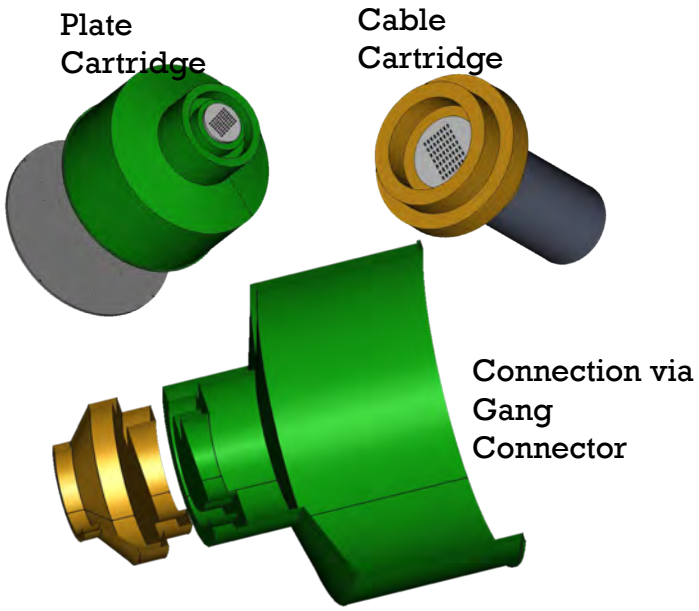
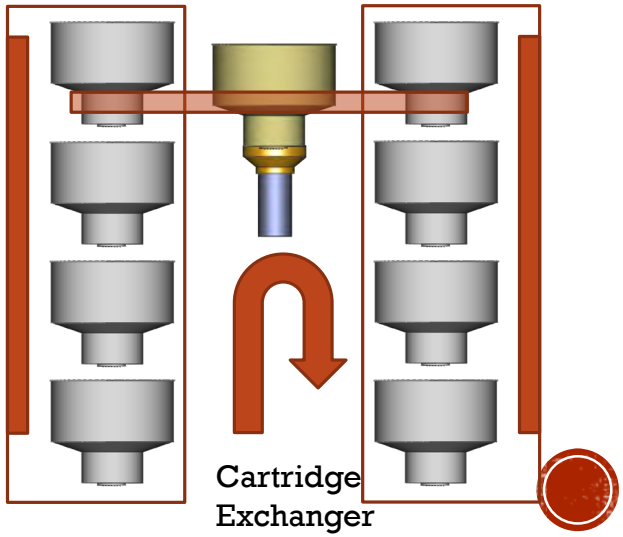
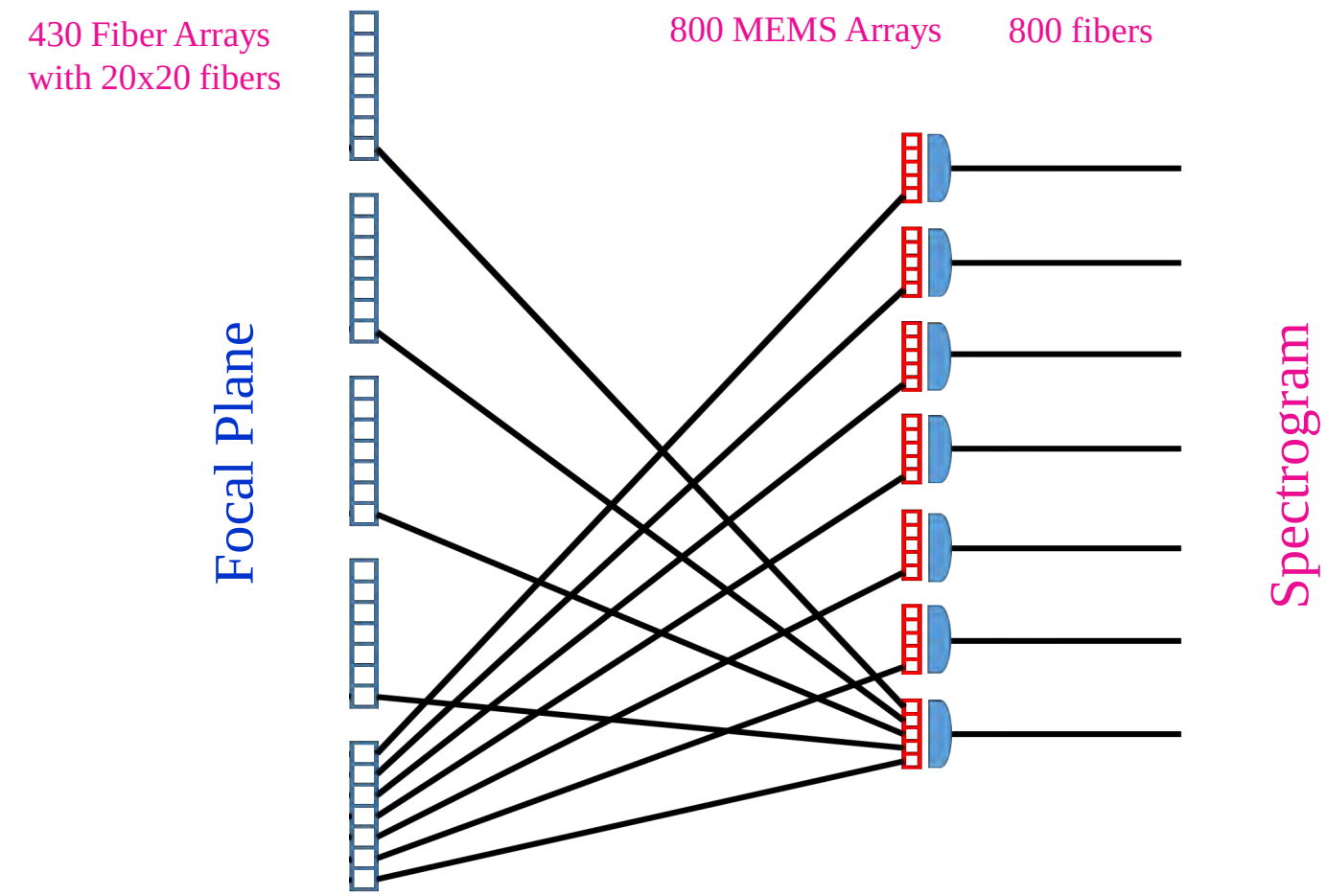
2.2 – ALTERNATIVE POSITIONER

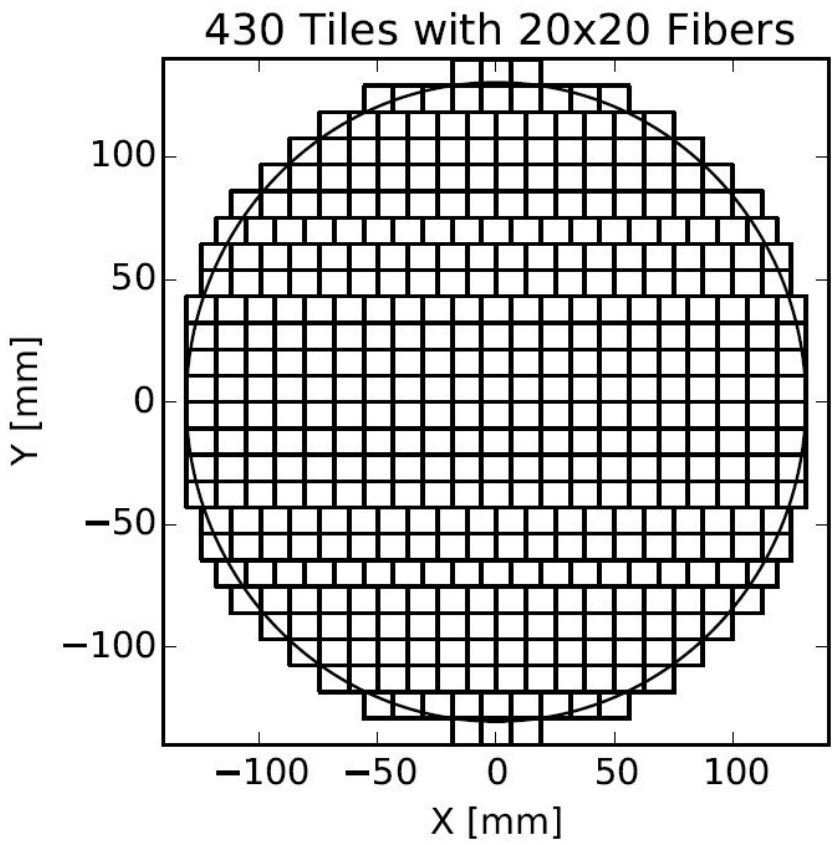
- Provides capability of high multiplexing (> 1,000) single fiber/IFU bundle MOS positioning
- Aimed to use the same space to the MANIFEST, with easy detachability.
- Consists of the following parts:
  - Plate cartridges: contain fiber/IFU bundles which are manually plugged to the focal plate.
  - Cable cartridge: fiber cable interface between plate cartridge and spectrograph through APOGEE-like gang connector.
  - Cartridge exchanger: a device to change field configuration from preinstalled plate cartridges.

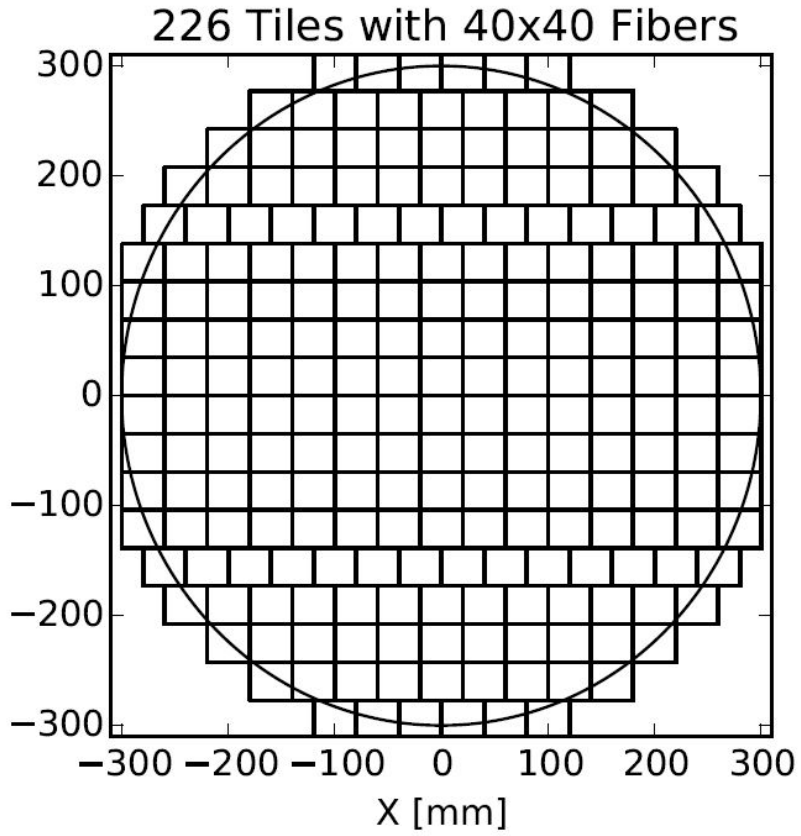




Gemini Case


430 Fiber Arrays
with 20x20 fibers
800 MEMS Arrays
800 fibers
Focal Plane
Spectrogram
앞단 micro lense:
F16/8.5 -> F3/4
광섬유 재배치
앞단 micro lense: 평행광
뒷단 micro lense: focusing
광섬유 코어 지름
150/400mm





Gemini

172,000 fibers

400 targets

GMT

361,600 fibers

1600 targets

제원

망원경	Gemini	GMT	
관측목표 한계등급	21.9	r=23.5	
FOV	7′	10′	
은하개수/FOV	220+-27	1871+-223	
Fiber diameter	0.7″	0.7″	
Fiber separation	1″	1″	
초점면 광섬유 총개수	172,000	361,600	
FAU 타일 개수	430	226	
FAU 당 입력단 광섬유 개수	20x20	40x40	
입력단 광섬유 코어 지름 (D_{core}^{in})	150 μm	400 μm	
FAU 크기	12.4mm x 10.89mm	40.0mm x 34.6mm	
MEMS 개수	800	1,600	
MEMS 당 입력단 광섬유 개수	430	226	
출력단 광섬유 총개수	800	1,600	
분광기	4k x 1	4k x 2	



CONCEPT DESIGN OF MULTI-OBJECT SPECTROGRAPHS : CASE OF LOAO



Changbom Park (KIAS)

with Sungwook E. Hong (UoS), Haeun Chung (SNU/KIAS), Ho Seong Hwang (KASI),

Survey Science Workshop @ High-1 Resort. 2019. 2. 20-23



Q. ARE EXTREMELY LARGE TELESCOPES THE OMNIPOTENT EQUIPMENT FOR ASTRONOMY?

Proposed GMT Instruments (limited by budget)

Natural Seeing Instruments

	Instrument	Capability	
★	GMACS	Visible MOS (R~3,000); 4.5' x 9' FoV	Natural
★	G-CLEF	Visible Echelle and precision RV (R ~ 40-100K)	Natural

AO Instruments

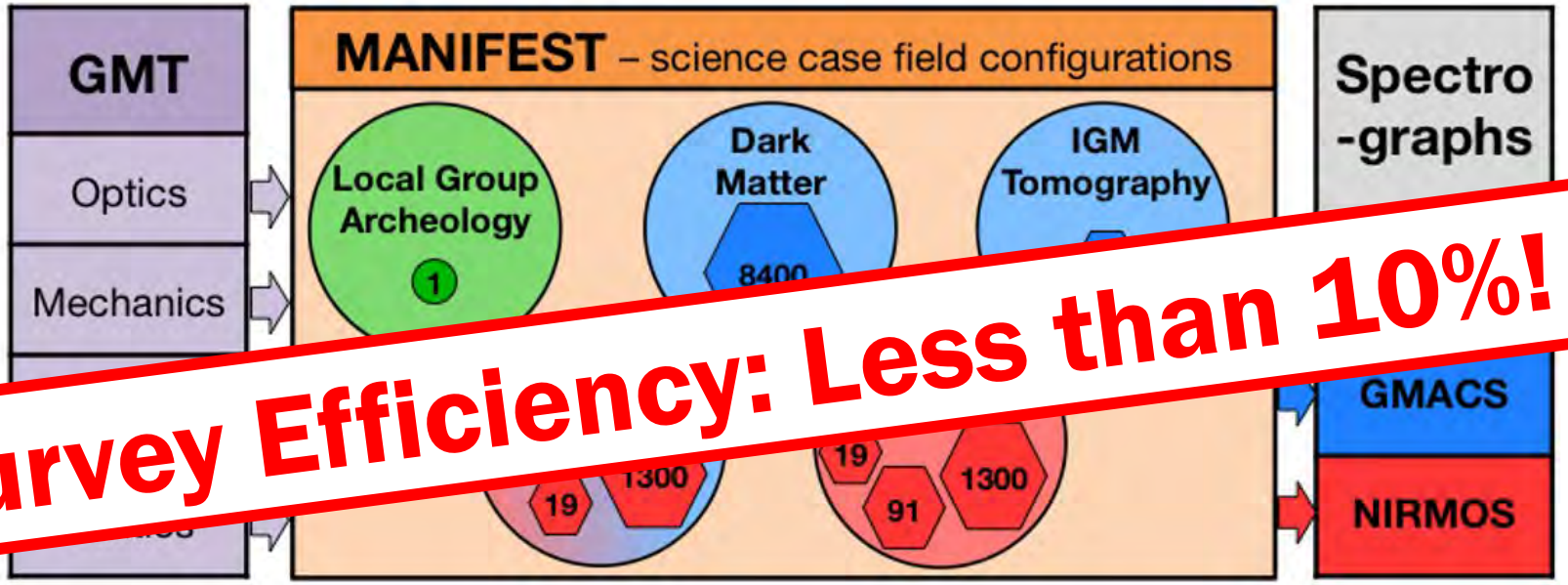
	Instrument	Capability	
★	GMTNIRS	JHKLM Echelle (R=50-100K)	LTAO, NGSAO
★	GMTIFS	JHK Integral Field Spectrograph / Imager (R=5-10K)	LTAO, NGSAO

Plus a robotic fiber feed: MANIFEST (AAO)

★ Included in implementation plan under development

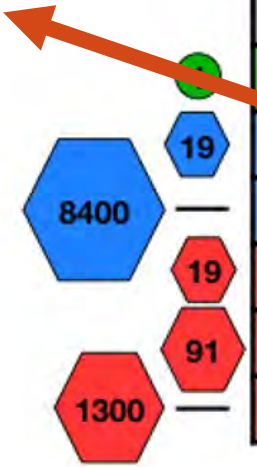
Modification of (c) Byeong-Gon Park, KASI

MANIFEST Science



Survey Efficiency: Less than 10%!

Reduced by 1/4!

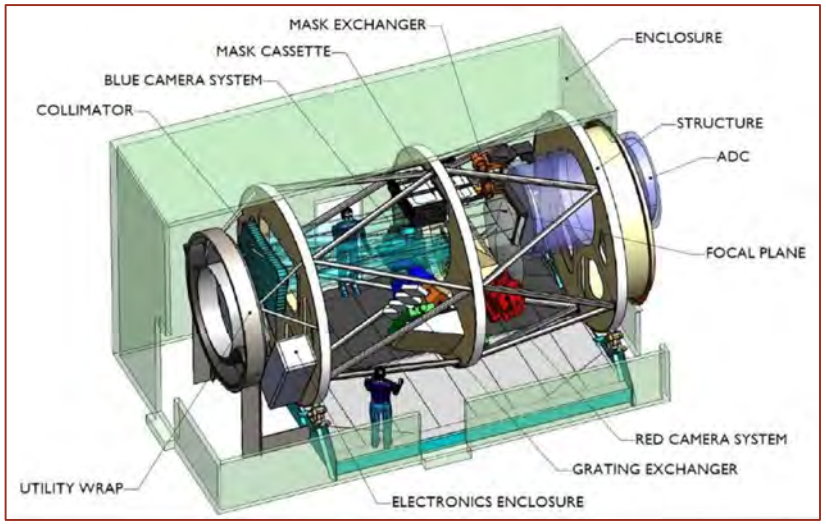


spectro -graph	# starbugs/IFUs in configuration	# fibres per starbug or IFU	field of view of starbug/IFU	
G-CLEF	43/4	1	0.7"	Initial available configurations
GMA[illegible]	420	19	1.0"	
GMACS	1	8400	23"	
NIRMOS	65	19	1.25"	Potential additional configurations
NIRMOS	14	91	2.75"	
NIRMOS	1	1300	9"	

(c) Australian Astronomy Observatory

HOW ABOUT OTHER ELTS?

© Luc Simard & Brent Ellerbroek



WFOS @ TMT

- FoV: 40.3 arcmin^2
- Multiplex: 200



MOSAIC @ E-ELT

- FoV: 32 arcmin^2
- Multiplex: 200

© E-ELT Consorthium

Concept Design of Multi-Object Spectrographs : Case of LOAO

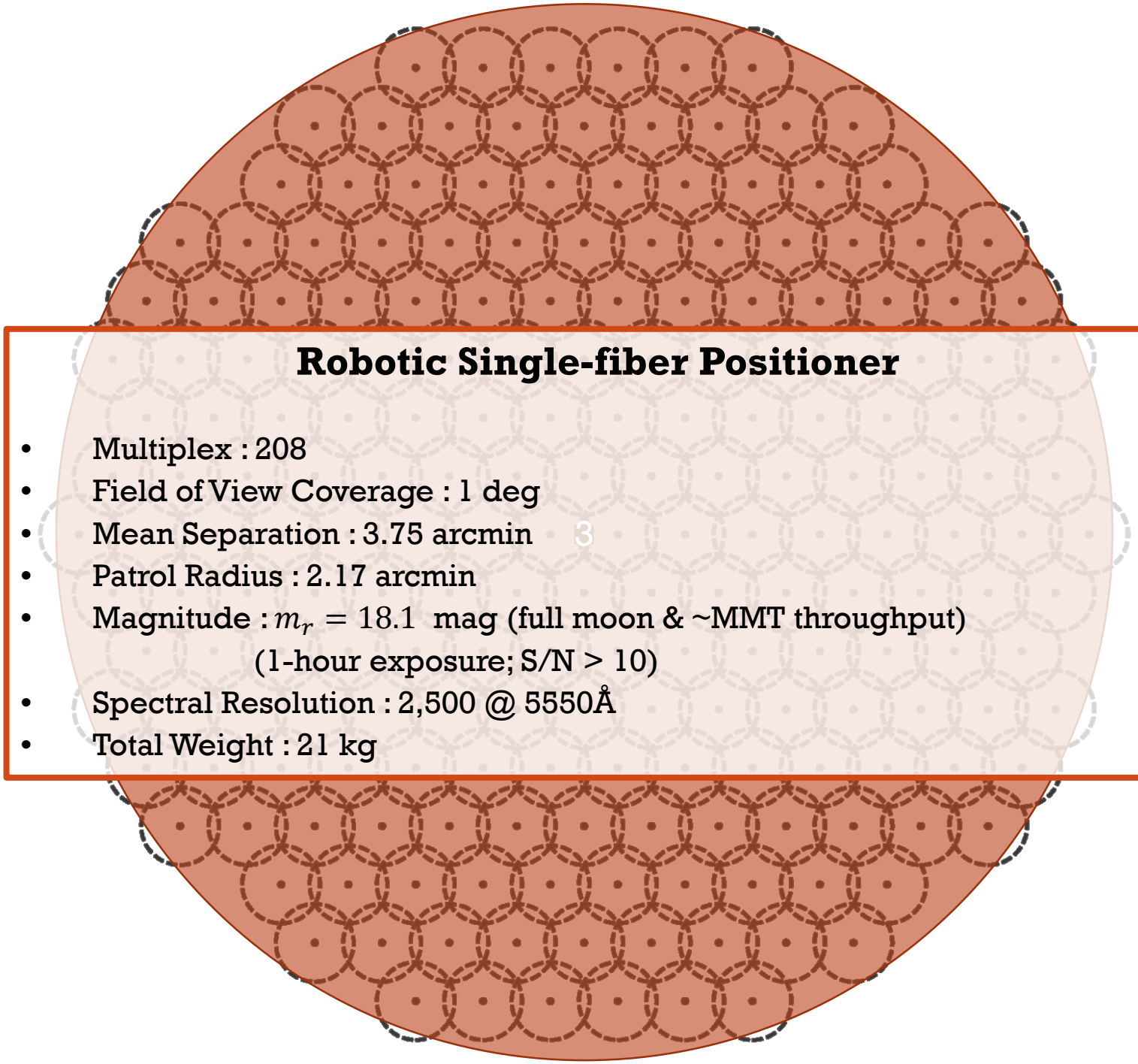
Robotic Single-fiber Positioner

- Multiplex : 208
- Field of View Coverage : 1 deg
- Mean Separation : 3.75 arcmin
- Patrol Radius : 2.17 arcmin
- Magnitude : $m_r = 18.1$ mag (full moon & ~MMT throughput) (1-hour exposure; S/N > 10)
- Spectral Resolution : 2,500 @ 5550Å
- Total Weight : 21 kg

Fixed Central IFU

- Field of View : 56 arcsec x 56 arcsec
- Spatial Resolution : 2.33 arcsec (24 x 24 = 576 pixels)
- Surface Brightness : $\mu_r = 19.8$ mag/arcsec^2 (1-hour exposure; S/N > 10)
- Spectral Resolution : 2,500 @ 5550Å

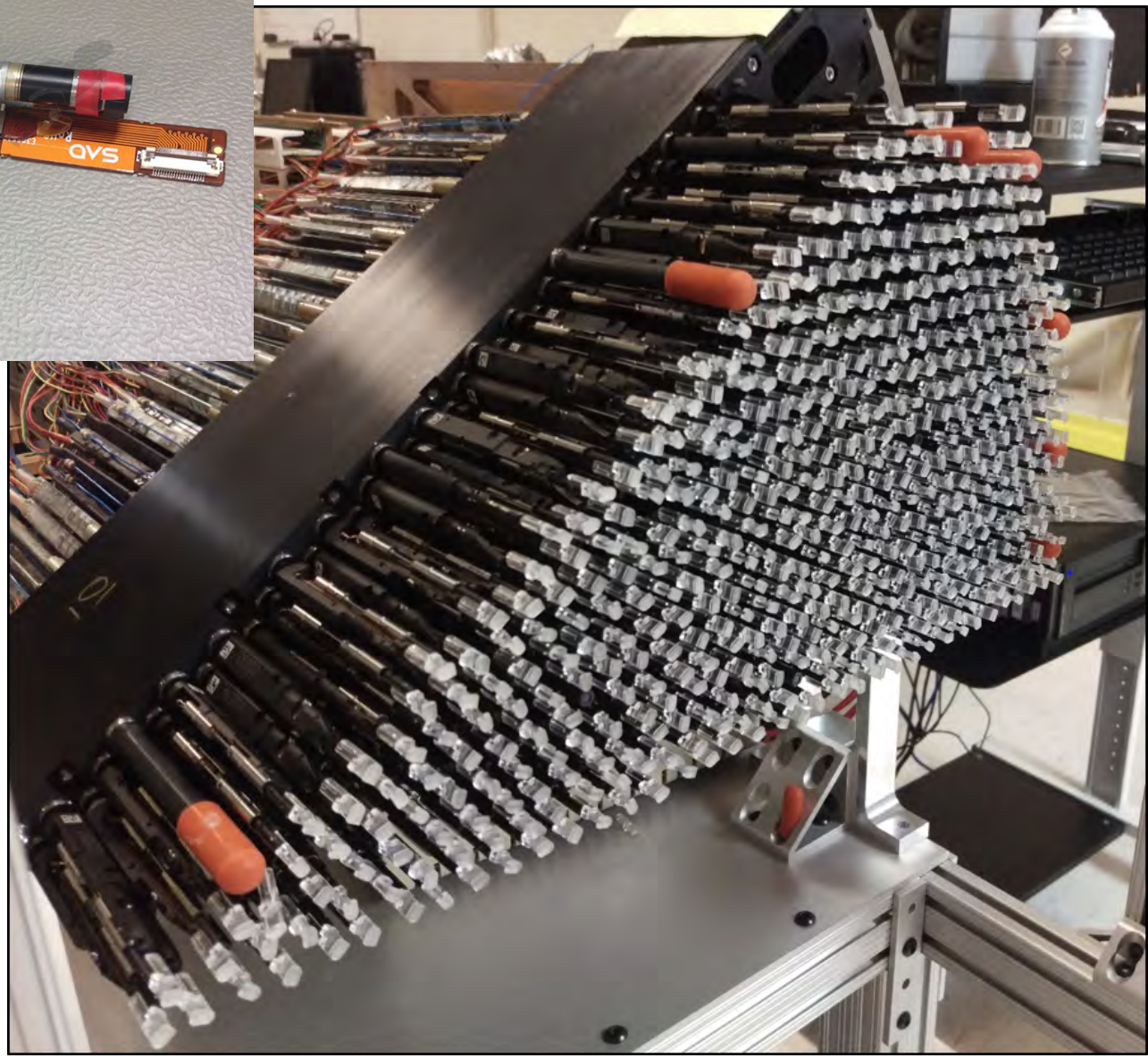


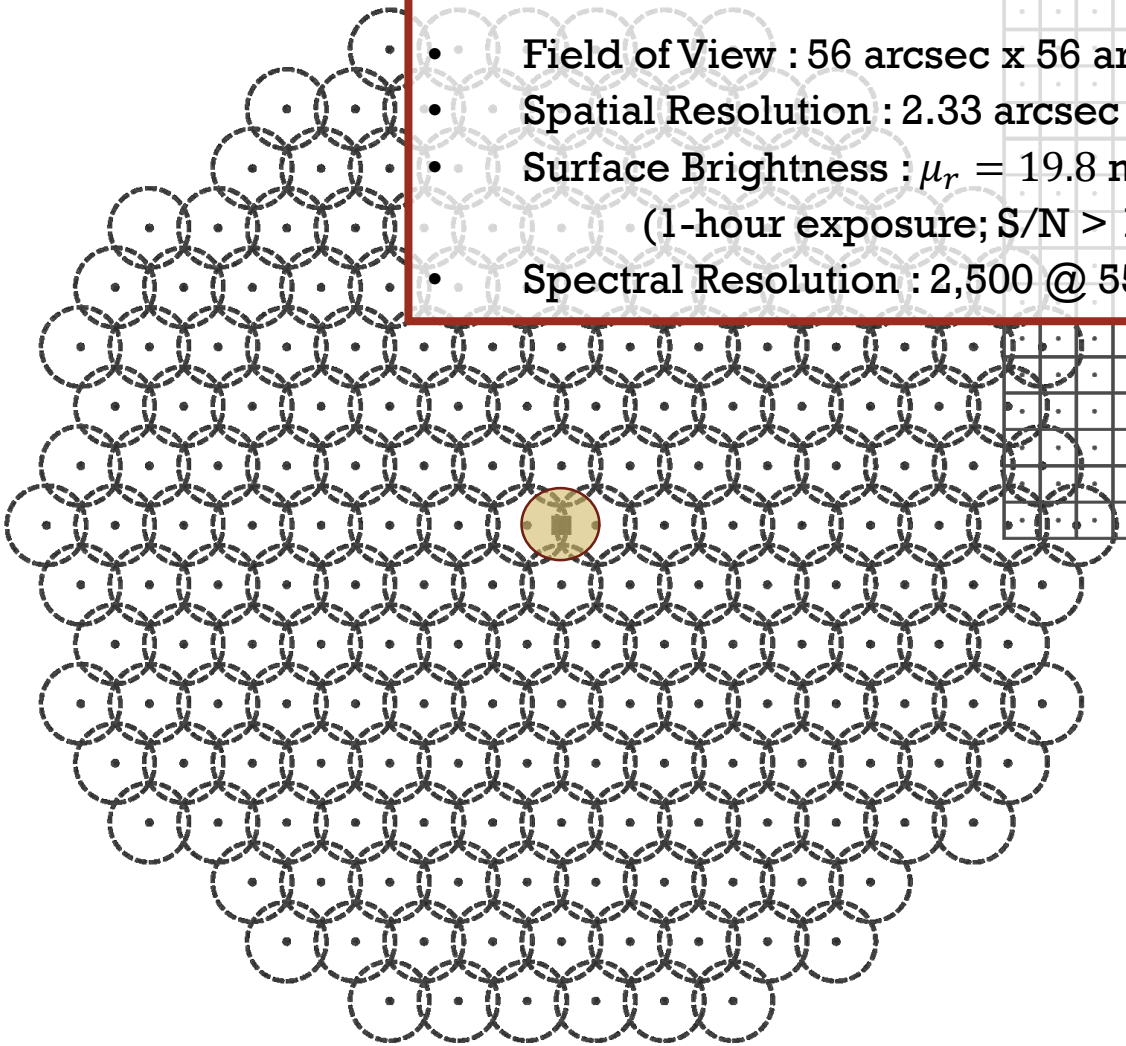


Robotic Single-fiber Positioner

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  (1-hour exposure; S/N > 10)
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- Total Weight : 21 kg


QVS





Fixed Central IFU

- Field of View : 56 arcsec x 56 arcsec
- Spatial Resolution : 2.33 arcsec
- Surface Brightness : $\mu_r = 19.8$ mag/arcsec^2
  (1-hour exposure; S/N > 10)
- Spectral Resolution : 2,500 @ 5550Å

SPECTROGRAPHS

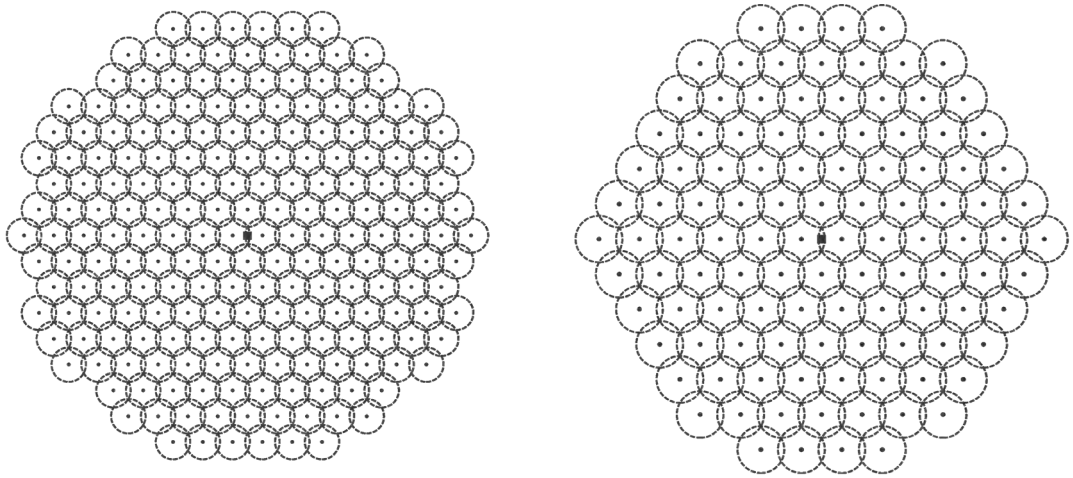
Dimensions (estimation)	$130 \times 150 \times 50\ \mathrm{cm}^3$
Camera f/#	f/1.6
CCD	E2V CCD44-82 2048 x 4096 pixels 15 μm/pix
Wavelength	3,700 ~ 7,400Å $R = 2{,}500$ @ 5,550Å
Fibers per Spectrograph	392
# Spectrographs	2

COST ESTIMATION

Part	Price/Unit (USD)	Number of Units	Total (USD)
Fiber Positioner	3 k	208	0.6 M
Spectrograph	400 k	2	0.8 M
Fiber + Microlens	-	-	0.1 M
Total	**-**	**-**	**1.5 M**

ALTERNATIVE DESIGN #1

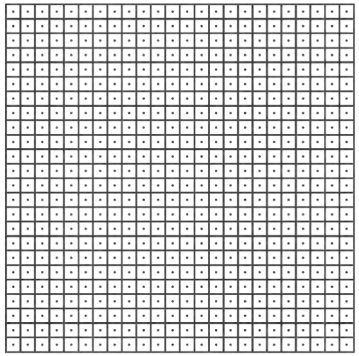
- Number of single-fiber multiplex : 208 → 110
- Mean Separation : 3.75 arcmin → 5 arcmin
- Patrol Radius : 2.17 arcmin → 2.89 arcmin
- Total Weight : 21 kg → 11 kg
- # Fiber per Spectrograph : 392 → 343
- Total Cost (est) : USD 1.5M → 1.2M

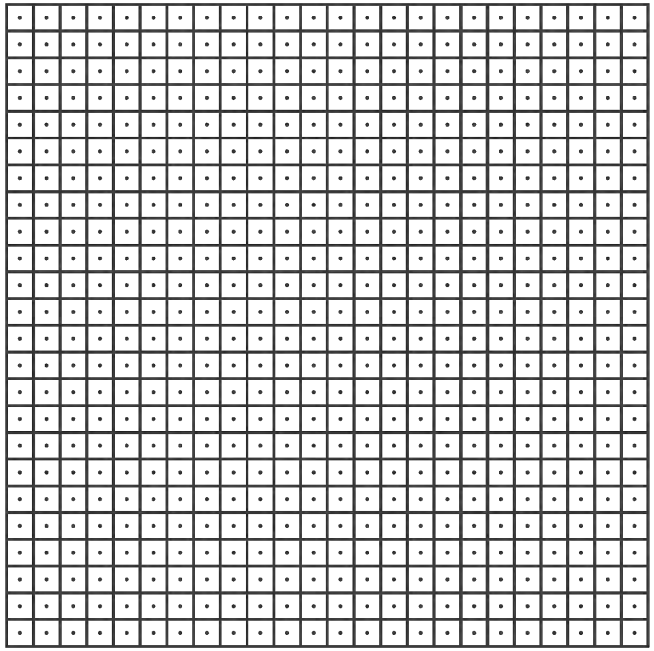


ALTERNATIVE DESIGN #2

- FoV of Central IFU : (56 arcsec)^2 → (1.74 arcmin)^2

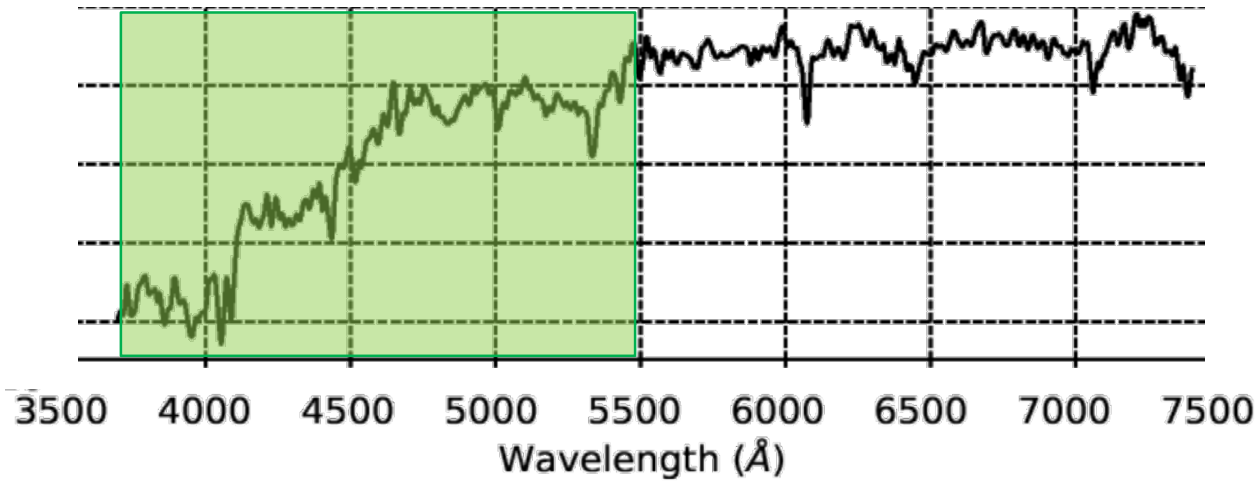
- Spatial Resolution : 2.33 arcsec → 4.36 arcsec



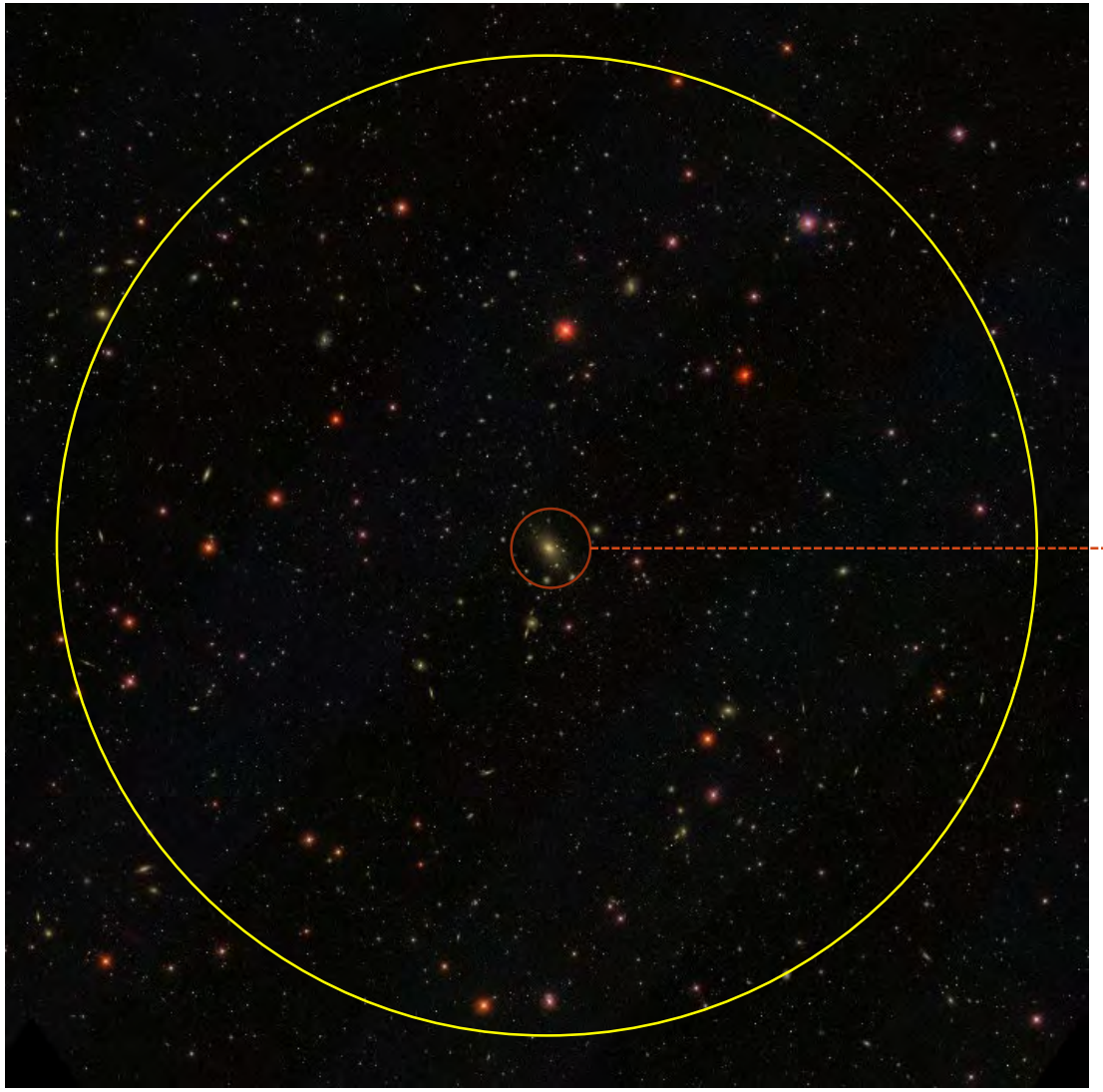


ALTERNATIVE DESIGN #3

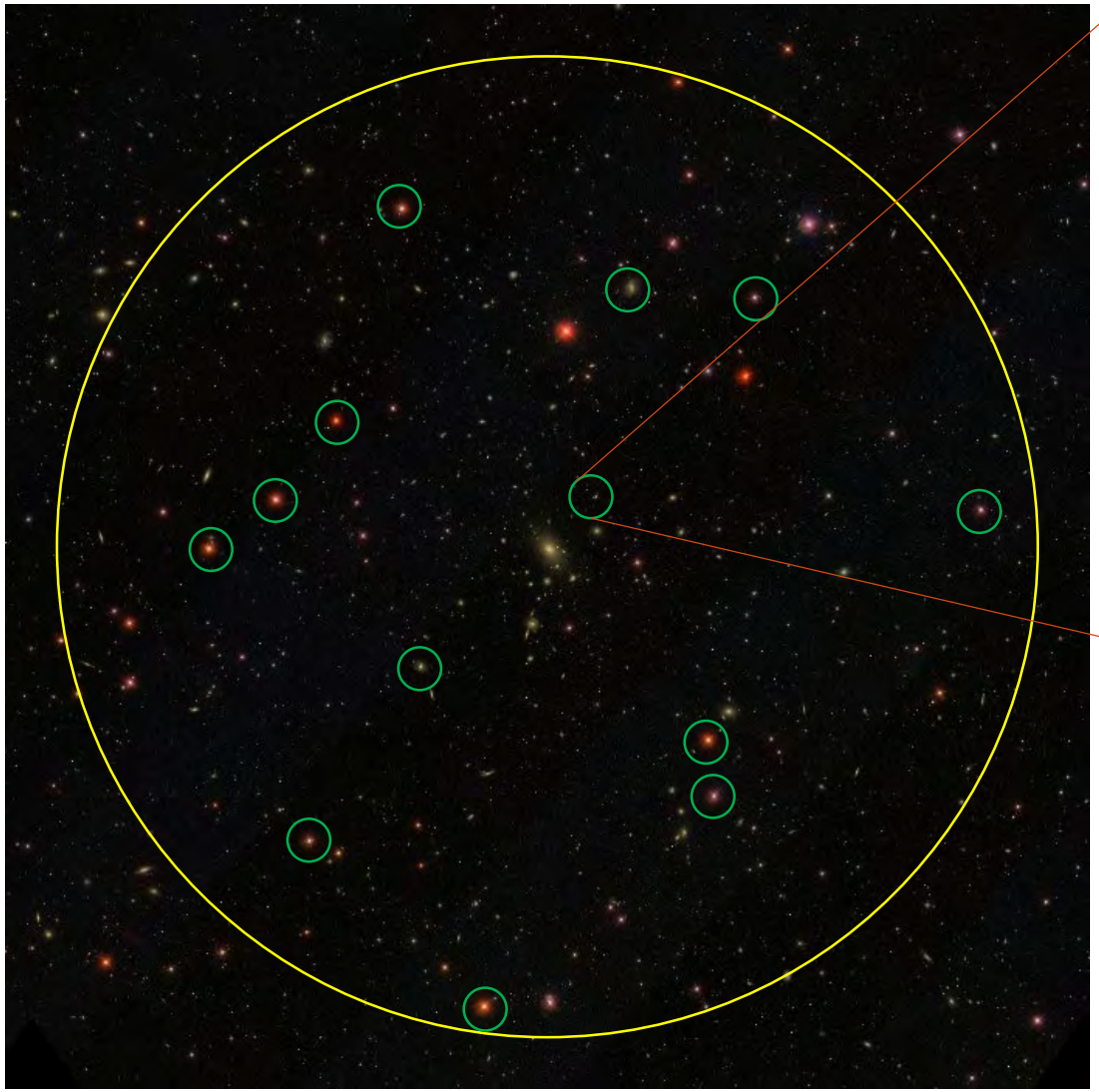
- Central Spectral Resolution : 2,500 → 4,200
- Spectral Coverage : 3,700~7,400Å → 3,700~5,500Å

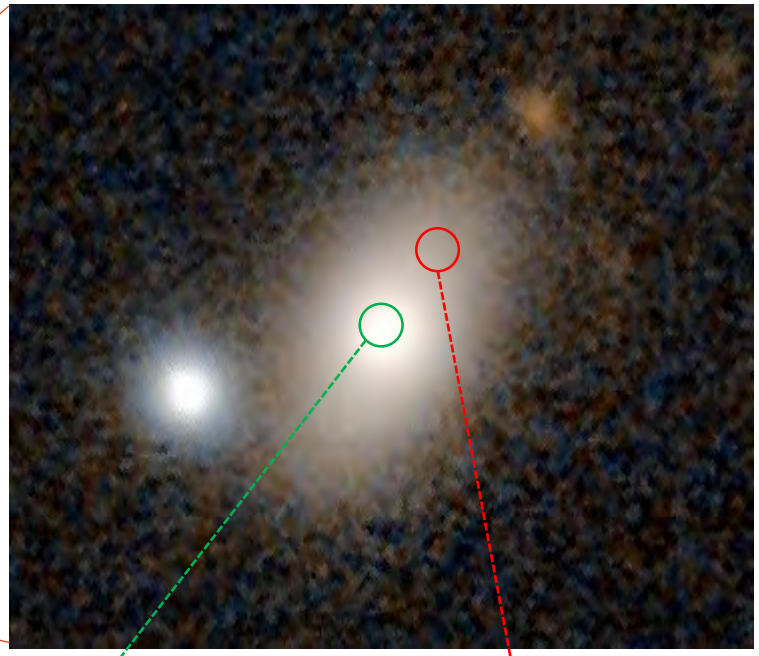


A SCIENCE CASE: SPECTROSCOPIC SURVEY OF GALAXY CLUSTERS AT $0.01 \leq z \leq 0.04$



Central IFU
for BCG & Environment

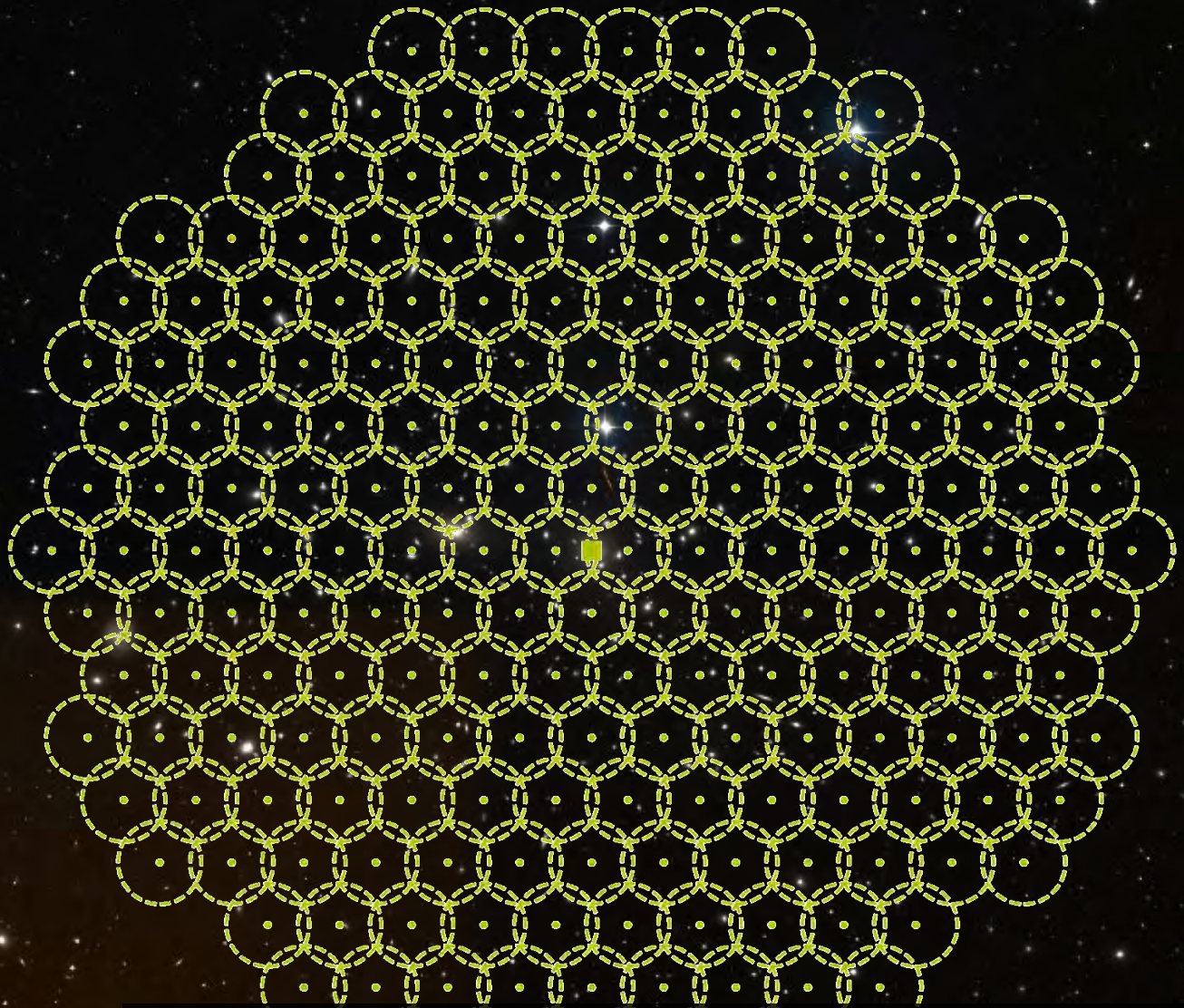




Center
for redshift
(if unknown)

Off-center
for kinematics

Coma Cluster (z = 0.023)



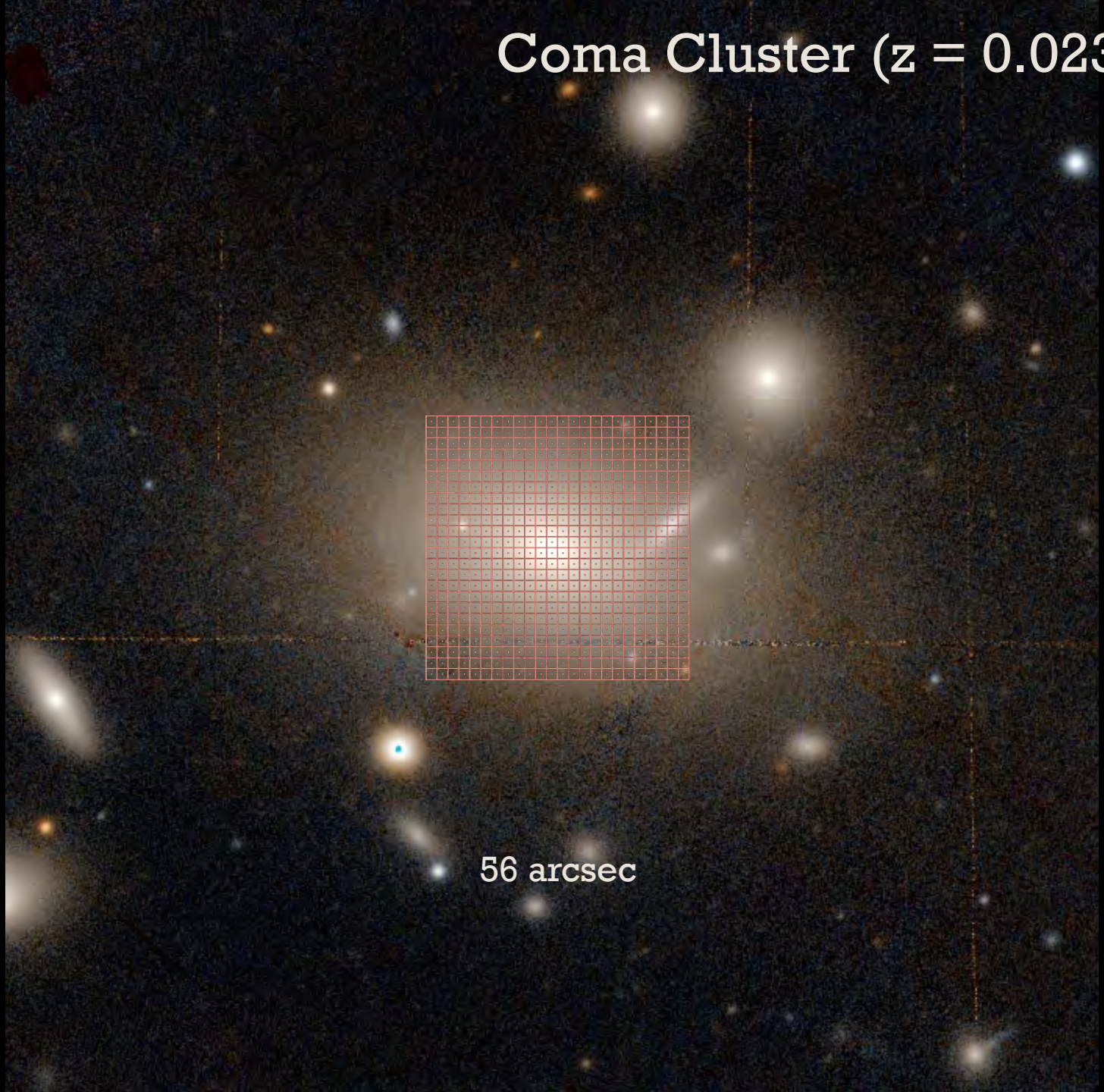
297 SDSS objects with $m_r \leq 17$ mag within 1 deg
118 SDSS objects without NED spec-z

Coma Cluster (z = 0.023)

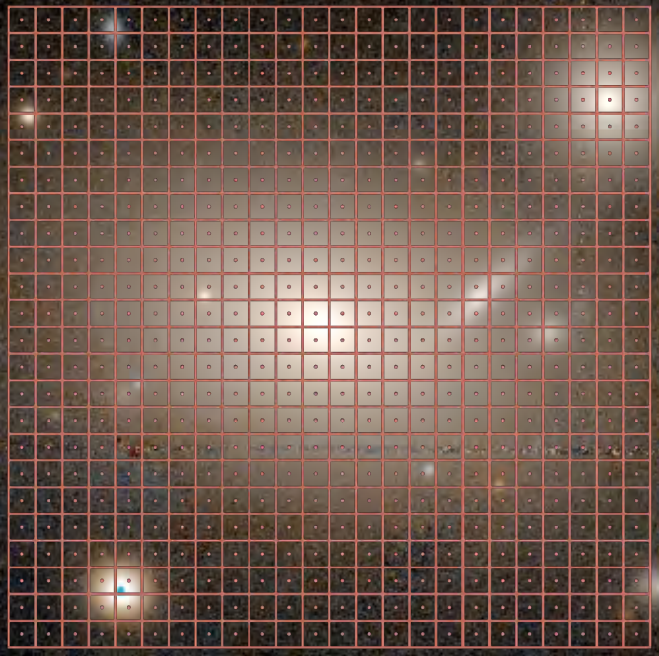


297 SDSS objects with $m_r \leq 17$ mag within 1 deg
118 SDSS objects without NED spec-z

Coma Cluster (z = 0.023)



Coma Cluster (z = 0.023)



1.74 arcmin

Strong community need for large FoV high multiplex MOS

Time is getting late but still not too late.

Identify scientific requirement and develop MOS's

