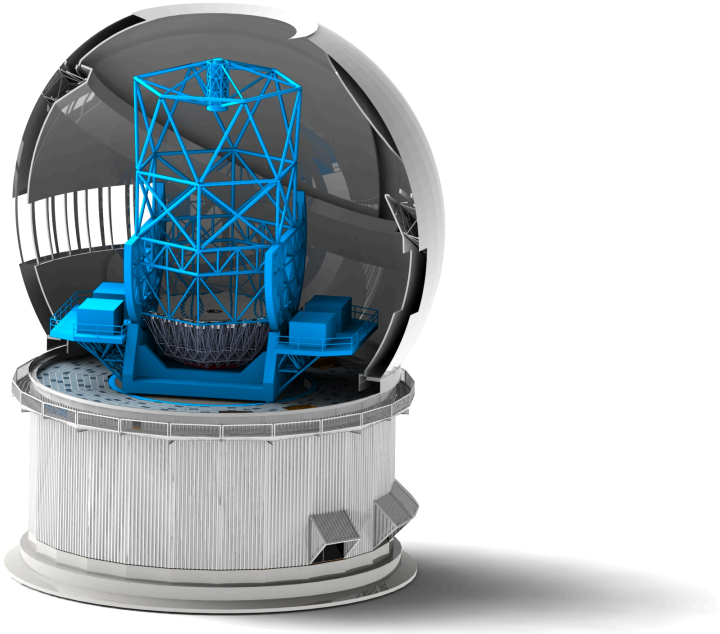
Maunakea Spectroscopic Explorer



MSE Engineering Development

Project Office

Nicolas Flagey (MSE Systems Scientist)
for Kei Szeto (MSE Project Engineer)

Outline

Review the baseline architecture

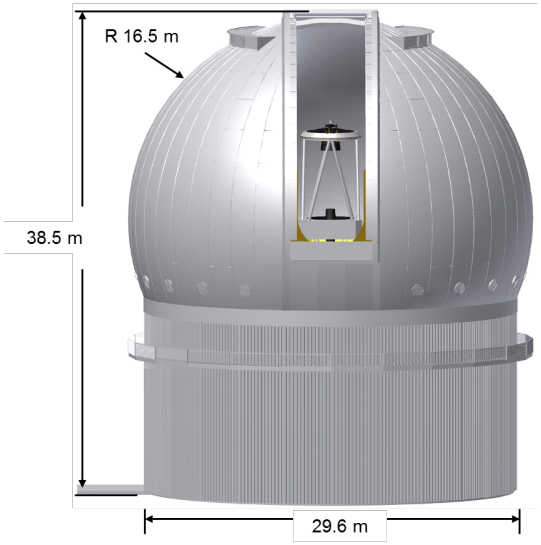
presented at the Paris Engineering Workshop last October

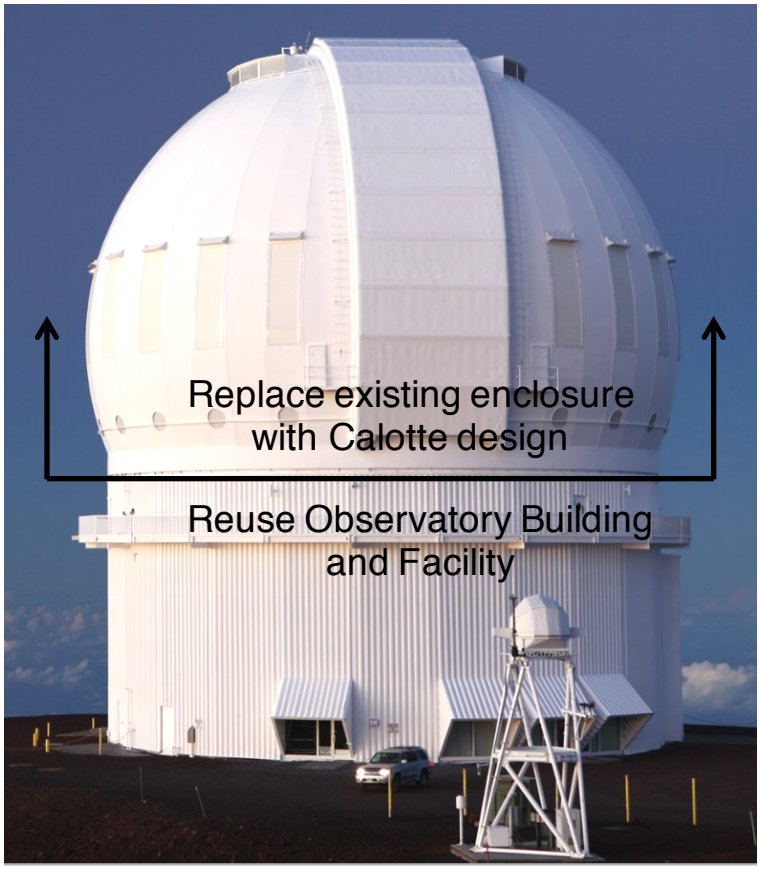
Introduce distribution of work among the engineering team

discussed at the Madrid Project Wide Collaboration Meeting

Planned MSE exterior appearance

- Retain current geometry
  - Maximum dimensional increase 10%
    - Overall structure height
    - Enclosure radius

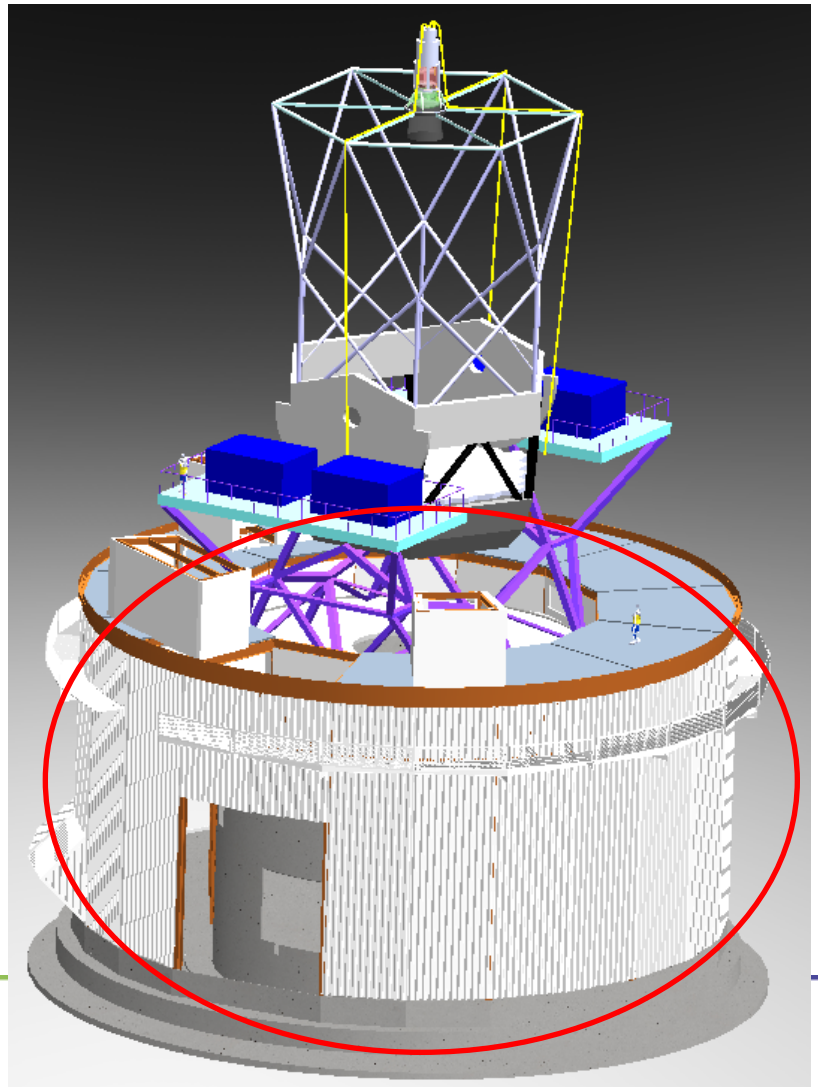




- Enclosure
  - Calotte design
    - Enable 12.5 m aperture opening yet retain the spherical form of CFHT dome

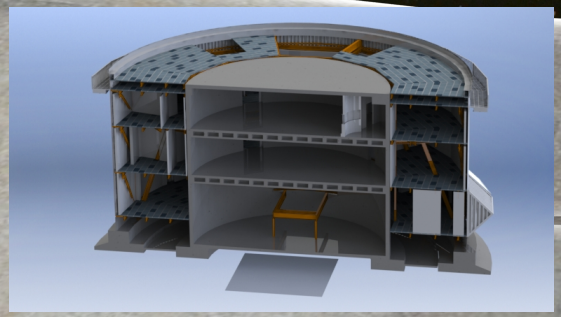
Baseline Architecture

- Reutilize observatory building and facilities (OBF)
  - Outer building
    - Structural support for enclosure
    - Mechanical and electrical plants
    - Infrastructure for operation
  - Inner pier
    - Structural support for telescope
    - HR spectrographs housed in Coudé room
  - Redevelopment work of OBF is organized by Steve Bauman



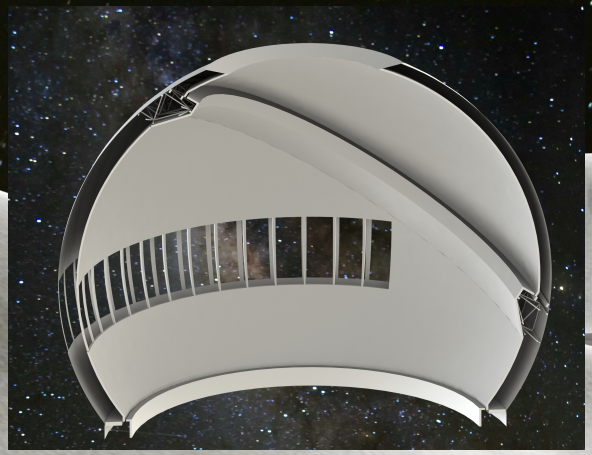
Maunakea Spectroscopic Explorer

Current Concept



Cross-section of “shortened” outer building with 5th floor removed

Calotte enclosure at zenith pointing orientation

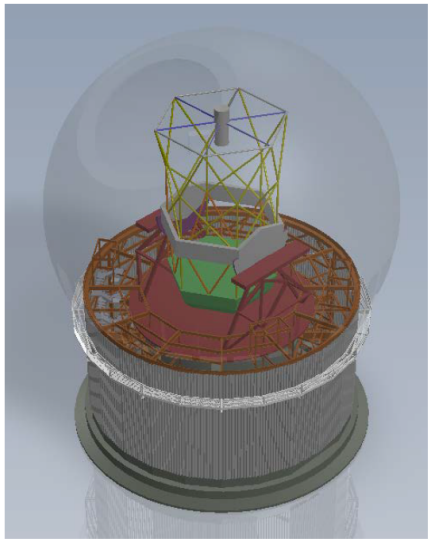


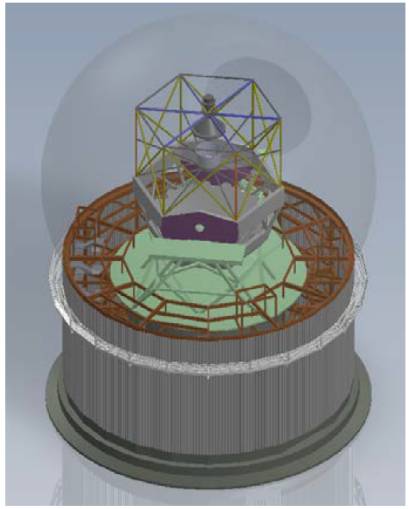
Cross-section of ~~enclosure~~ with vents open

Baseline Architecture

- Optical design selection
  - Trade study based on comparison of optical performance and non-optical attributes evaluated from an overall system perspective.
  - How does a telescope based on each optical design would impact the overall observatory design and operation?

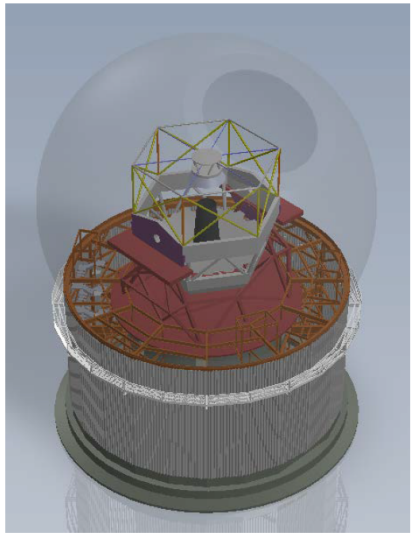
NRC PF

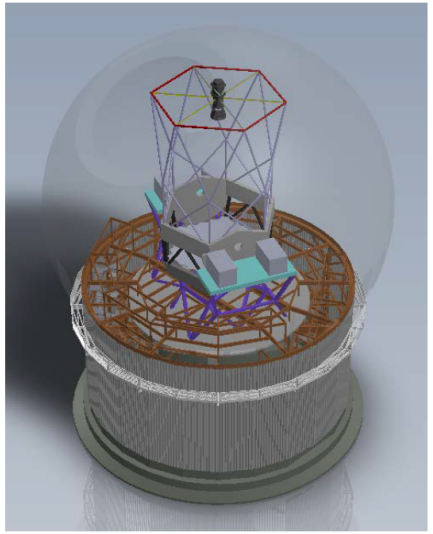




NIAOT QPF

AAO CF



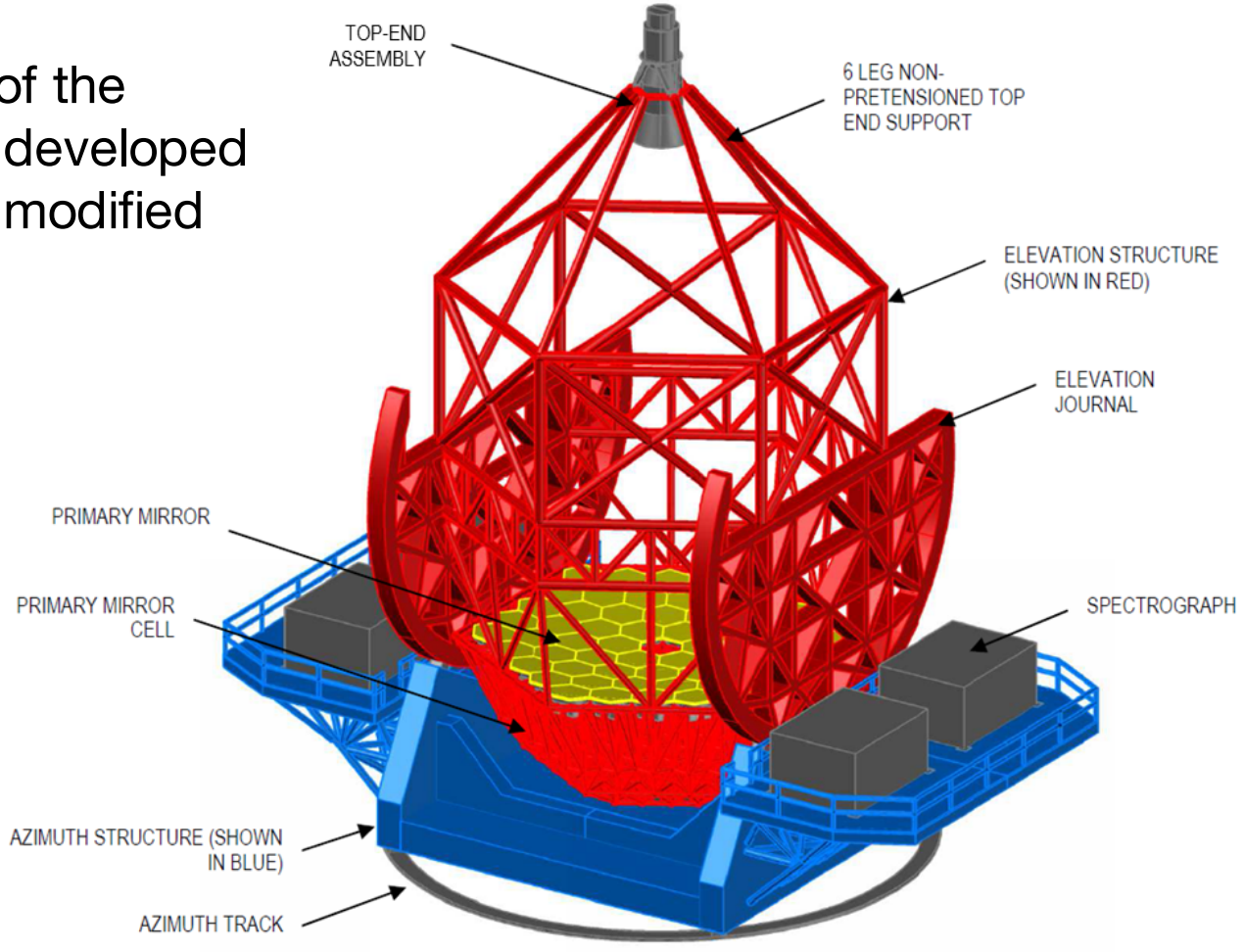


AAO PF

18

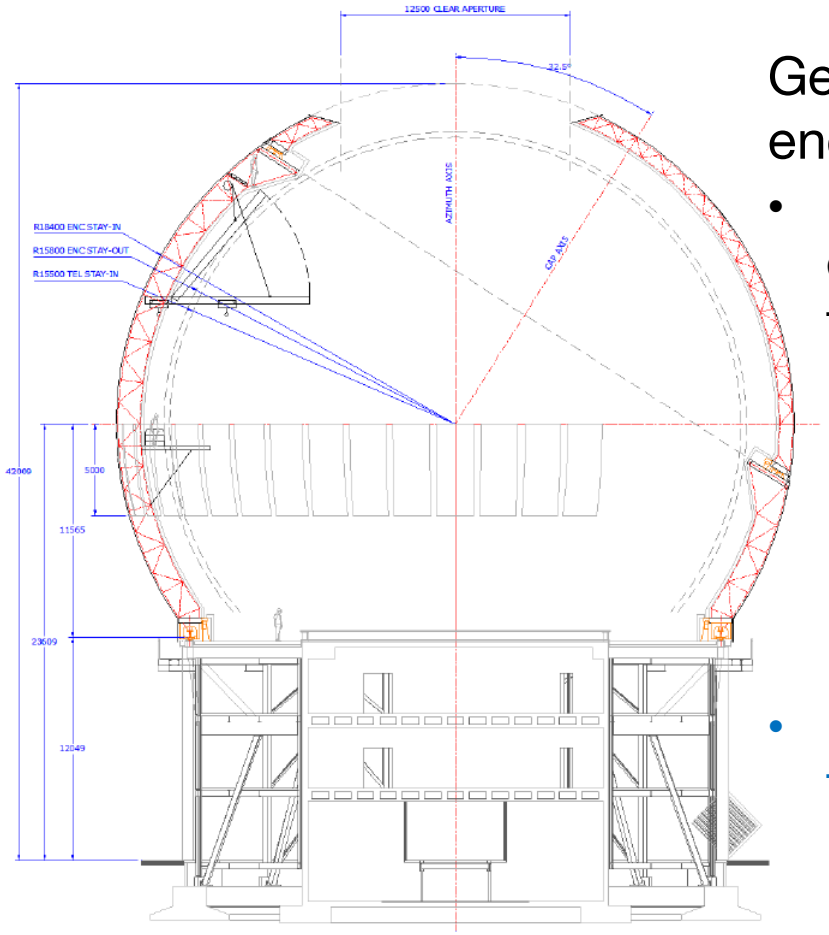
Current Concept

- Baseline architecture of the telescope structure is developed from Keck design but modified for MSE requirements
  - Two spectrograph platforms for LMR spectrographs
  - Telescope structure is open-truss to facilitate dome ventilation and flushing



Current Concept

DYNAMIC STRUCTURES

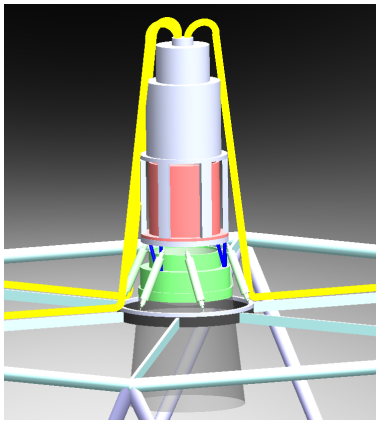


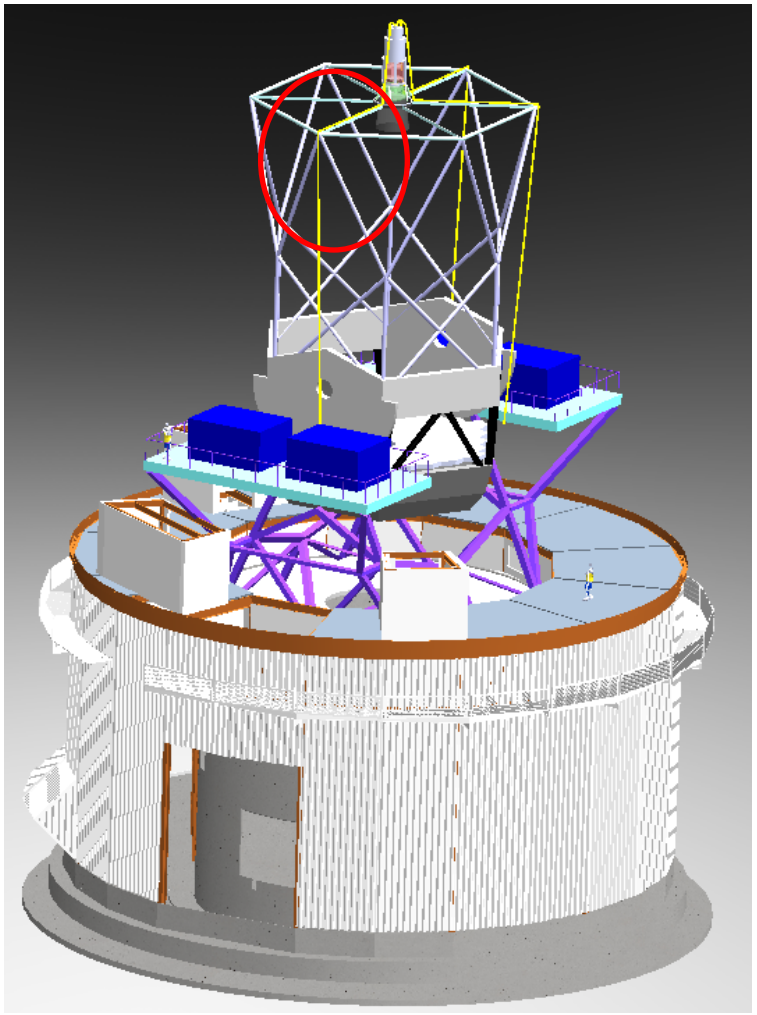
Geometry between telescope and enclosure

- For safety, a clearance zone of 0.3 m is enforced between the enclosure stay-out and telescope stay-in envelopes
  - To maintain optimal clearance, the enclosure spherical center should be coincident with the telescope center
    - Telescope center is the intersection point between the azimuth and elevation axes
    - This sets the height of the elevation axis
- Industrial contracts planned to progress telescope and enclosure conceptual designs
  - Call-for-bids in process for enclosure
  - Call-for-bids for telescope to be released in two weeks

Baseline Architecture

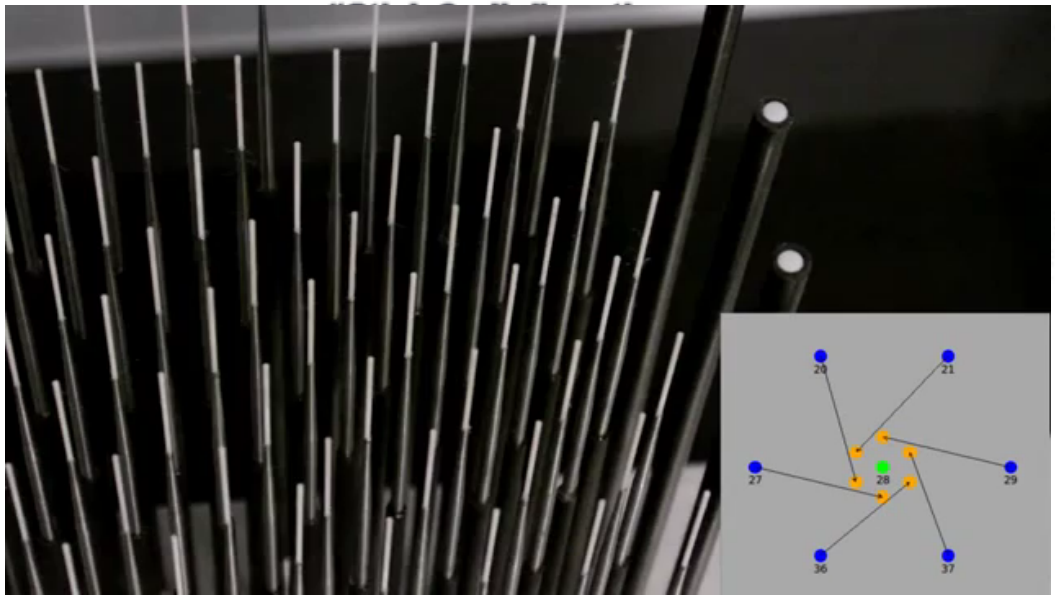
- Top end systems (INSU/DT team)
  - Hexapod
  - WFS/ADC opto-mechanics
  - Instrument Rotator
  - Positioners (3 competing studies)
  - Optical feedback system
    - Pointing & guiding
    - Image quality monitoring
      - Focus sensing
      - Segment alignment and figuring



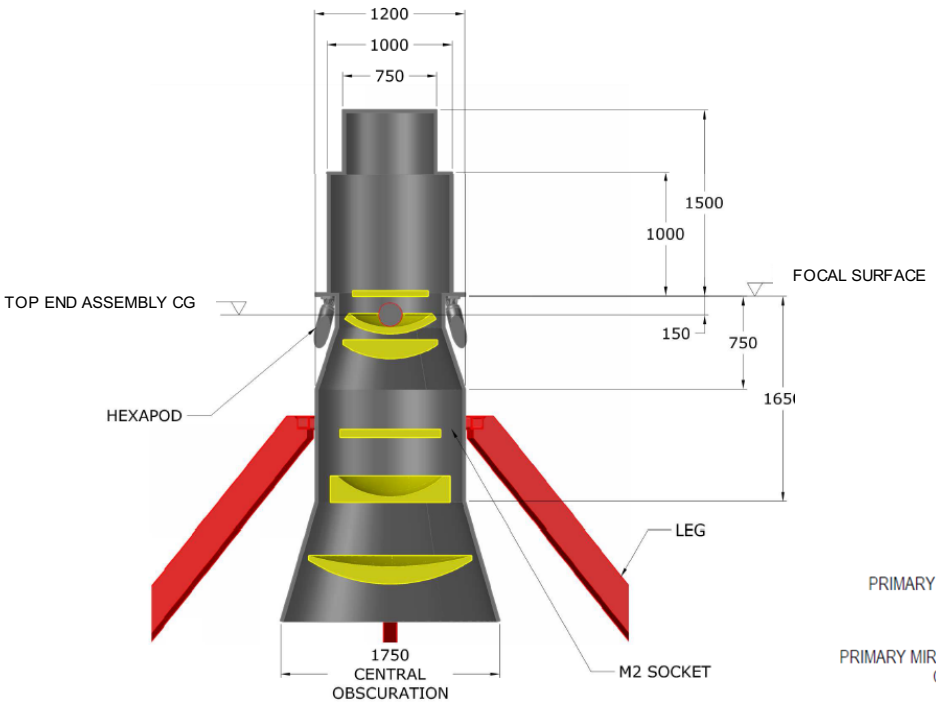


Baseline Architecture

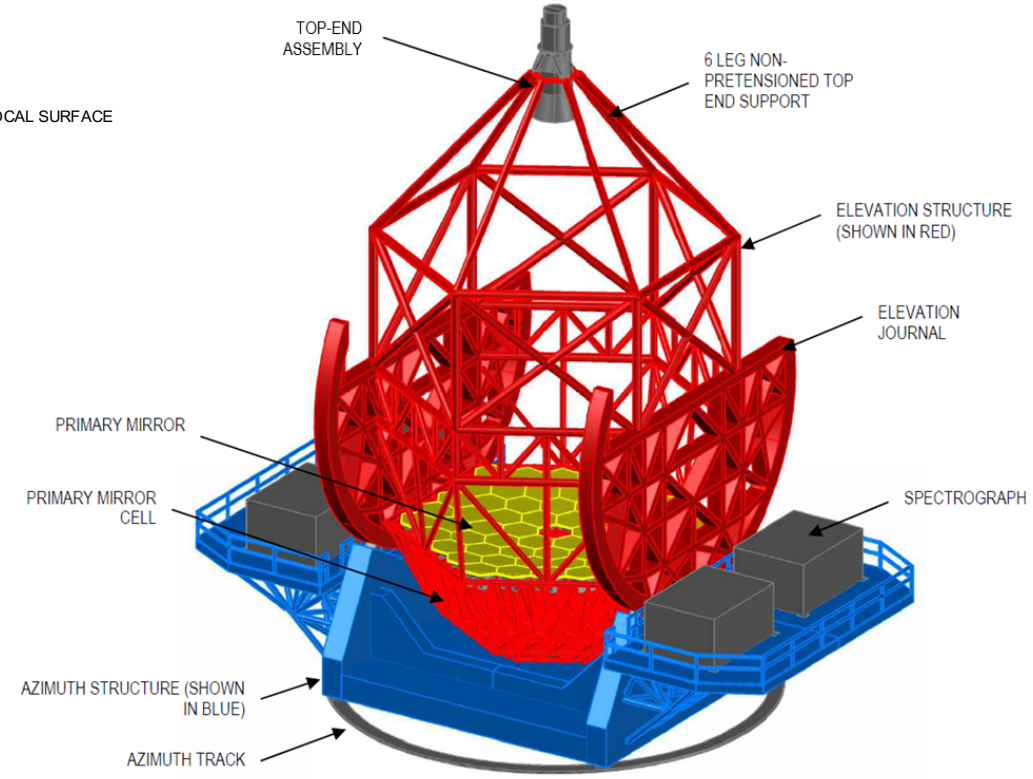
- Fiber positioners
  - SRD for multiplexing≥3,200 spectra at R3,000 and R6,500
  - ≥1,000 spectra at high resolution (R20K-40K)
- Two designs: Echidna and Phi-Theta



Current Concept

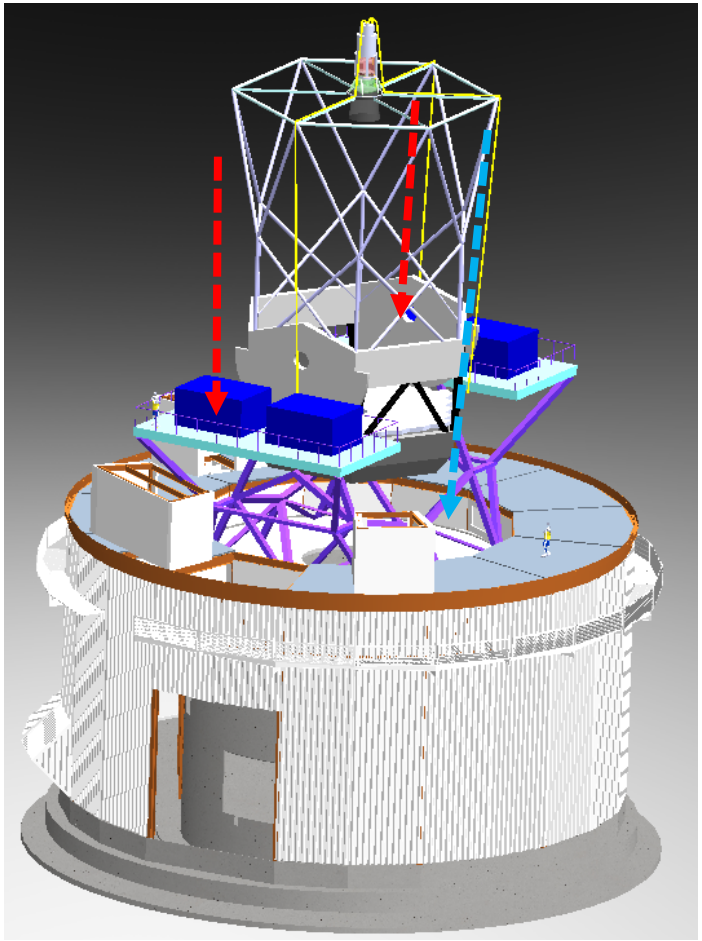


Section view of the top end system geometry



Baseline Architecture

- Fibre transmission system (NRC/HAA led study)
  - Minimum of three bundles
    - Two for LMR spectrographs
    - One for HR spectrographs
  - No connectors in the bundles between the positioners and spectrograph inputs
    - Maximize throughput
    - Preserve spectrograph stability and repeatability



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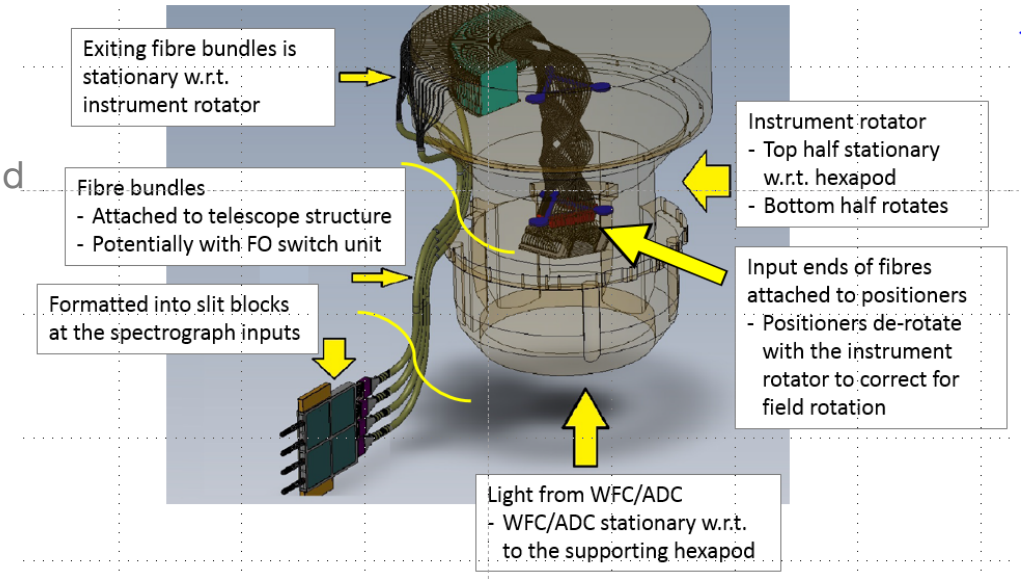
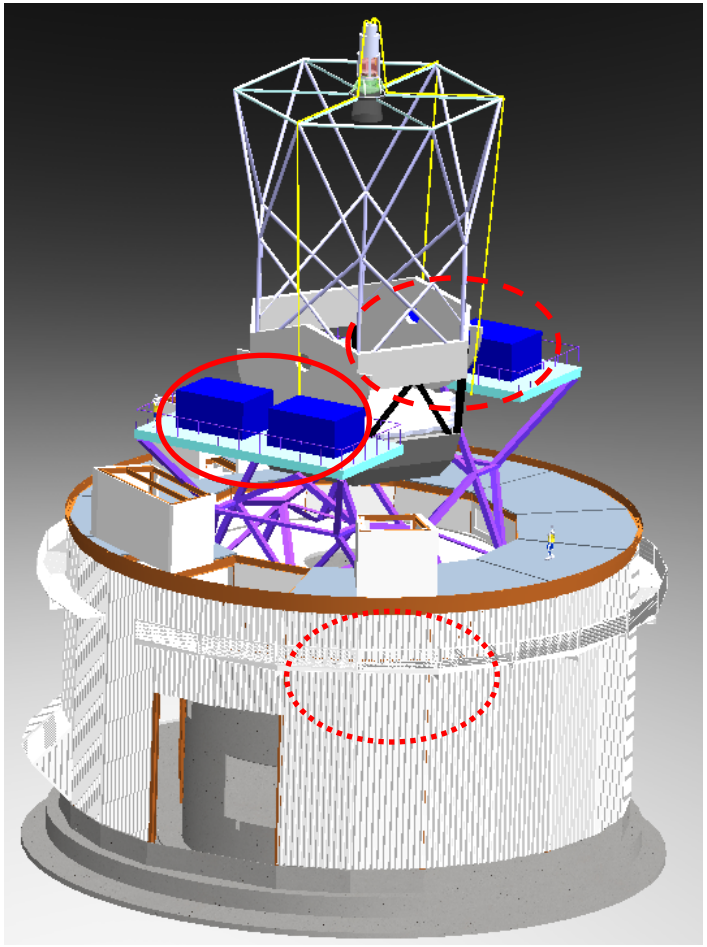


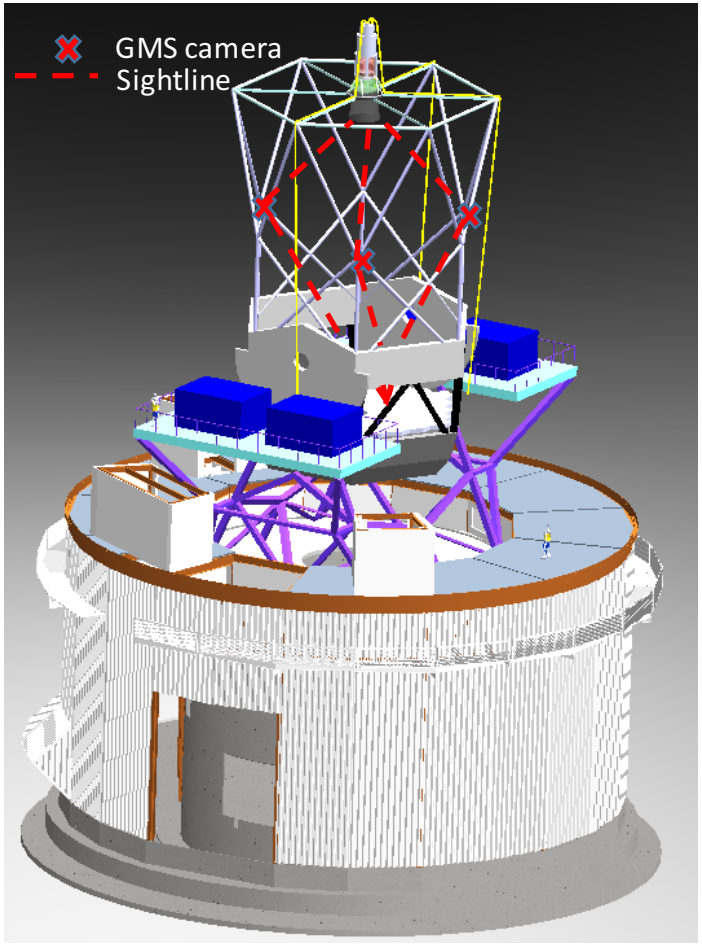
Baseline Architecture

- Spectrographs, LMR, HR
  - Spectrograph platforms house the LMR spectrographs
  - Coudé room houses the HR spectrographs
  - NIAOT supports HR spectrograph conceptual design
  - AAO/CRAL collaboration supports LMR spectrograph conceptual design (TBC)



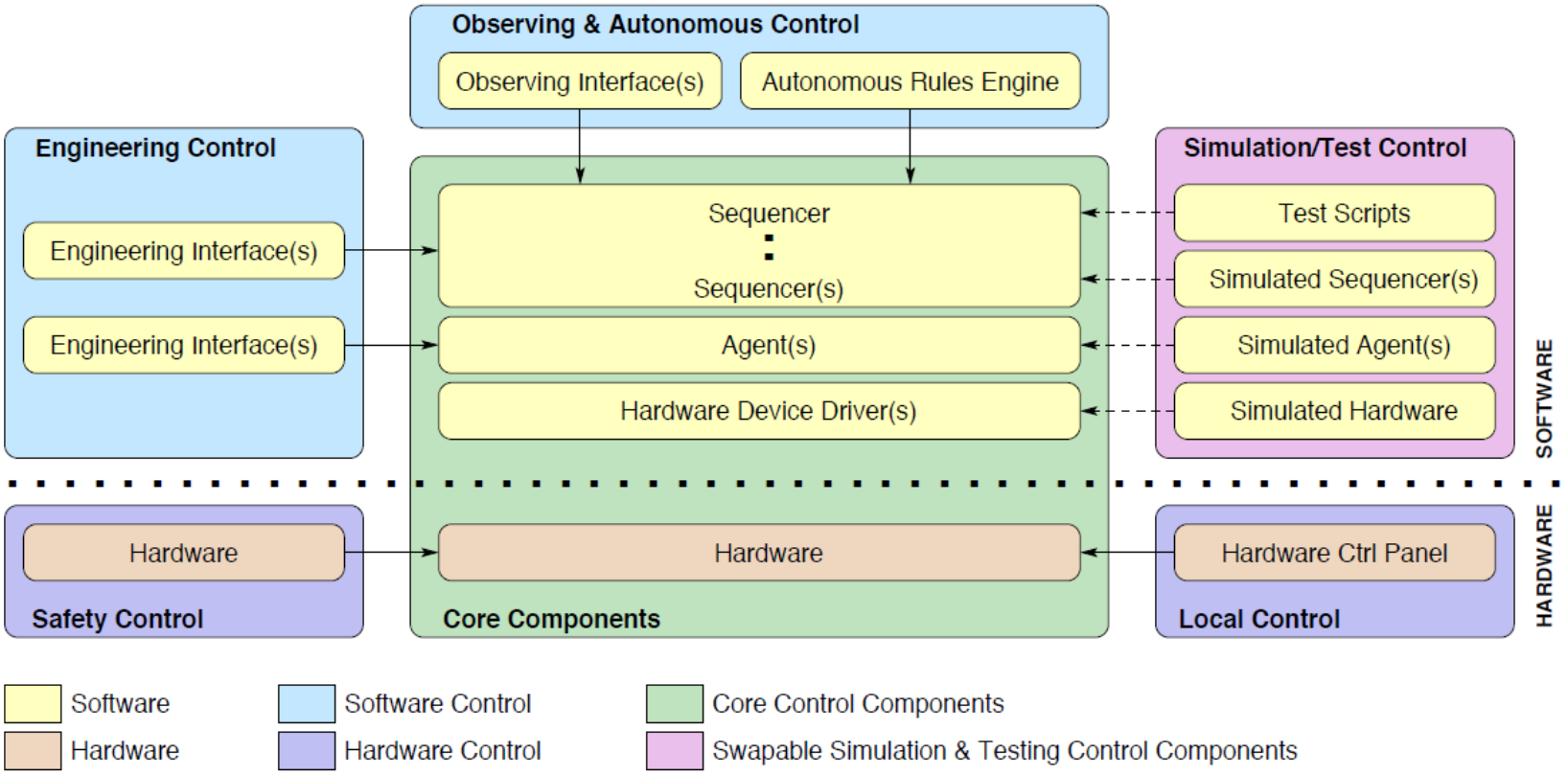
Baseline Architecture

- Fibre position metrology system
  - Included in the 3 positioner conceptual design studies
- Science calibration system
  - To be developed in parallel with science calibration requirements
- Global metrology system
  - Laser tracker system to facilitate initial alignment and provide ongoing monitoring of critical telescope dimensions and its position with respect to floor mounted fiducials

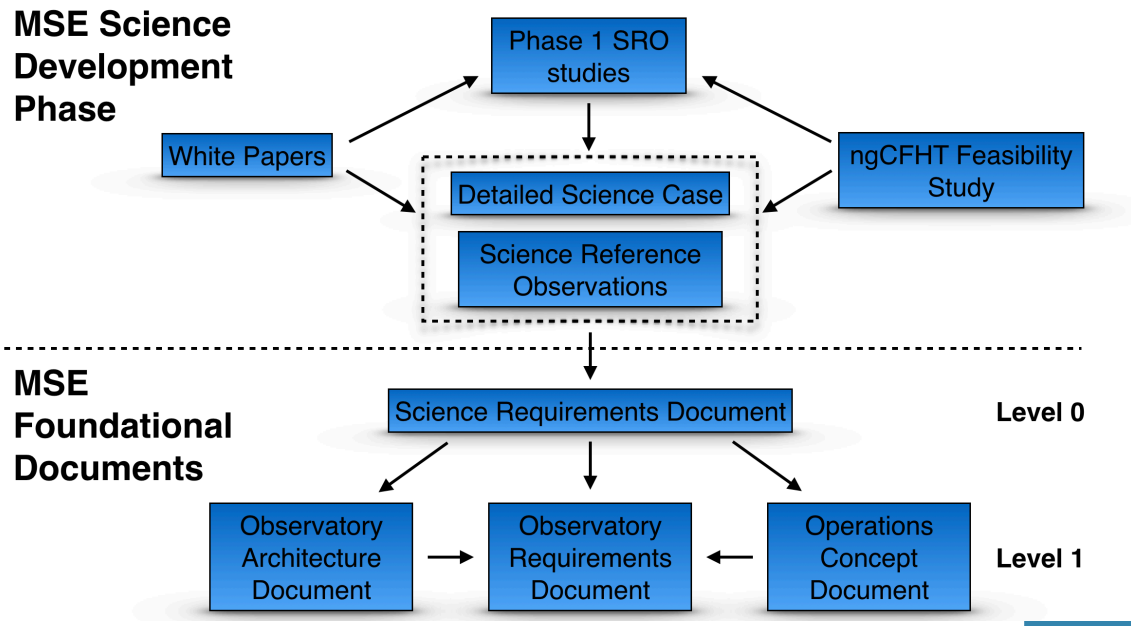


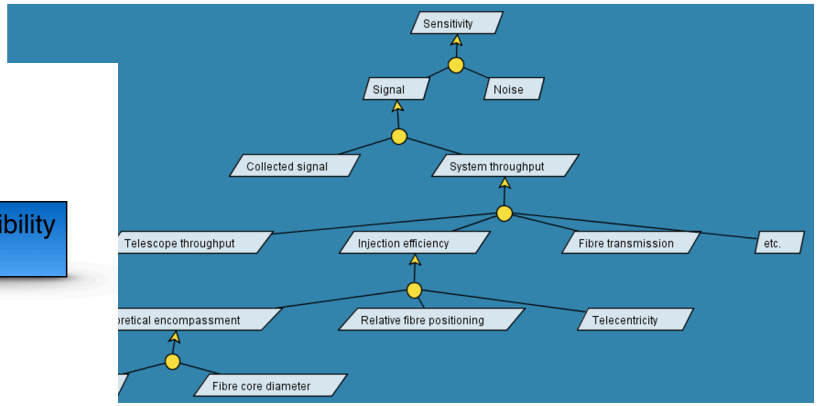
Baseline S/W and Control Architecture

- Conceptual design observatory software and control system architecture to be developed by Kanoa Withington and Kevin Ho



Systems Engineering





uirement flow-down from Sensitivity to IQ (incomplete diagram). The refinement links e target requirement is only met if all the source requirement are satisfied (KAOS semantics).

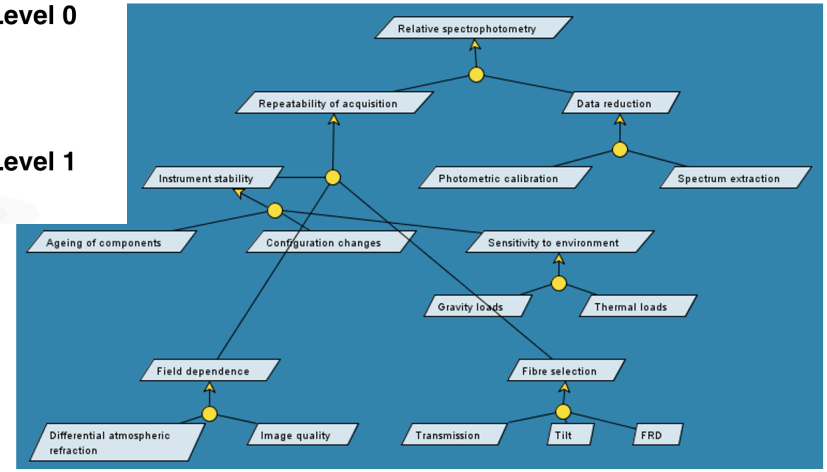


Figure 2. Requirement flow-down from Relative spectrophotometry to IQ (incomplete diagram).

Development of Level 2 requirements for subsystems

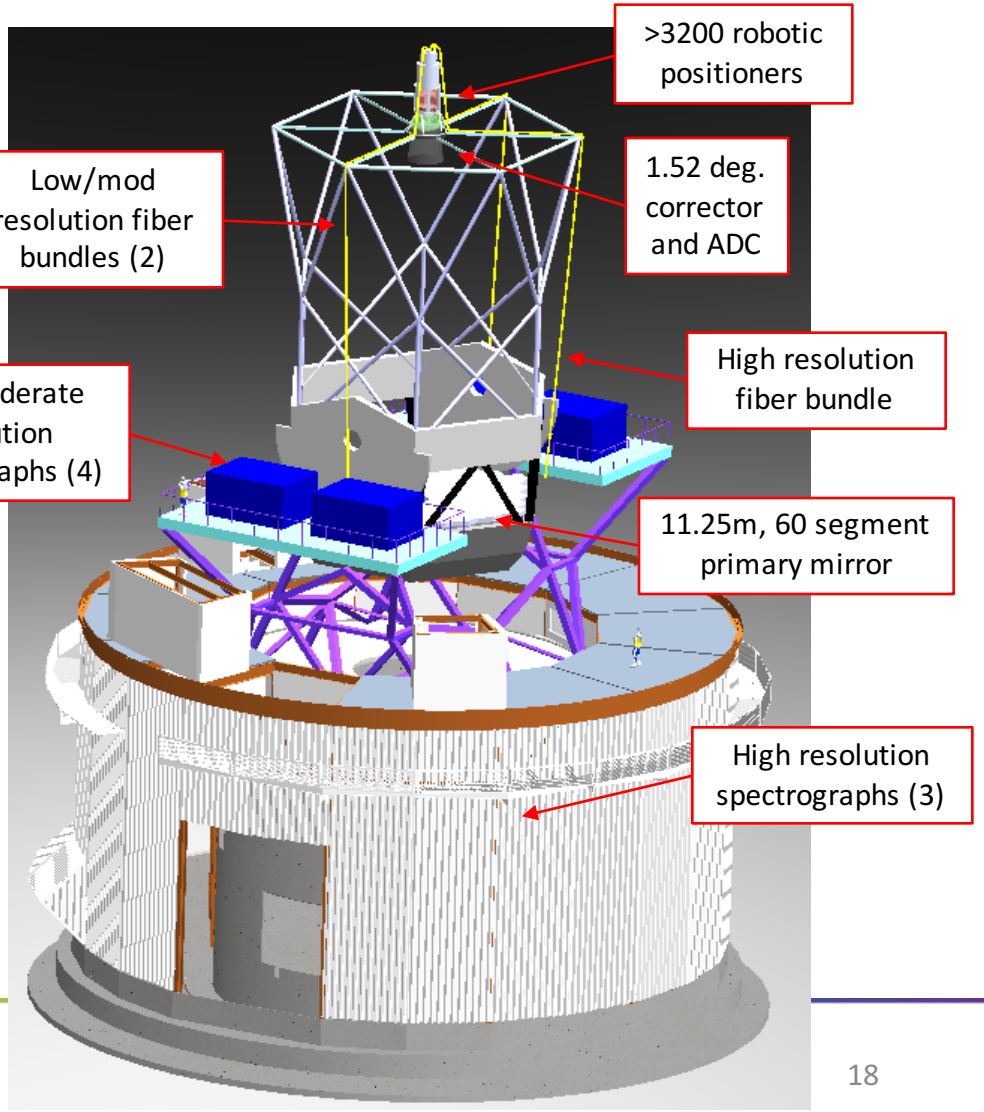
- Industrial contracts by Project Office
- Conceptual design work package partners/collaborators

Development of system budgets

- Adapted bottom-up approach to understand and capture the "complex" relationships between requirements
- Maintain traceability to Level 0 requirements from SRD
- Shan Mignot, Observatoire de Paris, is Systems Engineer

Baseline Architecture Summary

- Reutilize observatory building and facilities
  - Outer building
  - Inner pier
- Enclosure
  - Calotte design
- Telescope
  - Prime focus optical design
  - Telescope structure geometry
- Top end systems
  - Hexapod
  - WFS/ADC
  - Instrument Rotator
  - Positioners
- Optical feedback system
- Fibre transmission system
- Spectrograph locations, LR/MR, HR
- Fibre position metrology system
- Science calibration system
- Global metrology system
- Observatory software and control system architecture
- Systems Engineering



Baseline Architecture Summary

- Reutilize observatory building and facilities
  - Outer building
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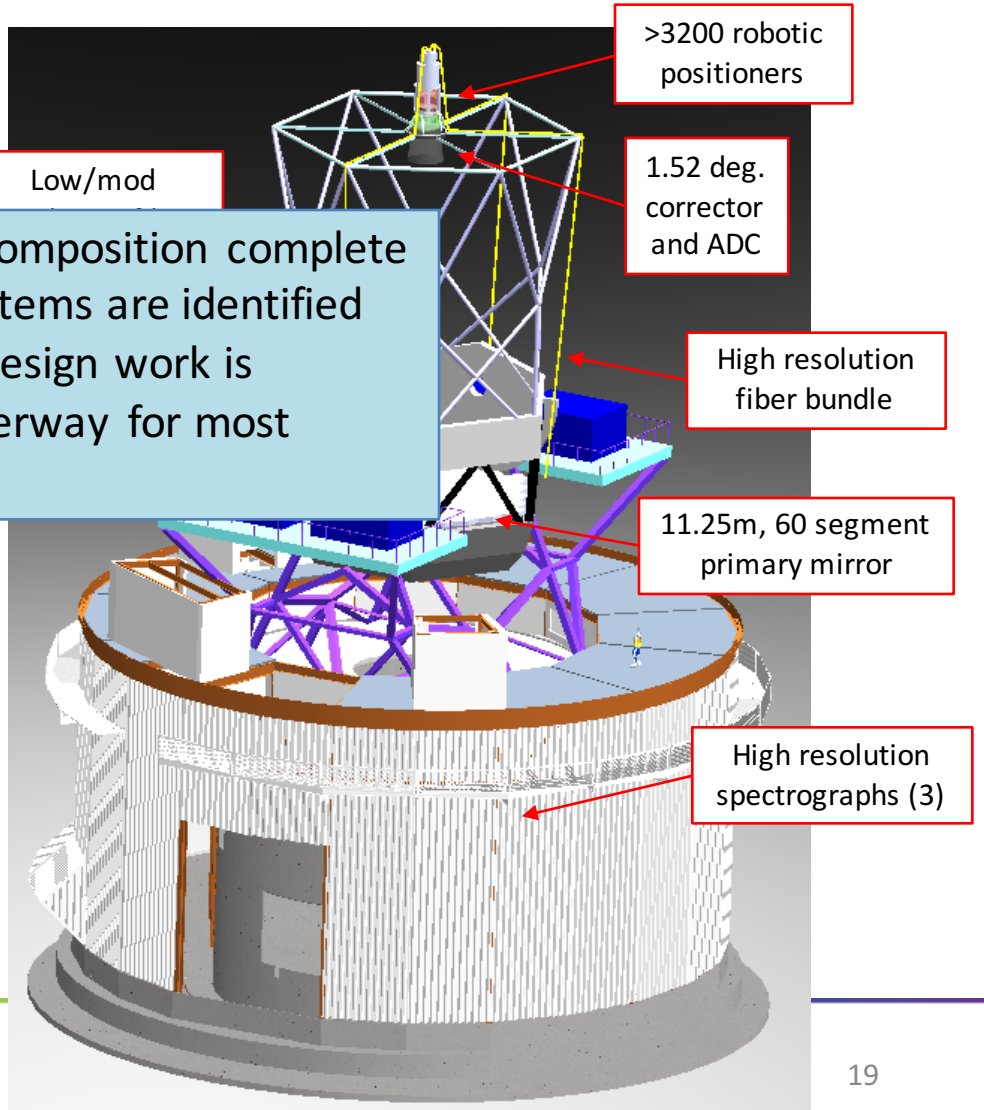
  - Instrument Rotator
  - Positioners
- Optical feedback system
- Fibre transmission system
- Spectrograph locations, LR/MR, HR
- Fibre position metrology system
- Science calibration system
- Global metrology system
- Observatory software and control system architecture
- Systems Engineering

MSE system decomposition complete

- Major subsystems are identified
- Conceptual design work is planned/underway for most subsystems



THANK YOU
- QUESTIONS?