すばる望遠鏡 装置の現在と近未来 概観

Instruments for Subaru: Overview

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Outline

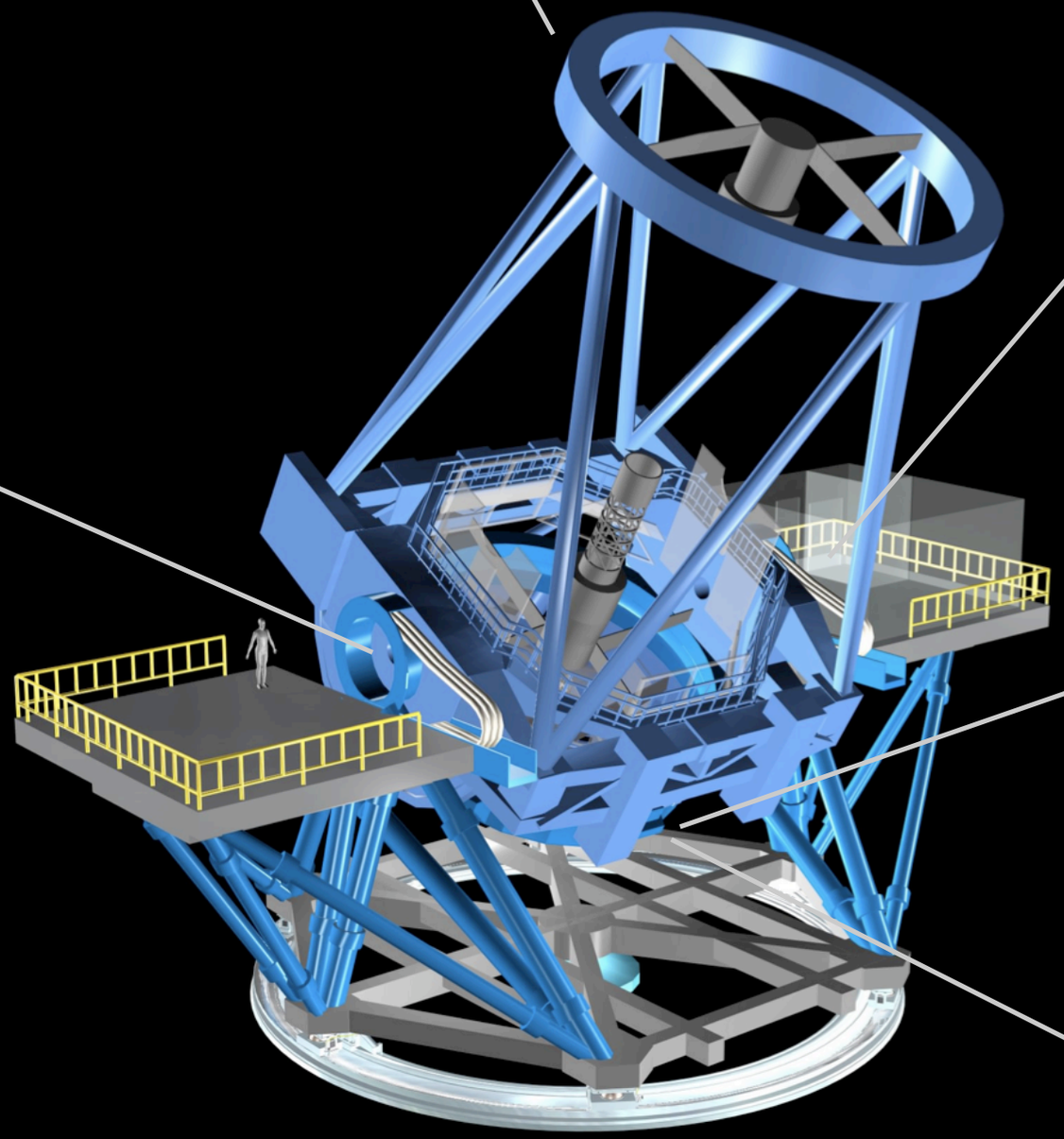
- Current Subaru Instruments
- New and Proposed Instruments
- Subaru Instrumentation Future Plan
  - Next-generation Instruments for Other Telescopes
  - Future Instrumentation Workshop
- Objective of This Workshop

Current Subaru Instruments

Primary

Suprime-Cam

FMOS



NsOpt

HDS

NsIR

AO188

IRCS

HiCIAO

SCExAO

CsOpt

FOCAS

Kyoto 3DII

CsIR

MOIRCS

COMICS

Optical Instruments

- **FOCAS**: 撮像、多天体分光、偏光撮像分光
  - FOV: 6'Φ, 0.10"/pix, R=250 - 7,500 (0.4" slit)
- **HDS**: 高分散分光
  - R=100,000 (0.38" slit), 0.14"/pix
- **Suprime-Cam**: 撮像
  - FOV: 34' x 27', 0.20"/pix
- **Kyoto 3D II**: 3次元分光
  - Fabry-Perot: FOV: 1.9'x1.9', 0.056"/pix, IFS: FOV: 3.4"x3.4", 0.094"/pix
- **Hyper Suprime-Cam**: 撮像
  - FOV: 1.5°Φ, 116 CCDs (4 for guiding), 0.2"/pix

Infrared Instruments

- **COMICS**: 中間赤外線撮像、分光
  - λ=8 - 25μm, FOV: 42”x32”, 0.13”/pix
- **FMOS**: 近赤外線ファイバー多天体分光
  - 400 fibers, λ=0.9 - 1.8μm, FOV: 30’Φ, R= 500 & 2,200
- **IRCS**: 近赤外線撮像、分光 (w/ AO)
  - λ=0.9-5.5μm, FOV: 21” (20mas/pix), 54” (52mas/pix), R: 100-2,000 (grism), ~20,000 (echelle)
- **MOIRCS**: 近赤外線撮像、多天体分光 (w/o AO)
  - λ=0.9-2.5μm, FOV: 4’x7’, 0.12”/pix

- **HiCIAO**: 高コントラスト近赤外線撮像
  - λ=0.85-2.5μm, FOV: 20”x10” (DI, PDI), 5”x5” (SDI), 1e-5.5 contrast at r=1”

New and Proposed Instruments

On-going and Proposed New Instruments

- SCExAO

- IR Doppler
- MIMIZUKU
- SWIMS
- SuFAIFS
- GIGMICS
- RAVEN

- IRCS-HDU
- SIRMOS
- MOIRCS IFU-Unit

- Hyper Suprime-Cam

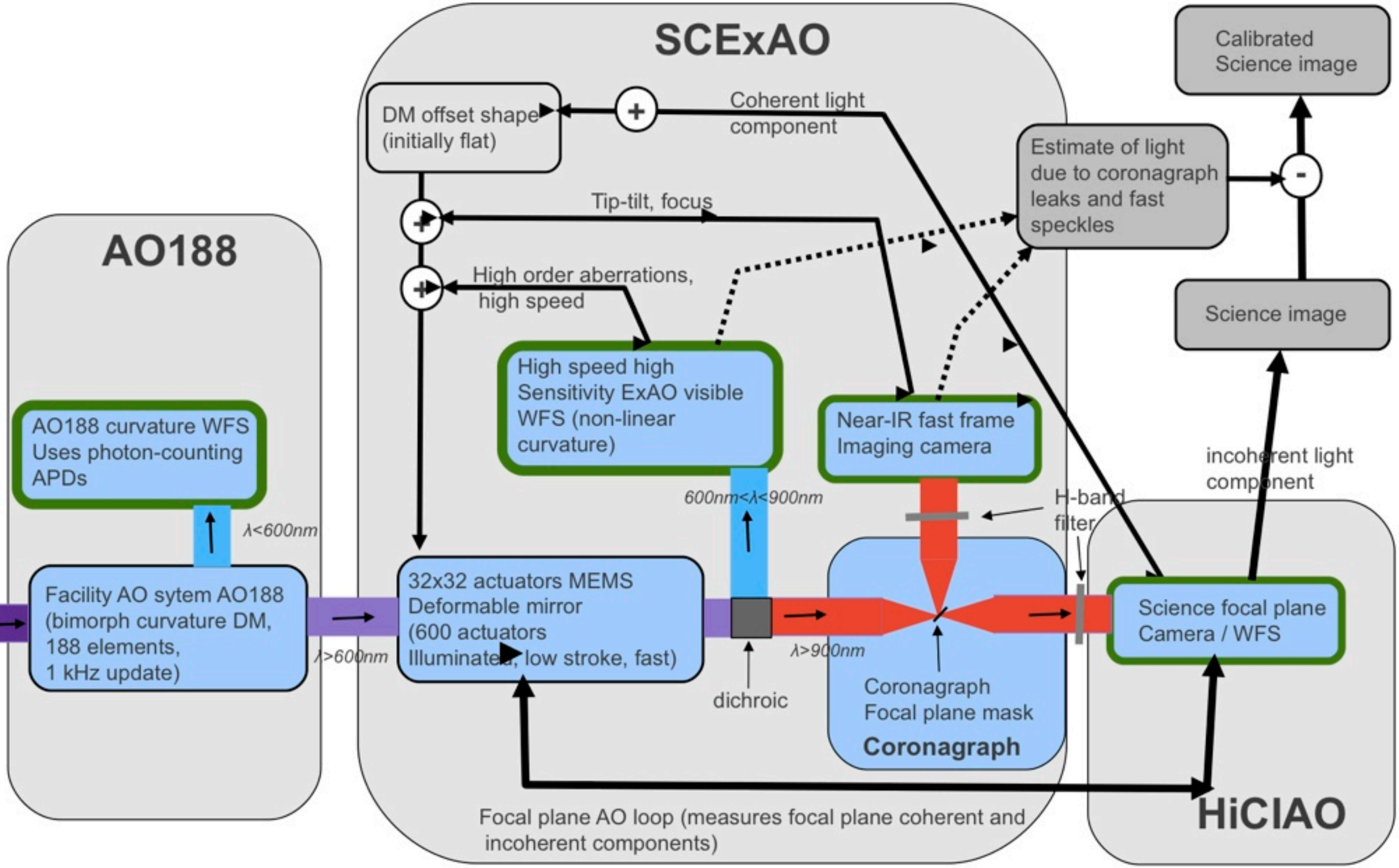
- Kyoto 3D II + AO188
- FOCAS Image Slicer

- Prime Focus Spectrograph (PFS)

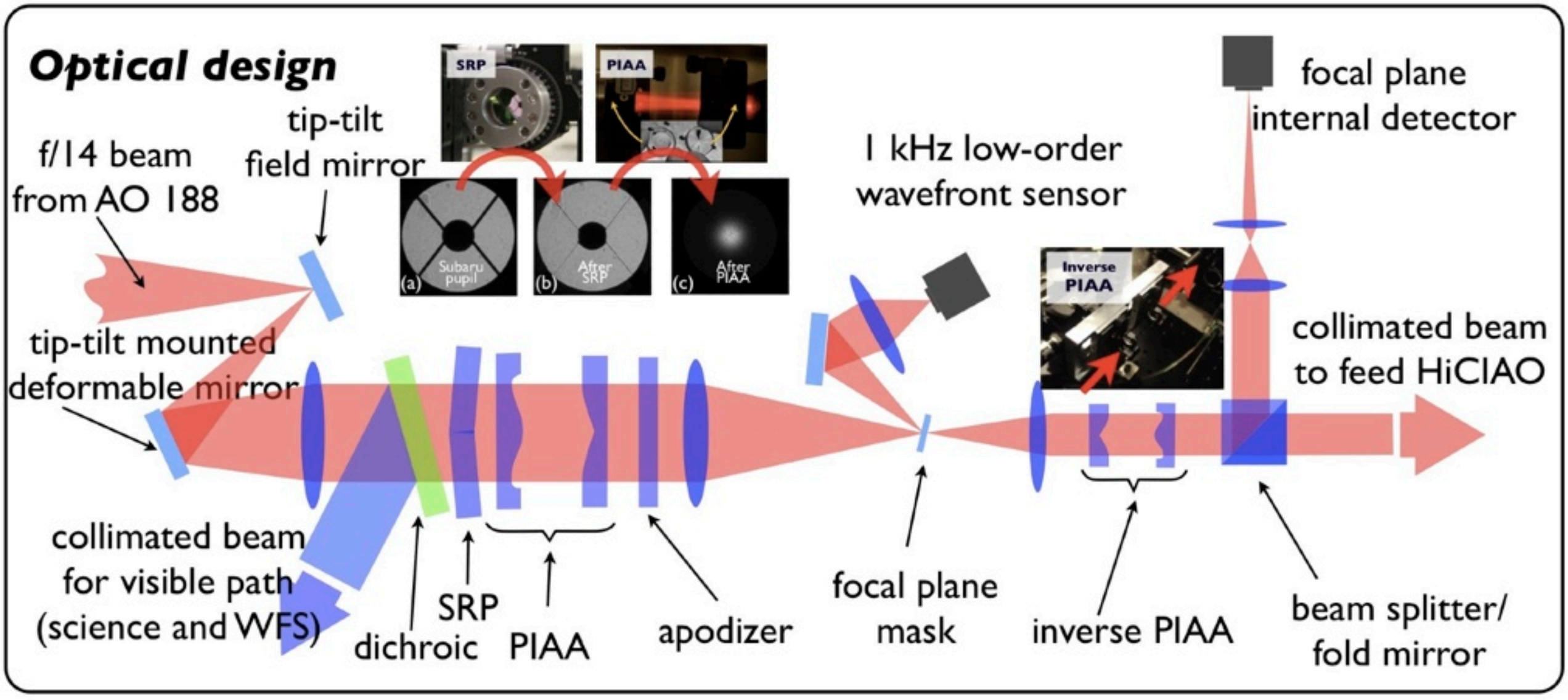
SCExAO: Subaru Coronagraphic Extreme AO

- 1k MEMS, PIAA Coronagraph to Reach <1e-6 at R<0.5”
- Upgrade to AO188 + HiCIAO
- PI-Type Instrument, PI: Oliver Guyon (Subaru / Univ. of Arizona)
- Day-time Engineering at the Summit (Aug. and Dec., 2010)
- Engineering Acceptance Test in the End of Jan., 2011
- Engineering Observations Scheduled in Feb. and March, 2011

SCExAO Wavefront Control architecture and speckle calibration

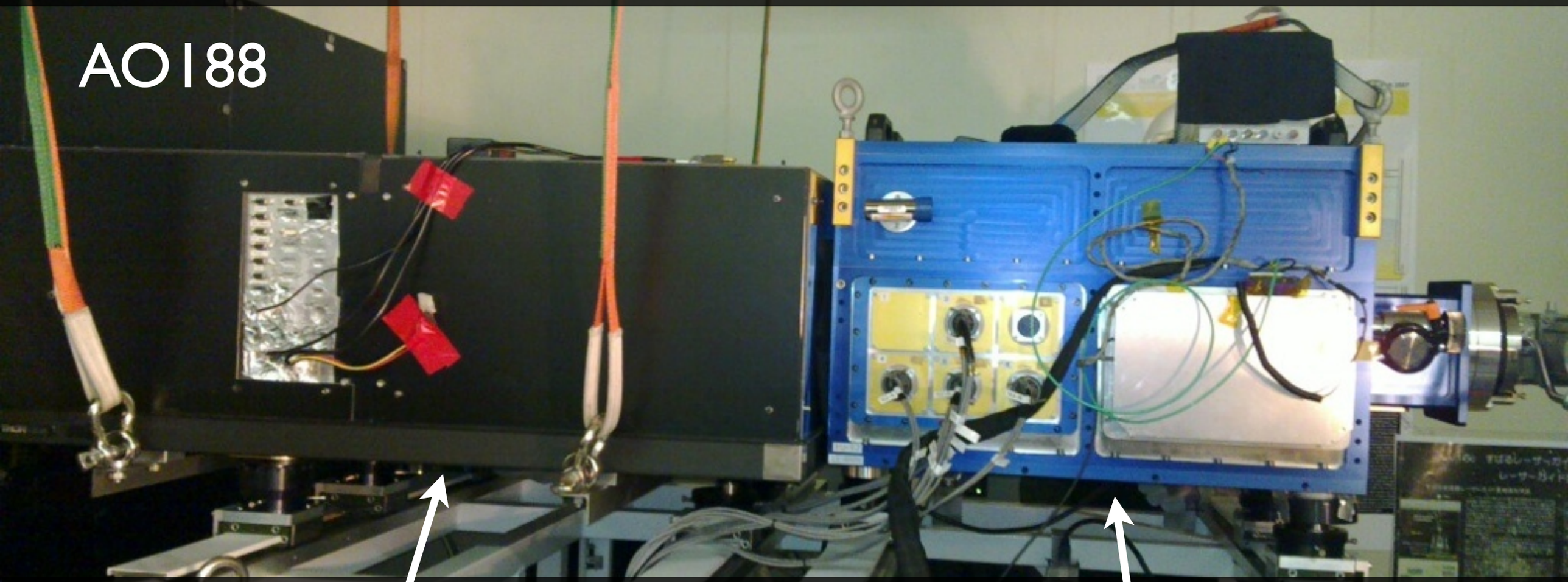


SCExAO Optical Design



SCExAO Day-Time Engineering, Dec. 2010

AO188

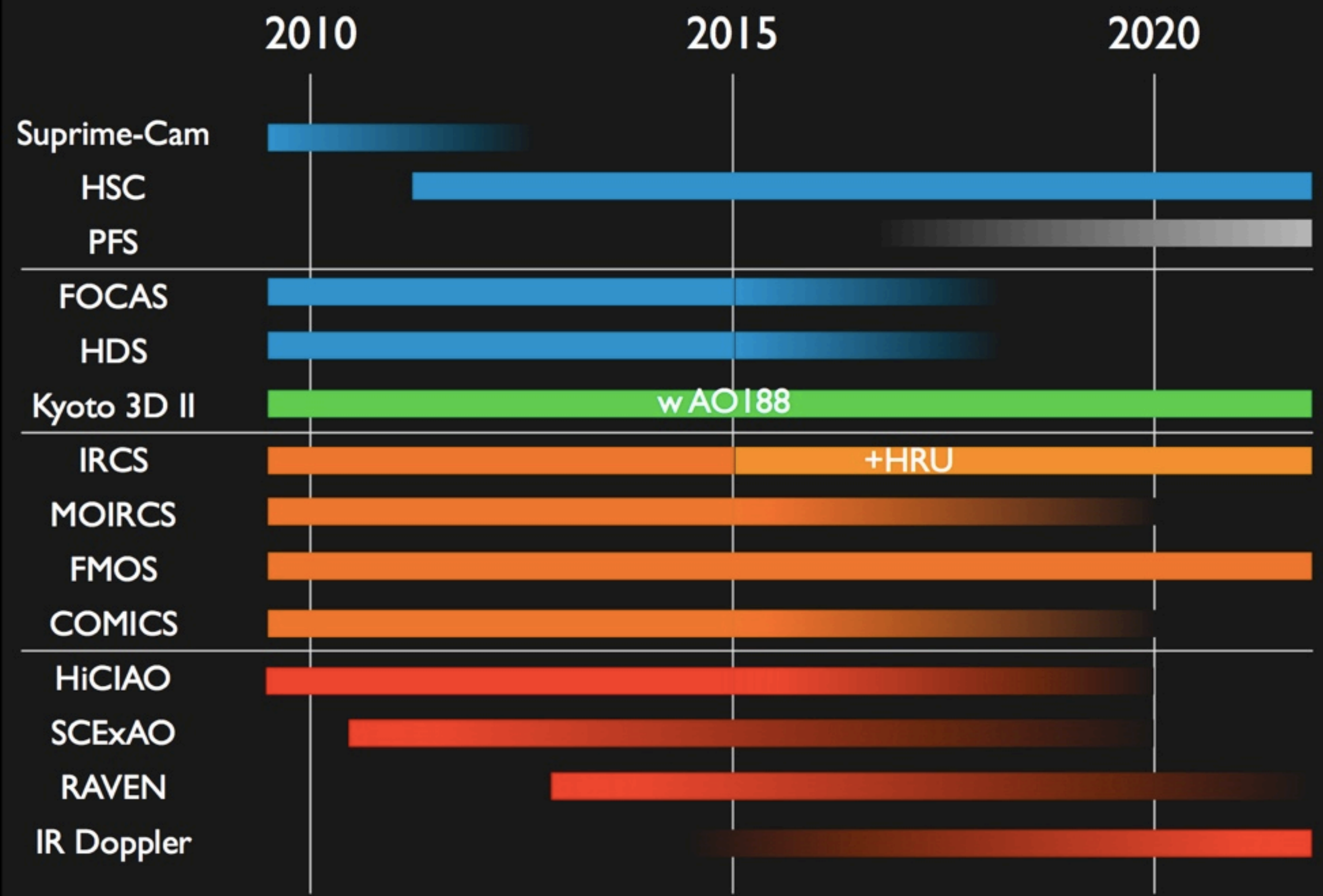


SCExAO

HiCIAO

Subaru Future Instruments

Current Instrument Plan



Strategy for Subaru Next-Gen Instruments

- Future Instrument Candidates (2009年SACレポートなど)
  - 主焦点可視多天体分光器 Wide-Field Multi-Object Spectrograph
  - 広視野近赤外線カメラ Wide-Field Near-IR Camera
  - AO多天体+面分光装置 Multi-Object + Integral-Field Spectrograph assisted by AO
  - 新中間赤外線装置 New Mid-infrared Instrument

What We are Missing

- **可視多天体分光装置**
  - → Prime Focus Spectrograph (PFS)
- **面分光装置**
  - 可視域: Kyoto 3D II
    - FOCAS Image Slicer Unit (Ozaki san)
  - 近赤外線
    - MOIRCS 面分光ユニット (2011 科研費 基盤S 申請中)

New Generation Large Instruments for Other Telescopes

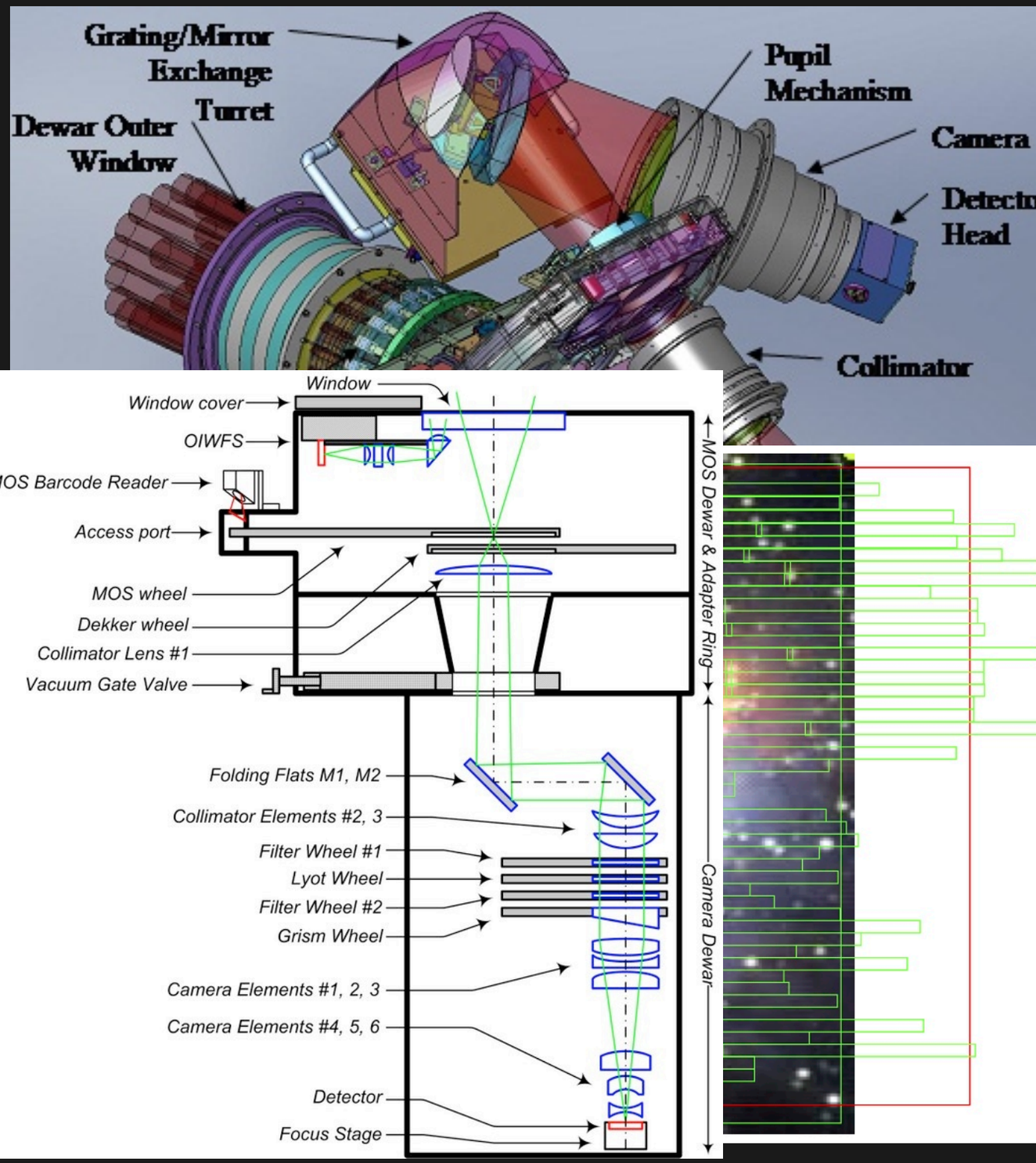
- MOSFIRE, NIRES
- GPI, FLAMINGOS-2
- KMOS

- MUSE

MOSFIRE for Keck I, FLAMINGOS-2 for Gemini-S

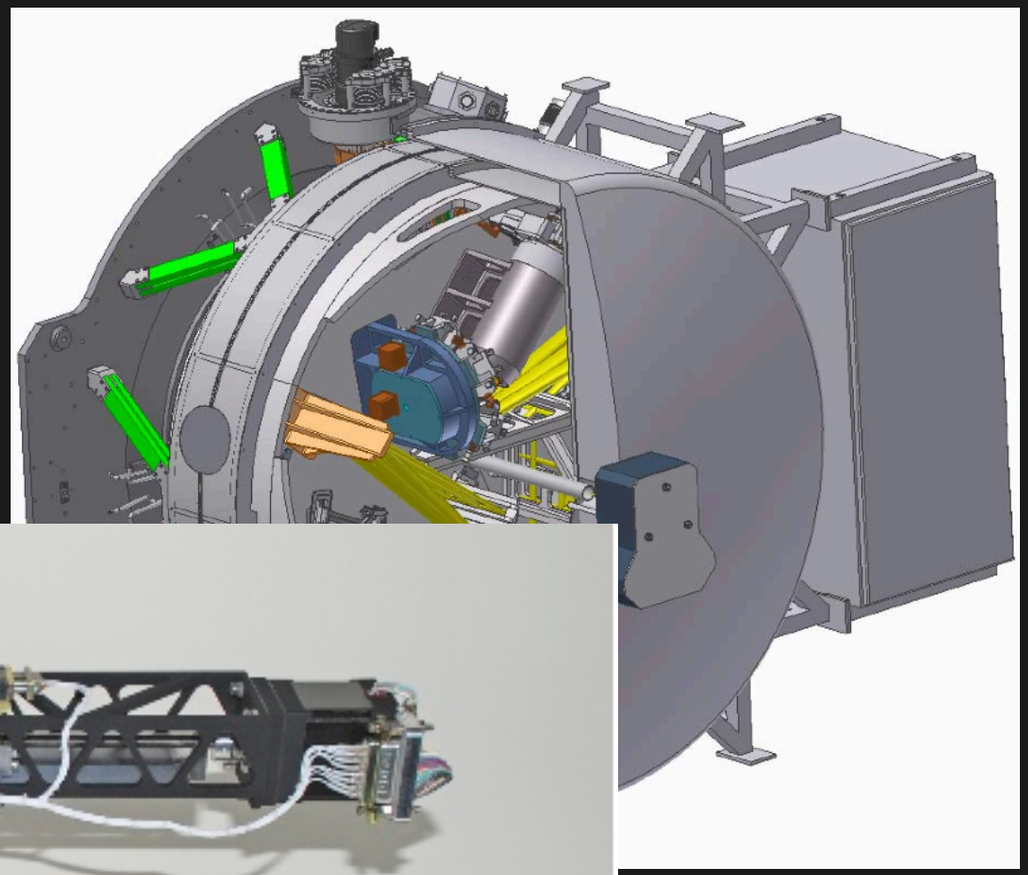
- MOSFIRE:
  - 46 Cryogenic Configurable Slit Unit
    - Each 7.3” long
  - FOV 6.1’
  - R=3270 (w/ 0.7” slit), 0.975 - 2.40μm

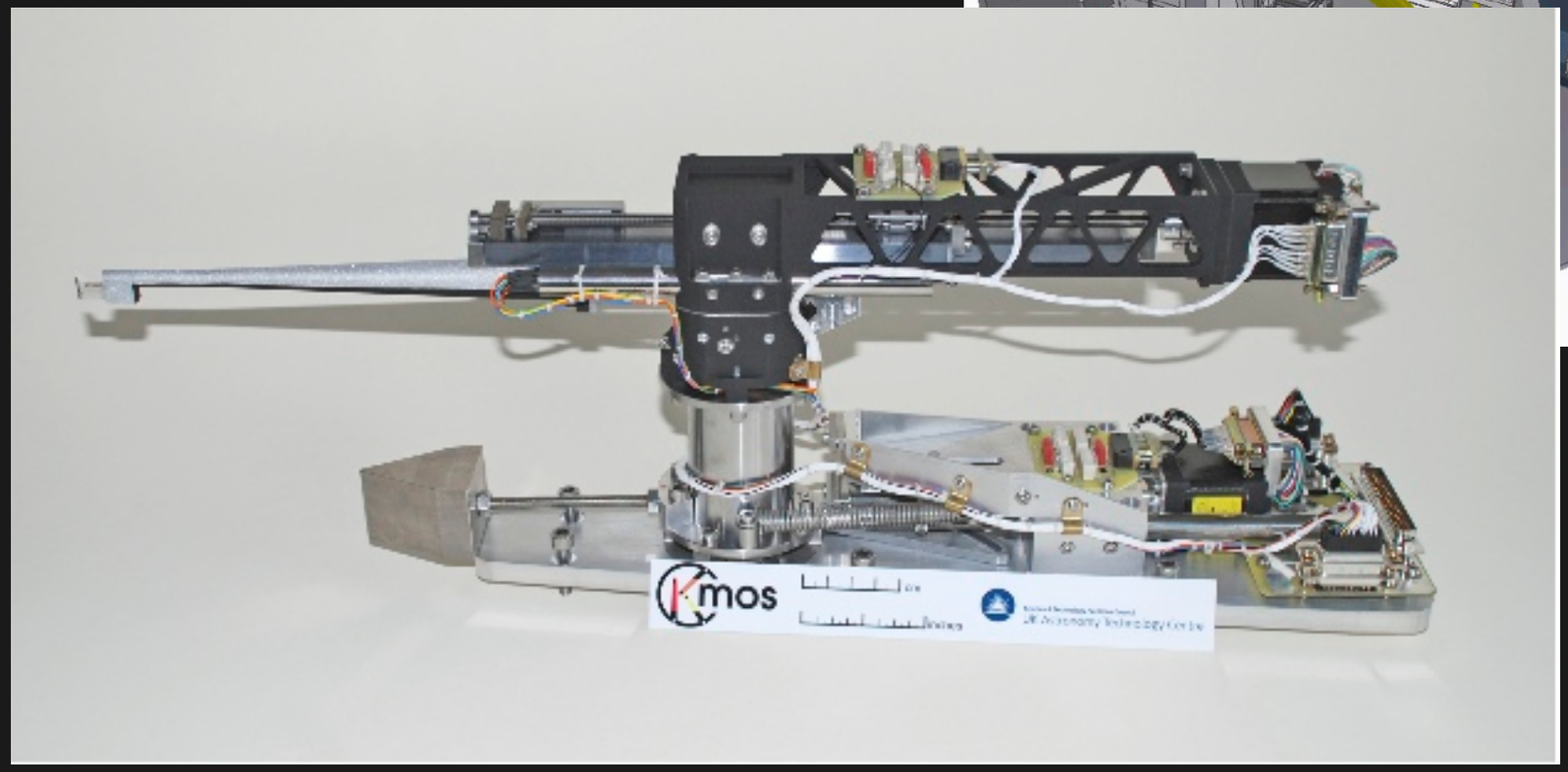
- FLAMINGOS-2:
  - FOV 6.1’
  - R=1,200-3,000
  - with MCAO: 0.09”/pix for 2’Φ FOV



KMOS for VLT

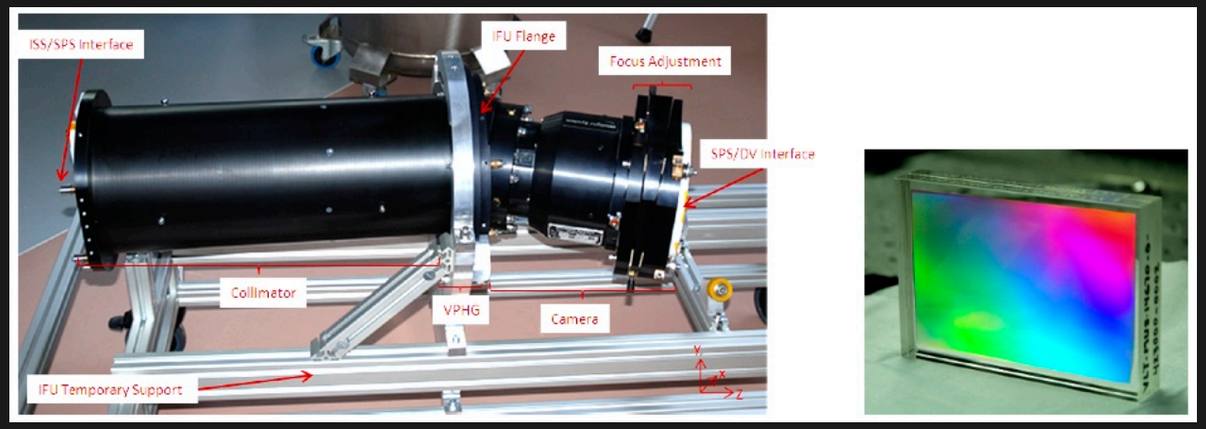
- Near-Infrared Multi-Object IFS (Integral Field Spectrograph)
- 24 IFUs (2.8” x 2.8” each), 0.2”/pix
- Patrol Field: 7.2’Φ
- 1.0 to 2.5 μm
- R~ 2,000 to 4,000
- Currently in Assembly Phase, First Light in 2011

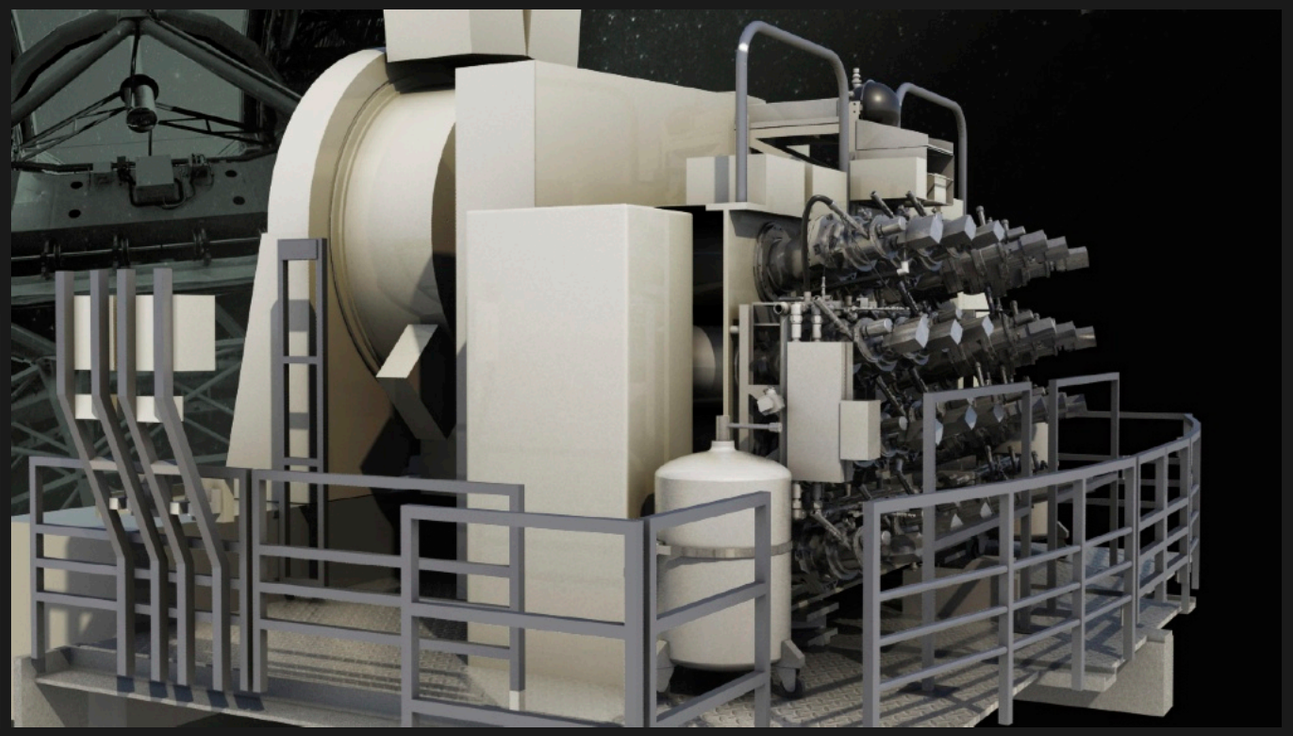




MUSE for VLT

- Optical Multi-Object IFS (Integral Field Spectrograph)
- 24 IFUs + 24 Spectrographs
- Wide-Field Mode: 0.2”/pix, FOV 1’ x 1’
- Narrow-Field Mode: 0.025”/pix, FOV 7.5” x 7.5”
- 0.465 to 0.93 μm
- R~ 2,000 to 4,000
- Ground-Layer AO (GALACSI), a part of AO Facility





Strategy for Subaru Next-Gen Instruments

- 将来装置計画ワークショップ Future Instrumentaion Workshop
  - #1 2010/9/9-10 @ IPMU
    - PFS and Next-Generation AO
  - #2 2011/1/18 @ Mitaka
    - PI-type / Carry-in Instruments
    - Instrument Development in Universities
  - #3 2011/6/2-3 @ Mitaka

本ワークショップの目的

- すばるが活躍を続けるためには、不断の装置の更新、アップグレードが必要
- 継続的な装置開発が必須

1.すばるへの取り付け、観測を希望する複数の装置計画のコミュニティへの紹介

2.大学での装置計画の在り方

  - 国立天文台(ハワイ観測所、ATC)と大学の協力、連携

Advantages of Carry-in Instruments

- 比較的少ないコストとマンパワー、短い期間で開発し、観測に結びつけることが可能
  - 装置開発の継続的な活動性の維持
  - 汎用的ではないが、特定の性能に特化した仕様
  - 汎用的共同利用装置が持たない機能を実現
  - 次世代の大型/汎用装置へのテストベッド、技術実証

Procedures for Carry-in Instruments

1. Contact Support Astronomer or Any Collaborators in Subaru
2. Submit A Proposal to Subaru Director
3. Subaru Internal Review Committee Makes A Report
4. Director Reports to SAC and User Community
5. Approval / Disapproval

- Reviews / Tests
  - Readiness Review, Engineering Acceptance Test, Final Acceptance Review
- Carry-in Approval Does Not Guarantee Science Observing Time
- See Details at:

  http://www.subarutelescope.org/Observing/Instruments/ApprovalProcessPIinstrument.pdf

議論すべき事項

- 大学における装置開発と国立天文台の関係
  - 国立天文台によるサポートはどうあるべきか
  - 大学間の連携
- すばる望遠鏡用装置開発の在り方
  - TMTにむけた装置開発との関係
- 装置が大型化し、開発が長期化する中で人材を育てていくためには

Strategy for Subaru Next-Gen Instruments

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「すばる次世代AOワークショップ」

次世代赤外線装置 Next-Gen IR Instrument

- 2010年代 - 2020年代にすばるに必要な赤外線装置は?
  - 多天体分光能力の強化
  - 面分光機能
- 次世代の補償光学は?
  - Ground-Layer AO による広視野での解像度の向上
  - 多天体AO (MOAO)
- スペース、TMTがあっても価値のある装置とは?

次世代赤外線装置 Next-Gen IR Instrument

- Working Group Just Founded
  - GLAO, MOAOの基礎的study
  - 次世代AOの仕様案策定 = 望遠鏡機能のUpgrade案
  - 次世代AOを活かす装置案の設定
  - サイエンス面からの要請

  → 6/2-3 「次世代AOワークショップ」にて