



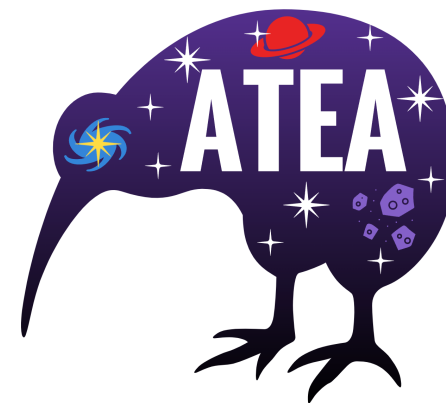
NZ61cm望遠鏡用 UV-OPT-NIR同時撮像カメラATEAの開発状況 (ATEA: UV-OPT-NIR simultaneous imager for the 61cm telescope in NZ)

Daisuke Suzuki (UOsaka)

Yui Okumoto, Hibiki Yama (UOsaka), Toshihiro Tsuzuki (ATC, NAOJ)

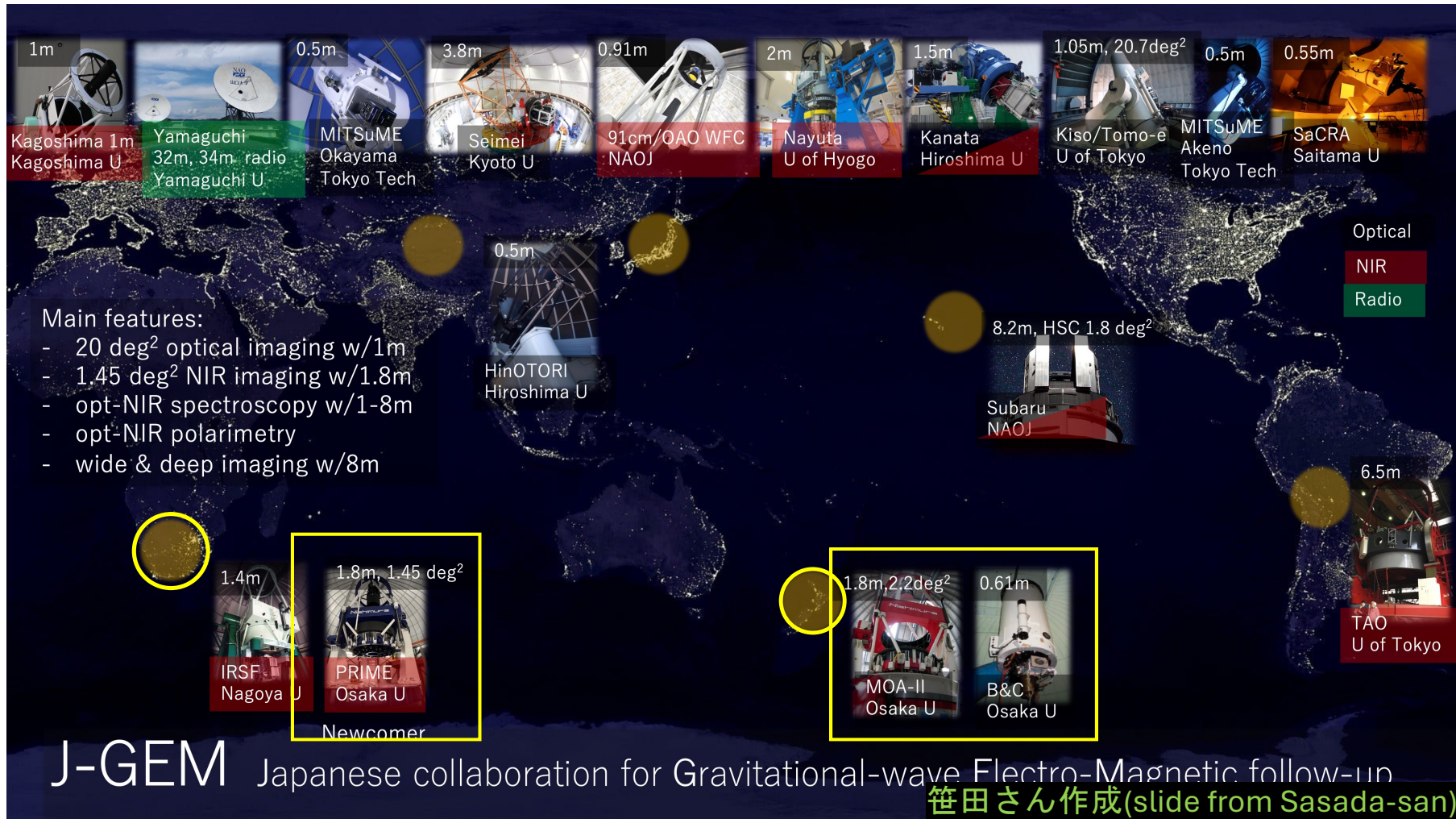


大阪大学
THE UNIVERSITY OF OSAKA

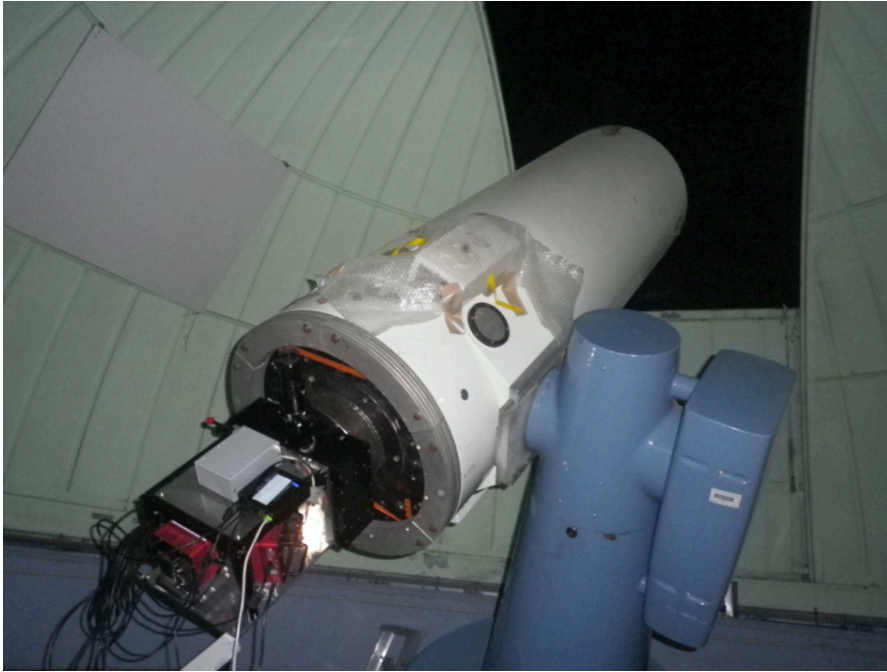


可視赤外線観測装置技術ワークショップ@京産大

Need multi-band observations for southern sky



61cm B&C telescope to be updated for NIR(+UV)

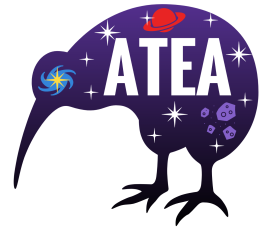


- ✓ @Mt. John Observatory, (43°59.2'S, 1029m)
- ✓ Primary mirror : 61cm diameter
- ✓ Managed by Canterbury U
- ✓ Relatively easy to get the telescope time
- ✓ An optical 3-band camera (tripole5) was used to be available for follow-up of μ lensing & GW events (incl. GW170817).
- ✓ **Tripole5 camera (g,r, i) is not available as the telescope F is changed from F/13.5 to F/6.25**

「南天における突発天体の可視光近赤外線多波長即時観測」
“Rapid Opt-NIR observations of transients in the Southern sky”

- **Update the B&C telescope to have a NIR camera along with an optical camera**
- **This will be the first dedicated NIR astronomical instrument in NZ**
(except for NASA's SOFIA mission that flew over NZ several years ago)

ATEA (Aotearoa Triple-band Equipment for Astrophysics)



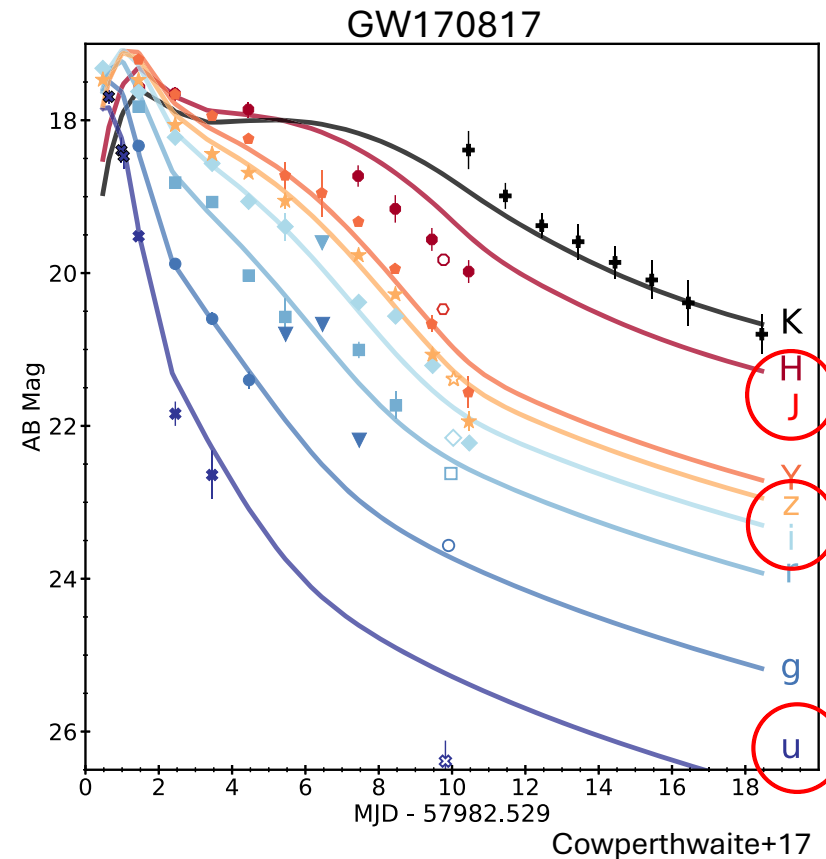
- Our original idea was to build a 3-band camera with two optical cams and one NIR cam.

*UV is challenging,
but must be interesting!!*

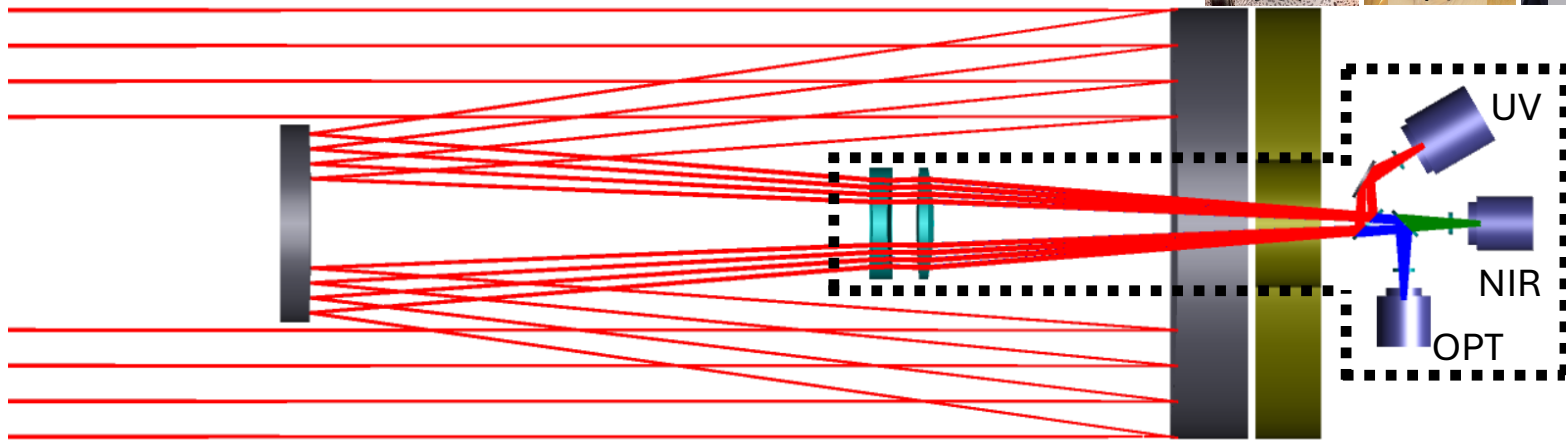


- Our new 3-band camera will have **NUV**, **Optical** and **NIR** imagers.

ATEA can observe

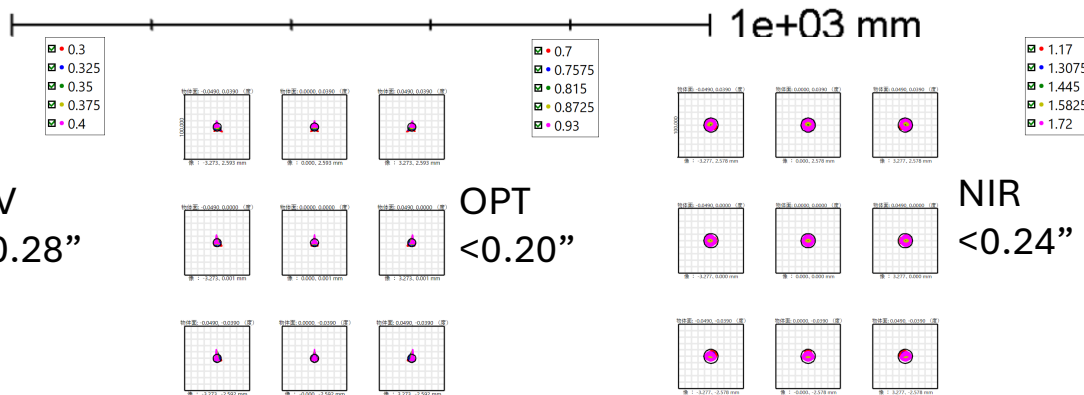


Optical design of ATEA



We design & fabricate/procure the parts in the enclosed area

- Conversion Lens 1
- Conversion Lens 2
- Dichroic mirror 1
- Dichroic mirror 2
- Flat mirror for UV
- UV camera *(next yr's scope)*
- OPT camera
- NIR camera
- NIR filter *(Already we have)*
- UV filter
- OPT filter
- Housing



Doable!!

面像 : Detector

スポットダイアグラム	
UV, 2024/11/17 03:02	Zemax Ansys Zemax OpticStudio 2024 R2.01
単位: μm 寸, エアリー半値: 2.667μm, 凡例アイテムは視野位置を参照	
視野: 1 2 3 4 5 6 7 8 9	
RMS半値: 5.117 3.373 5.117 4.091 5.151 4.091 5.117 3.373 5.117	
GDQ半値: 10.127 7.784 10.127 8.497 5.588 8.497 10.127 7.784 10.127	
ボツス規: 100.000 基準: セントロイド	

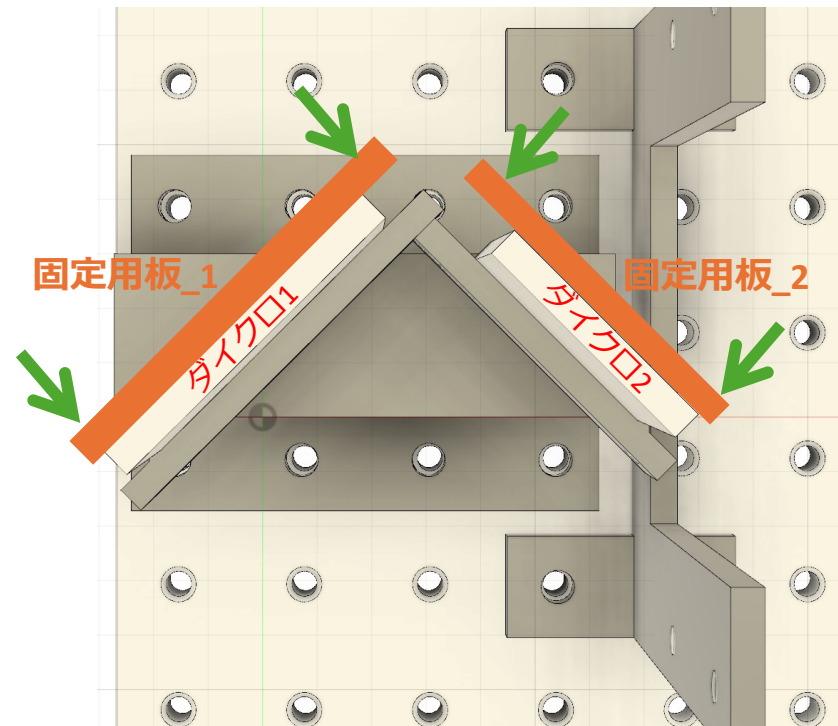
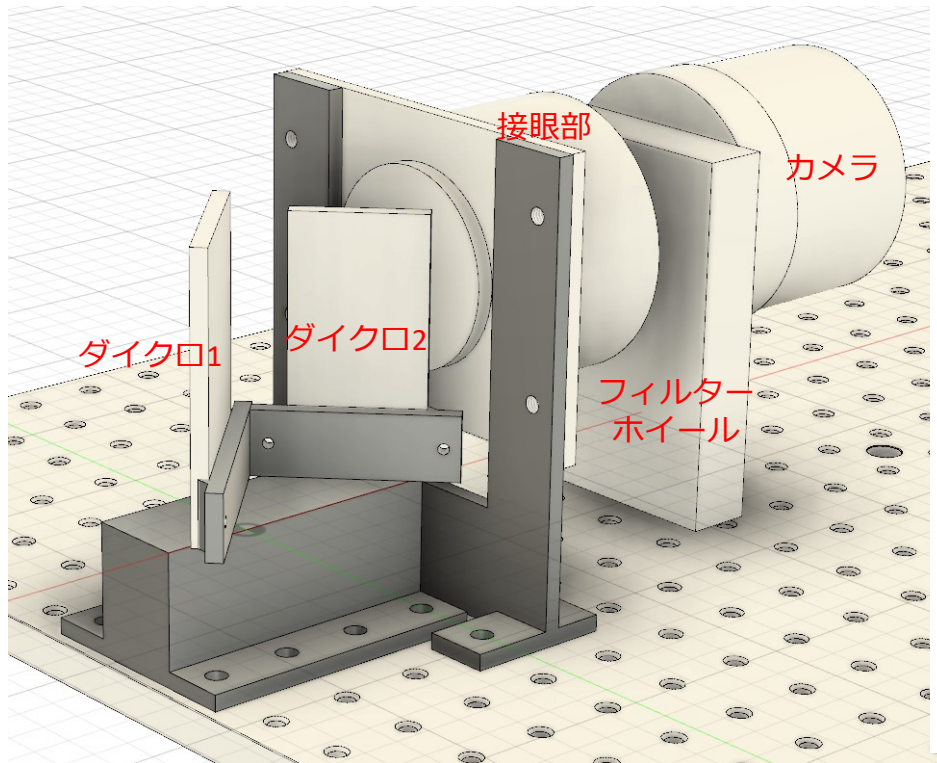
面像 : Detector

スポットダイアグラム	
VIS, 2024/11/17 03:03	Zemax Ansys Zemax OpticStudio 2024 R2.01
単位: μm 寸, エアリー半値: 4.223μm, 凡例アイテムは視野位置を参照	
視野: 1 2 3 4 5 6 7 8 9	
RMS半値: 3.699 3.480 3.699 3.278 3.136 3.278 3.511 3.422 3.511	
GDQ半値: 10.620 9.577 10.620 11.960 12.122 11.960 13.530 13.680 13.530	
ボツス規: 100.000 基準: セントロイド	

面像 : Detector

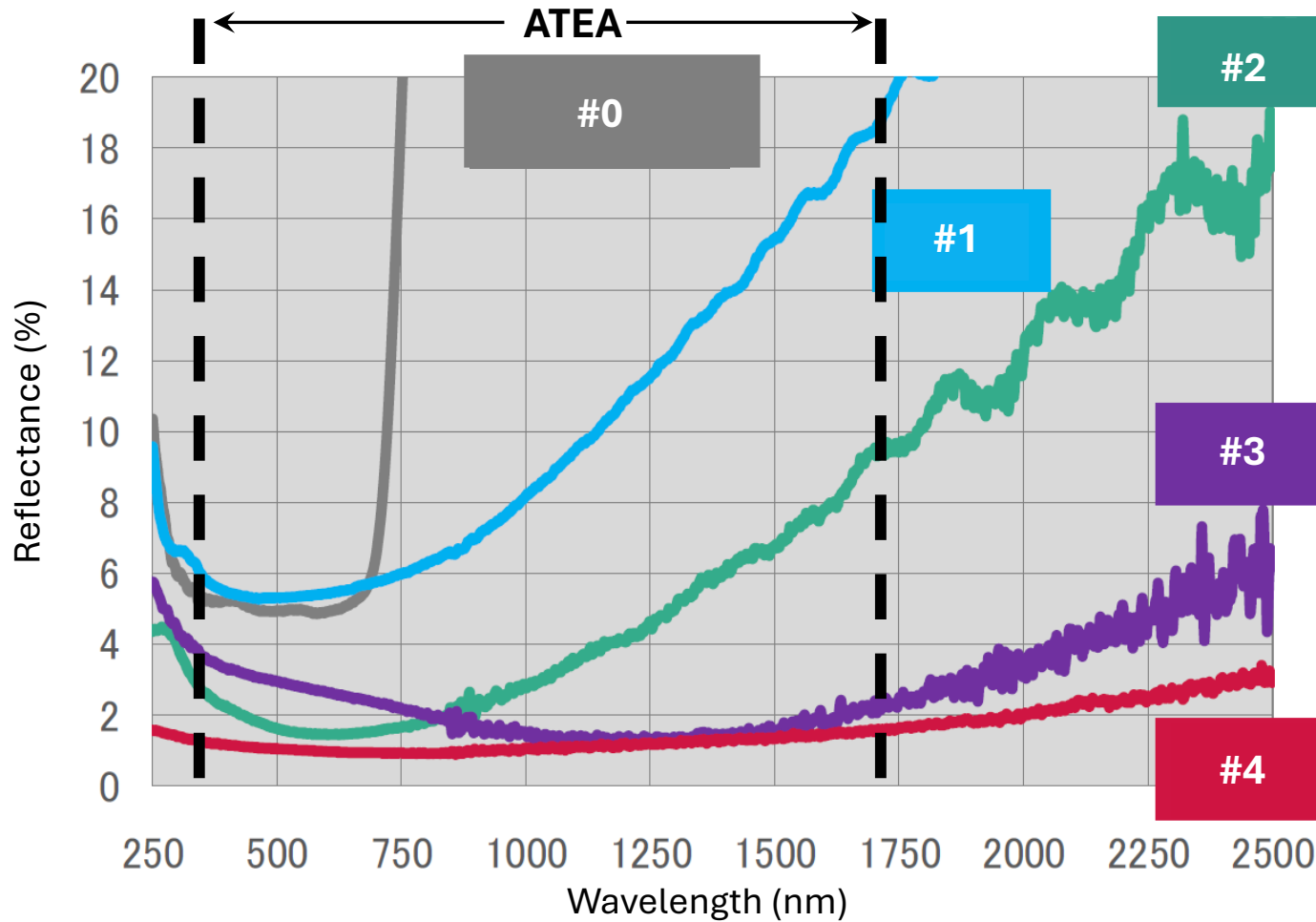
スポットダイアグラム	
NIR, 2024/11/17 02:52	Zemax Ansys Zemax OpticStudio 2024 R2.01
単位: μm 寸, エアリー半値: 11.009μm, 凡例アイテムは視野位置を参照	
視野: 1 2 3 4 5 6 7 8 9	
RMS半値: 4.260 4.095 4.260 4.075 3.892 4.075 4.402 4.188 4.402	
GDQ半値: 10.191 10.216 10.191 9.547 9.441 9.547 10.610 9.399 10.610	
ボツス規: 100.000 基準: セントロイド	

Current design of dichroic mirror unit






- The above design is being updated because it is difficult to manufacture.
- Also, the UV and OPT cam port are being designed.

Black anodizing of the aluminum parts



- ✓ Reflectance: (poor)#0 --- #4 (better)
- ✓ Cost : (low) #0 --- #4 (high)
- We choose #2

ATEA (Aotearoa Triple-band Equipment for Astrophysics)

設計仕様	紫外線	可視光	近赤外線
観測波長	350-400 [nm]	550-940 [nm]	1170-1720 [nm]
フィルター	SDSS u-band(仮)	SDSS r',*i',z-s'-band	J, Hs-band
カメラ	QHY2020(仮) 	ASI533MMPro 	QHY990 
ピクセルスケール	0.35 ["/pixel](仮)	0.2 ["/pixel]	0.27 ["/pixel]
視野	5.83×4.68 [arcmin ²]		
結像性能 (RMSスポット半径)	0.4 ["]		

収差を含めてスポットが
Mt.Johnのseeing 1.5"
を十分下回るように設定

使用予定の検出器の
最小視野

*メインで使用するband

エラーバジェット

大分類	中分類	Value (UV)	Value (OPT)	Value (NIR)
設計	望遠鏡 + ATEAの性能	0.23	0.20	0.20
面精度	製造誤差	0.27	0.25	0.21
組み立て誤差	光学調整後のノミナル性能からの性能変化	0.15	0.19	0.2
コンペンセイターでの調整量		0	0.015	0.018
調整残差の影響	調整機構の調整ピッチ残差の影響	0.07	0.13	0.09
その他	指向・振動・環境変化等による誤差	0.05	0.05	0.05
Total optical resolution		0.397	0.399	0.364
Specification		0.4	0.4	0.4
Margin to 0.4arcsec		0.047	0.020	0.165

単位は["]

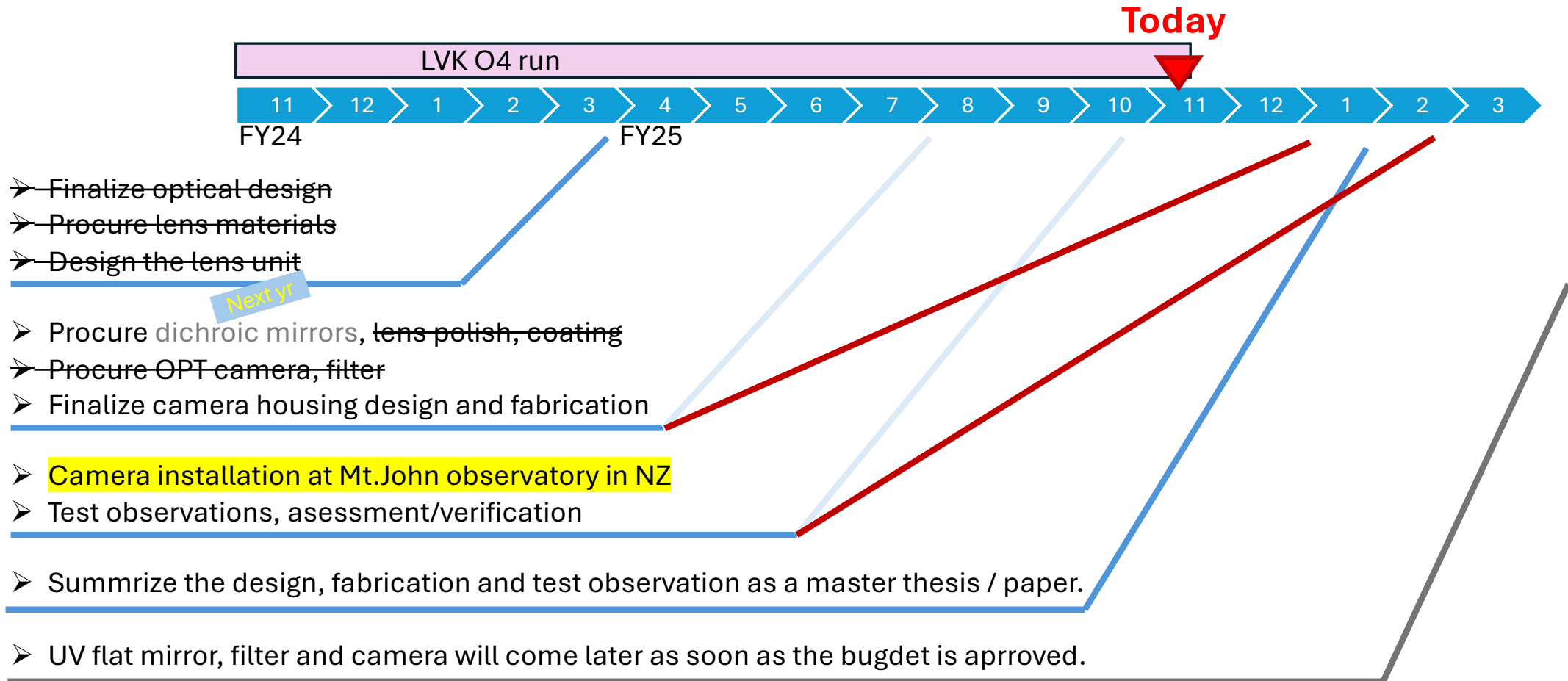
天文学会秋季年会2025 (V209a, 奥本講演) のスライドより

Schedule (as of 2024 Nov)



- Finalize optical design
- Procure lens materials
- Design the lens unit
- Procure dichroic mirrors, lens polish, coating
- Procure OPT camera, filter
- Finalize camera housing design and fabrication
- **Camera installation at Mt. John observatory in NZ**
- Test observations, assessment/verification
- Summarize the design, fabrication and test observation as a master thesis / paper.
- UV flat mirror, filter and camera will come later as soon as the budget is approved.

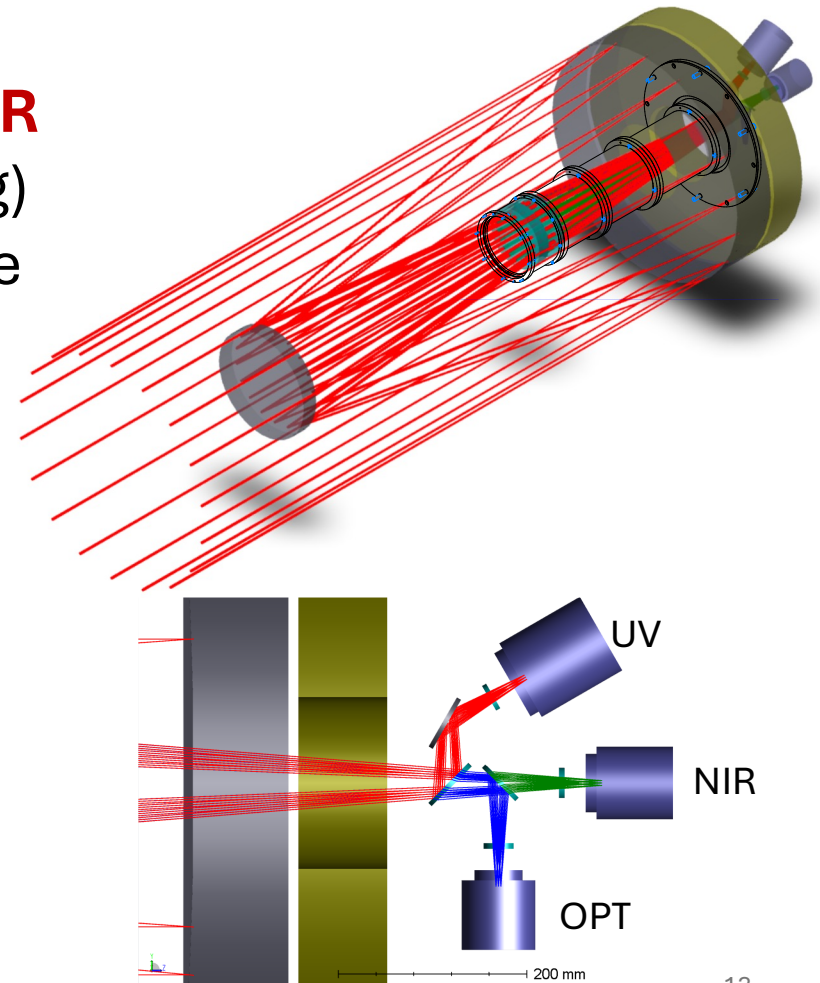
Schedule (as of 2025 Nov)



Summary



- ATEA : 3-band imager with **UV**, **OPT** and **NIR**
 - For Transients(kilonova, GRB, μ lensing)
 - UV filter & camera, dichroic mirrors are out of scope this year
 - They will be added if funded.
- ATEA will be installed on the 61cm B&C telescope in NZ in Feb 2026



This work is being supported by the JSPS KAKENHI (JP24H01811) and by Advanced Technology Center (ATC) of NAOJ.