Algorithms for Starbugs
-Development & Applications(?)

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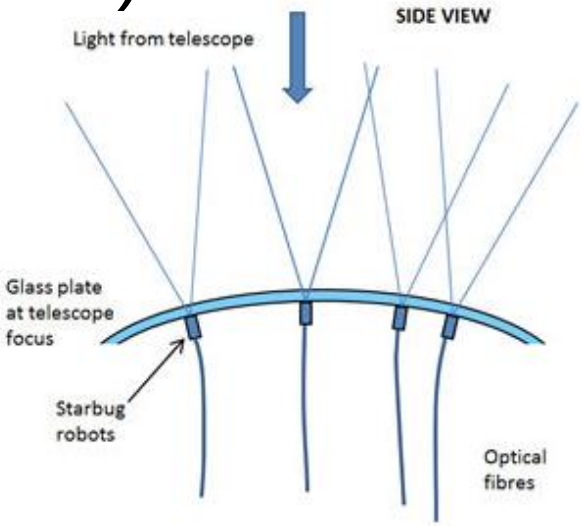
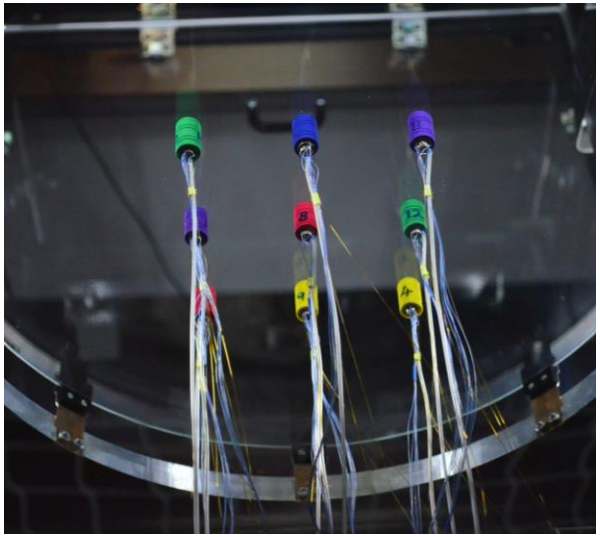
MANIFEST: MANy Instrument FibEr SysTem
Matthew Colless (AAO)

- ~2000 moving Starbugs
- Covers the GMT's full 20' diameter field
- Single-fibre/image-slicer/IFU feeds for NIRMOS/GMACS/G-CLEF
- Higher target multiplex and/or higher spectral resolution
- Configuration time < 3 min
- Object spacing > 10 arcsec

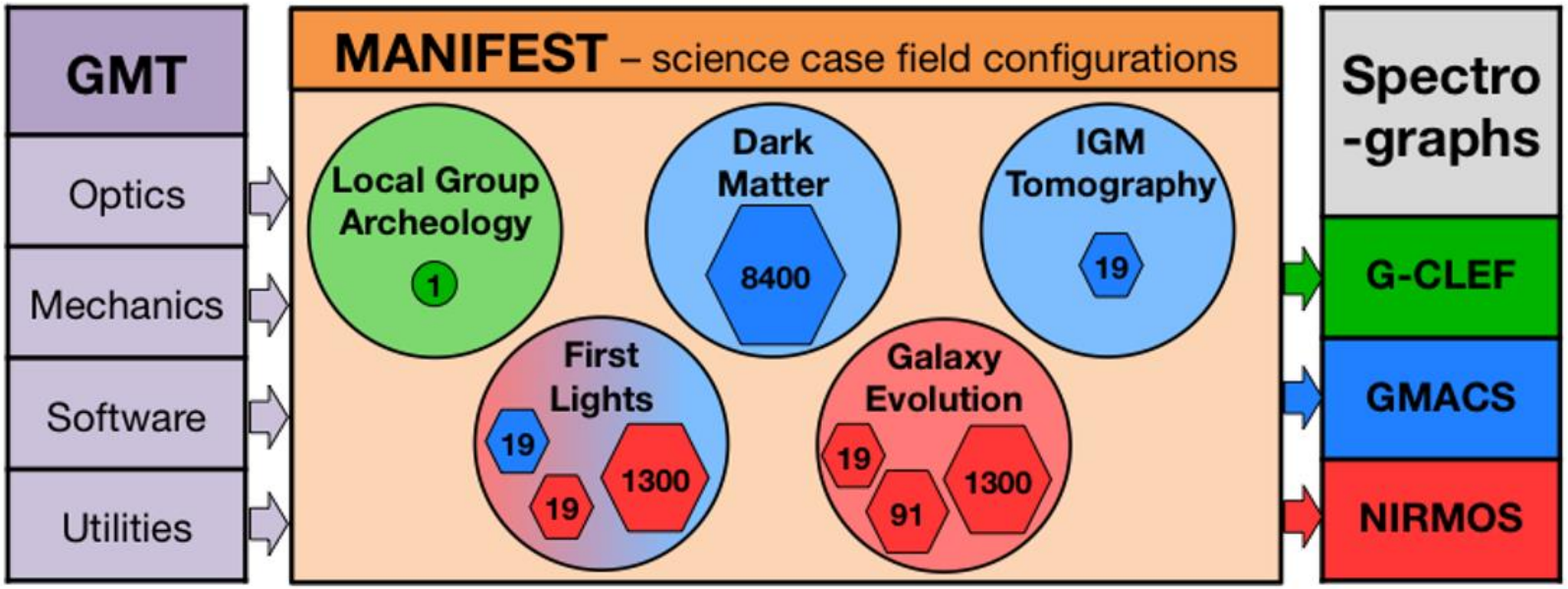


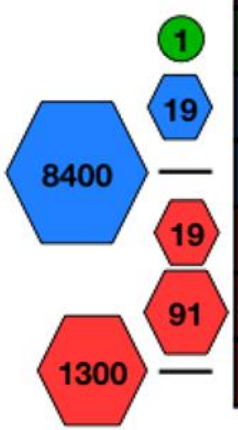


from B.G. Park's slide

Telescope+Instrument	Diam (m)	D^2	AΩ
GMT+MANIFEST	25.4	=1	=1
TMT+WFOS	30	1.4	0.23
E-ELT+DIORAMAS	39.3	2.4	0.39

MANIFEST Science





spectro -graph	# starbugs/IFUs in configuration	# fibres per starbug or IFU	field of view of starbug/IFU
G-CLEF	43/4	1	0.7”
GMACS	420	19	1.0”
GMACS	1	8400	23”
NIRMOS	65	19	1.25”
NIRMOS	14	91	2.75”
NIRMOS	1	1300	9”

Initial available configurations

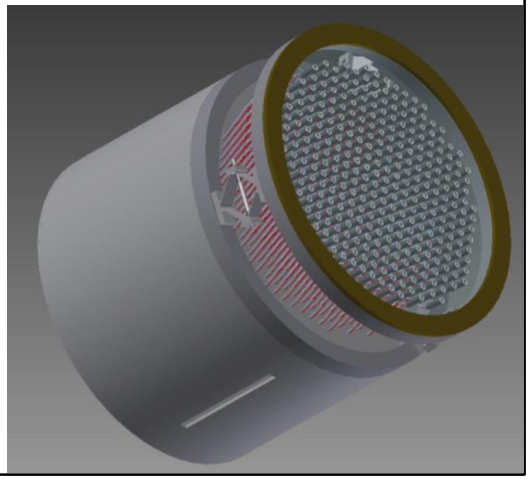
Potential additional configurations

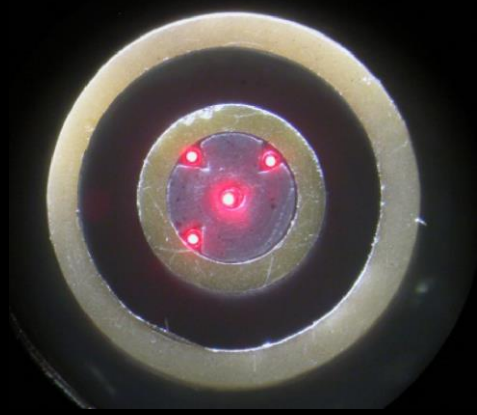
from J. Lawrence’s slide

TAIPAN: A precursor of MANIFEST

- To be installed on UK Schmidt Telescope
- Aimed to observe 0.5M galaxies and 2M stars in 5-year survey
- Number of Starbugs: ~150 (~300 later)
- Field of view: > 6 degree
- R > 2000 with wavelength coverage 370 ~ 870 nm
- Configuration time: < 5 min
- Starbugs diameter: ~9 mm (~ 10′)

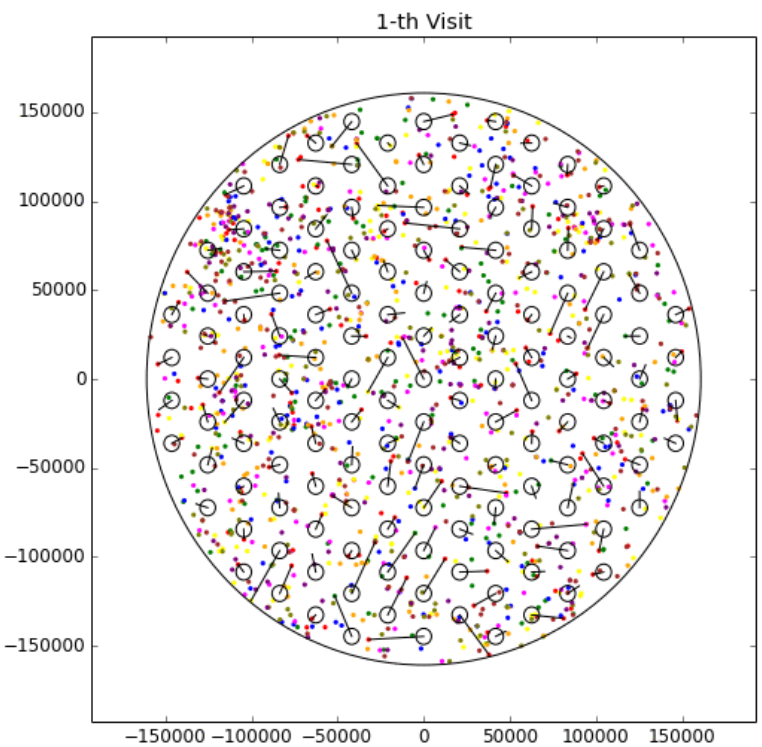
- **~tens of "actual" Starbugs are produced**

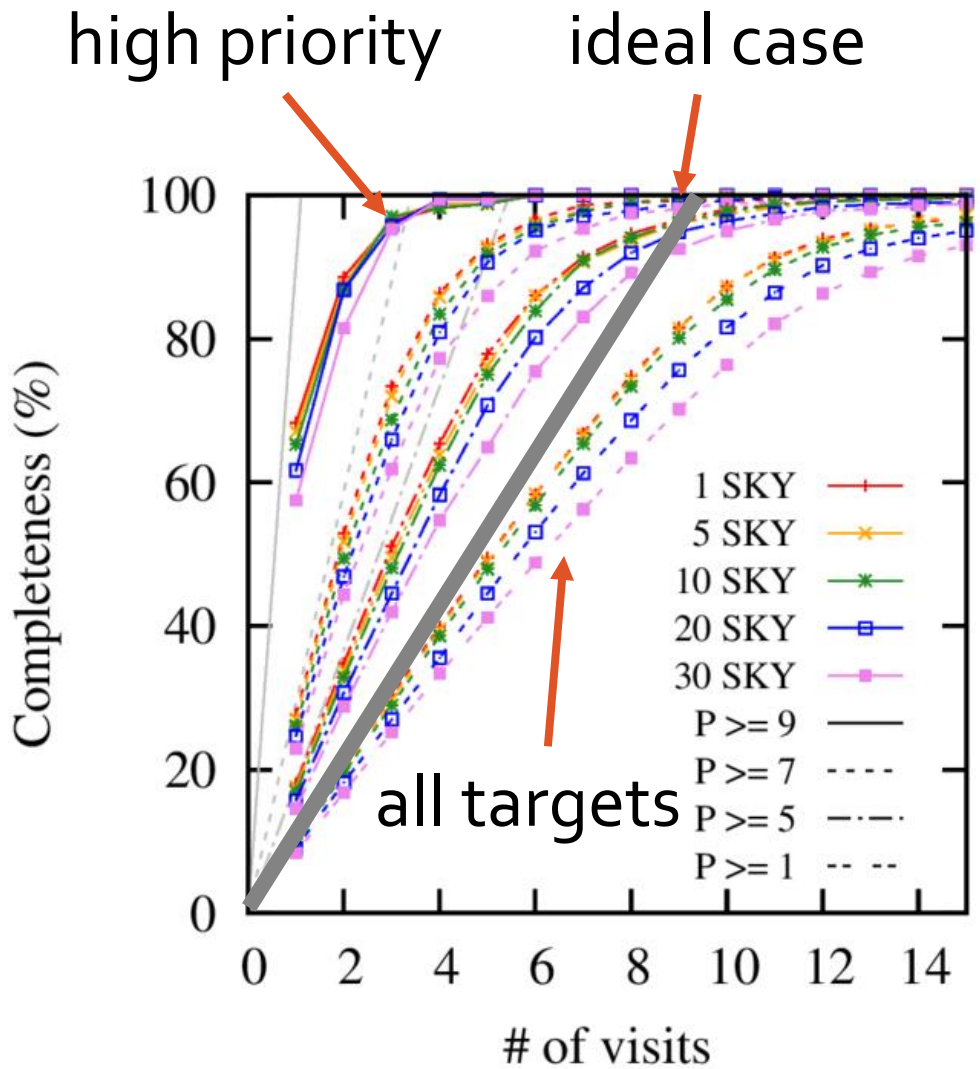




Starbugs Identification

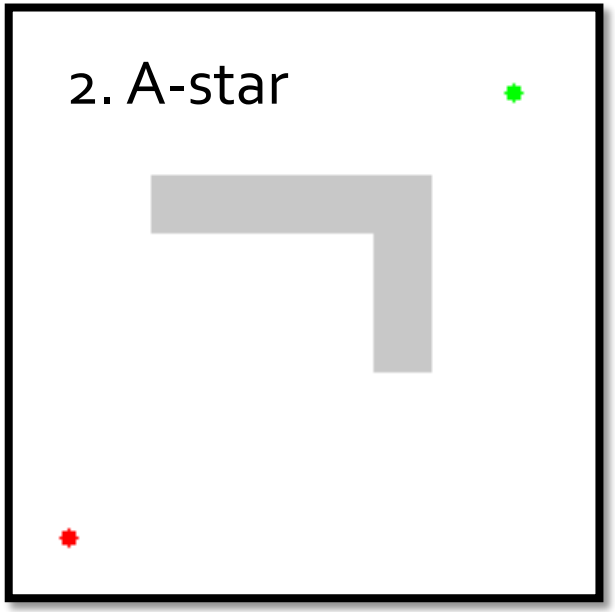
Target Allocation



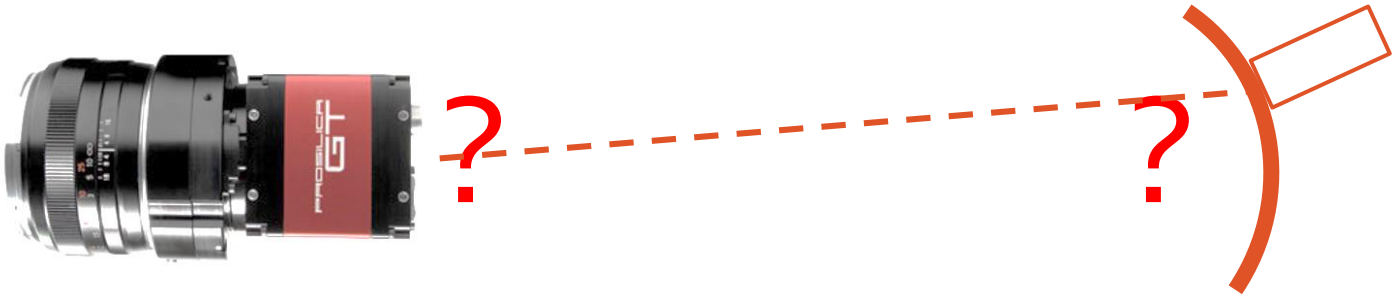


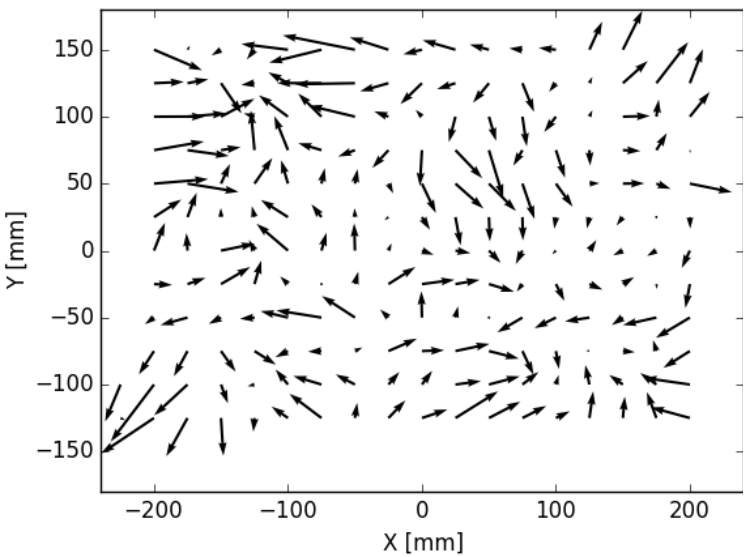
Starbugs Routing

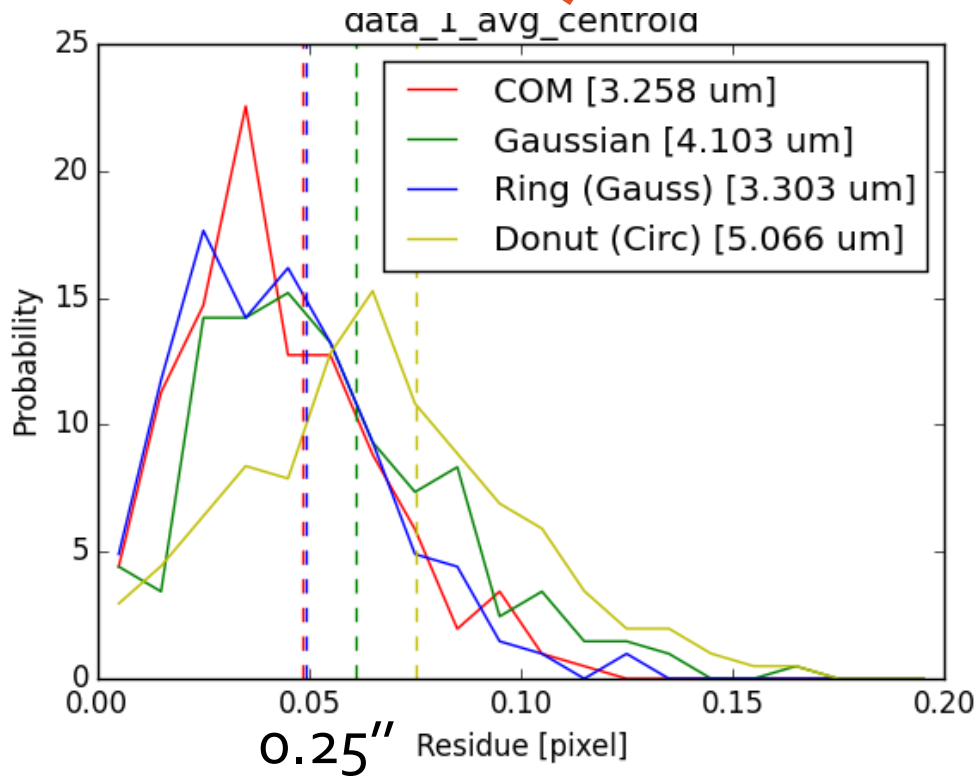
1. Traffic Light



Metrology Camera Calibration

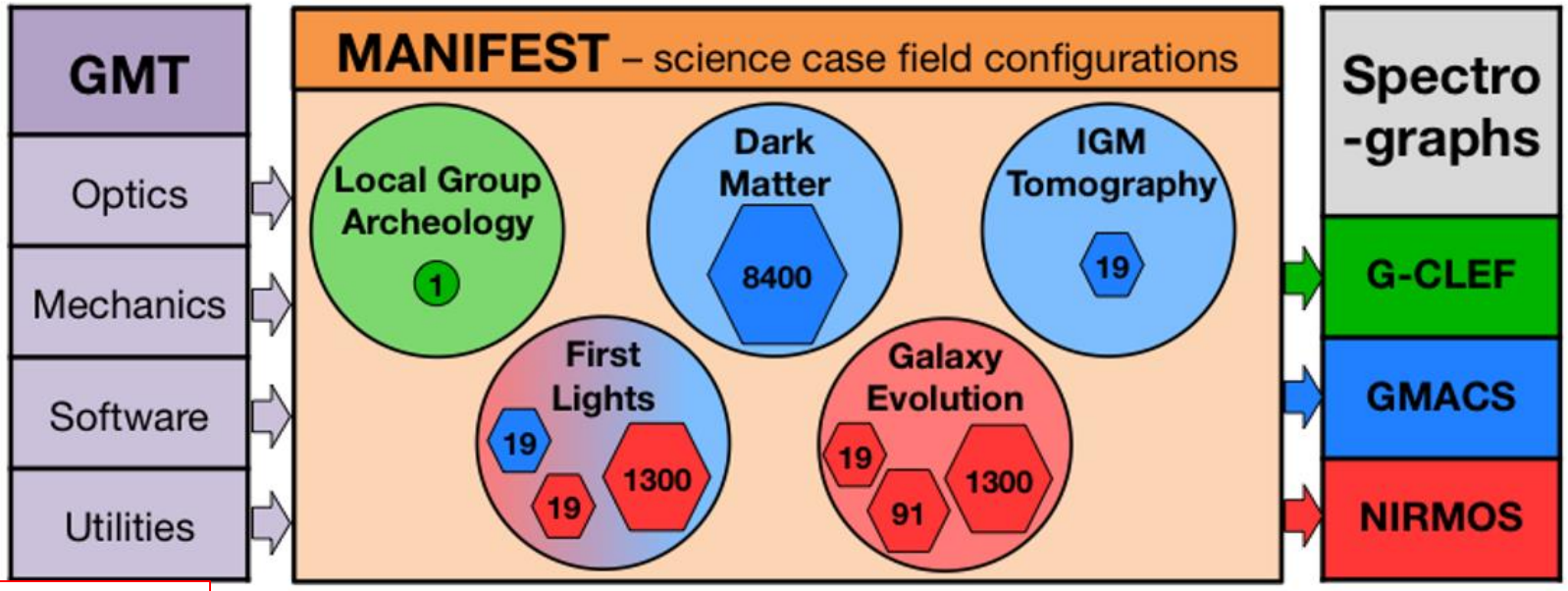






0.25″

MANIFEST Science



only for GMACS original design!!!

spectro -graph	# starbugs/IFUs in configuration	# fibres per starbug or IFU	field of view of starbug/IFU	
G-CLEF	40/4	1	0.7"	Initial available configurations
GMACS	420	19	1.0"	
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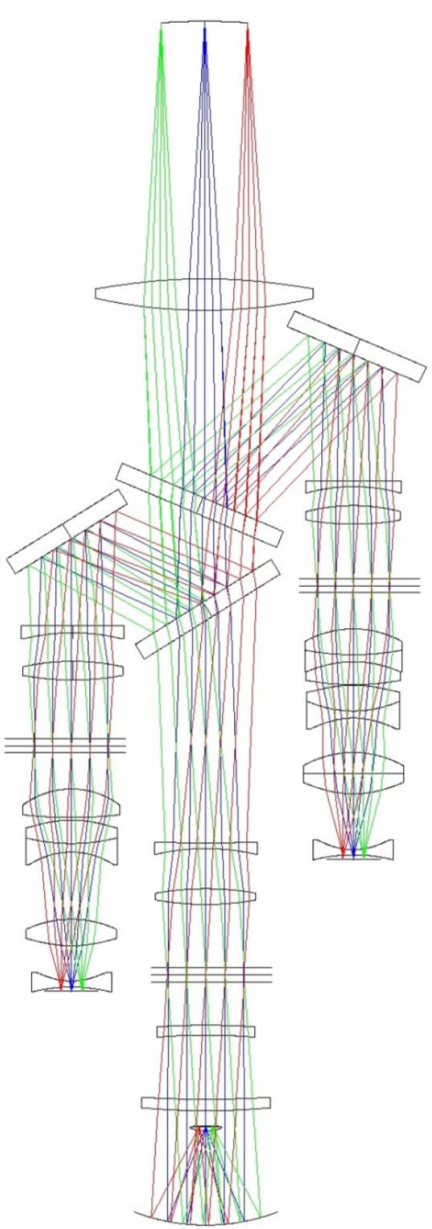
from J. Lawrence's slide

GMACS: GMT Areal Camera and Spectrograph
PI: Darren DePoy (Texas A&M)

- General purpose optical spectrograph for GMT
- Field of view (per "arm"): 4.5 arcmin × 9 arcmin fields
  - Blue/red "channels" for each "arm" (10K x 20K pixels per channel)
  - Good sensitivity over ~370 – 1020 nm
- Multi-slit masks – ~80 slits per mask; or ~500 fibers
- Resolution: 1000 – 4000

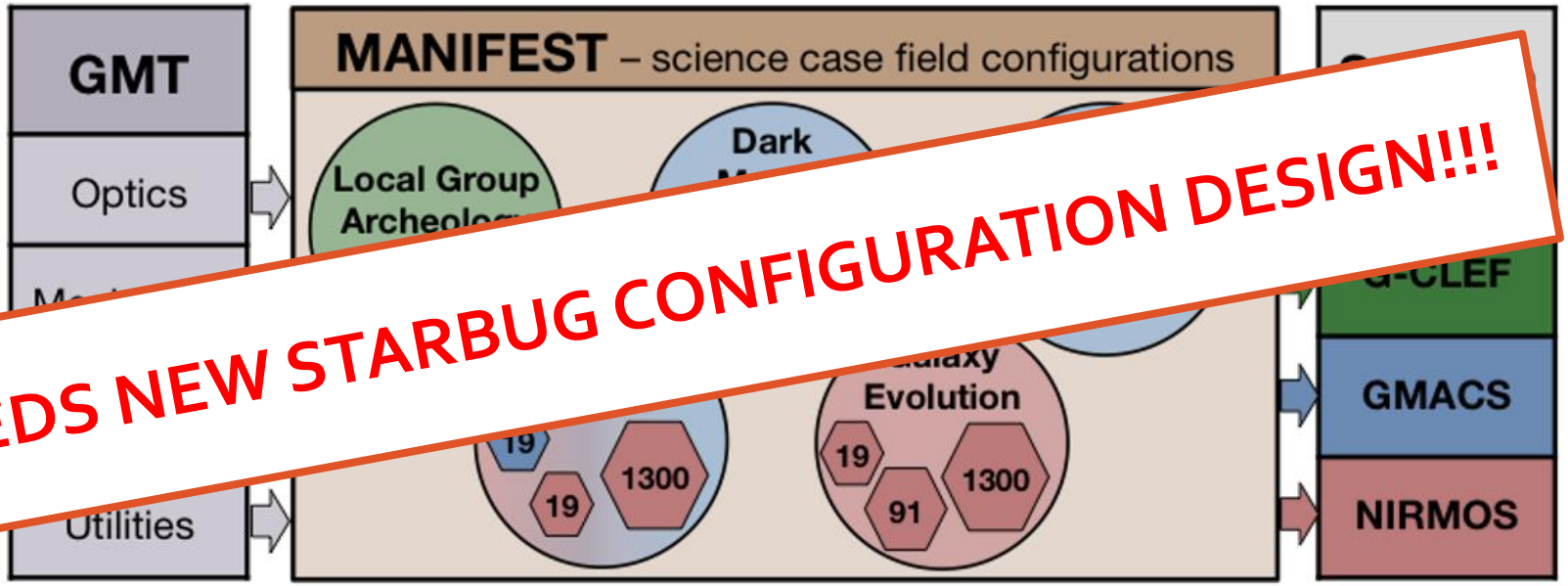
- Option for MANIFEST fibers: full 20' coverage, IFUs, R~10,000
- Can be expanded to 3 additional modules
  - 9 x 18 arcmin field
  - ~300 slits per mask; or 2000 fibers, IFUs

from B.G. Park's slide

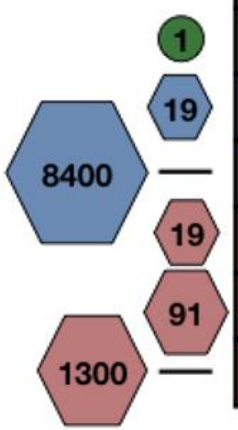


Original GMACS	TRIMOS
4-arms Off-axis	Single arm On-axis
Blue/Red Channels	Blue/Red/NIR Channels
4 arms x 4.5′ x 9′ Effective FoV	1 arm x 4.2′ x 8.4′ (smaller at NIR)
Max. 8,400 Fibers	Max. 1,636 Fibers
20′ Full FoV	10′ without Wide Field Corrector

MANIFEST Science



NEEDS NEW STARBUG CONFIGURATION DESIGN!!!



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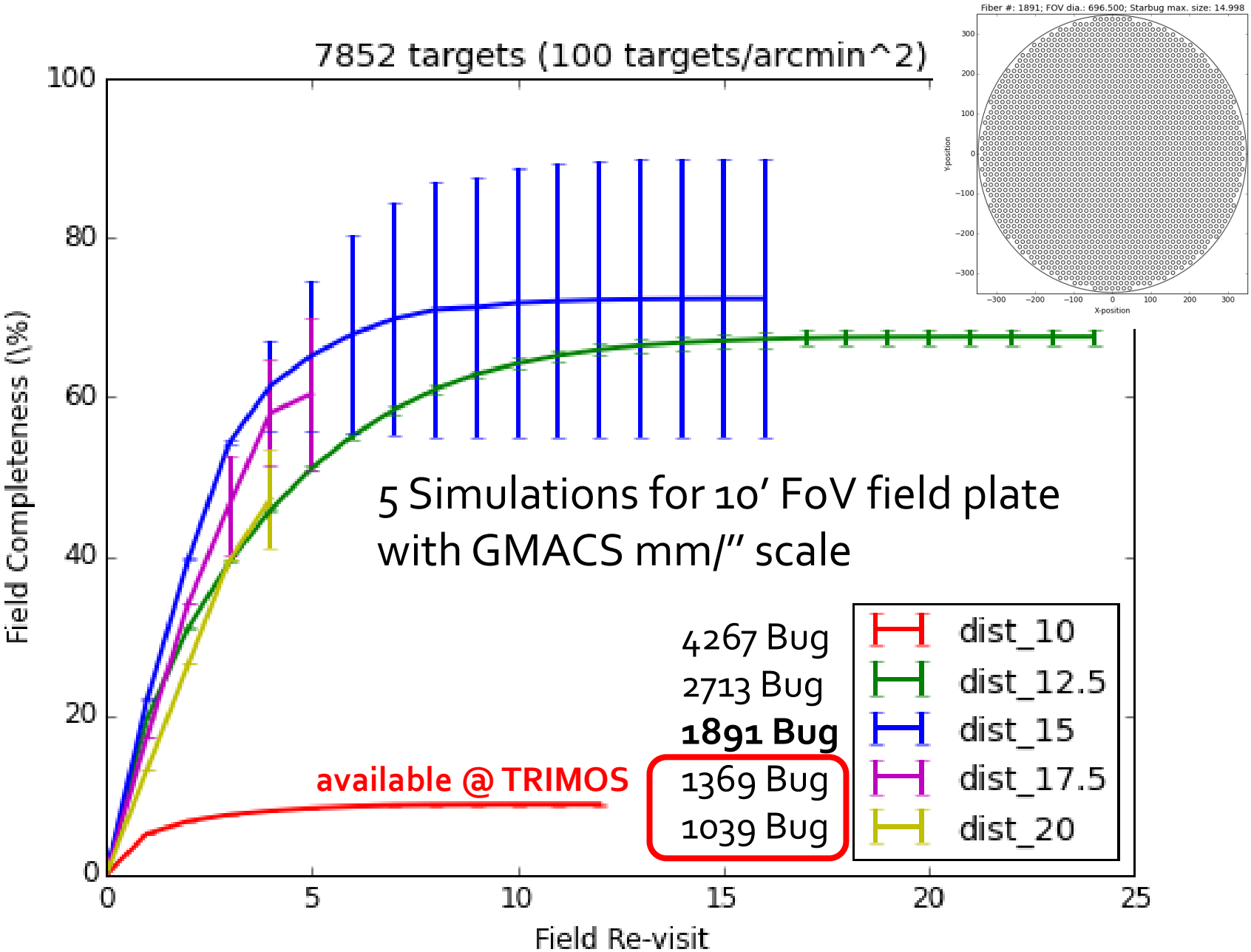
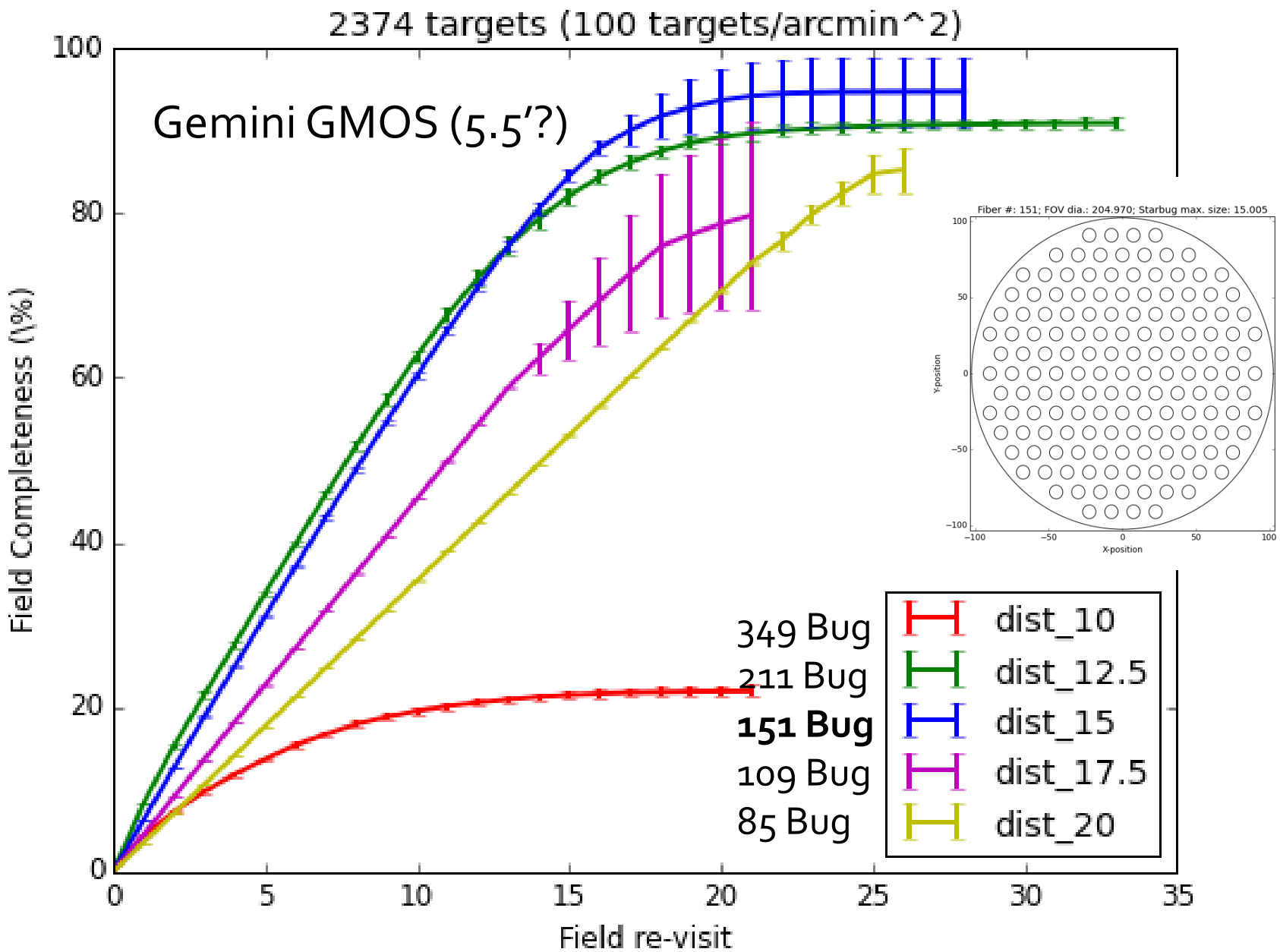
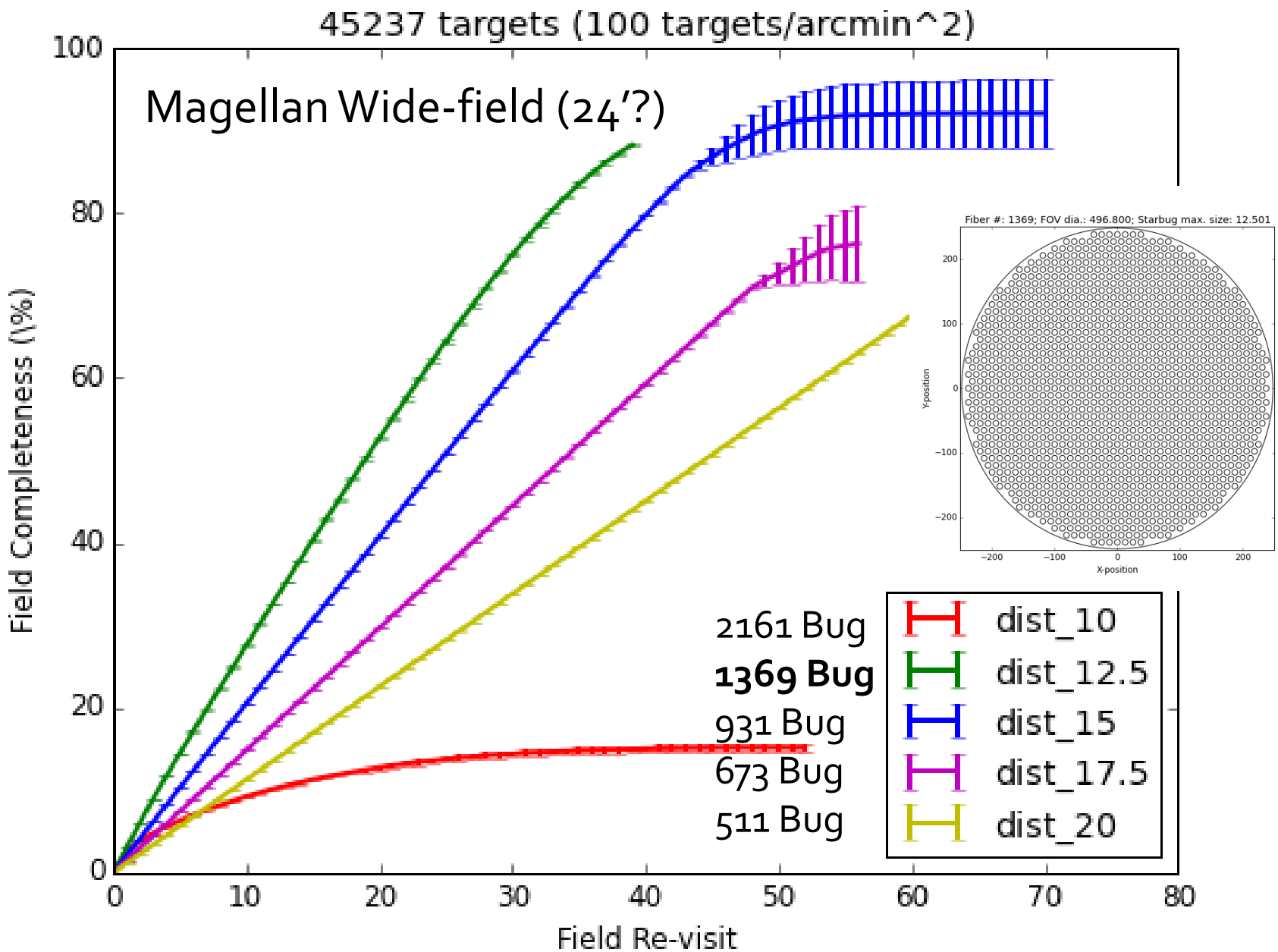

7852 targets (100 targets/arcmin^2)
Field Completeness (\%)
Field Re-visit
5 Simulations for 10' FoV field plate
with GMACS mm/" scale
4267 Bug
2713 Bug
1891 Bug
1369 Bug
1039 Bug
available @ TRIMOS
dist_10
dist_12.5
dist_15
dist_17.5
dist_20
Fiber #: 1891; FOV dia.: 696.500; Starbug max. size: 14.998
X-position
Y-position


2374 targets (100 targets/arcmin^2)
Gemini GMOS (5.5'?)
Field Completeness (\%)
Field re-visit
0
20
40
60
80
100
0
5
10
15
20
25
30
35
Fiber #: 151; FOV dia.: 204.970; Starbug max. size: 15.005
X-position
Y-position
349 Bug
211 Bug
151 Bug
109 Bug
85 Bug
dist_10
dist_12.5
dist_15
dist_17.5
dist_20


45237 targets (100 targets/arcmin^2)
Magellan Wide-field (24'?)
Field Completeness (\%)
Field Re-visit
0
20
40
60
80
100
0
10
20
30
40
50
60
70
80
Fiber #: 1369; FOV dia.: 496.800; Starbug max. size: 12.501
X-position
Y-position
2161 Bug
1369 Bug
931 Bug
673 Bug
511 Bug
dist_10
dist_12.5
dist_15
dist_17.5
dist_20

Summary

- Starbugs algorithms are under development
  - Starbug Identification
  - Target Allocation / Routing
  - Metrology Camera Calibration

- We could also imagine Starbugs configuration!
  - MANIFEST – GMACS should be reconfigured
  - (Starbug distance) ~ 1.5 x (Starbug diameter) seems to be optimal (need more tests)
  - with Gemini/Magellan/others?