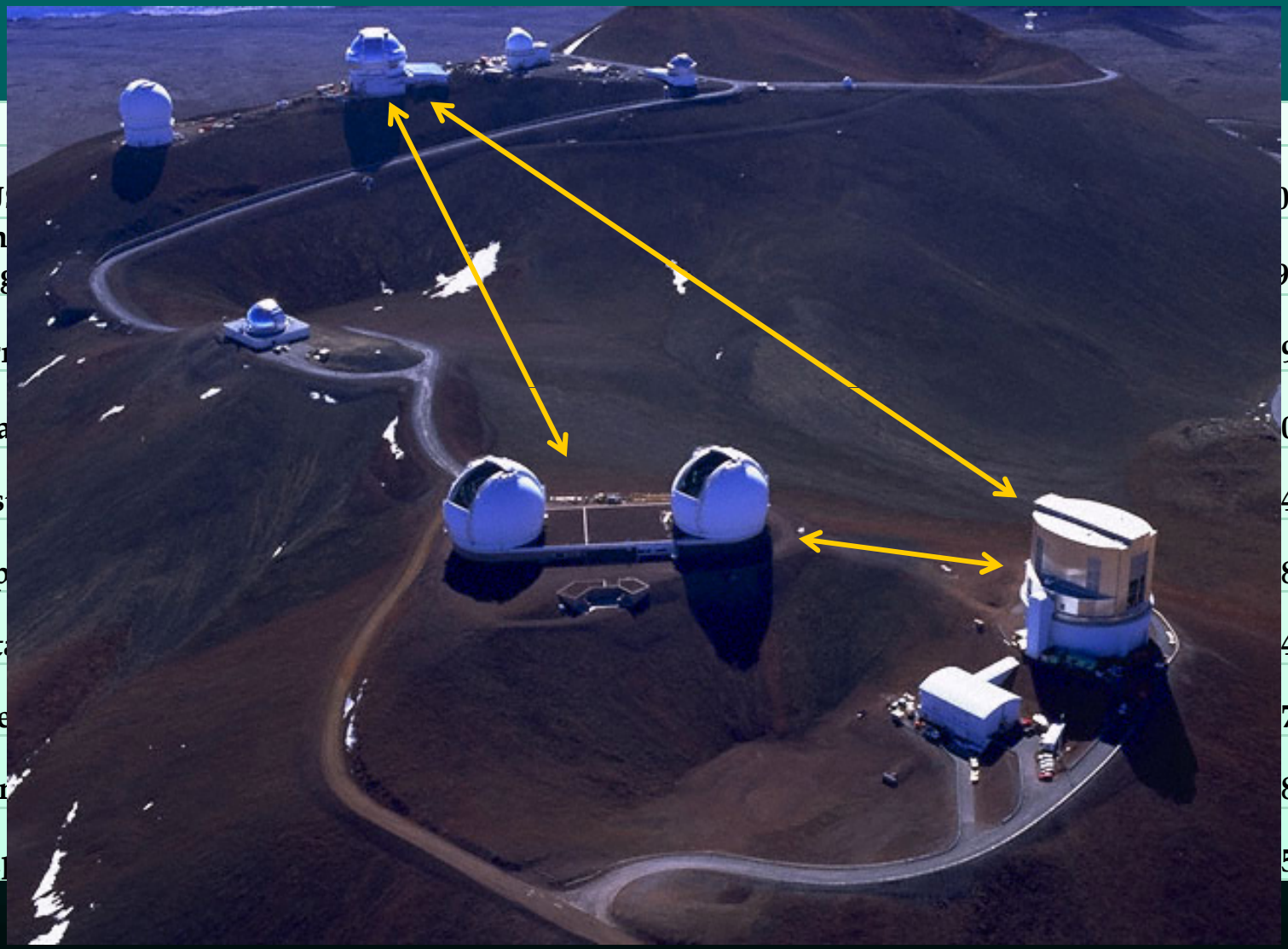
Edwin Hubble





Mt. Wilson
100 Inch
Telescope

The Globalization of Astronomy is Upon Us



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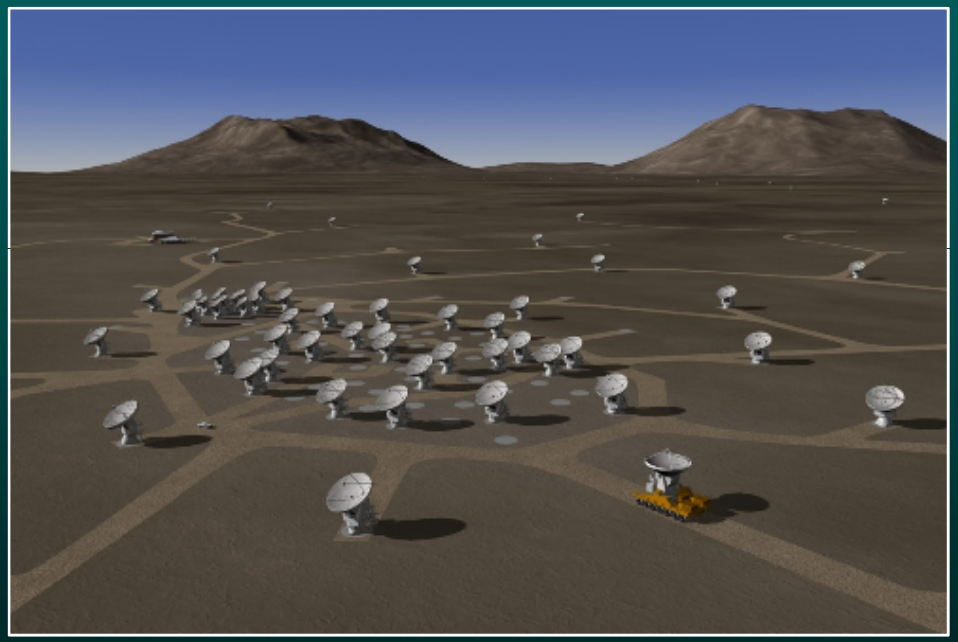
Ger	9%
Fra	0%
Aus	4%
Sp	8%
It	4%
Nethe	7%
Ca	8%
Ja	5%

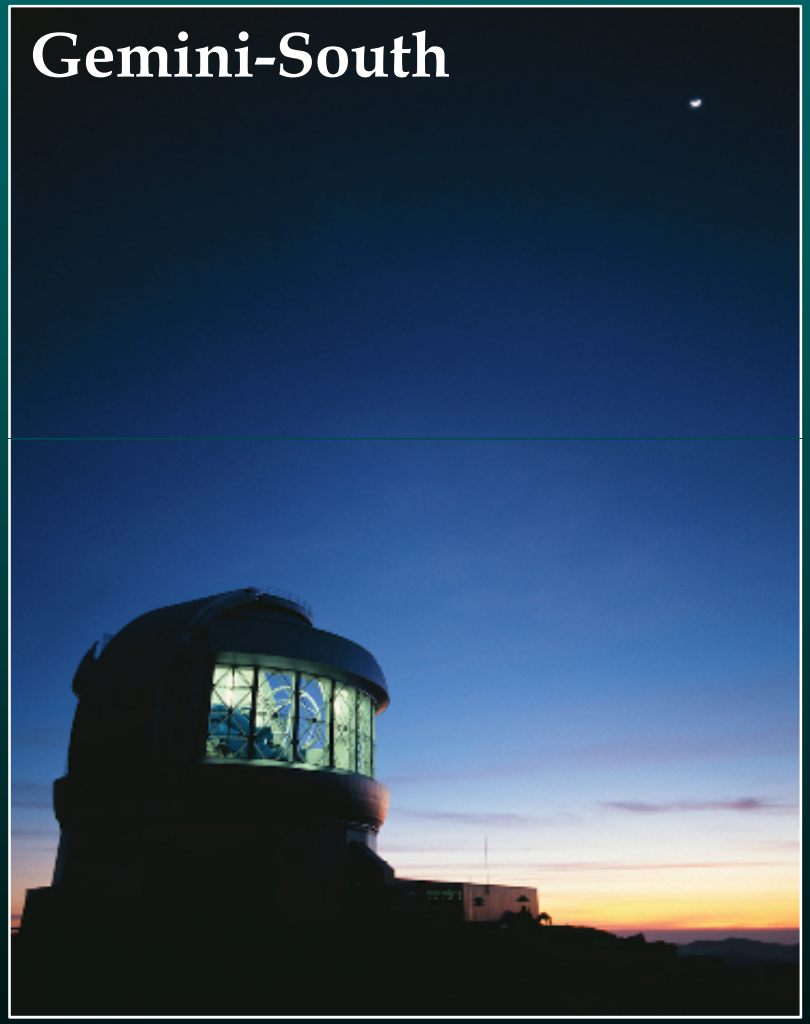
*Table prepared by Dennis Crabtree, Gemini Observatory

Synergies Will Drive Us Together

ALMA



Gemini-South



Emergence of a Pan-Pacific Astronomy Alliance

Where From Here?

- In ~4 months, Gemini will submit its next 5 yr budget proposal to its funding agencies
- A key part of this proposal will be a requirement that Gemini's future instrumentation funding commitment must be at the same level as our base operations funding
- In this proposal, Gemini will focus on next-gen instruments designed to –
  - Replace an aging fleet of workhorse instruments
  - Maintain a balance between a blend of workhorse instruments and a few advanced "pathfinder" instruments designed to take advantage of Gemini's design strengths

Gemini will continue to w[illegible]losely with Subaru to
[illegible]abo[illegible]cognizing that even
[illegible]oc[illegible]FMOS, we have
simply come too far dow[illegible]ad together to turn
back now…

GEMINI OBSERVATORY

Subaru Telescope
National Astronomical Observatory of Japan

WFMOS as a Pathfinder into the Future of Astronomy