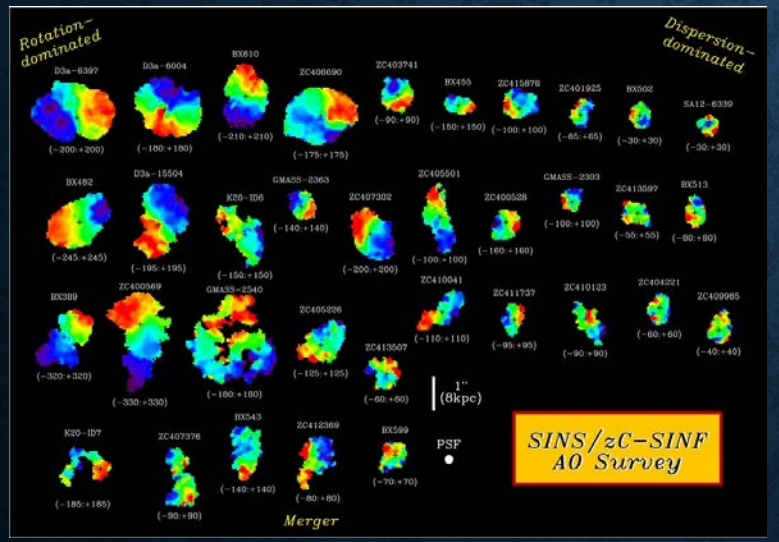
SUBARU NEAR-INFRARED IFU FACILITY (SNIFF)

Ichi Tanaka (Subaru Telescope)

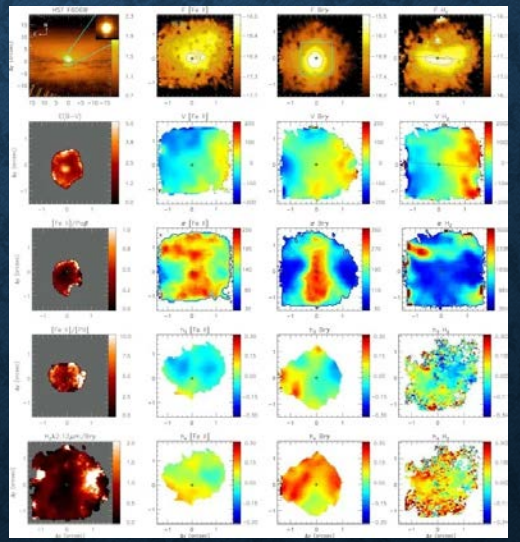
Tsuyoshi Ishigaki (Iwate Univ.), Yoko Tanaka, Julien Rouselle (Subaru), Iwata Ikuru (NAOJ), Tetsuo Nishimura (Subaru) & Subaru Instdiv.

BACKGROUND

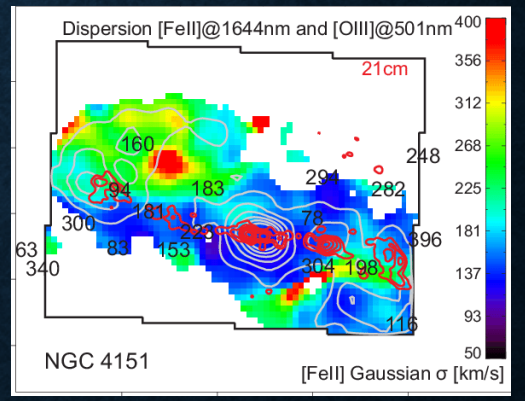
- SINFONI, NIFS, OSIRIS, KMOS etc … A new era of 2-D Spectroscopy (2005-)
- Only Subaru NEVER had the NIR IFU.



VLT (SINFONI)



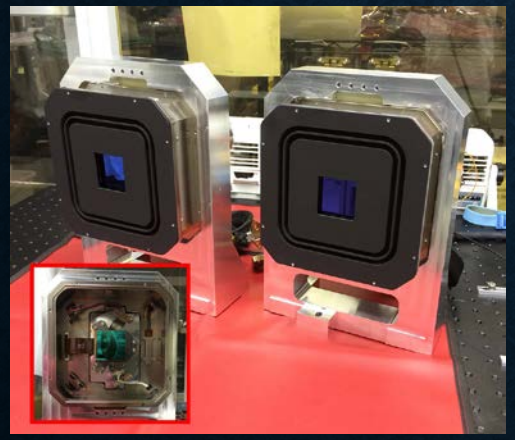
Gemini (NIFS)

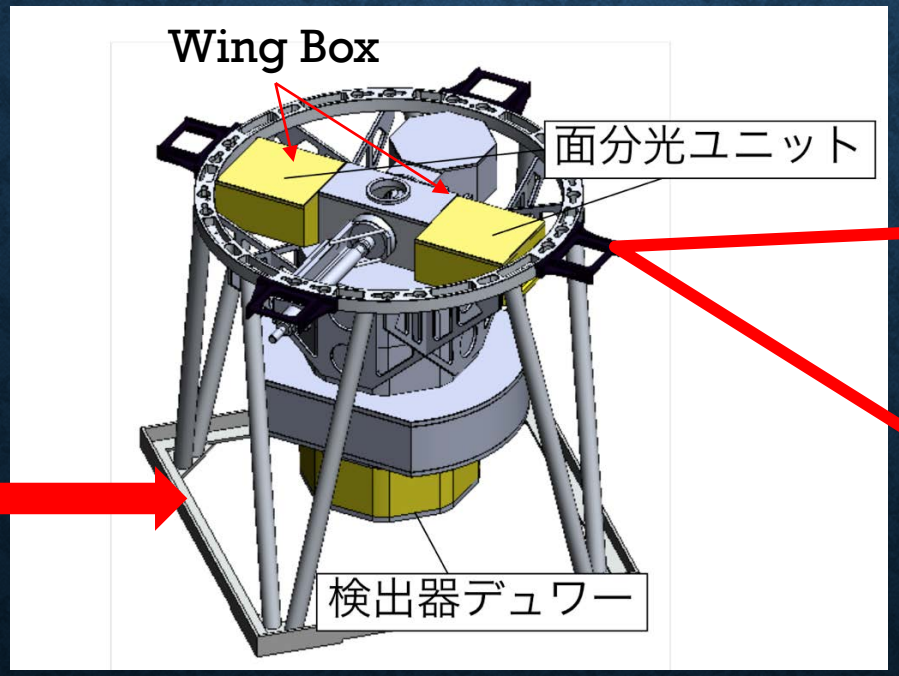


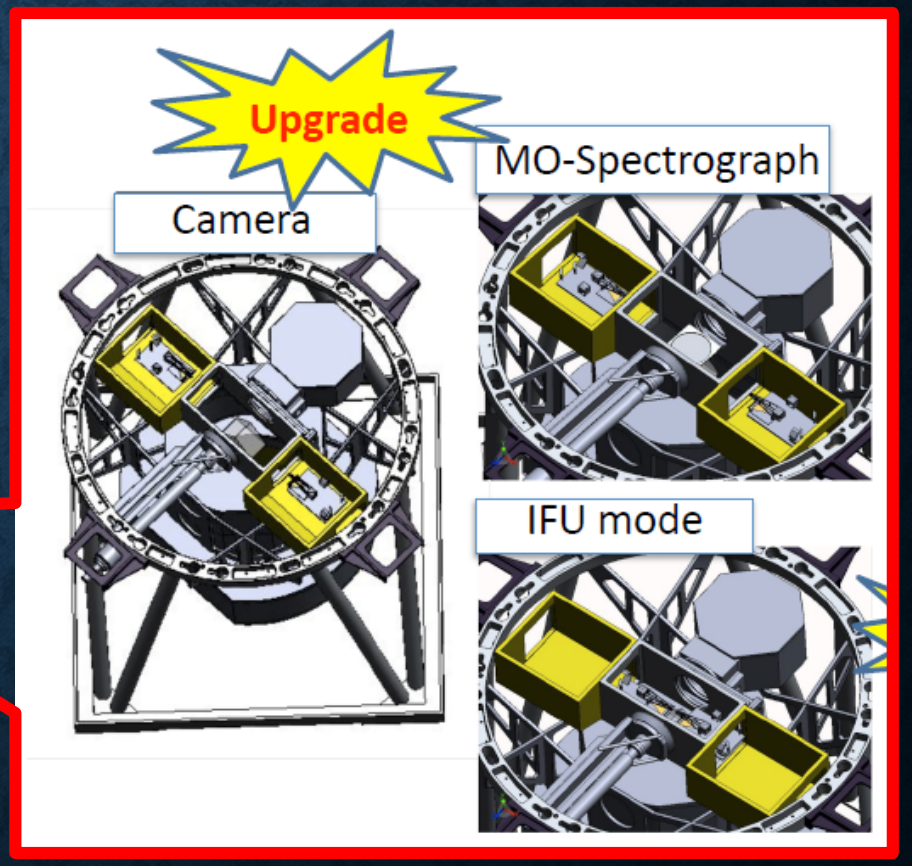
Keck (OSIRIS)

BACKGROUND

- The "nuMOIRCS" project (2010-2015)
  - ✓ Detector Upgrade
  - ✓ IFU development

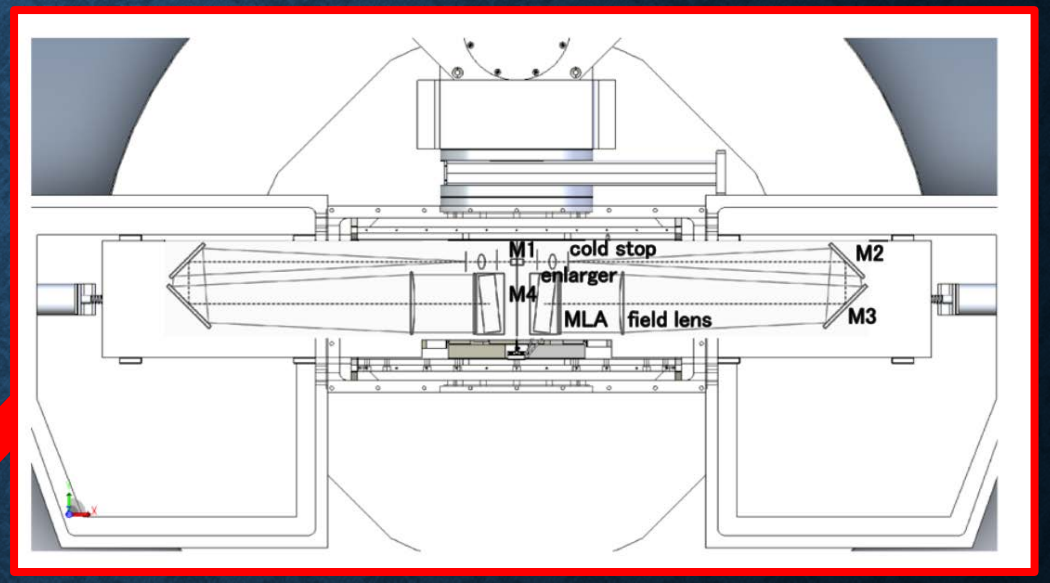


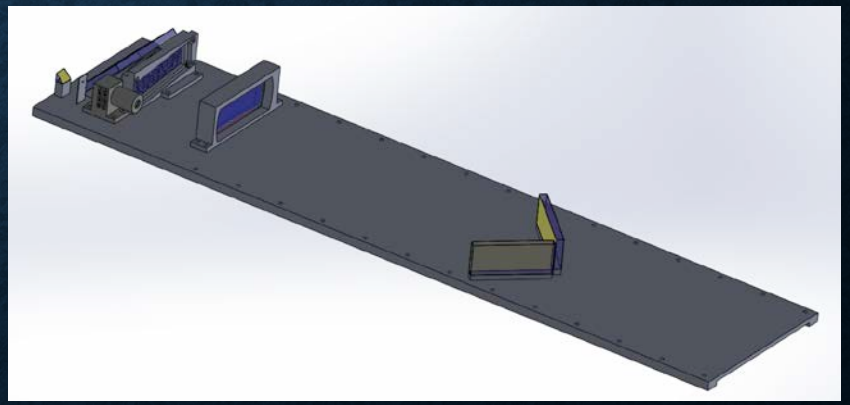




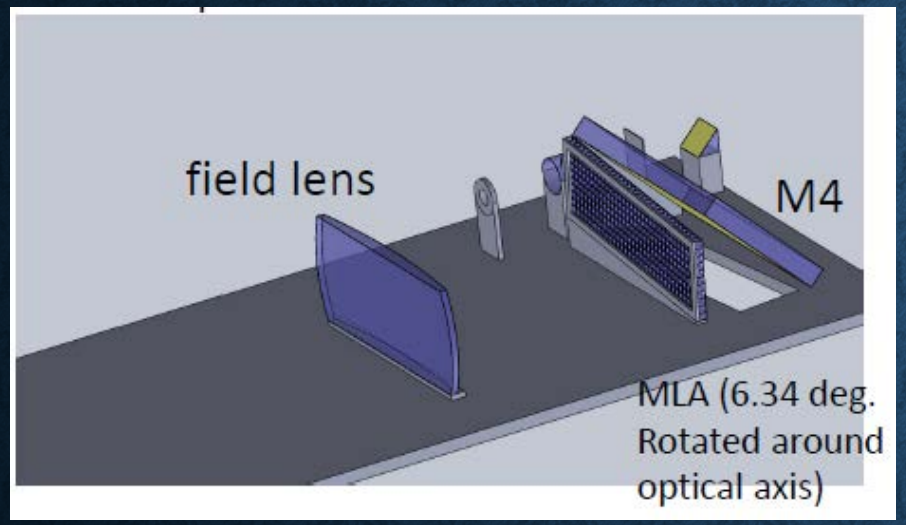
NUMOIRCS MLA-IFU (PI: T. ISHIGAKI)

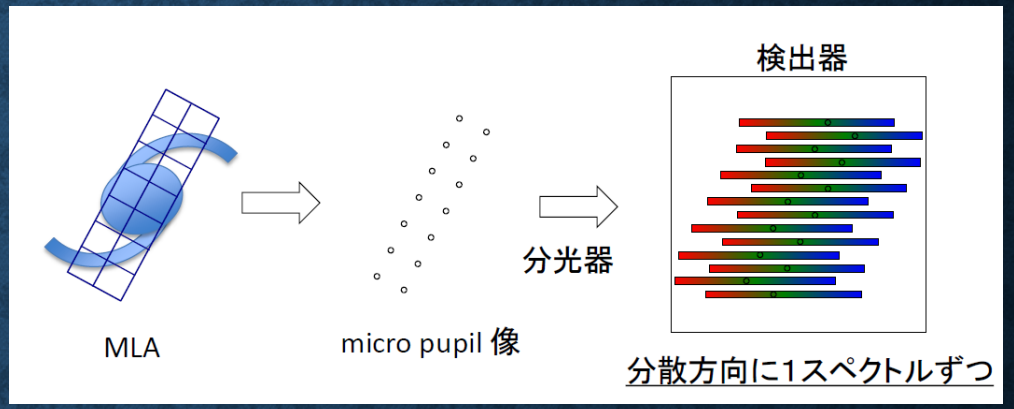
- MLA-type IFU.
- 0.2'' sampling,
- 9x31 lenslets. → 1.8'' x 6.2'' FOV.

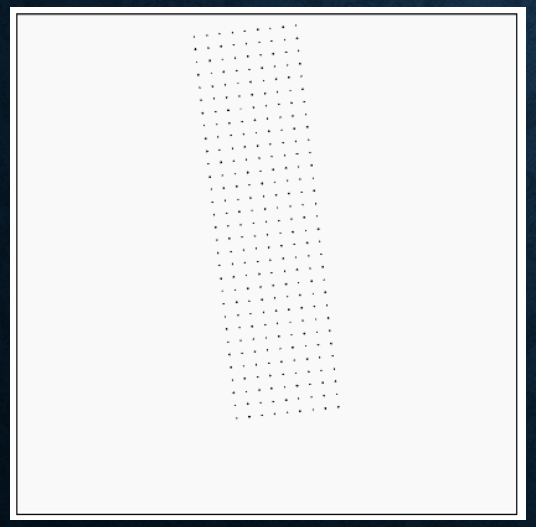


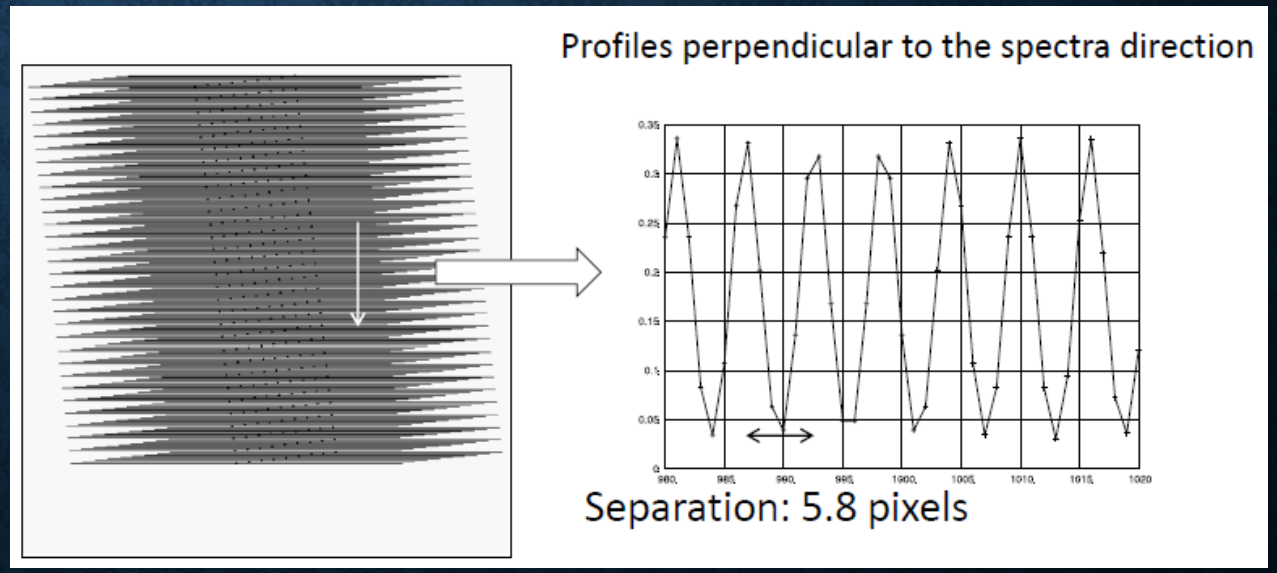


MICRO-LENS ARRAY IFU



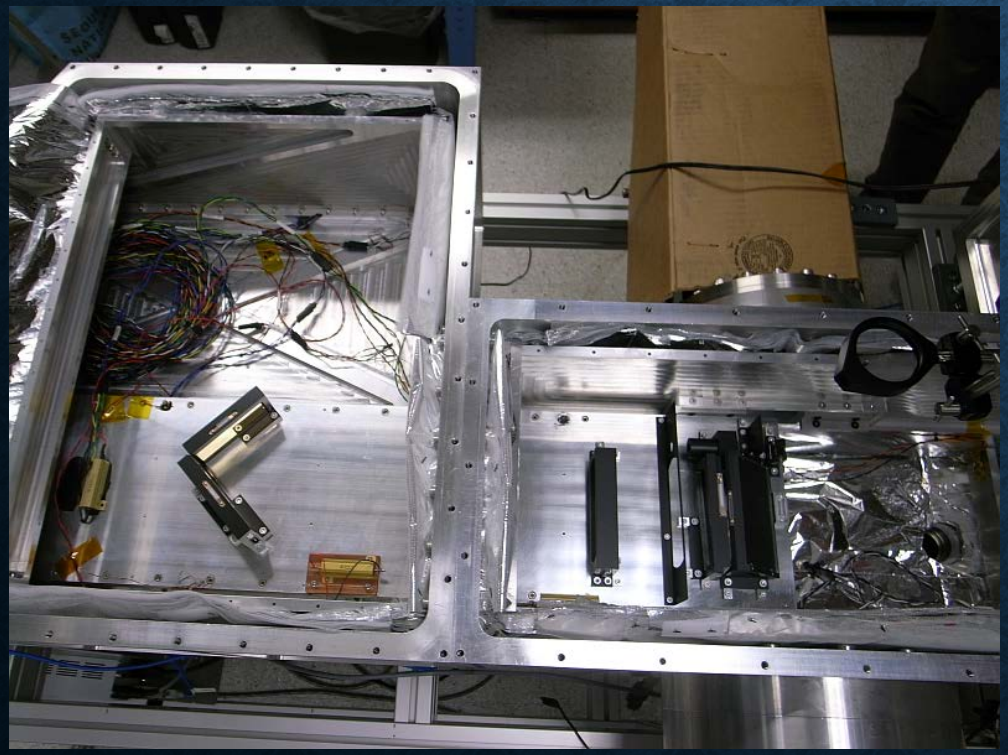


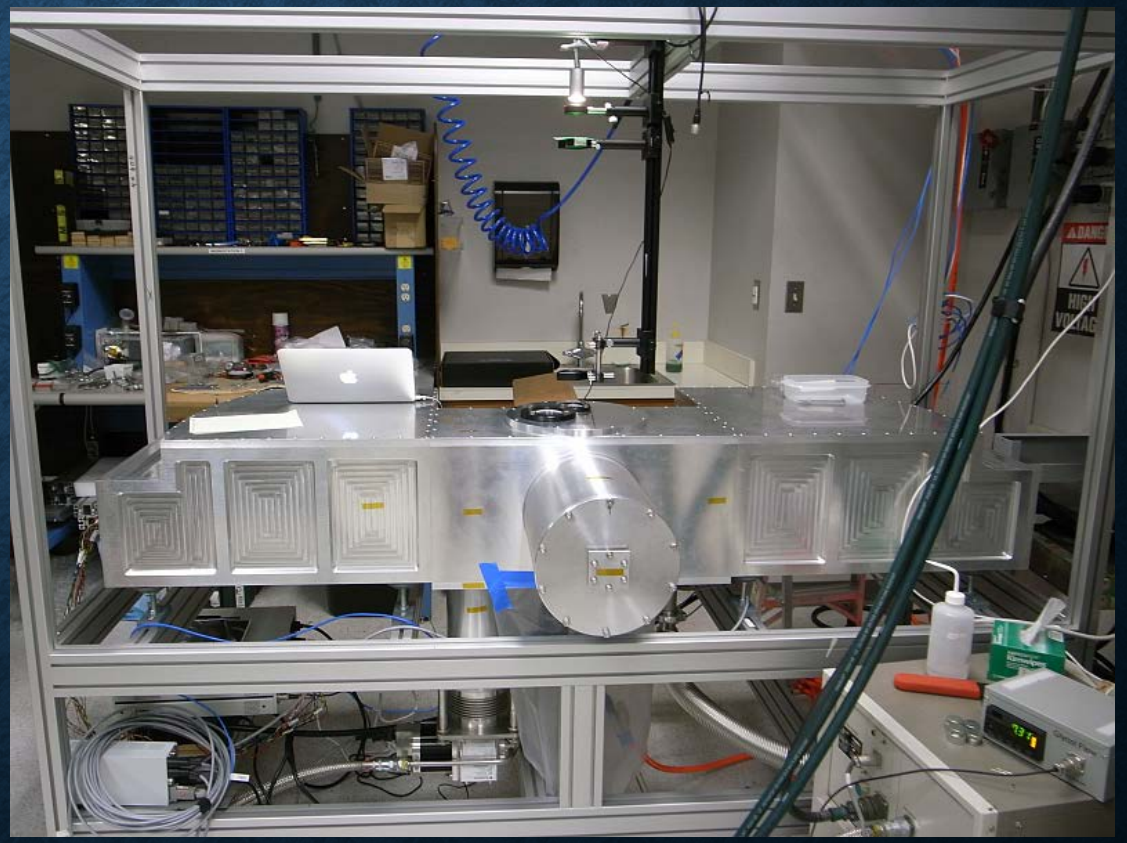




NUMOIRCS MLA-IFU (PI: ISHIGAKI)

- "Mini Lab" was made.
- A stage with optics was made.





HOWEVER!...

IFU Proejct Stalled due to …

Too much thermal mass.

Workforce deficit in observatory.

Fund deficit.

SO WE PROPOSE

THE "SNIFF" PROJECT!

"SNIFF" = Subaru Near-Infrared IFU Facility

(**nuMOIRCS IFU → AO-assisted IFU**)

INTRODUCING SNIFF

- Re-using Mini Lab as a Stand-alone Instrument.

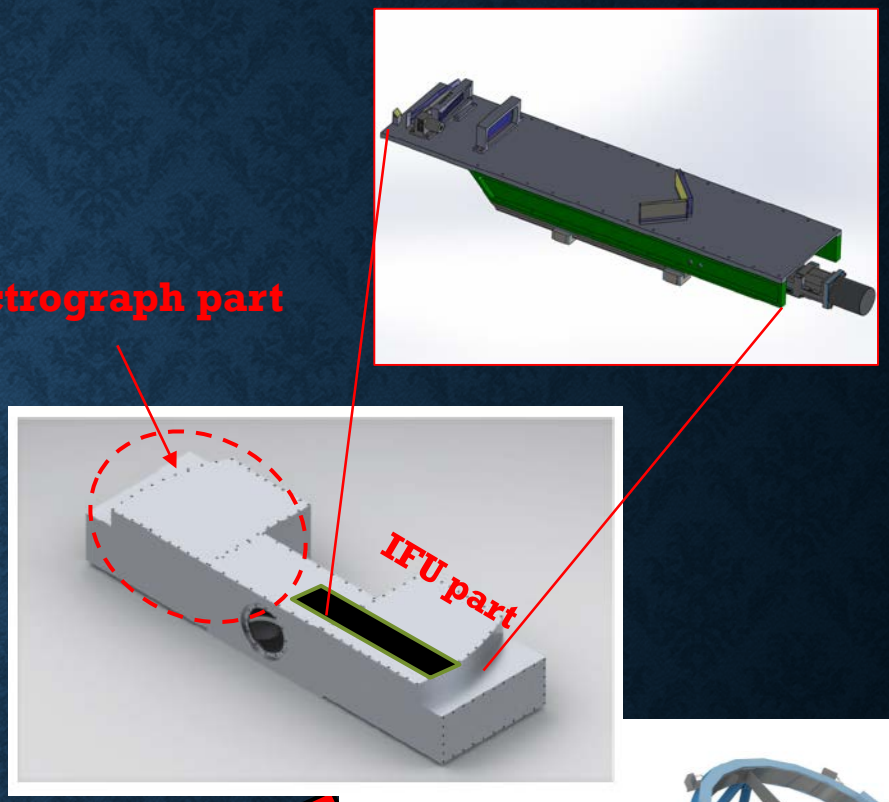
  MOIRCS is not necessary.

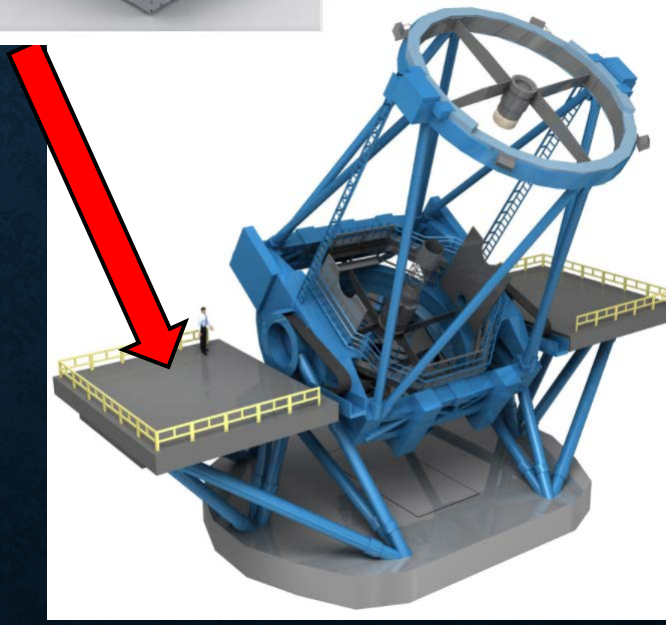
- One side is MLA IFU, the other side is Spectrograph.

- SNIFF will go to NsIR platform with AO188.

  AO-assisted!

"QUICK, less RISK, & ECO".



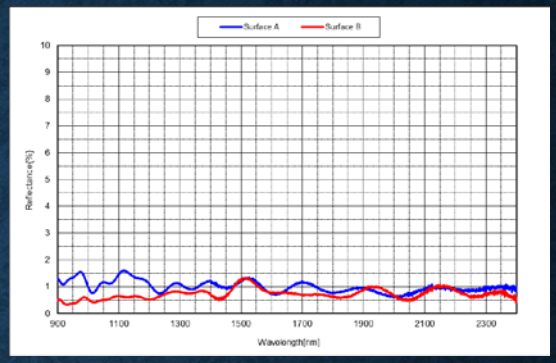


INTRODUCING SNIFF

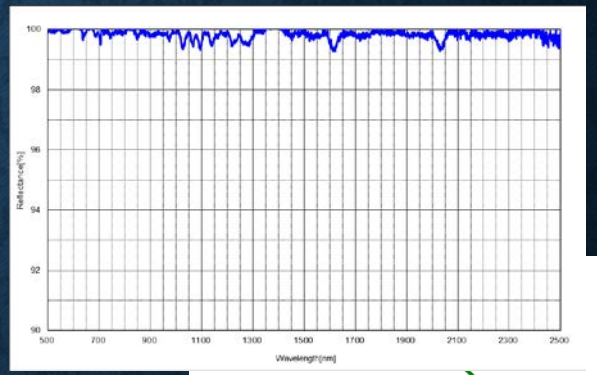
Goal: "BEST Throughput Instrument"

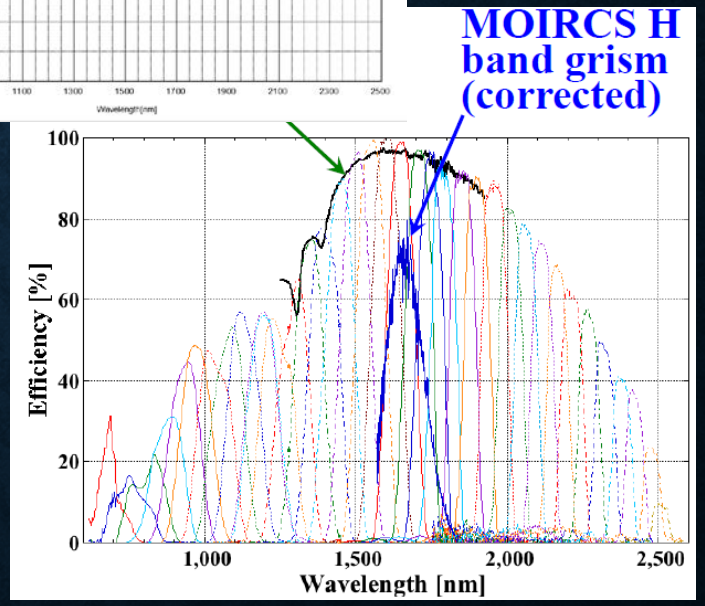
- State-of-the-art AR-Coating: goal 99.5% transmission/surface!
- >99.5% Super-reflection mirror!
- Using High-Efficiency LightSmyth Grating: Peak transmission >95%.

AR Coat (Asahi Bunkou @2015)



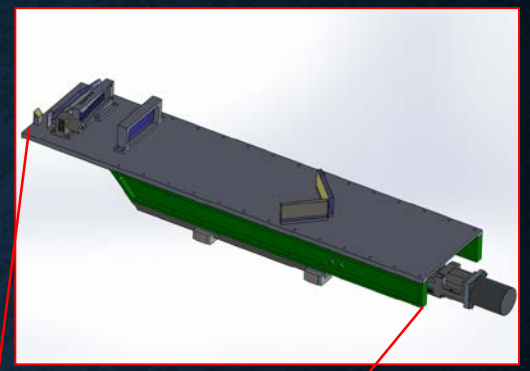
Super Reflection Mirror (2019)

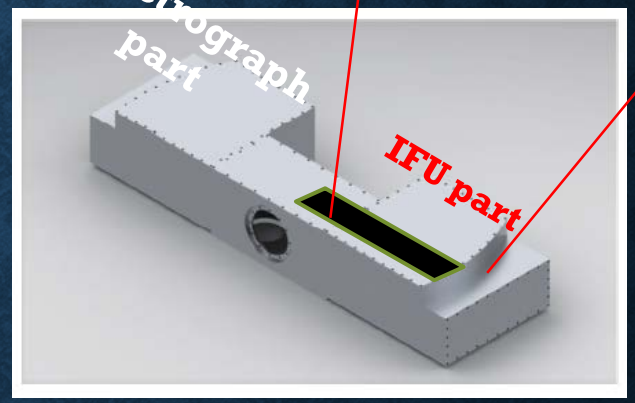




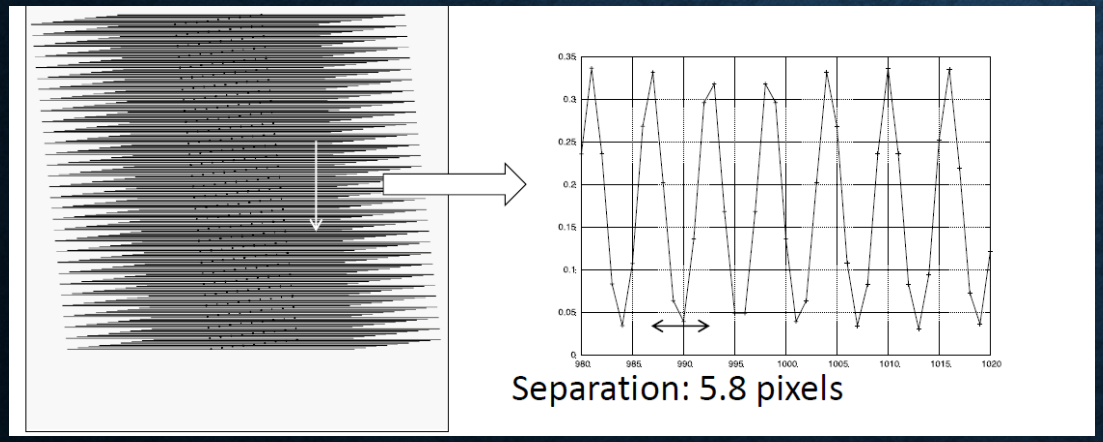
MLA-IFU SPECIFICATION

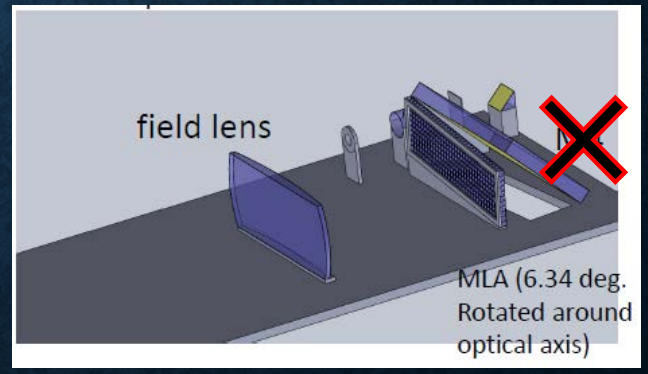
Fold mirror (M4) is not necessary – directly send light to the other box.





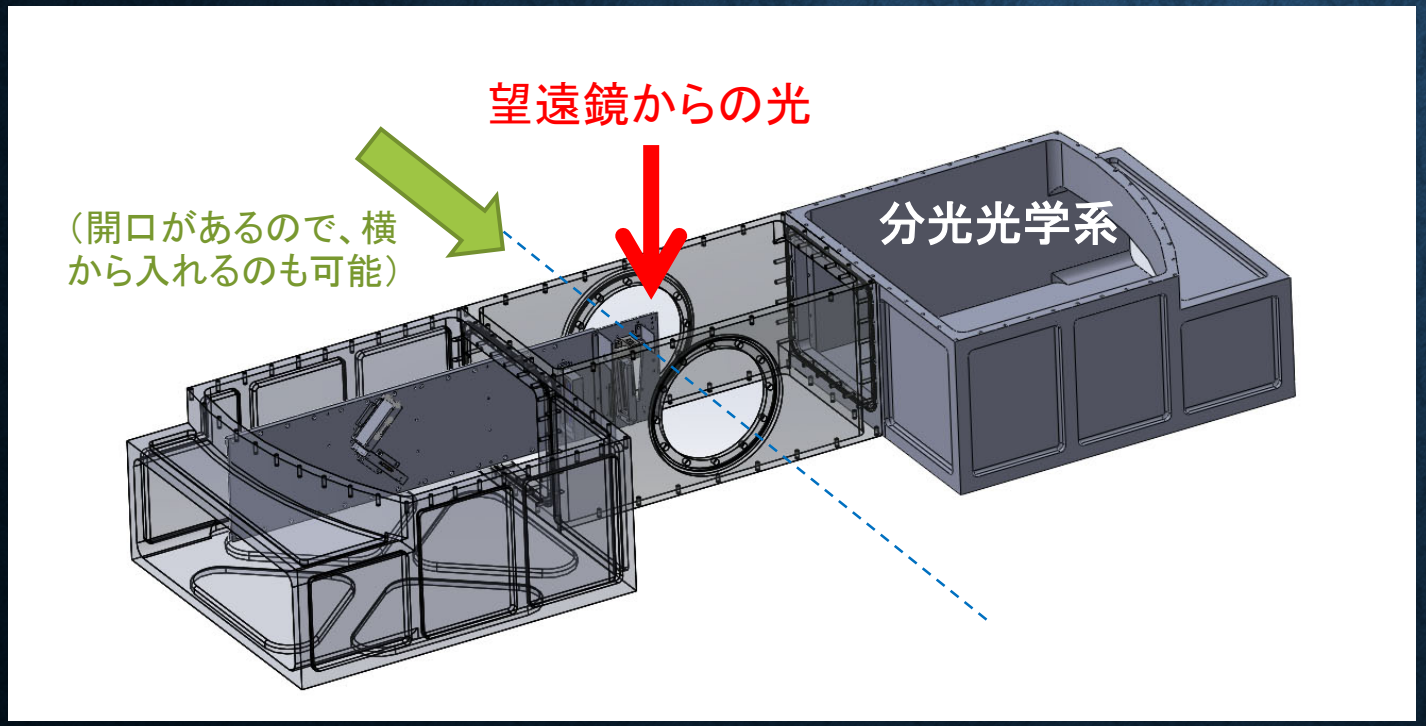
Spatial Sampling	0.2 arcsec
MLA format	9 x 31 lenses
Field-of-view	1.8 arcsec x 6.2 arcsec
Magnification of enlarger optics	X 30
Size of 1 lens	3mm x 3mm
MLA rotation angle	6.34 deg.

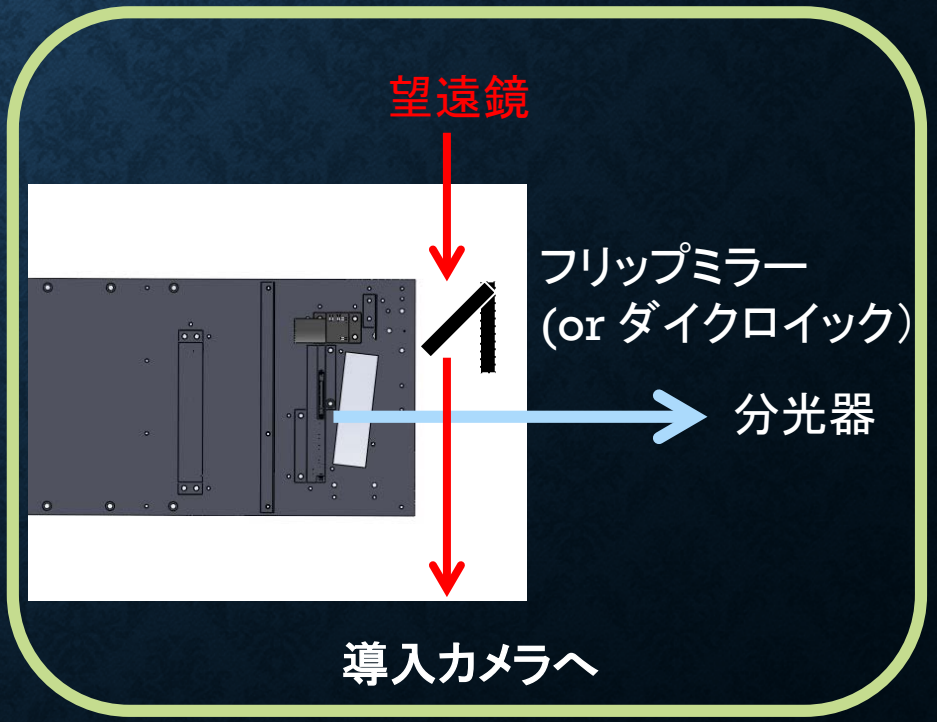




IFU IN MINILAB

- MLA Stage will be installed vertically.
- Field Acquisition Camera (optical) will be placed on the bottom.

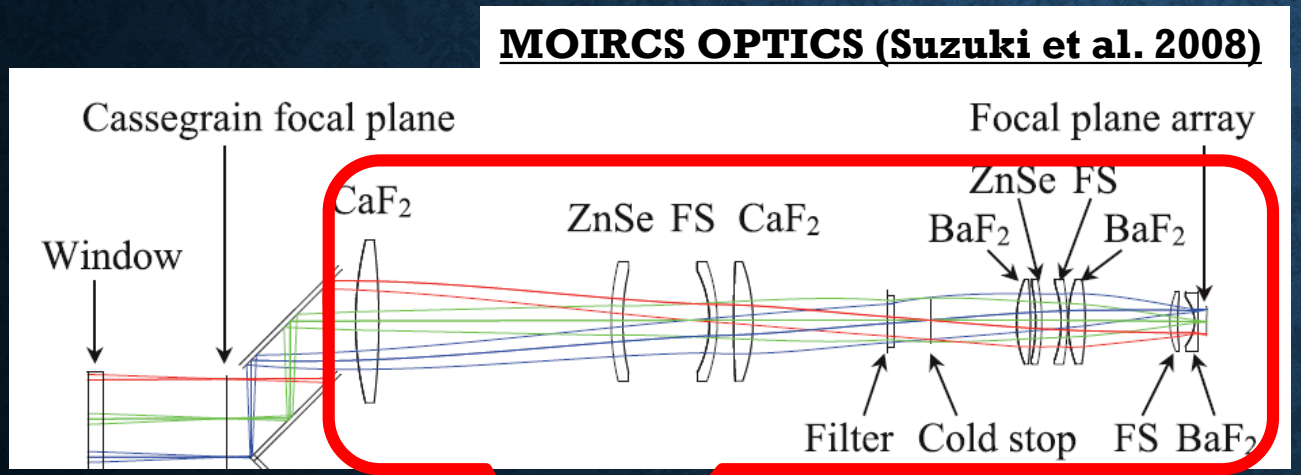


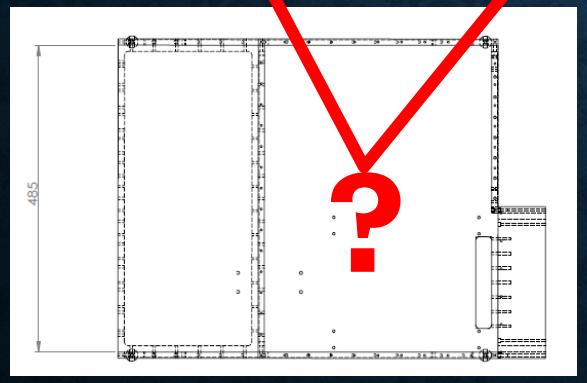


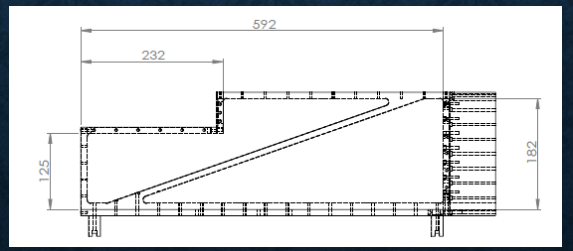
OPTICS – (BASICALLY) SAME AS MOIRCS

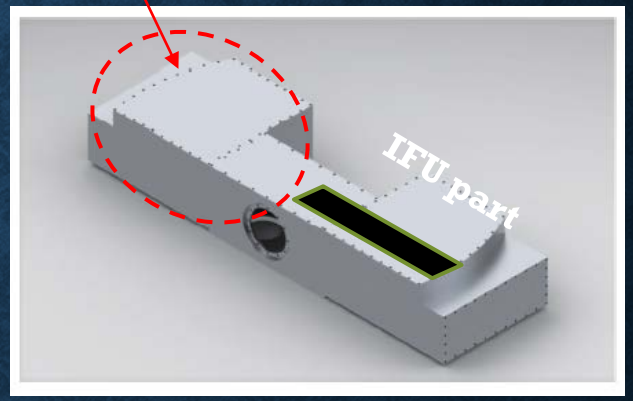
→ Can keep the original IFU specification

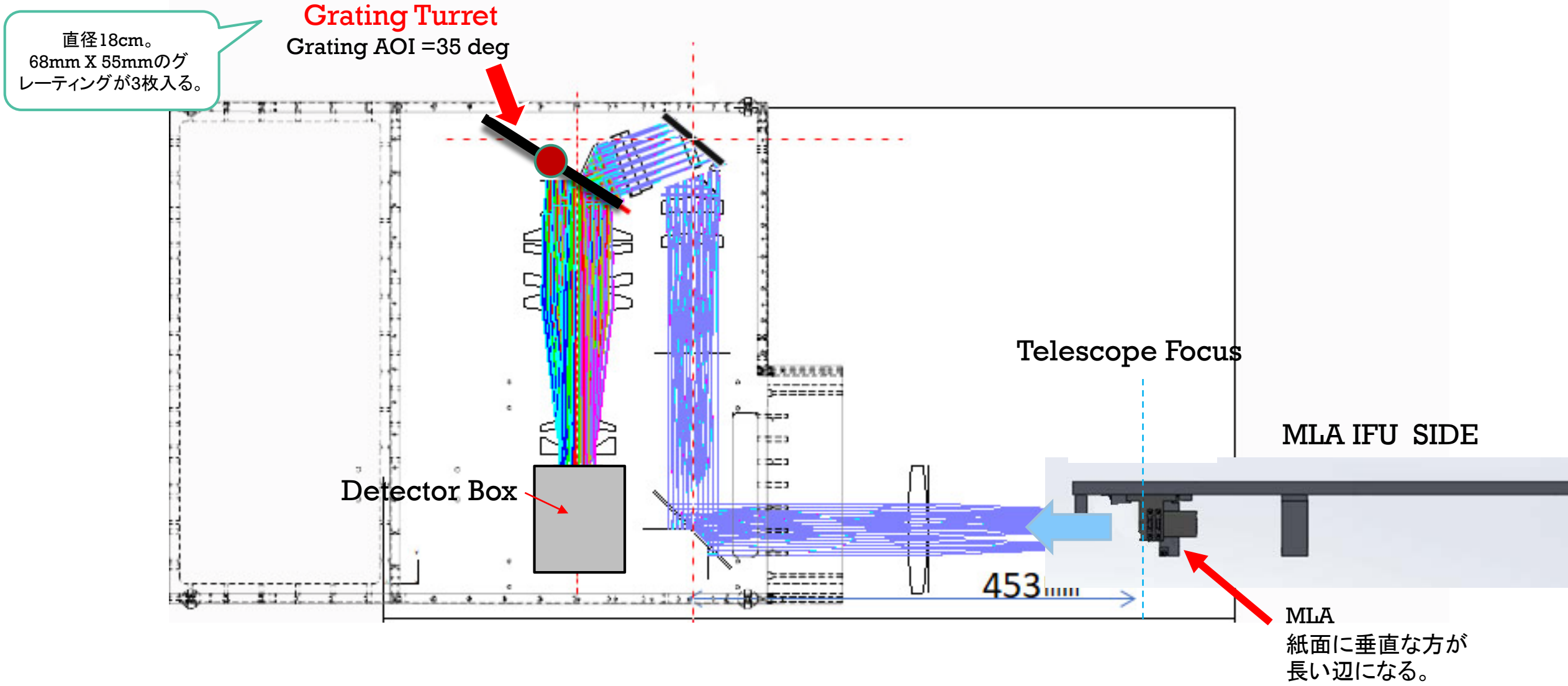
Would these lenses fit in the minilab space?









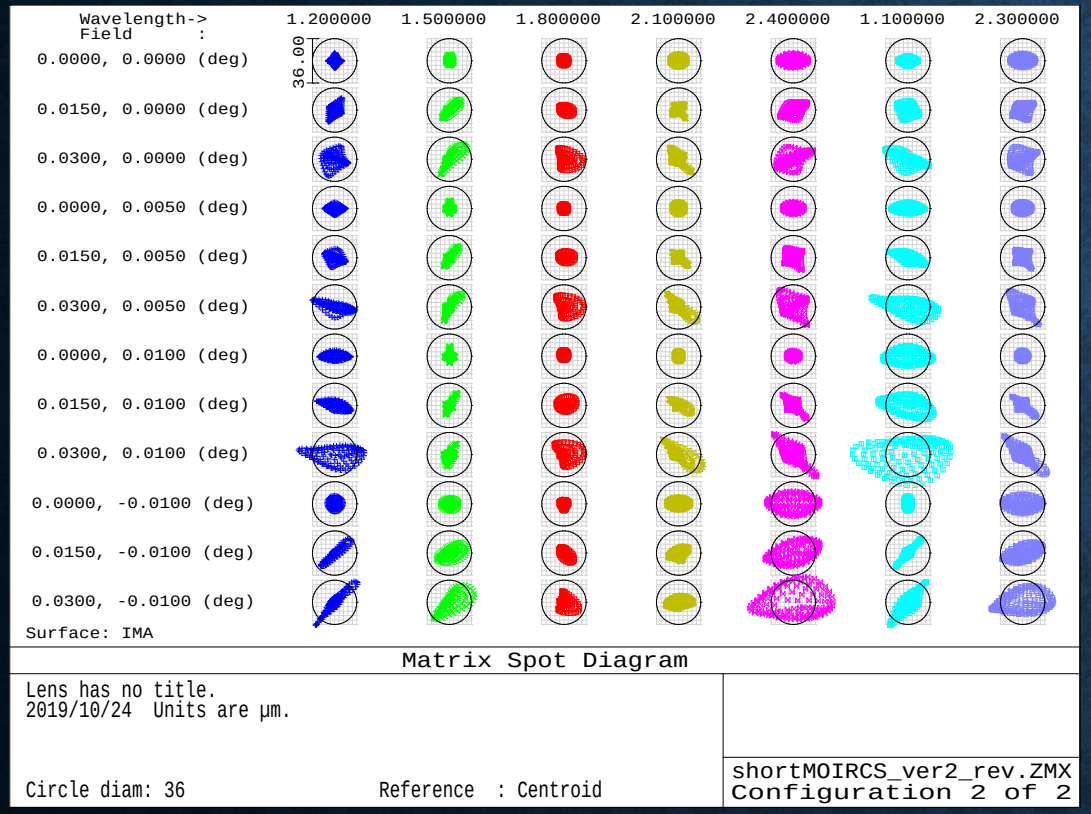


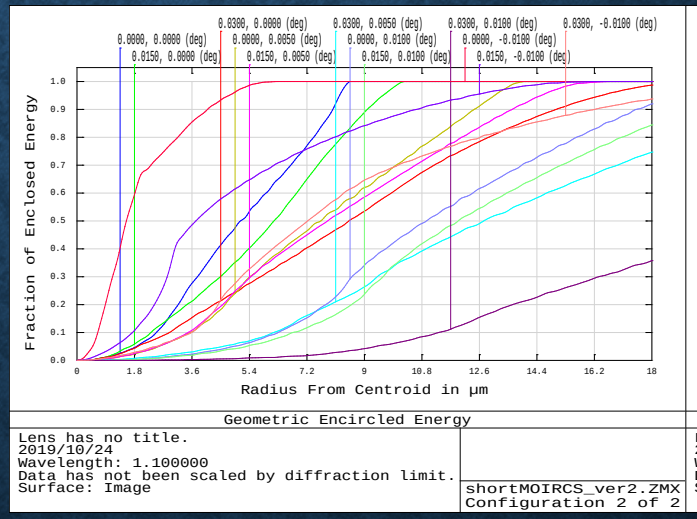
OPTICS CAN FIT INTO MINILAB!

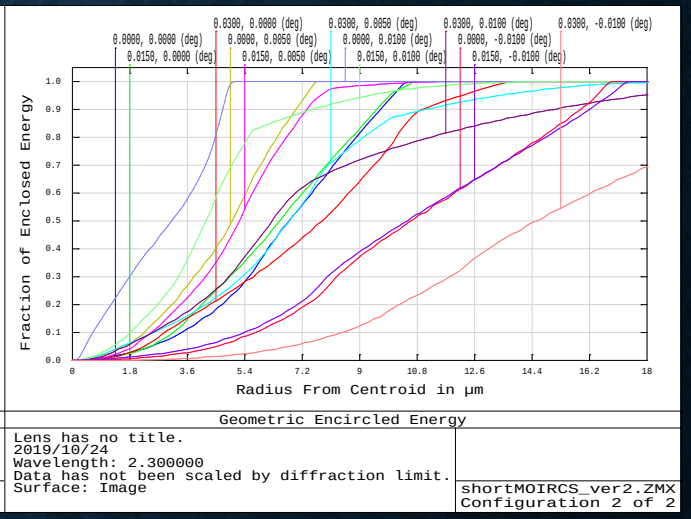
スポット性能

カメラ系の端を通る、1.1umと2.4umでのスポット性能が悪い。

＊ ただし、MOIRCSの分光結像性能が元々悪く、コリメータの修正で悪化したのではない。



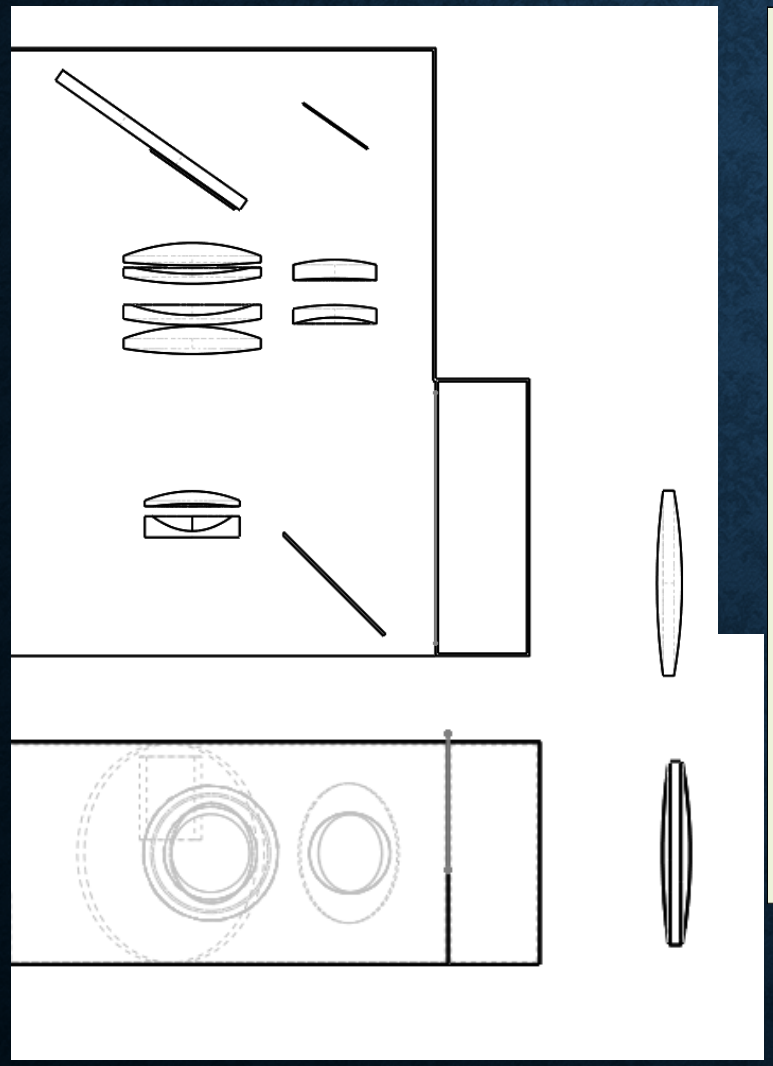


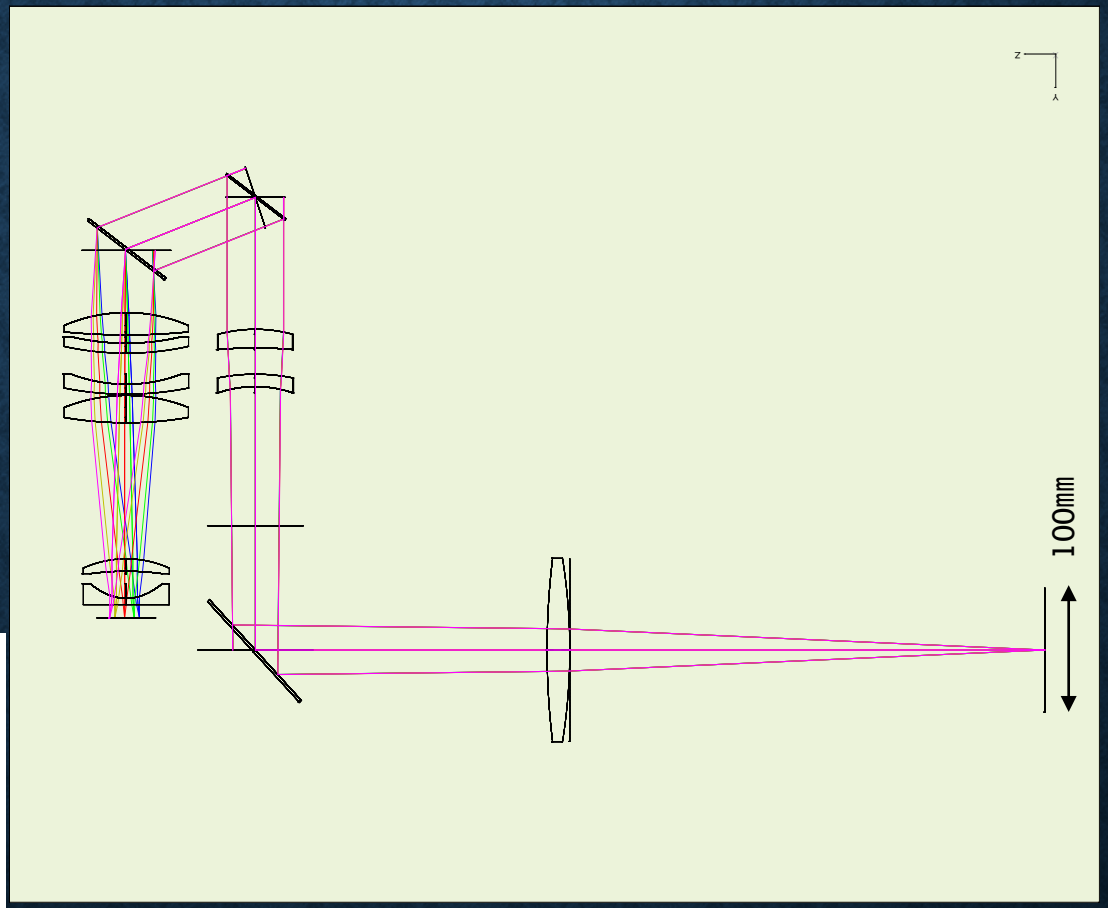


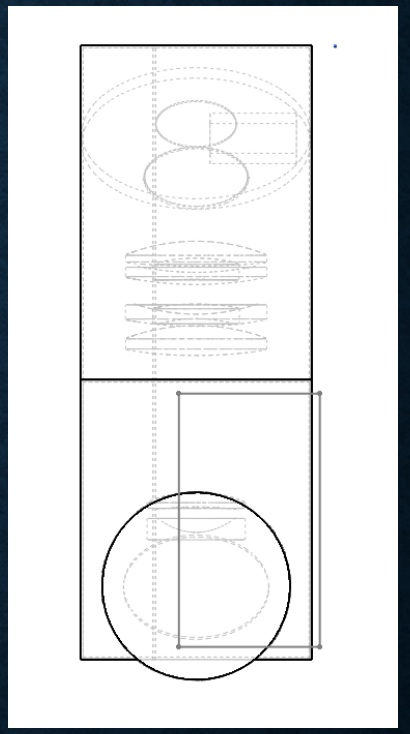
encircled energy (半径)。右端が18um=1pix.
左図@1.1um　右図@2.4um
視野端の一部を除き、80%EEはほぼ2pix以下。

十分再設計の余地あり。特にカメラ部。

MORE IMPROVEMENT NOW ON-GOING







Changing the desigin of Camera Section would be better.
Work by Yoko Tanaka

EXPECTED THROUGHPUT

MLA side --- 3 lenses, 3 mirrors
Spectrograph side --- 10 lsenses, 2 mirrors, 1 grating.
Assuming 0.995 for lenses and mirros.

→SNIFF would have ~90% efficiency!

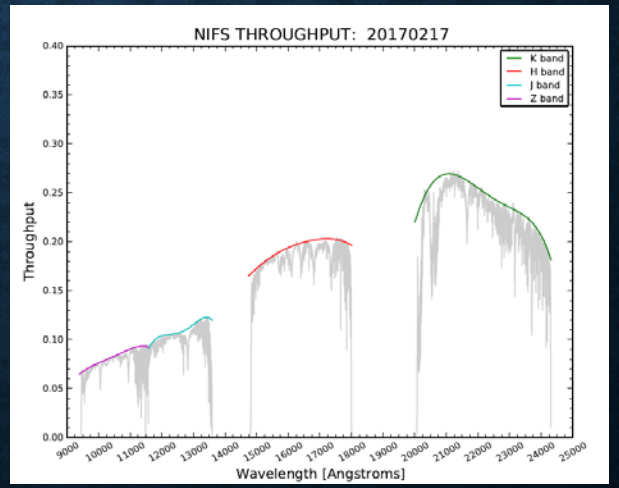
+ detector, telescope, sky, AO.

→ **Total Throughput = 54% !!**

SNIFF CAN BE **THE** MOST POWERFUL IFU MACHUNE!

cf.

- NIFS ~ 10% @ J, 25%@K
- SINFONI ~ 25% JHK
- OSIRIS ~ 2%@ J, 9%@HK



SUMMARY：早い・安い・多くの利点

- 100Kまで冷える箱が既にある。
- MLA IFUと関連光学系がある。
- **今の最新の高スループット技術を投入できる！**
- NsIRなので装置姿勢が不変　→　凝った作り込み不要。
- **検出器は観測所から借りる**（？インハウスで作れば・・・）。
- グレーティングも開発した遺産をそのまま使うだけ。

基本、光学系などを買ってきて並べたら大体完成。(嘘)

SUMMARY：早く、安く

開発要素: 導入用CCDカメラ、Grating用タレット、レンズホルダ、読み出し系。

上手くいけば・・・

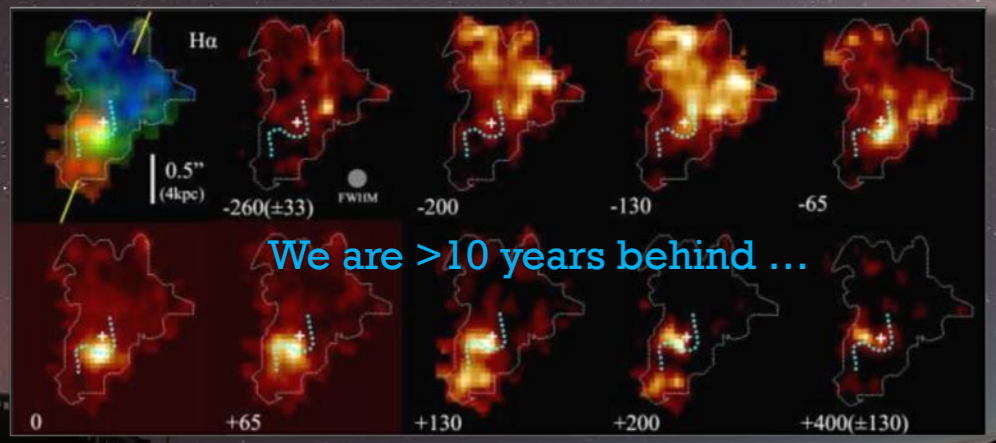
8m鏡の**AOアシスト高スループットIFU装置**として売り込める。

ULTIMATE-Subaruにもフィット。

仲間募集中！

（プロジェクトを引っ張る人特に。）

END



We are >10 years behind …

Genzel et al. 2006, Nature, 442, 786