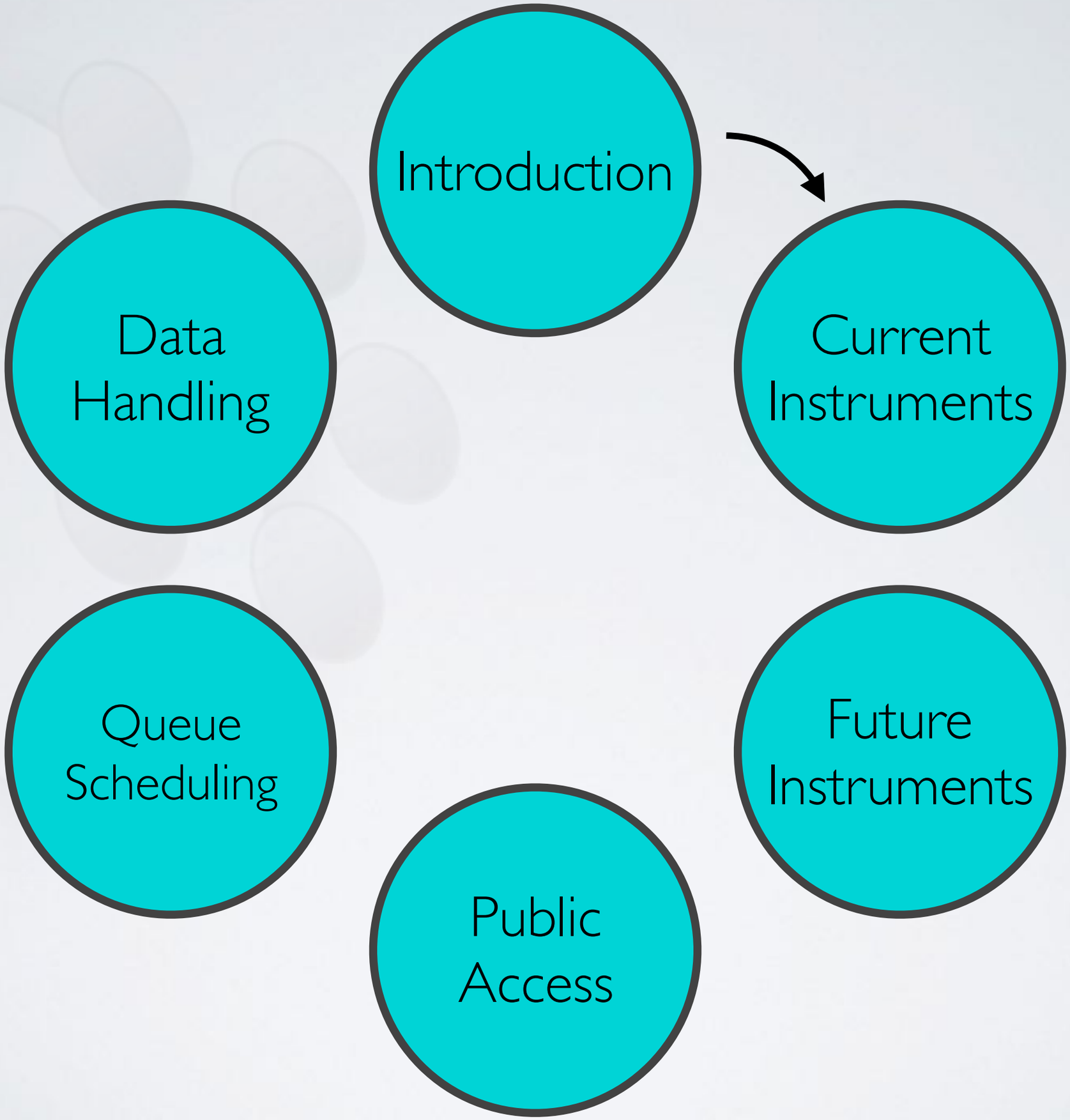
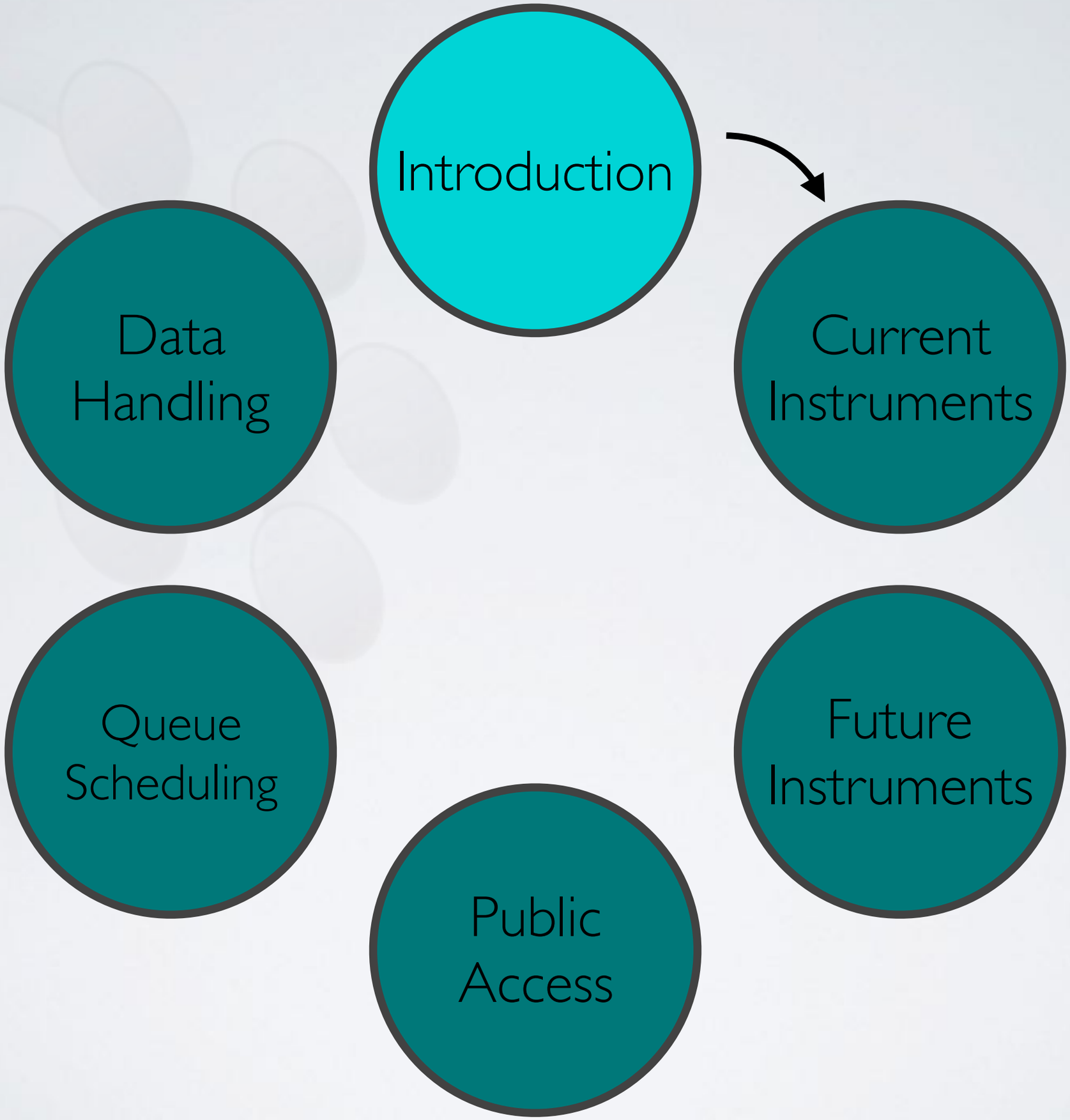
The MMT Observatory and Time Domain Astronomy

G. Grant Williams
Director, MMT Observatory

Smithsonian Astrophysical Observatory

The University of Arizona


Introduction
Current Instruments
Data Handling
Queue Scheduling
Future Instruments
Public Access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Mount Hopkins

~40 miles south of Tucson, AZ
8550-ft (2606-m) elevation

Multiple Mirror Telescope
Six 1.8m Mirrors (=4.5m)
1979 - 1998

MMT

6.5-m Primary Mirror
2000 - Present

CAUTION
Telescopes in
Operation

Fred Lawrence Whipple Observatory

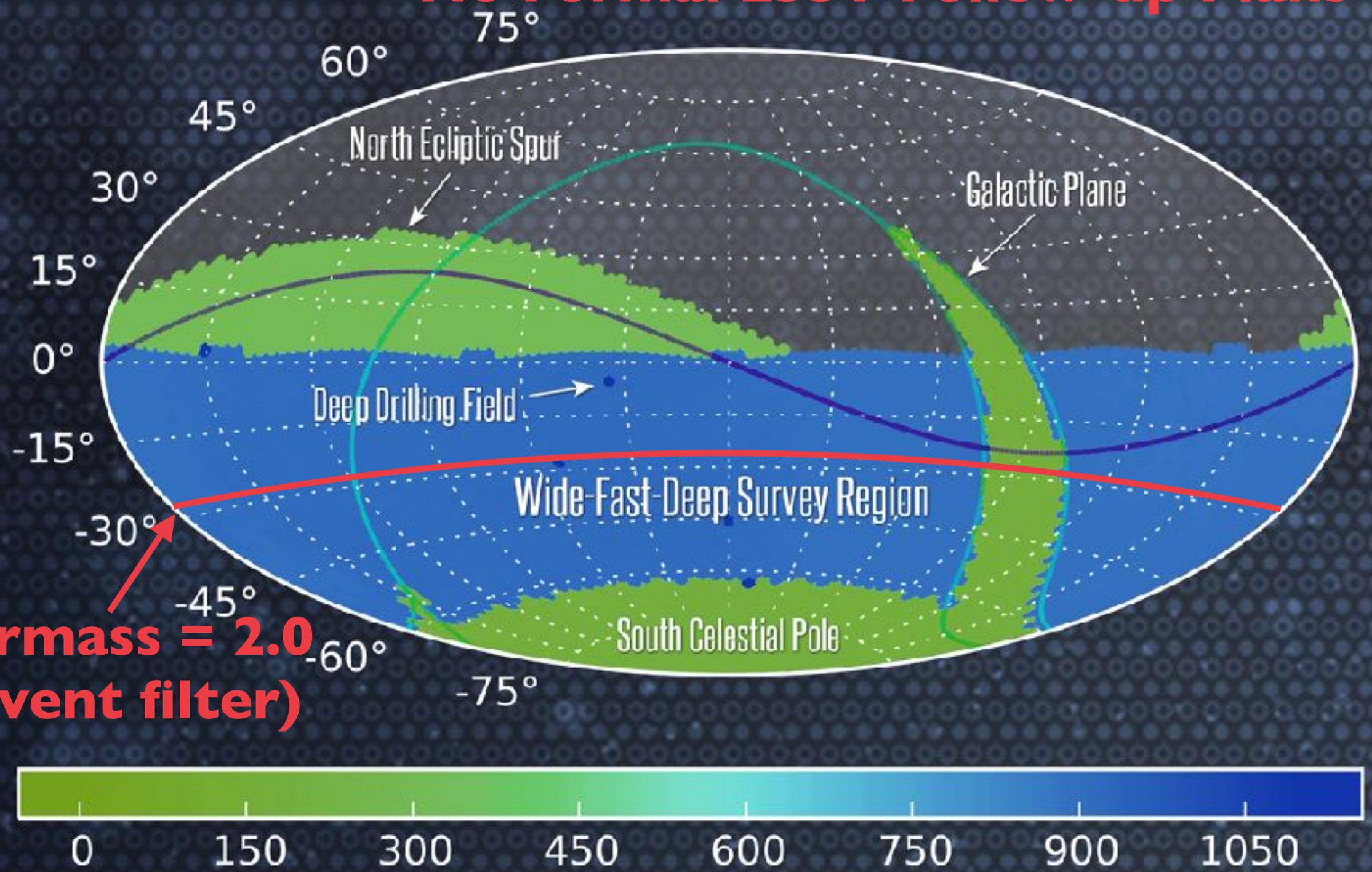
VERITAS (**V**ery **E**nergetic **R**adiation **I**maging **T**elescope **A**rray **S**ystem)

Fred Lawrence Whipple Observatory

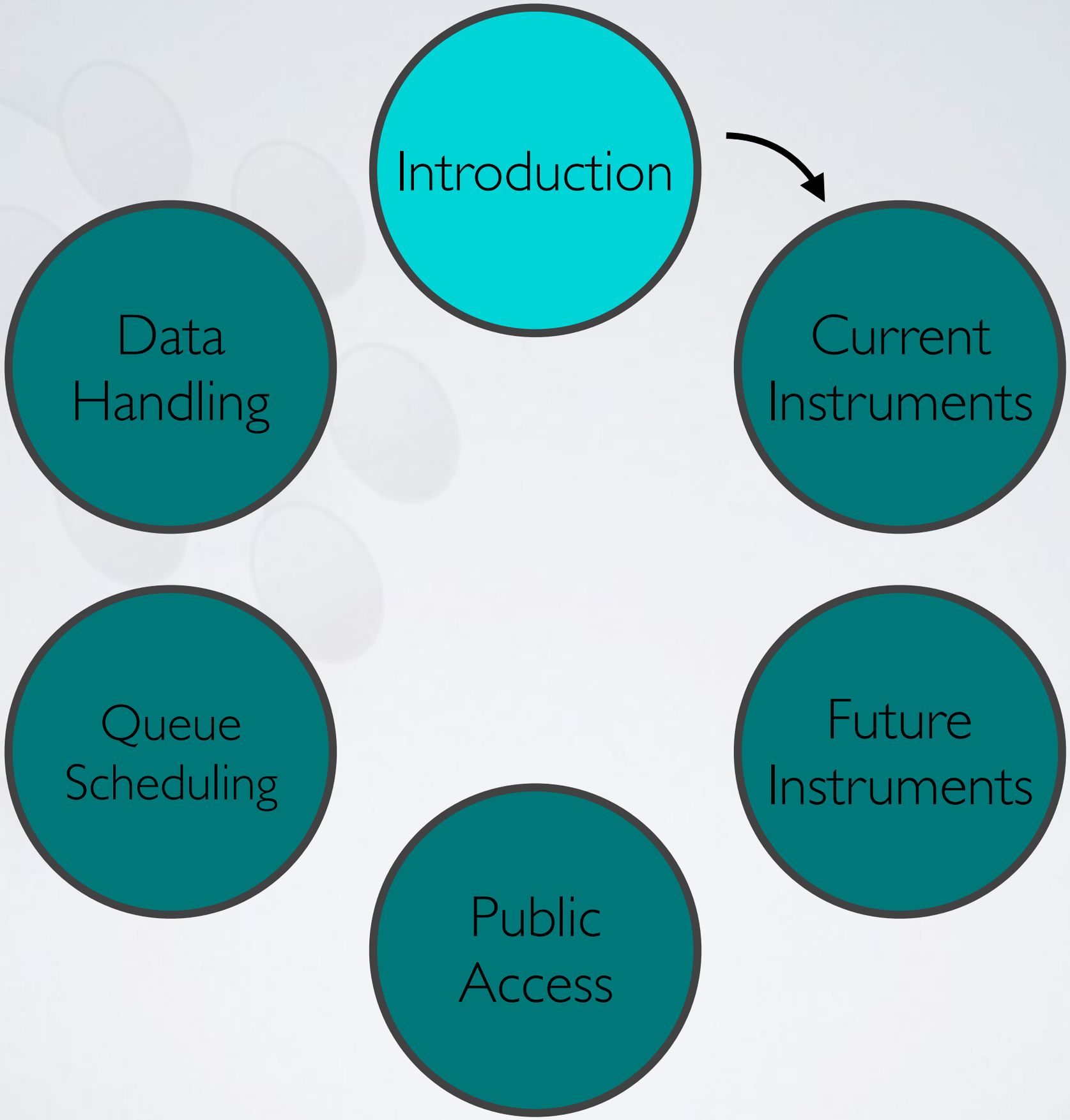
Number of Visits

(all-band, 10 years)

No Formal LSST Follow-up Plans Yet



Airmass = 2.0 (event filter)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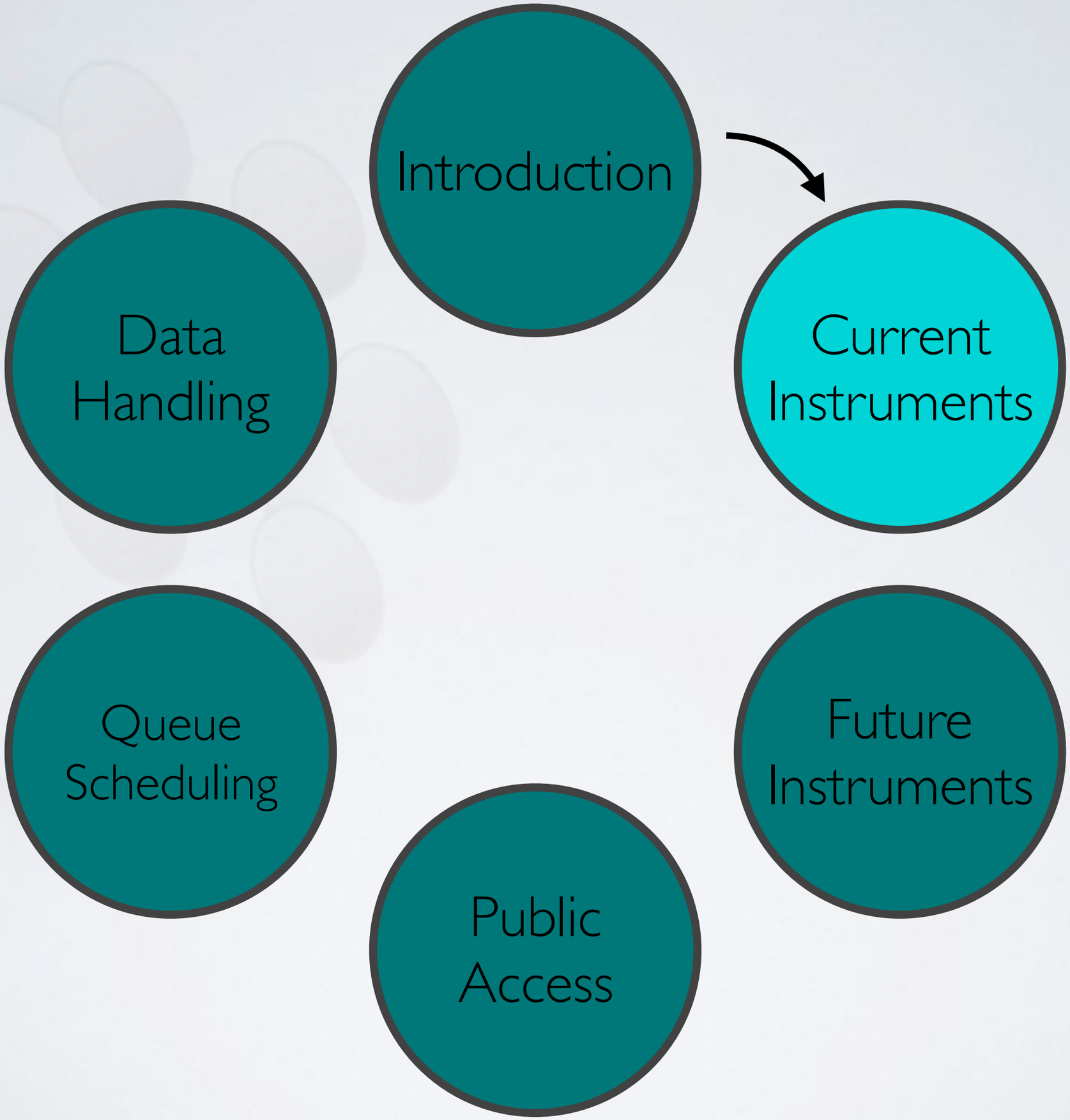
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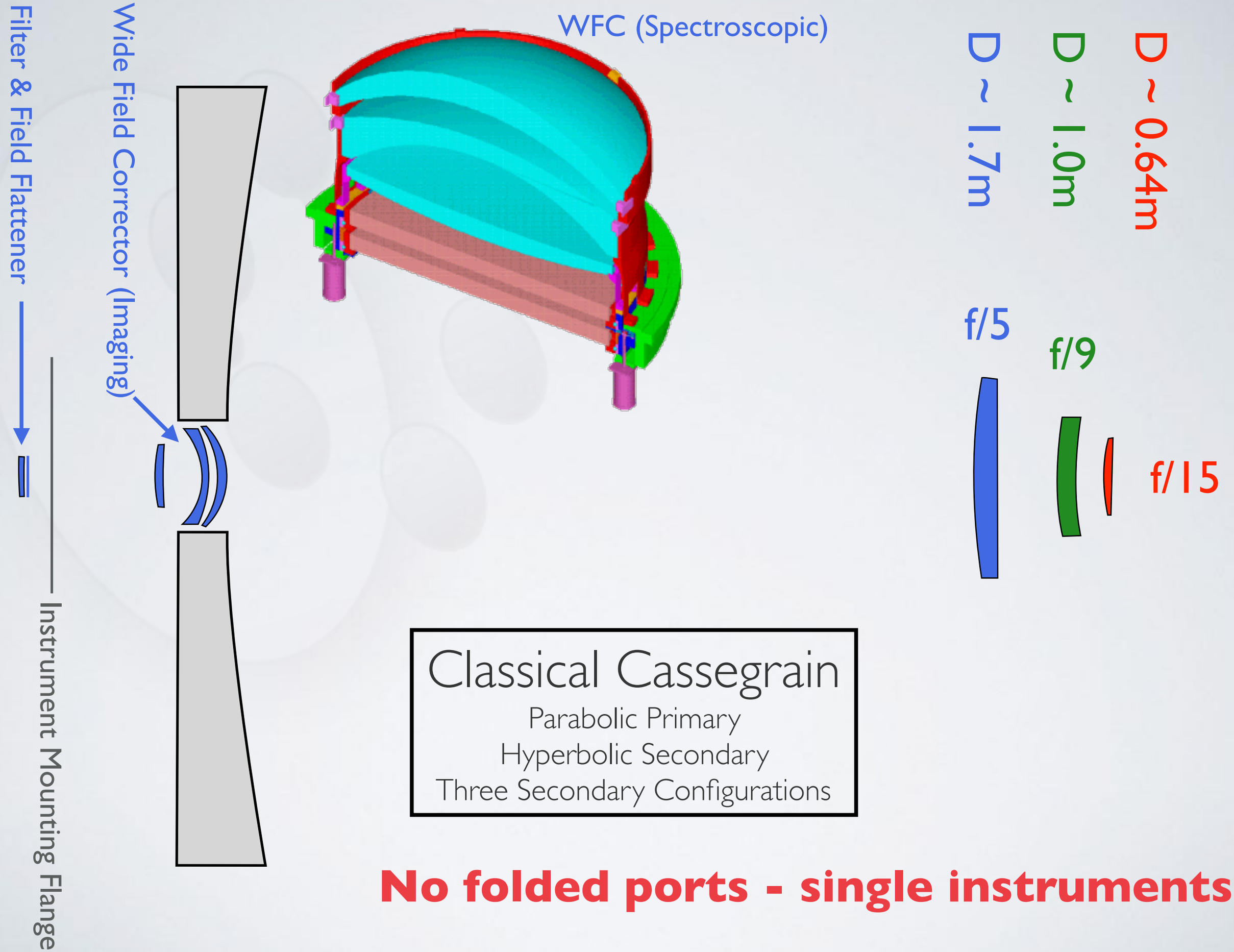


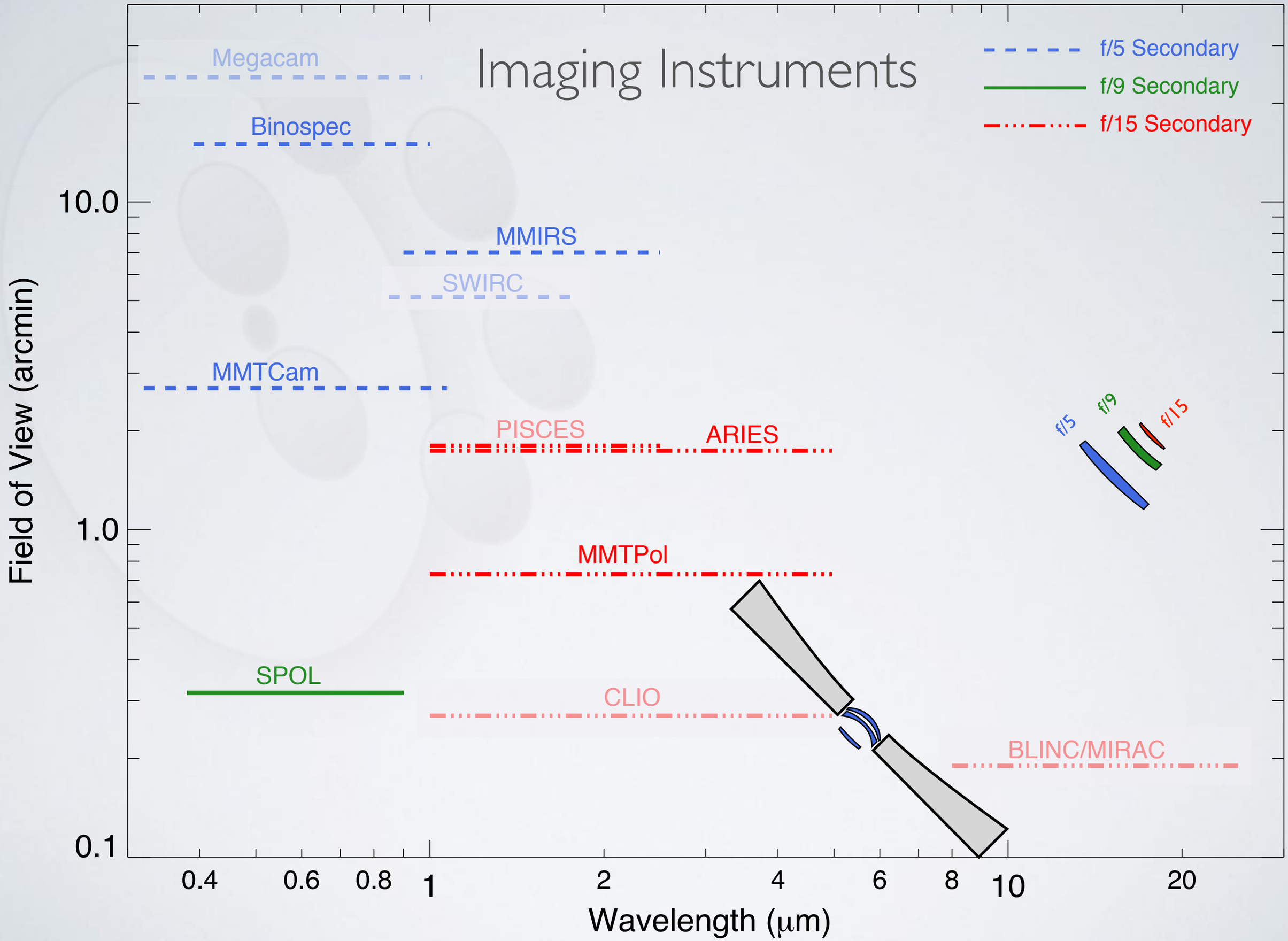
Classical Cassegrain

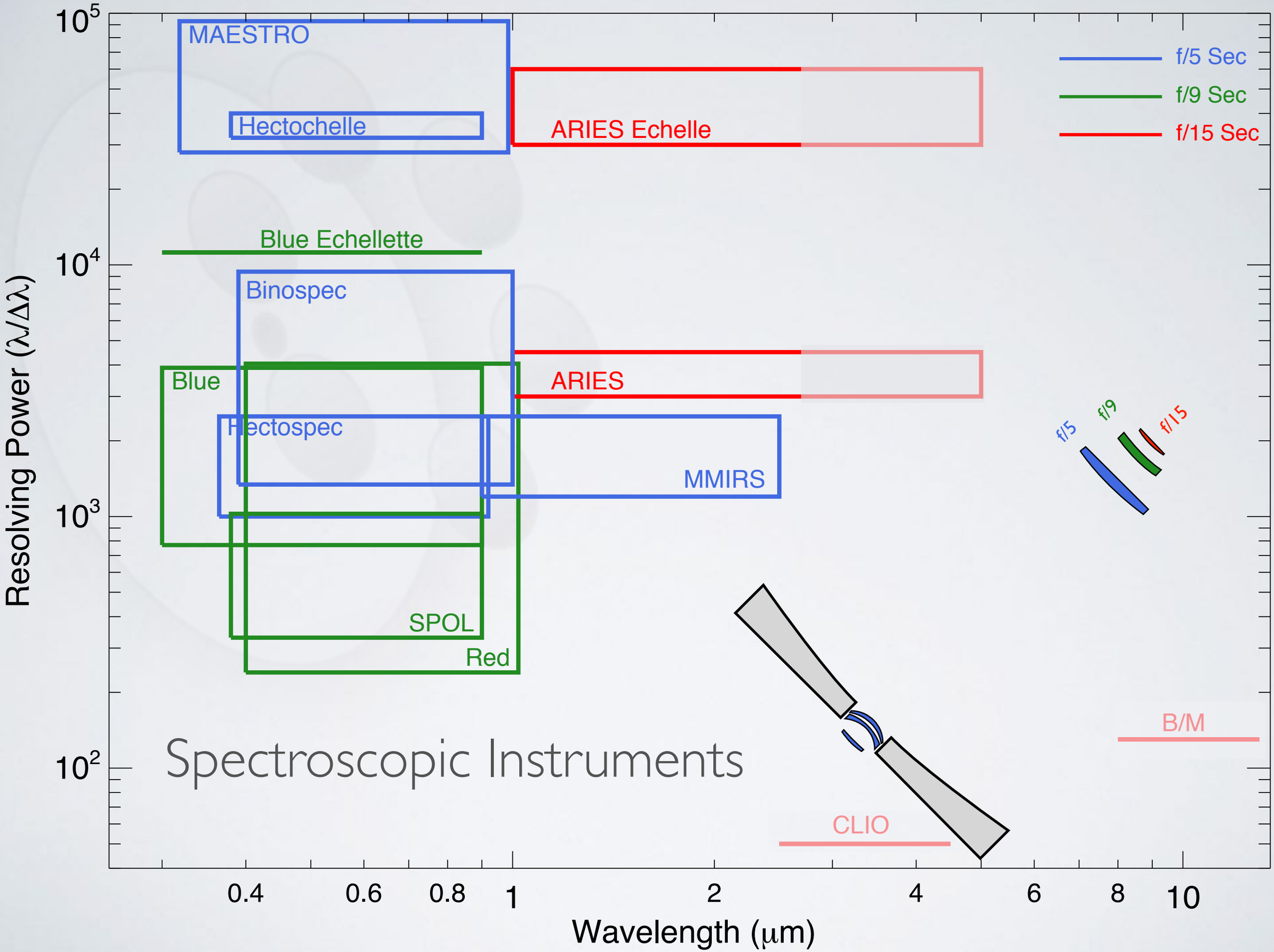
Parabolic Primary

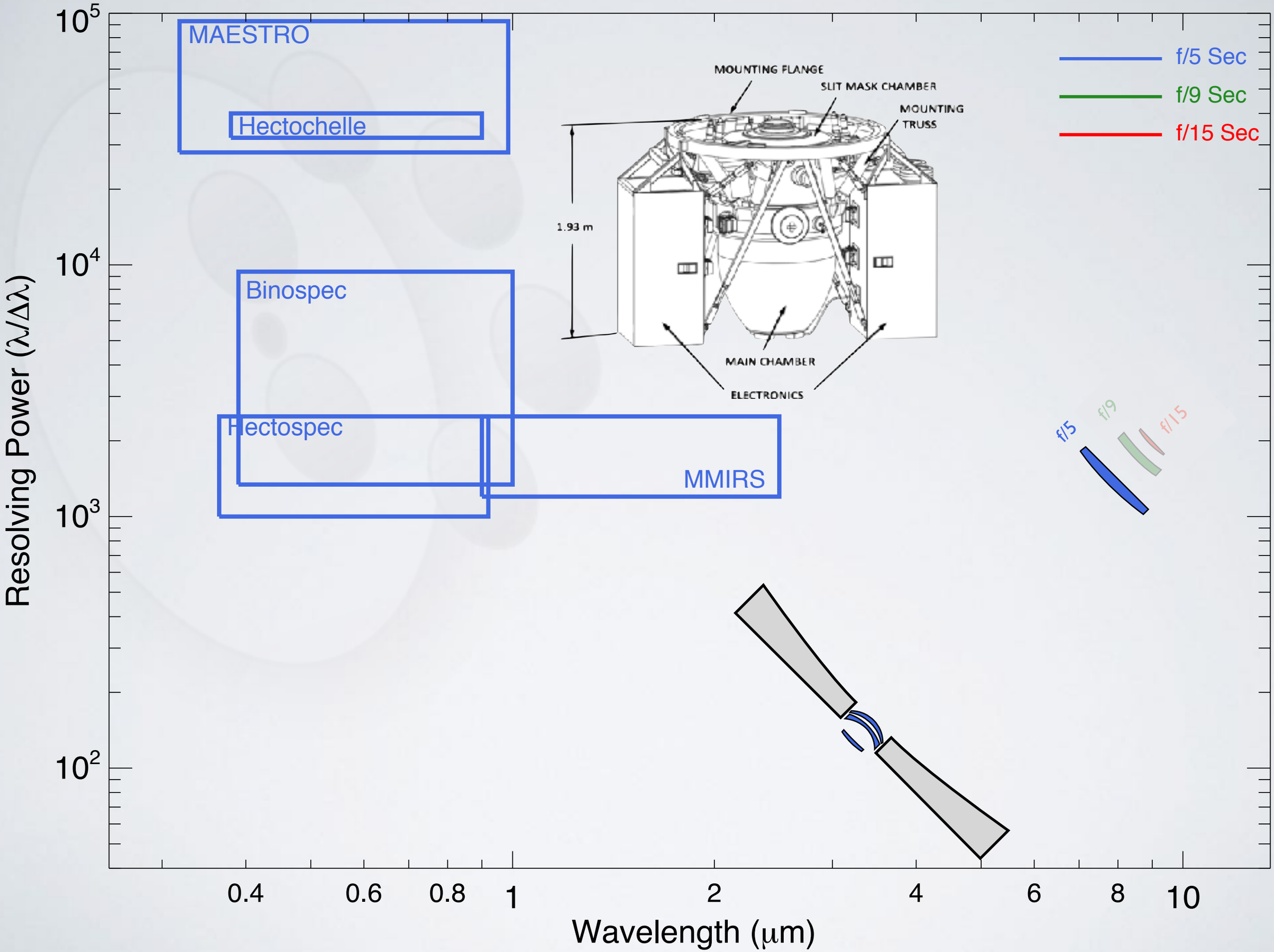
Hyperbolic Secondary

Three Secondary Configurations

No folded ports - single instruments


Imaging Instruments
f/5 Secondary
f/9 Secondary
f/15 Secondary
Megacam
Binospec
MMIRS
SWIRC
MMTCam
PISCES
ARIES
MMTPol
SPOL
CLIO
BLINC/MIRAC
f/5
f/9
f/15
Field of View (arcmin)
10.0
1.0
0.1
0.4
0.6
0.8
1
2
4
6
8
10
20
Wavelength (μm)

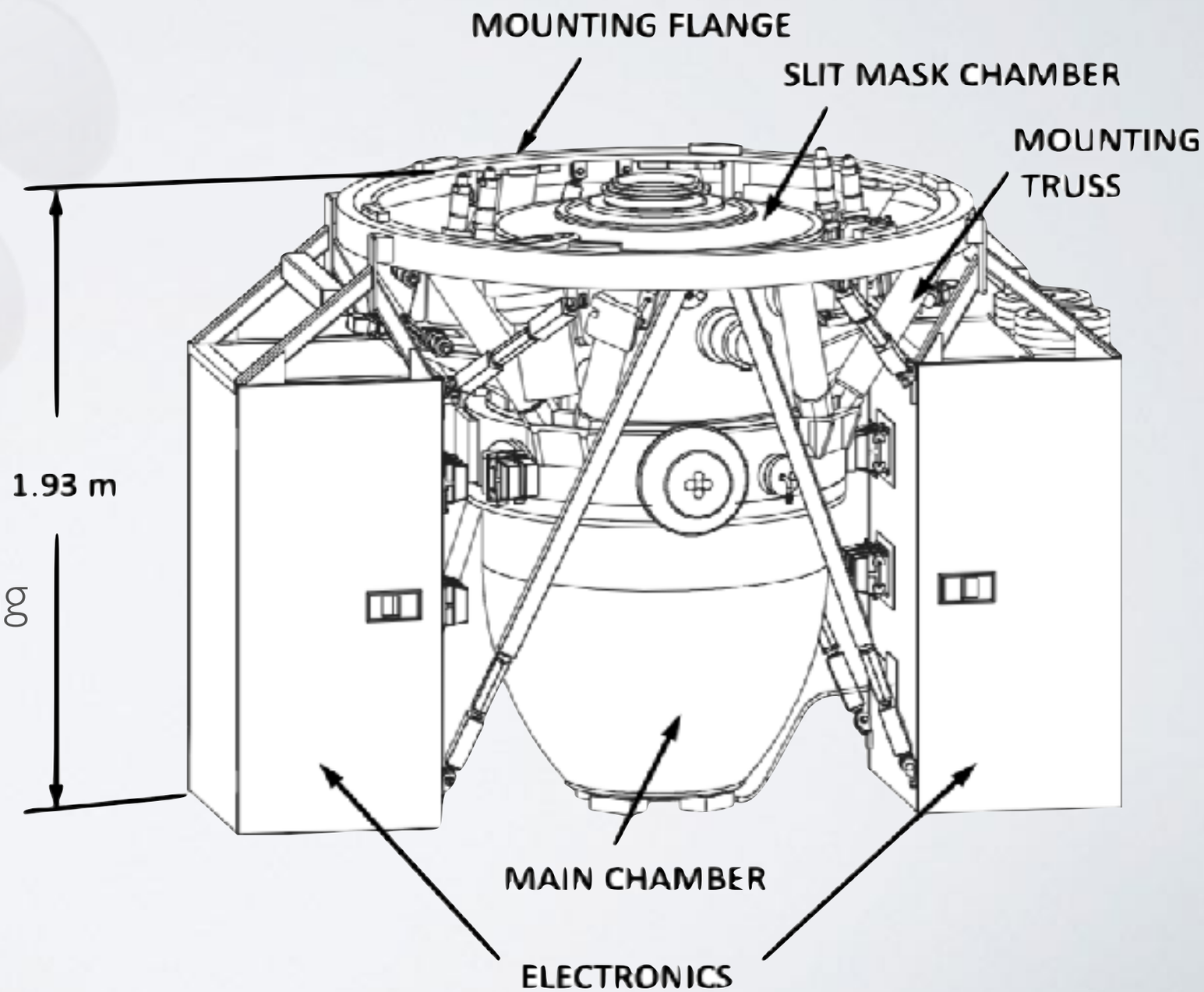

Spectroscopic Instruments
MAESTRO
Hectochelle
ARIES Echelle
f/5 Sec
f/9 Sec
f/15 Sec
Blue Echellette
Binospec
Blue
ARIES
Hectospec
MMIRS
SPOL
Red
f/5
f/9
f/15
B/M
CLIO
Resolving Power (λ/Δλ)
Wavelength (μm)
10^5
10^4
10^3
10^2
0.4
0.6
0.8
1
2
4
6
8
10

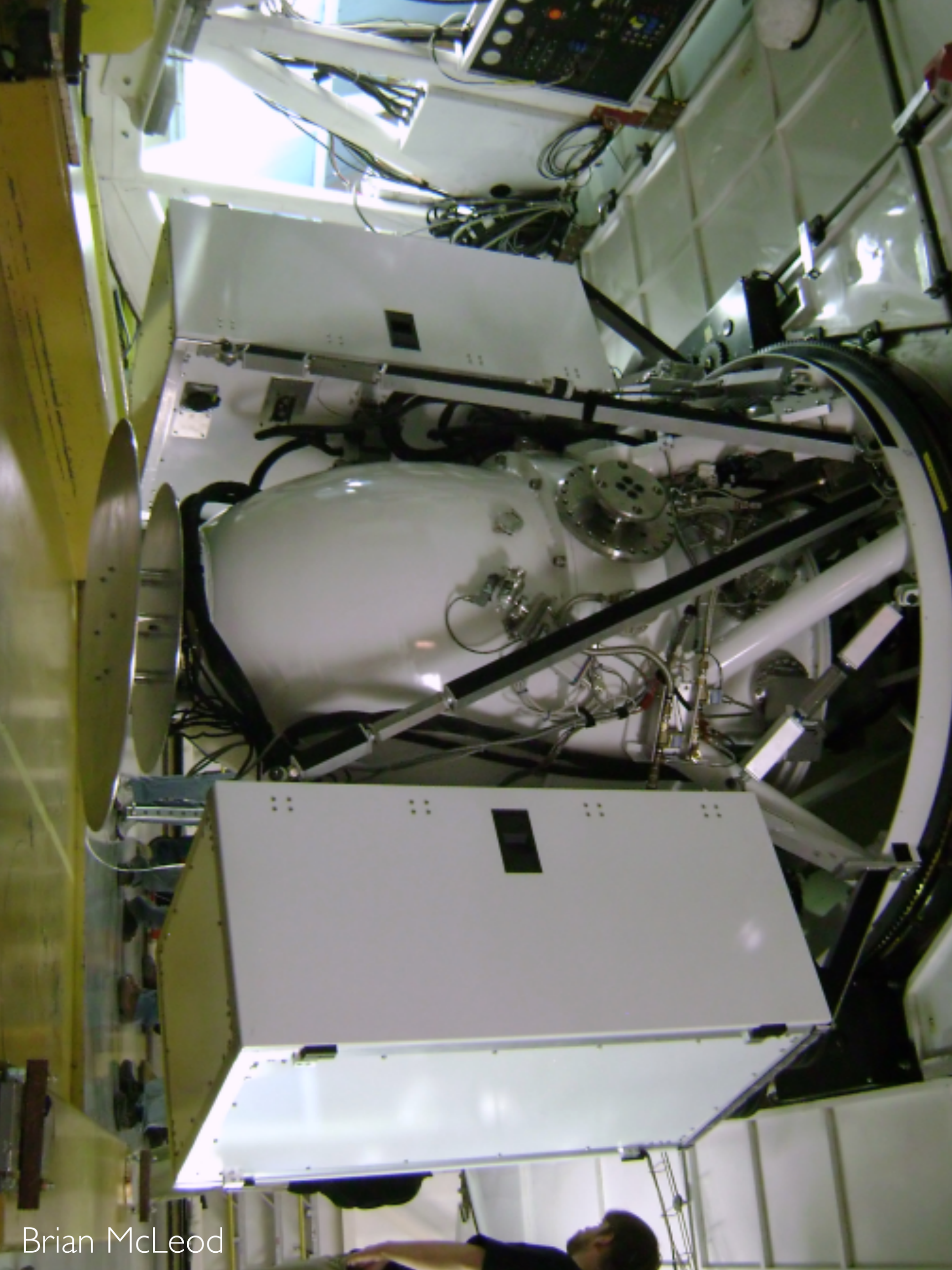

MAESTRO
Hectochelle
Binospec
Hectospec
MMIRS
f/5 Sec
f/9 Sec
f/15 Sec
MOUNTING FLANGE
SLIT MASK CHAMBER
MOUNTING TRUSS
1.93 m
MAIN CHAMBER
ELECTRONICS
f/5
f/9
f/15
Resolving Power (λ/Δλ)
Wavelength (μm)
10^5
10^4
10^3
10^2
0.4
0.6
0.8
1
2
4
6
8
10

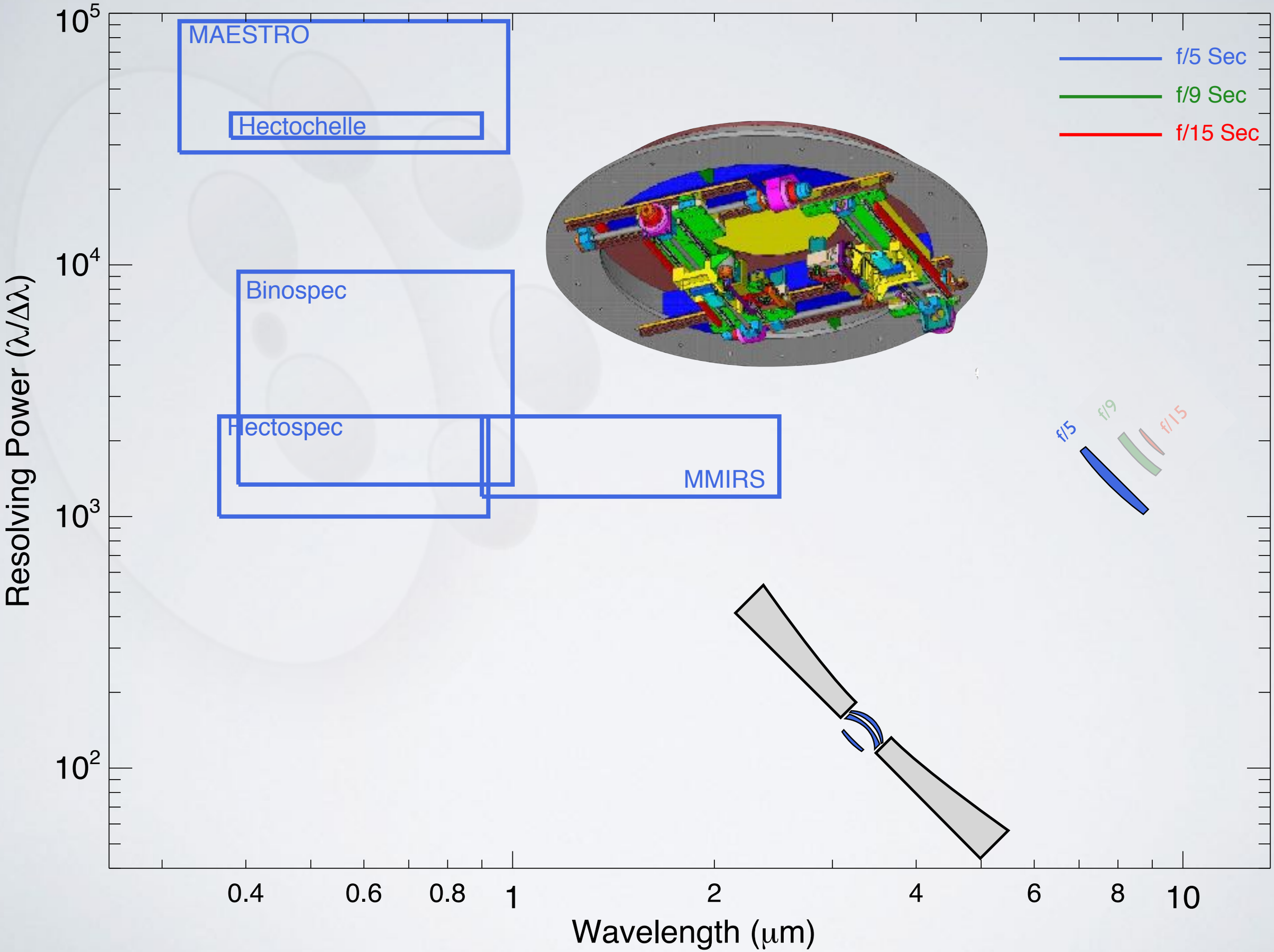
MMIRS - MMT & Magellan Infrared Spectrograph

PI: B. McLeod (SAO)

- NIR imager and multi-object spectrograph
- Based on FLAMINGOS & FLAMINGOS2
- @ Magellan 2009-2015
- Hawaii-2RG detector (2014)
- 0.2''/pixel
- Imaging YJHK filters
- Imaging FOV = 6.9' x 6.9'
- MOS FOV = 4' x 6.9'
- MOS coverage 0.9 - 2.4μm
- ~50 x 7'' slitlets
- R = 1200 - 3000 (0.4'' slit)
- Long slit mode
- Continuous wavefront sensing
- **Queue scheduled**




Brian McLeod


MAESTRO
Hectochelle
Binospec
Hectospec
MMIRS
f/5 Sec
f/9 Sec
f/15 Sec
f/5
f/9
f/15
Resolving Power (λ/Δλ)
Wavelength (μm)
10^5
10^4
10^3
10^2
0.4
0.6
0.8
1
2
4
6
8
10

Hectospec, Hectochelle, & MMTCam

PI: D. Fabricant & A. Szentgyorgyi (SAO)

Hectospec

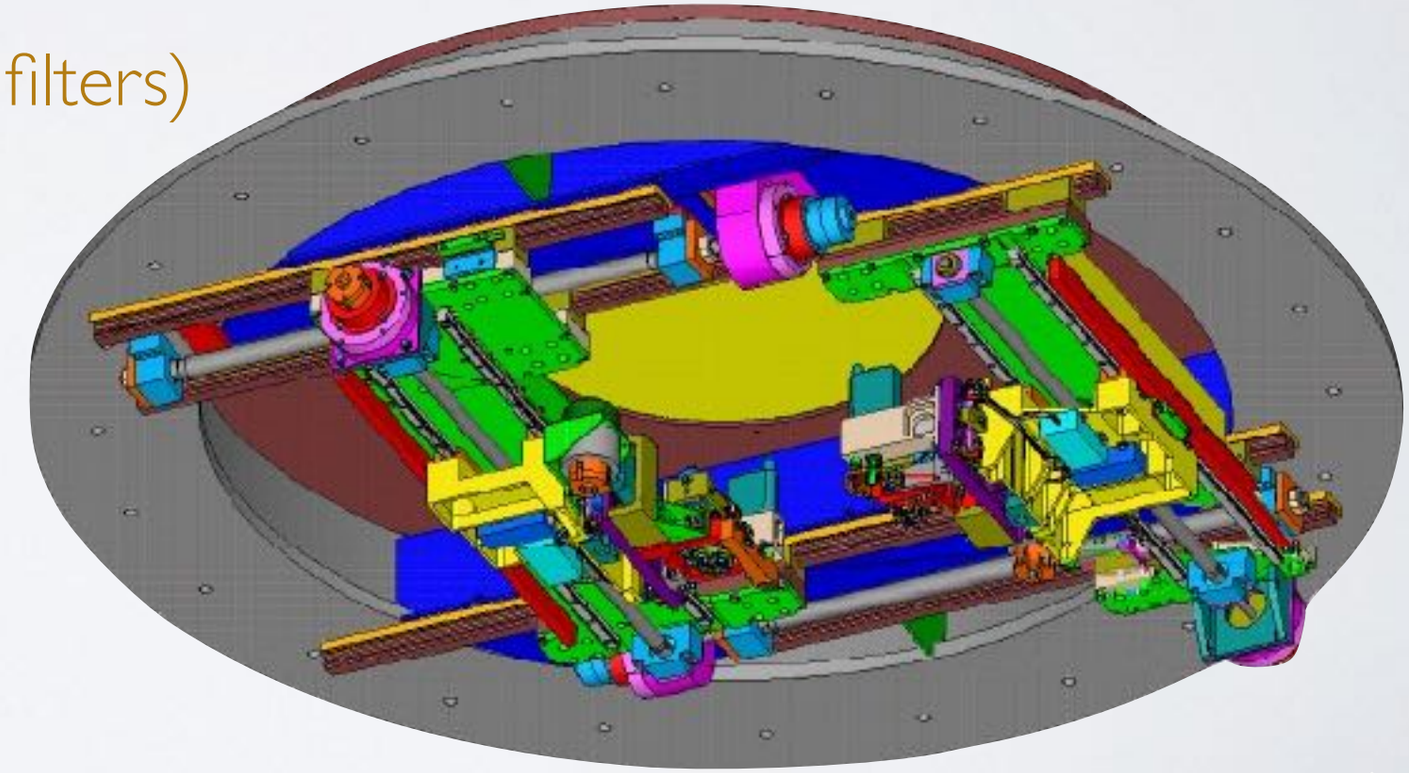
- Optical multi-object fiber fed spectrograph
- Up to 300 fibers positioned in 300s
- 1.0° field-of-view
- 3650 - 9200 Å
- R = 1000 - 2000
- 270 & 600 lpm gratings

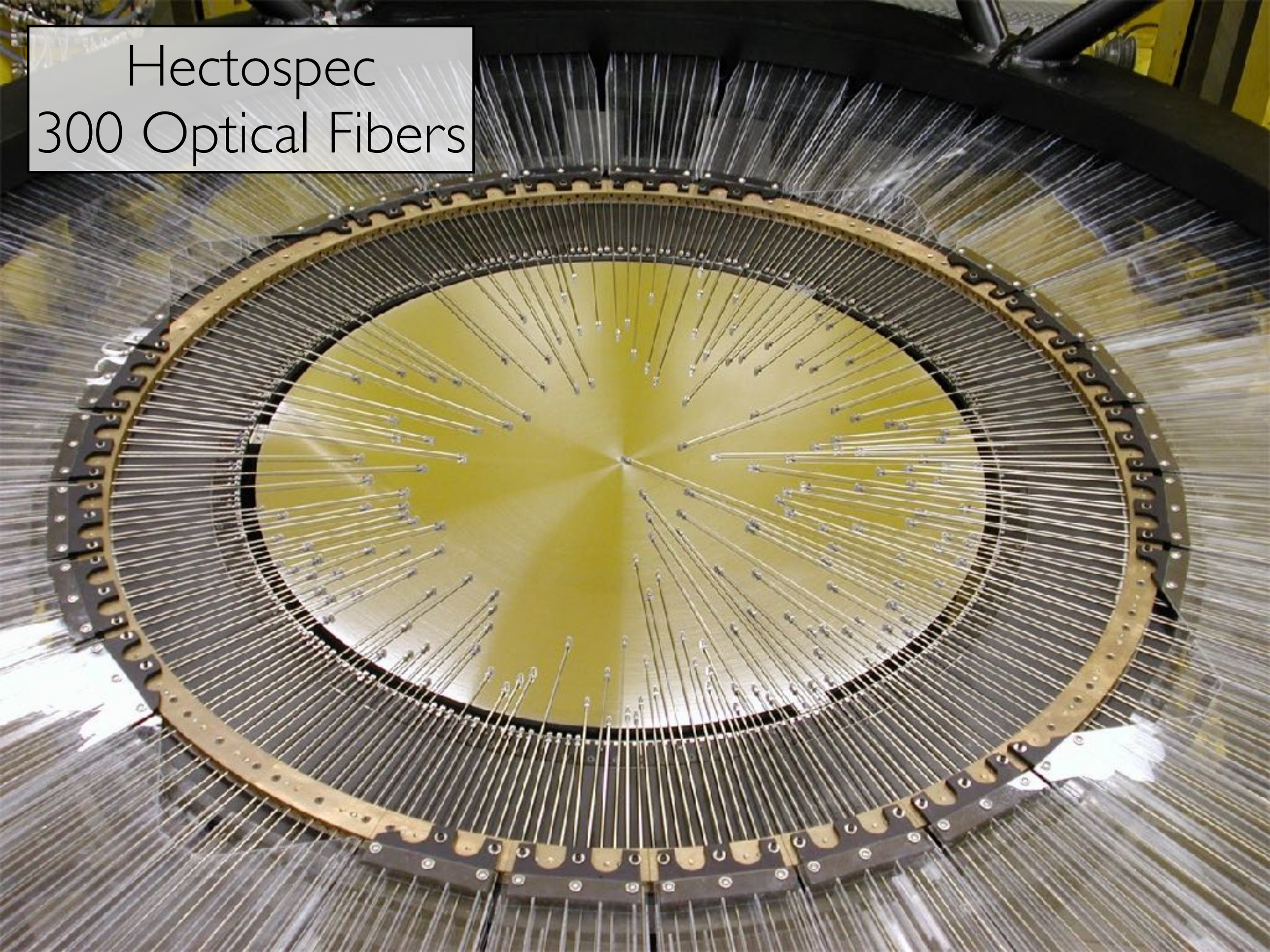
Hectochelle

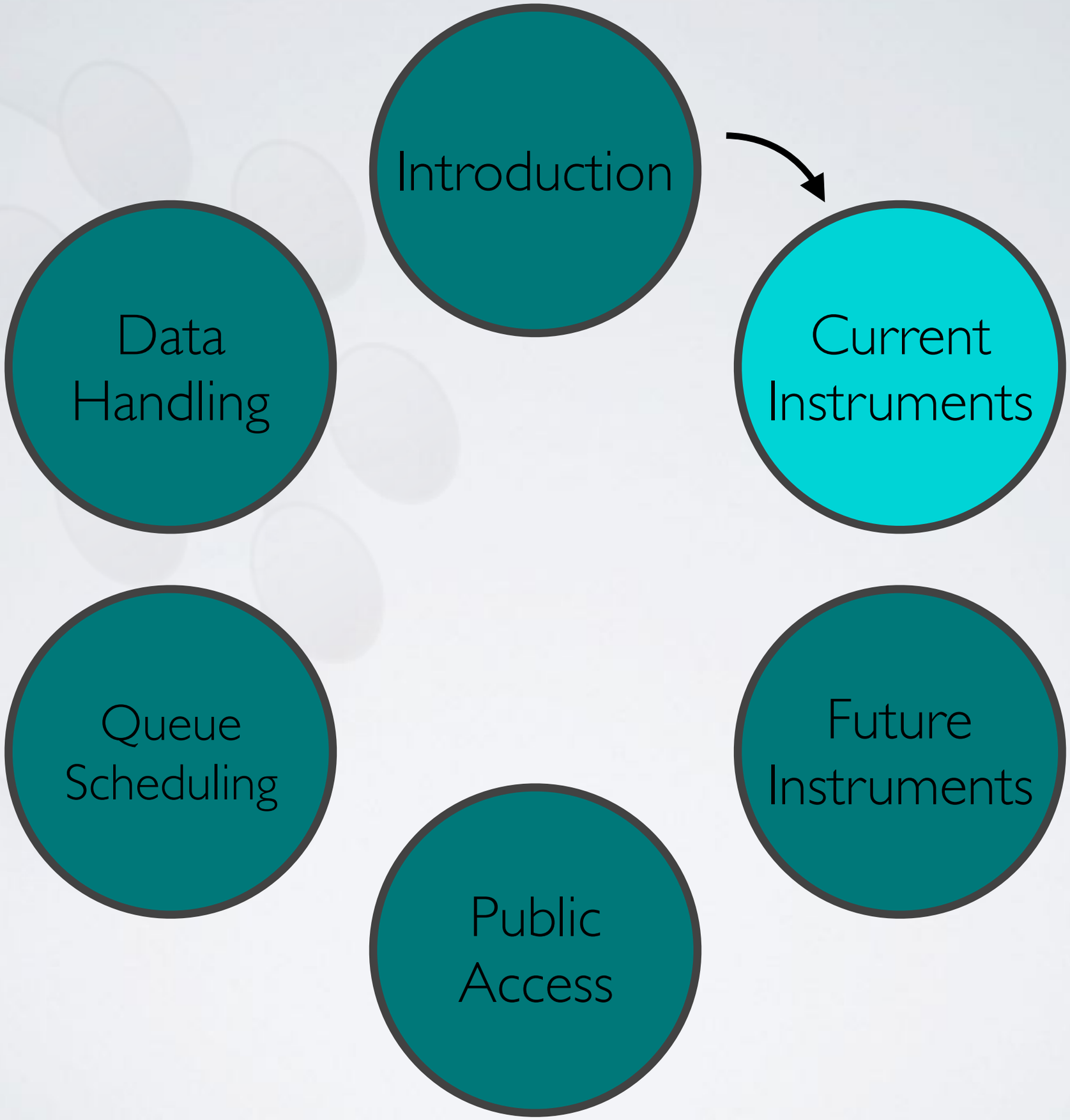
- Single order (11 order sorting filters)
- R = 32,000
- 3800 - 9000 Å
- Up to 240 fibers
- 240 lpm grating

MMTCam (Imaging)

- u, g, r, i, & SII filters
- 0.08''/pixel
- 2.7' x 2.7' field-of-view
- **Queue scheduled**




Hectospec
300 Optical Fibers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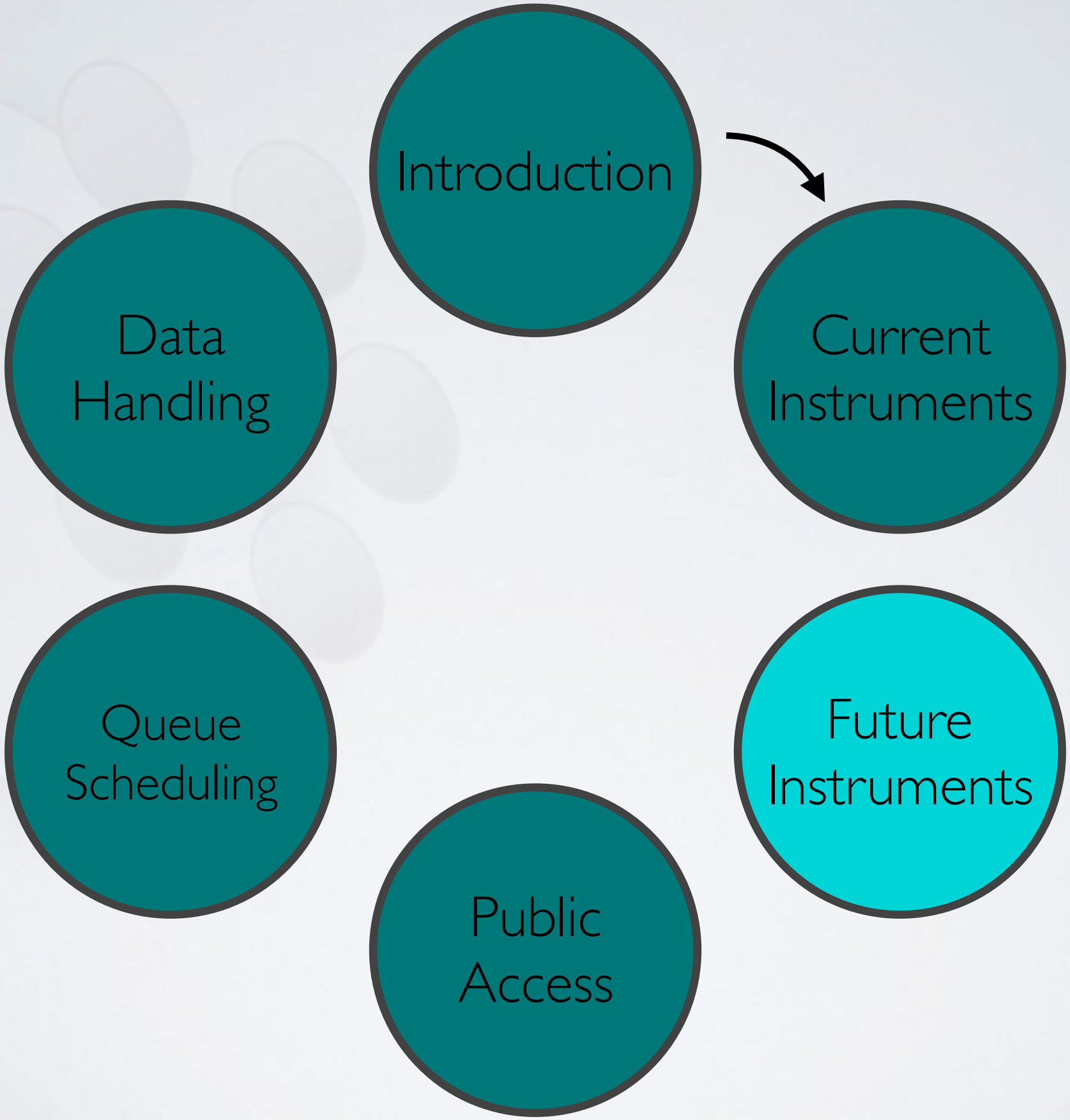
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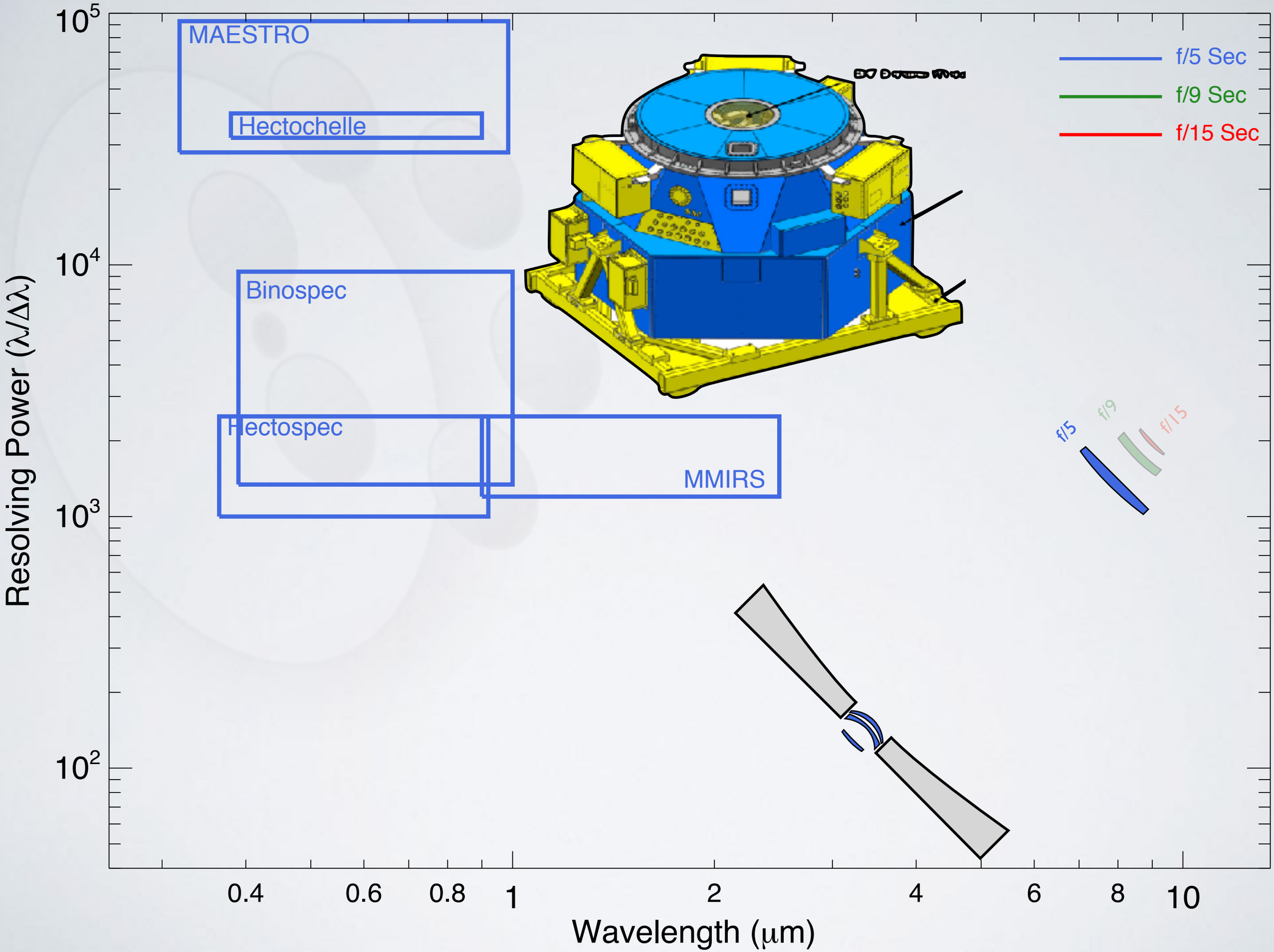
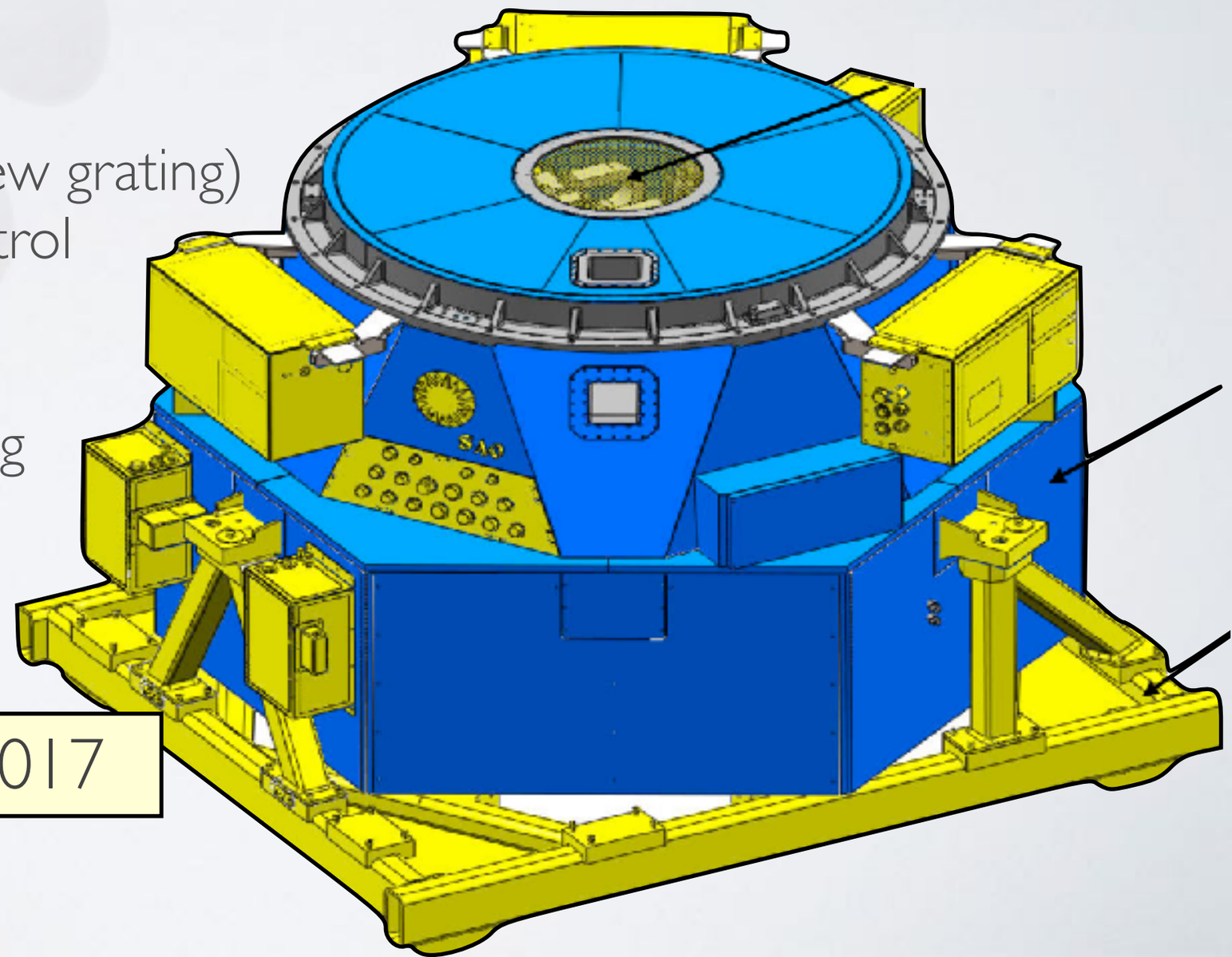

MAESTRO
Hectochelle
Binospec
Hectospec
MMIRS
f/5 Sec
f/9 Sec
f/15 Sec
f/5
f/9
f/15
Resolving Power (λ/Δλ)
Wavelength (μm)
10^5
10^4
10^3
10^2
0.4
0.6
0.8
1
2
4
6
8
10

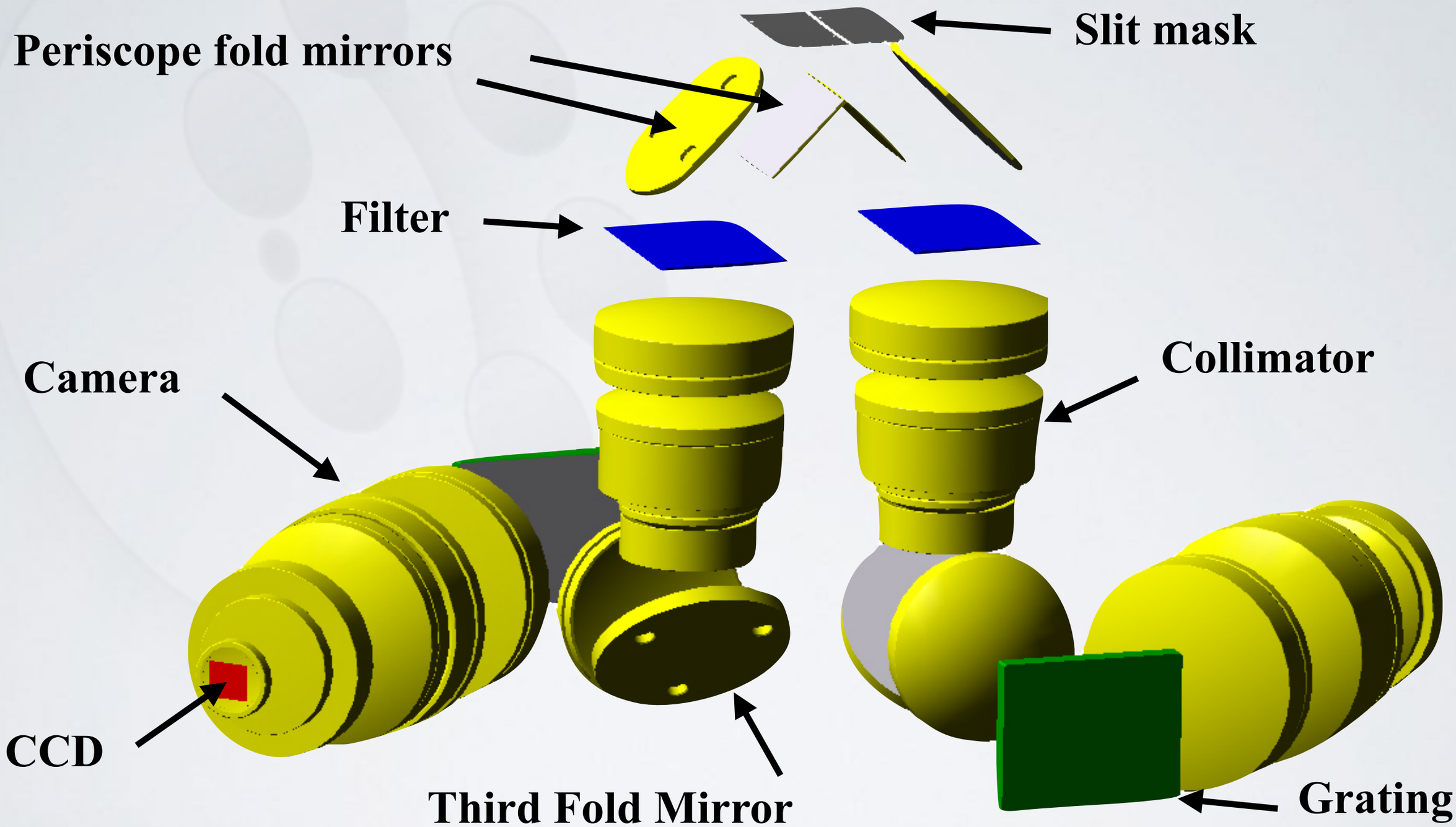
Binospec

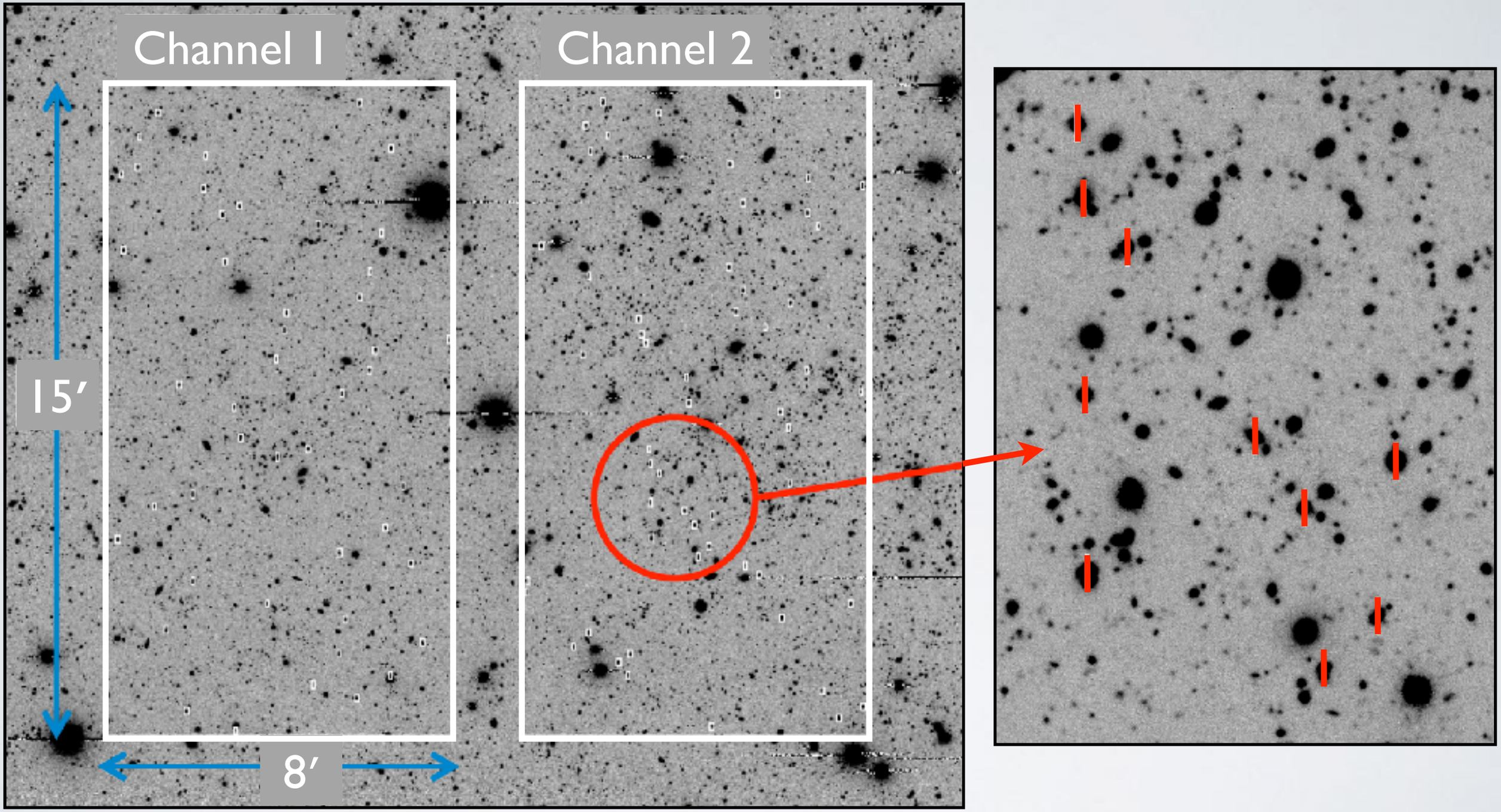
PI: Dan Fabricant (SAO)

- Optical imaging & multi-object spectrograph
- All refractive optics
- 200 mm collimated beam
- Two identical beams observing adjacent 8' x15' fields
- 0.24''/pixel
- 3900 - 10000 Å
- Imaging g, r, i & z
- R = 1300 - 4400 (9400 w/new grating)
- Active flexure and focus control
- Up to 300 x 6'' long slitlets
- Long slit mode
- Continuous wavefront sensing
- **Queue scheduled**



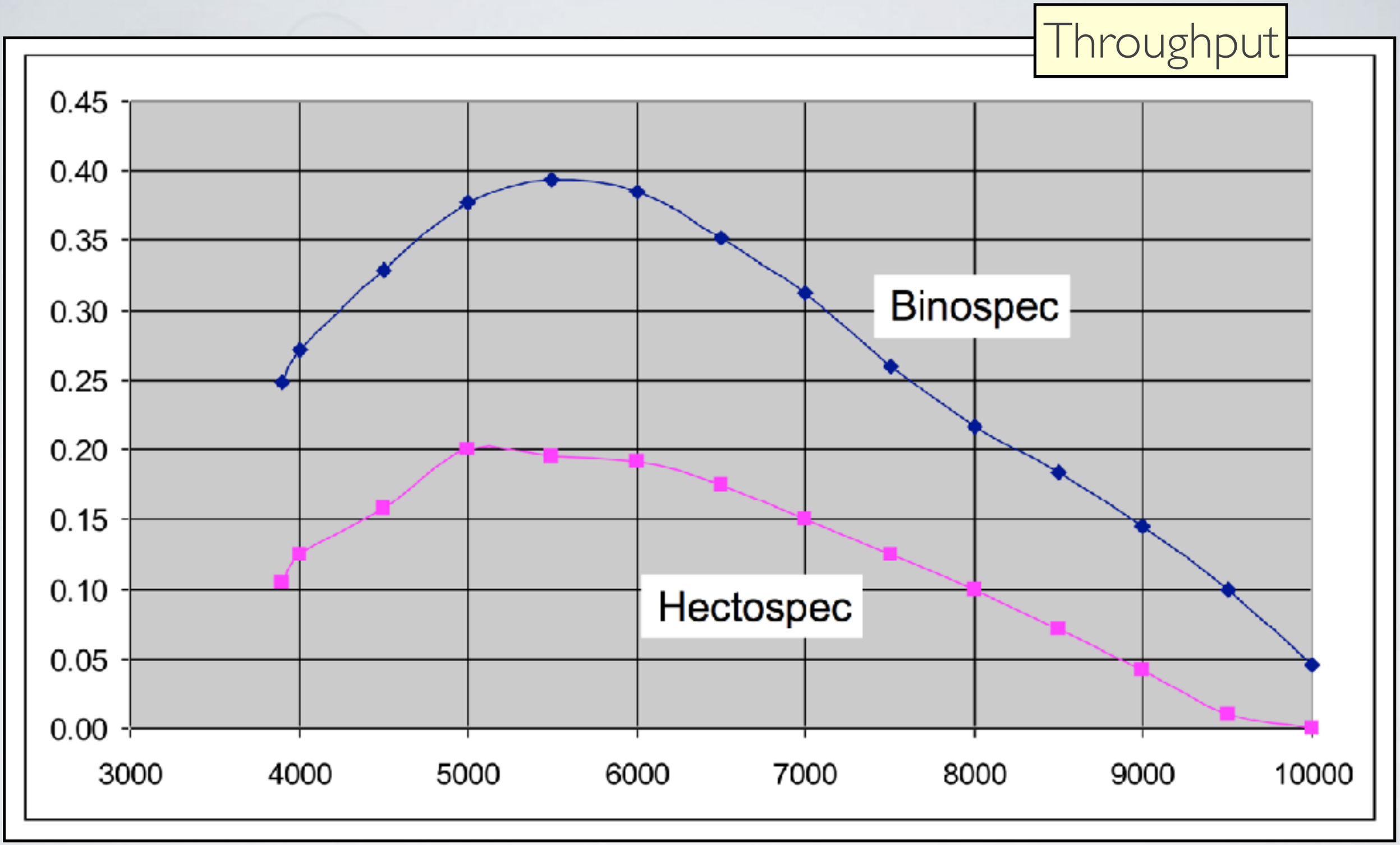
Commissioning Fall 2017


Periscope fold mirrors
Slit mask
Filter
Camera
Collimator
CCD
Third Fold Mirror
Grating

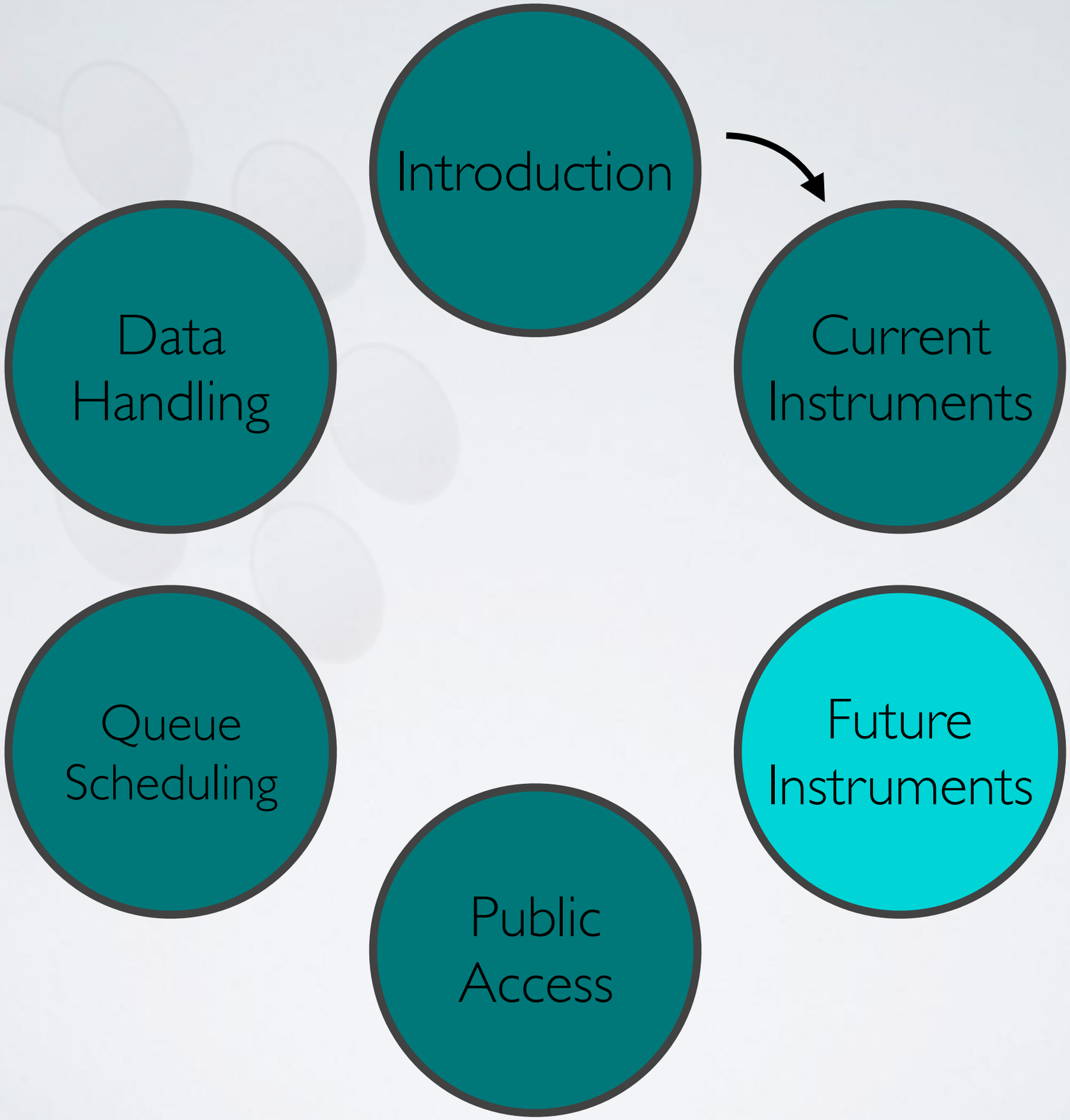

Channel 1
Channel 2
15′
8′

Laser Slit Mask Cutter

Located on site.



Telescope & corrector optics included.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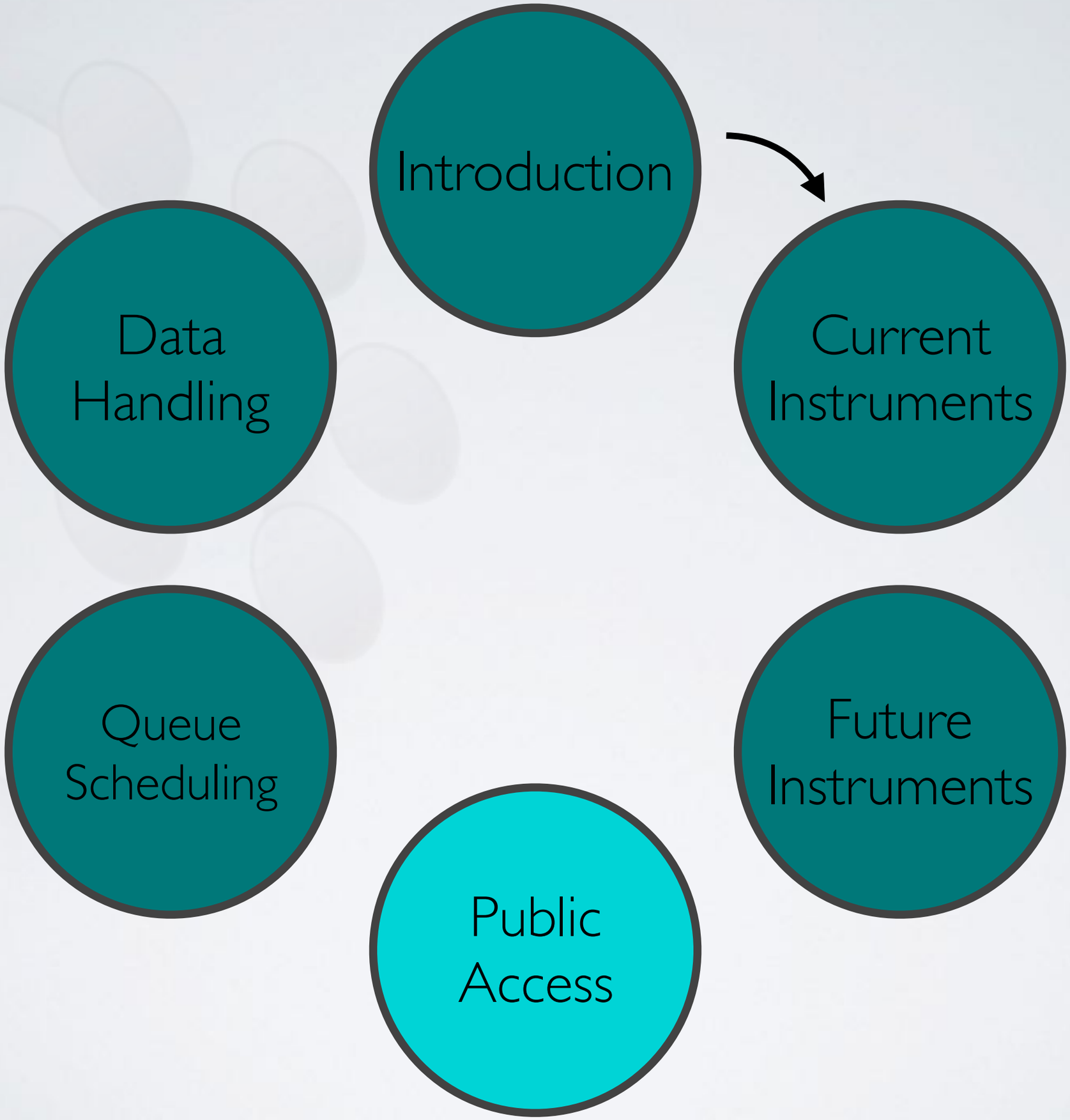
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MMT Observatory is a joint facility of the…

Smithsonian Astrophysical Observatory

THE UNIVERSITY OF ARIZONA

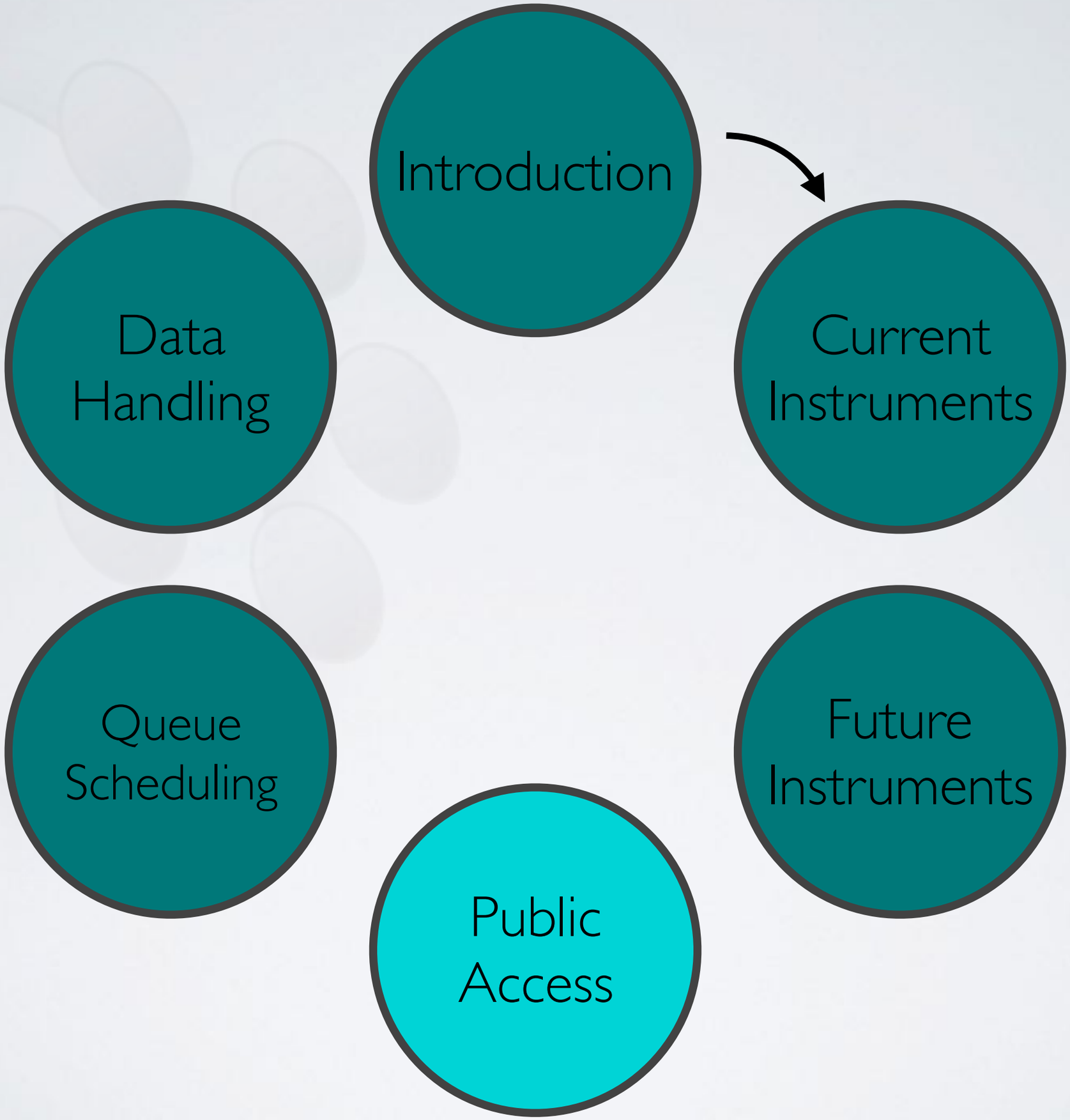
Separate TACs

Currently No Public Access

Historically ~6% Public Access time

2000-2013: 258 nights (NOAO TAC)

TSIP Funding for ARIES, Binospec, MAESTRO & MMIRS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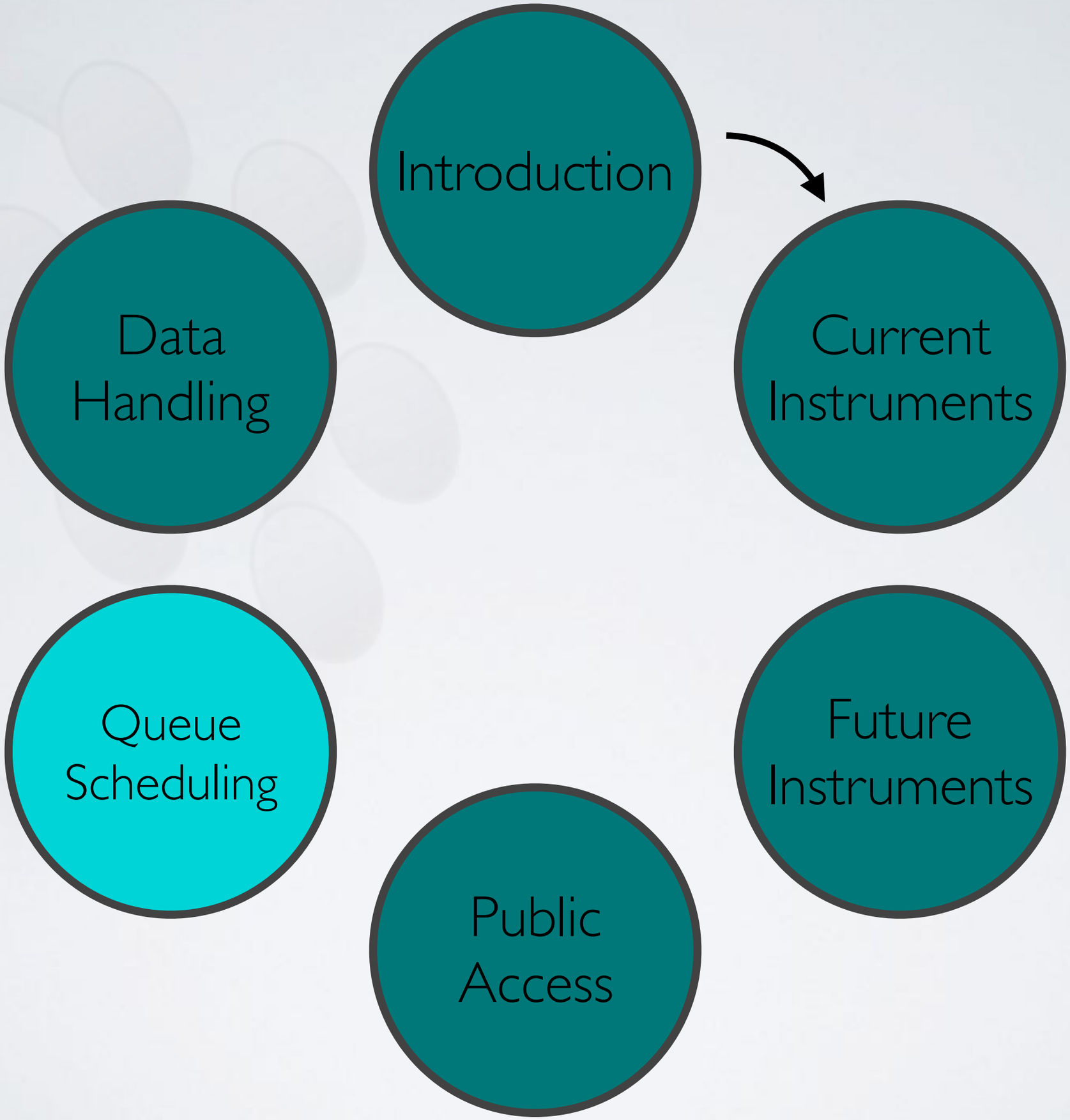
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Queue Scheduling

ToOs are triggered as part of the Queue

Observing blocks stored and accessed through a PHP framework on top of MySQL.

Queue scoring based on customization of Python based astropy/astroplan.

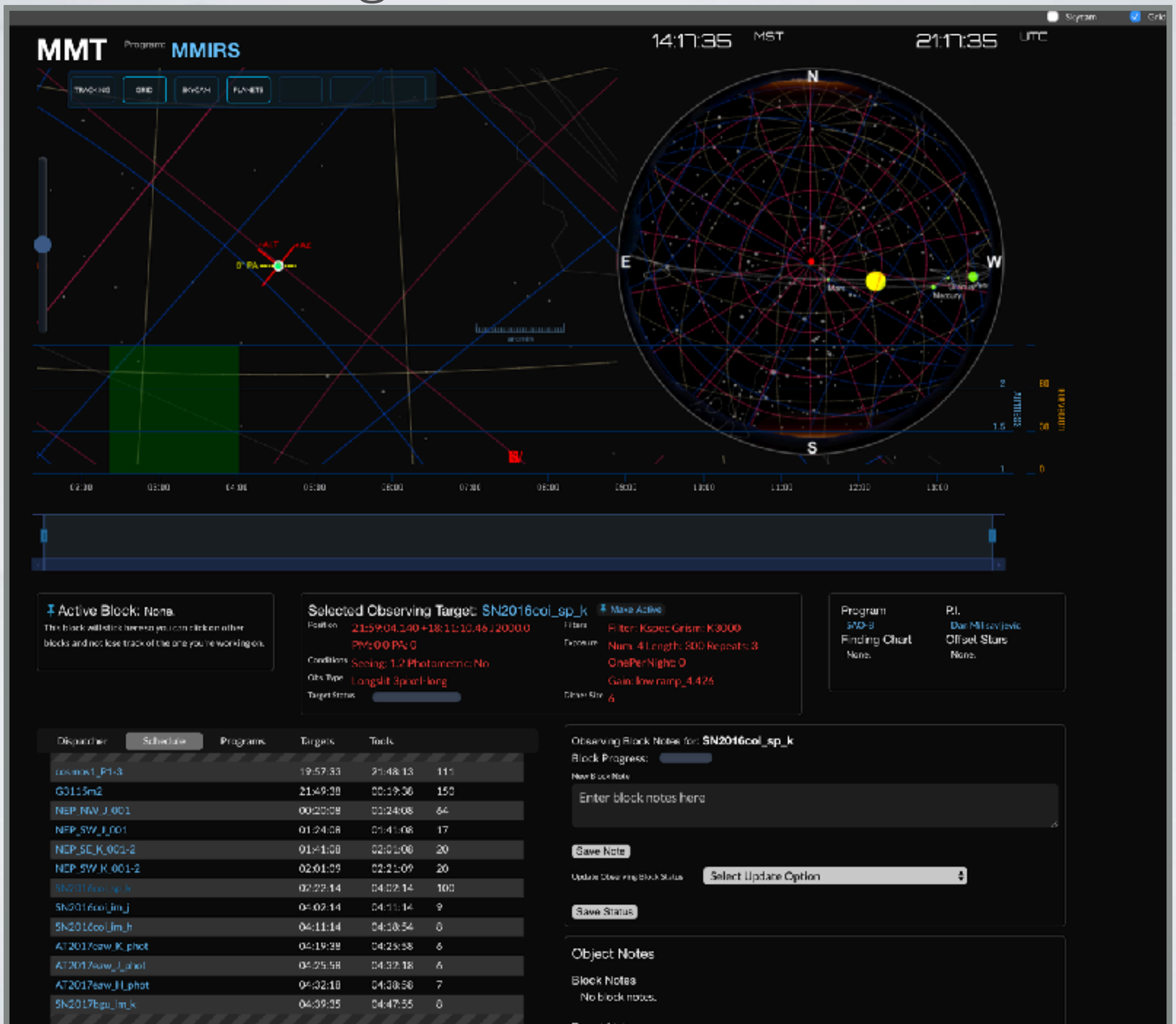
Score: product of all constraint values evaluated at the beginning, middle, and end of each time slot.

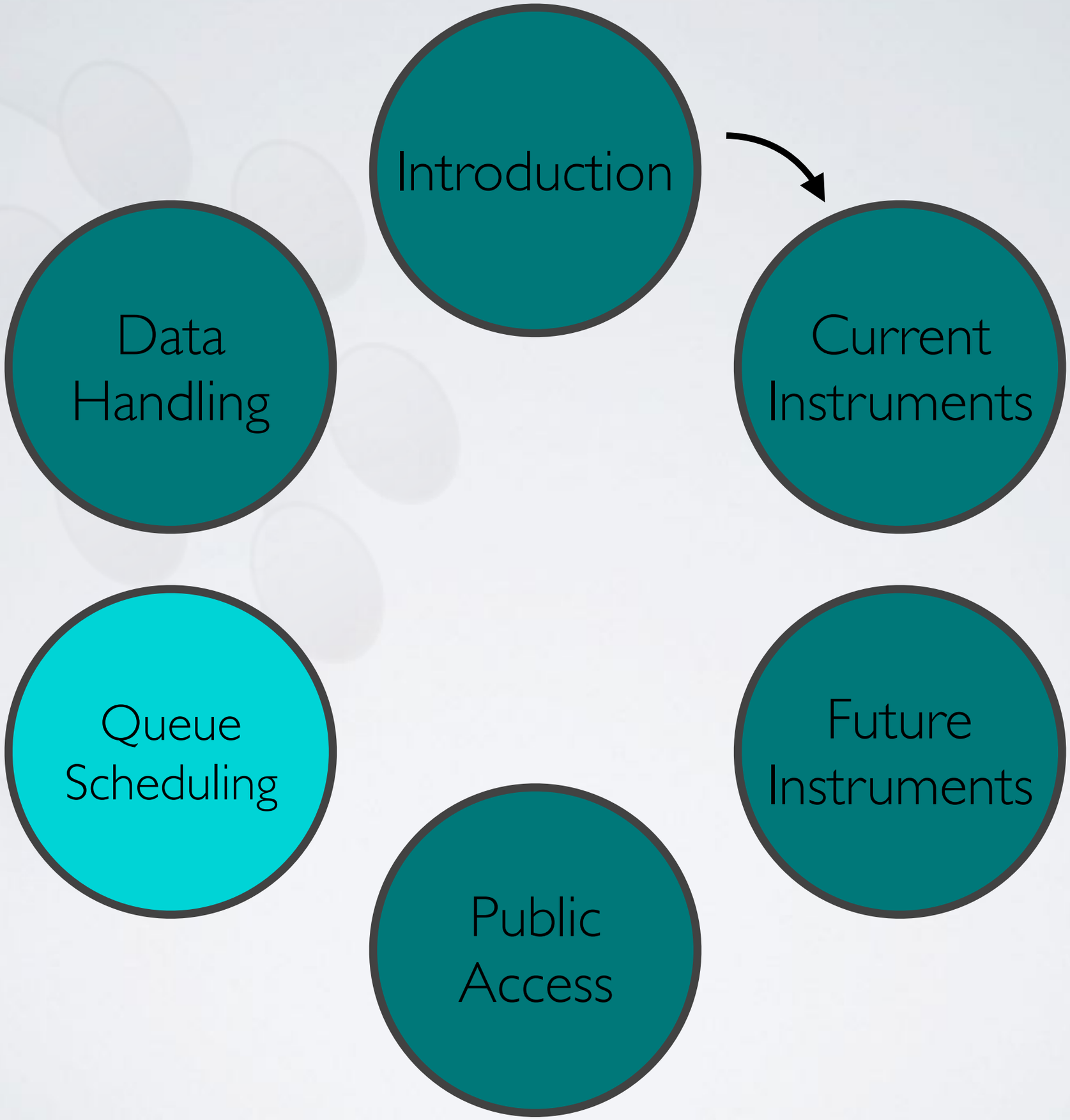
Real time ranked list of observing blocks served up to the QO in a "dispatcher".

Boolean (1 or 0)
Airmass Constraint
Altitude Constraint
At Night Constraint
Moon Separation Constraint
Rotator Constraint
Time Constraint

Float (1.0 to 0.0)
Meridian Constraint
PI Priority Constraint
Time Allocation Constraint
TAC Priority Constraint
Setting or Rising Constraint

Queue Scheduling

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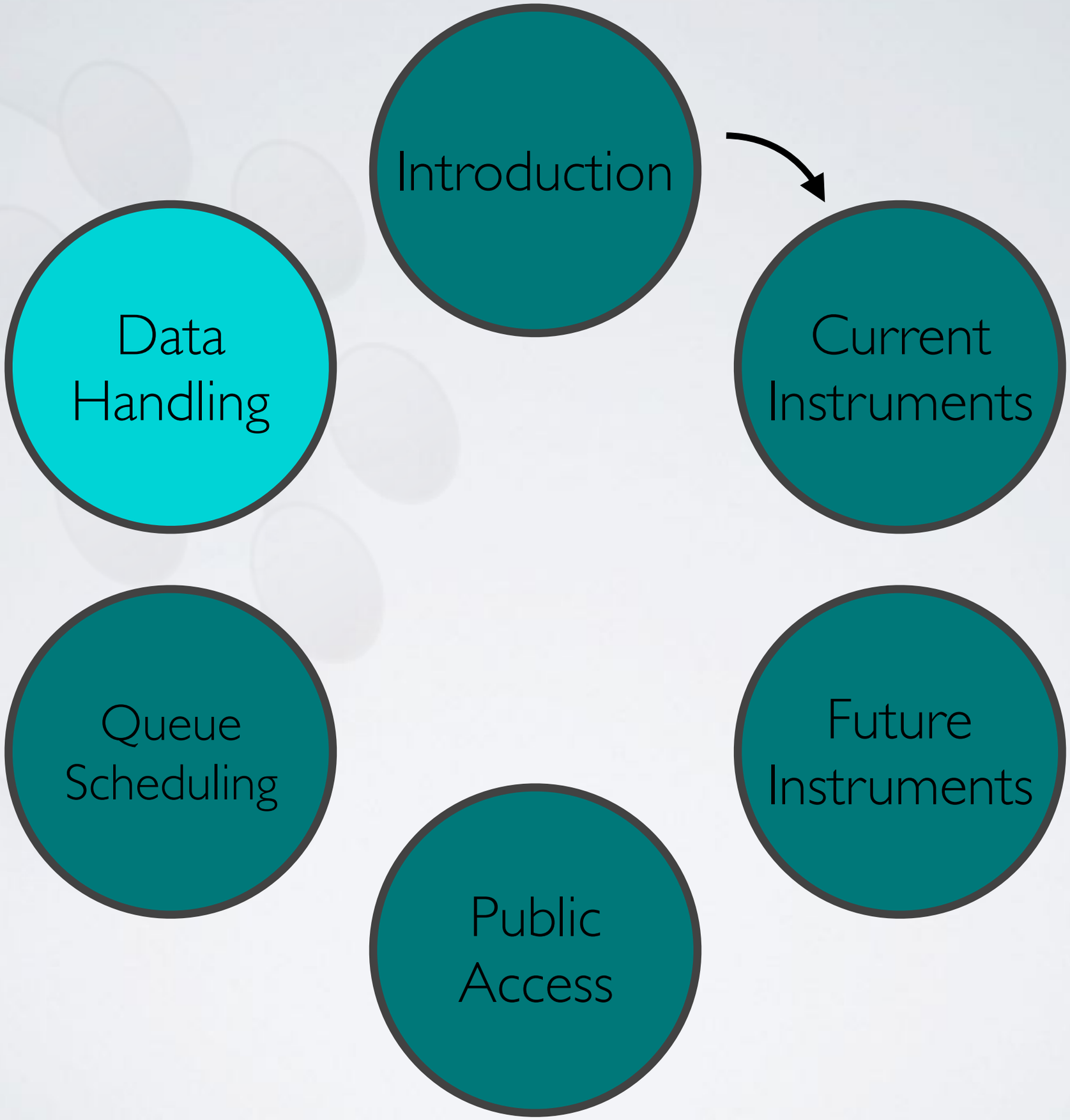
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Data Handling

Local data storage, pipeline hosting, & quick look tools are being developed for Binospec (and will be expanded).

Goal: fully reduced data accessible through MMTO

Thank You!