Subaru Telescope Instrument Plan toward 2020s

2014/12/09 I. Iwata

References

- Instrument Planning 2015 web page
  - http://www.naoj.org/Projects/newdev/instplan2015/
- Instrument Planning Task Force web page
  - http://www.naoj.org/Projects/newdev/instplan2015/TF/

Timeline for Establish the Plan

- Subaru Advisory Committee 12/23 HST, 2014
- Subaru Users Meeting 1/14 HST, 2015
- PFS funding status and plan update: Early summer 2015?
- Feedbacks and Revisions
- Another community meeting in Early summer 2015?
  - PFS (community agreement required for the updated plan)
  - HSC queue (starting from S16A)
  - Instrument Plan
  - ULTIMATE

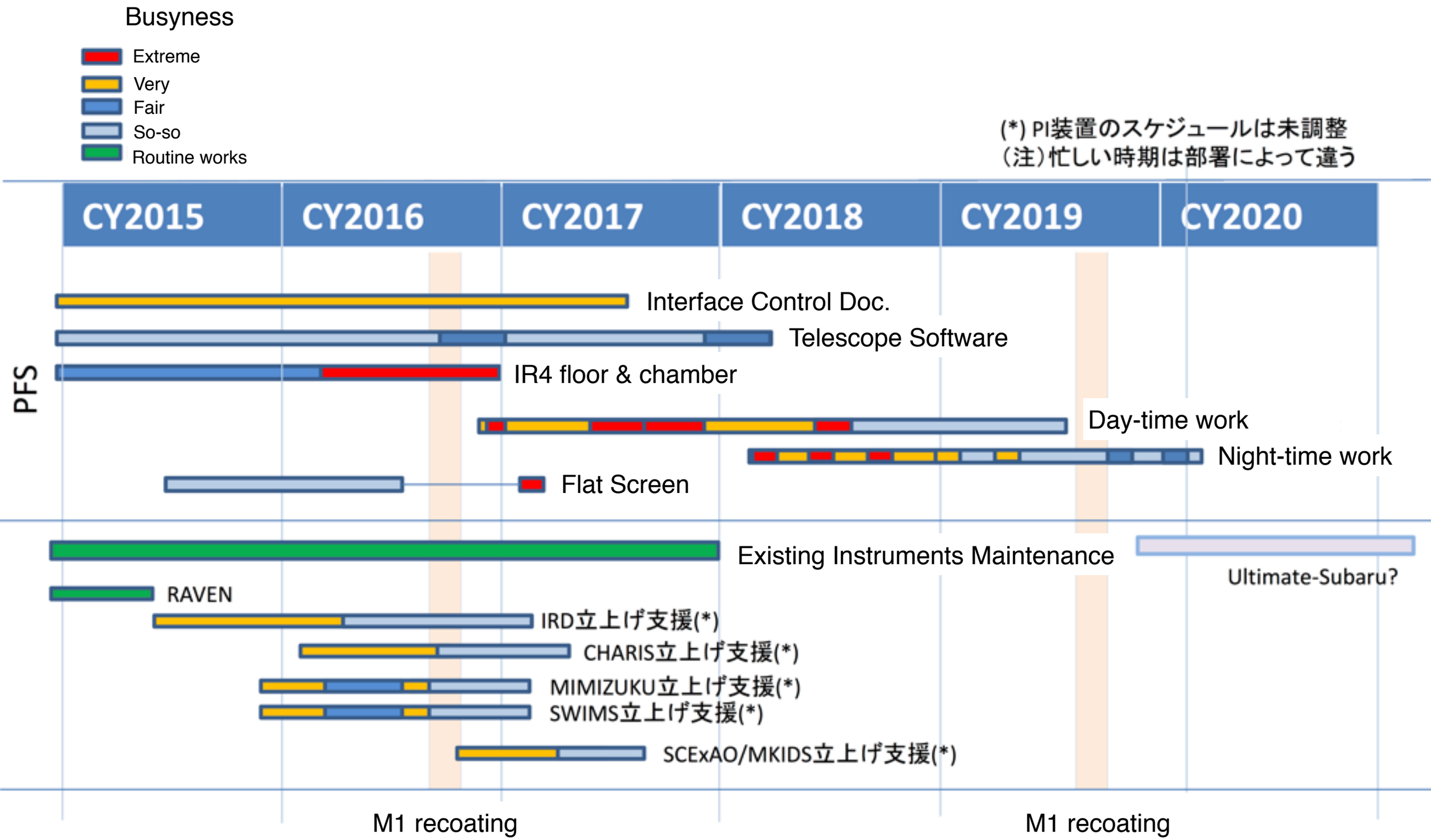
Why Instrument Planning is Necessary Now

Why Instrument Planning is necessary Now

- Two Major Milestones
  - PFS commissioning - EFL in 2017
    - HSC + PFS operations
  - TMT operations - FL in 2024
- Carry-out PFS commissioning while operating Subaru open-use
- Carry-out HSC + PFS operations, including SSPs
- Enforcement of Infrared Facility Instrument(s)
  - Competitive among 8-10m telescopes
  - ULATIMATE-SUBARU

Commissioning Schedule of PFS and PI-type Instruments

Takato-san



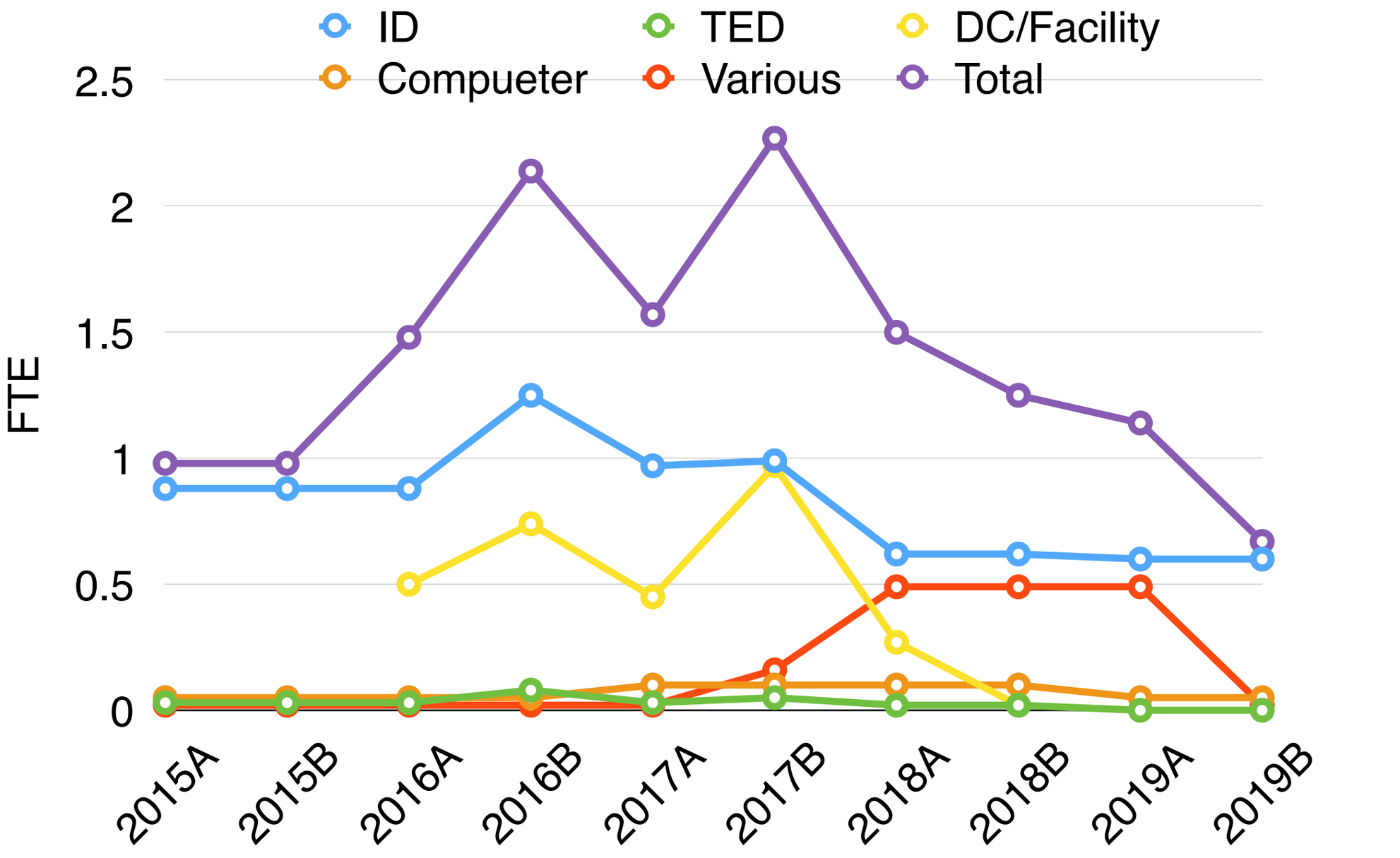
PFS受入れに必要な作業(CY2015~)

Ver. 2014.11.17
N. Takato

1. PFS project office 運営
2. 望遠鏡インターフェース検討支援
3. 望遠鏡制御ソフトウエア(三菱ソフト)のPFS対応化
4. 分光器階 (IR 4th floor)の床設置
5. IR3, IR4階への電力、冷却水、乾燥空気、通信の供給
6. 分光器冷却室の設置
7. 装置冷却システムの検討支援、設置
8. TUE階PFI待機場所の整備
9. 山頂制御棟2F及び山麓計算機室への制御計算機の設置支援
10. Gen2との I/F 検討
11. 共同利用データパイプライン処理システムの構築
12. データアーカイブシステムの構築
13. 天体用光ファイバー(Cable B)敷設(望遠鏡、ドーム)
14. 校正用光源システムの設置
15. 装置の荷受け、管理
16. 分光器の設置作業補助
17. 汎用カセグレンコンテナの提供
18. 試験観測のための装置設置補助
19. 昼間試験サポート
20. 夜間試験サポート
21. Acceptance review
22. Commissioning 完了後の保守、運用

			2015A	2015B	2016A	2016B	2017A	2017B	2018A	2018B	2019A	2019B	
1	PFS PO	Takato	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
1	PFS PO	ID	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
2	ICD	ID	0.25	0.25	0.25	0.25	0.25	0.25					
3	Tel. Soft.	TED	0.03	0.03	0.03	0.03	0.03	0.03					
3	Tel. Soft.	ID	0.03	0.03	0.03	0.03	0.03	0.03					
4	IR4	DC1			0.5	0.5							
5	Infrastructure	Facility				0.05							
5	Infrastructure	TED				0.05							
5	Infrastructure	ID				0.05							
6	Sp. chamber	ID				0.05							
6	Sp. chamber	DC				0.16							
7	Cooling sys.	ID				0.27							
8	TUE PFI stand-by	ID					0.04	0.04					
9	Computers installation												
9	Archive												
10	Gen2 I/F		0.05	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.05	0.05	
11	Data pipeline				1.0	1.0	1.0	1.0	1.0	1.0			
12	Archive installation												
13	Fibre Cable B	DC						0.5					
14	Calibration system	ID					0.05	0.05					
14	Calibration system	DC					0.2	0.2					
15	Instrument installation	DC					0.25	0.25	0.25				
16	PFI installation	TED						0.02	0.02	0.02			
16	PFI installation	DC						0.02	0.02	0.02			
16	PFI installation	ID						0.02	0.02	0.02			
17	Cs container	DC				0.03							
18	Day-time support	various						0.14	0.14	0.14	0.14		
19	Night-time support	various							0.33	0.33	0.33		
20	Acceptance review	various	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	

FTE Required for PFS commissioning



* This does not include Takato-san
and one person for data pipeline.

Why Instrument Planning is necessary Now

- Subaru Telescope's primary objective is to produce excellent scientific results by itself.
- Assumption on Human Resources and Budget: NAOJ will try to keep the size of Subaru operations as large as it is now, until TMT starts operation
  - We cannot expect significant increase of HR and budget
- Shifts toward Survey-oriented Observations
  - Dark nights will be mostly occupied with HSC and PFS

Why Instrument Planning is necessary Now

- Under these circumstances, we should try to keep scientific outputs from Subaru Telescope as high as possible.
- For stable operations in parallel to the commissioning of PFS, we need:
  - To establish plans to reduce work loads
  - To have optimum science operations
- Workload required for PFS is still unclear, and Instrument Troubles are unpredictable. Given those uncertainties, we should have plans in advance to the beginning of PFS commissioning.

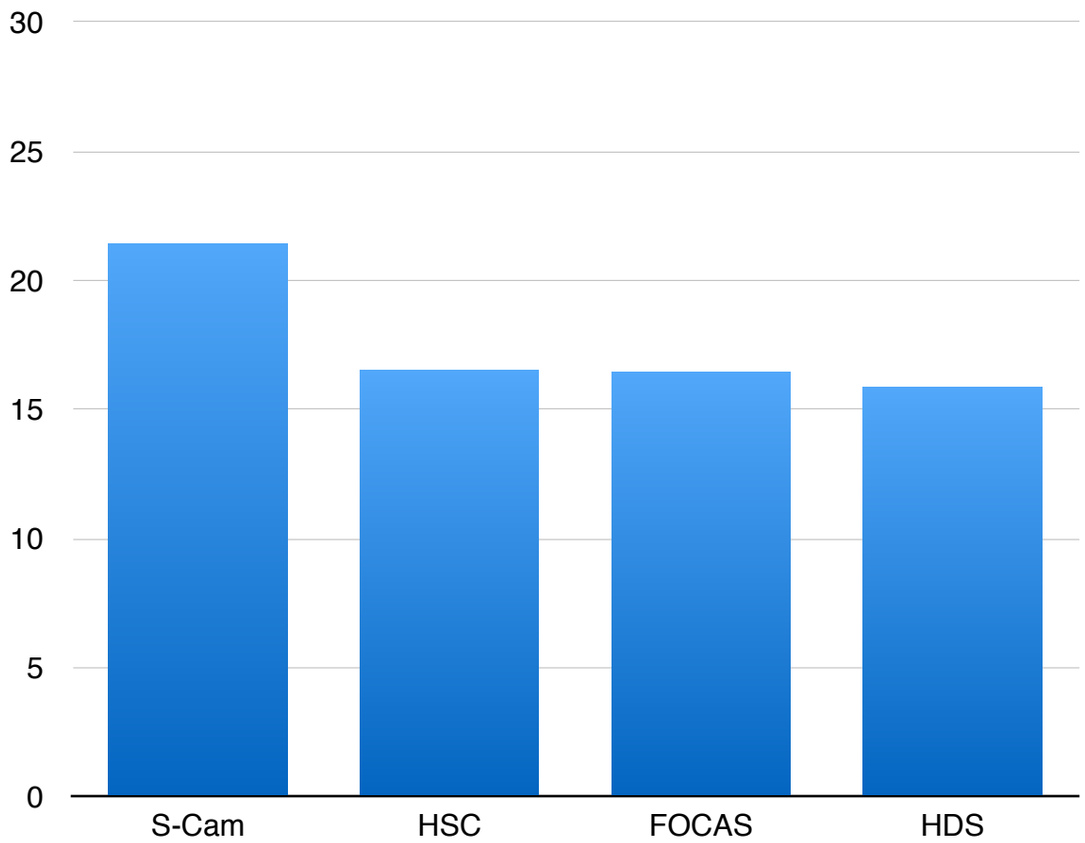
Instrument Radar Charts

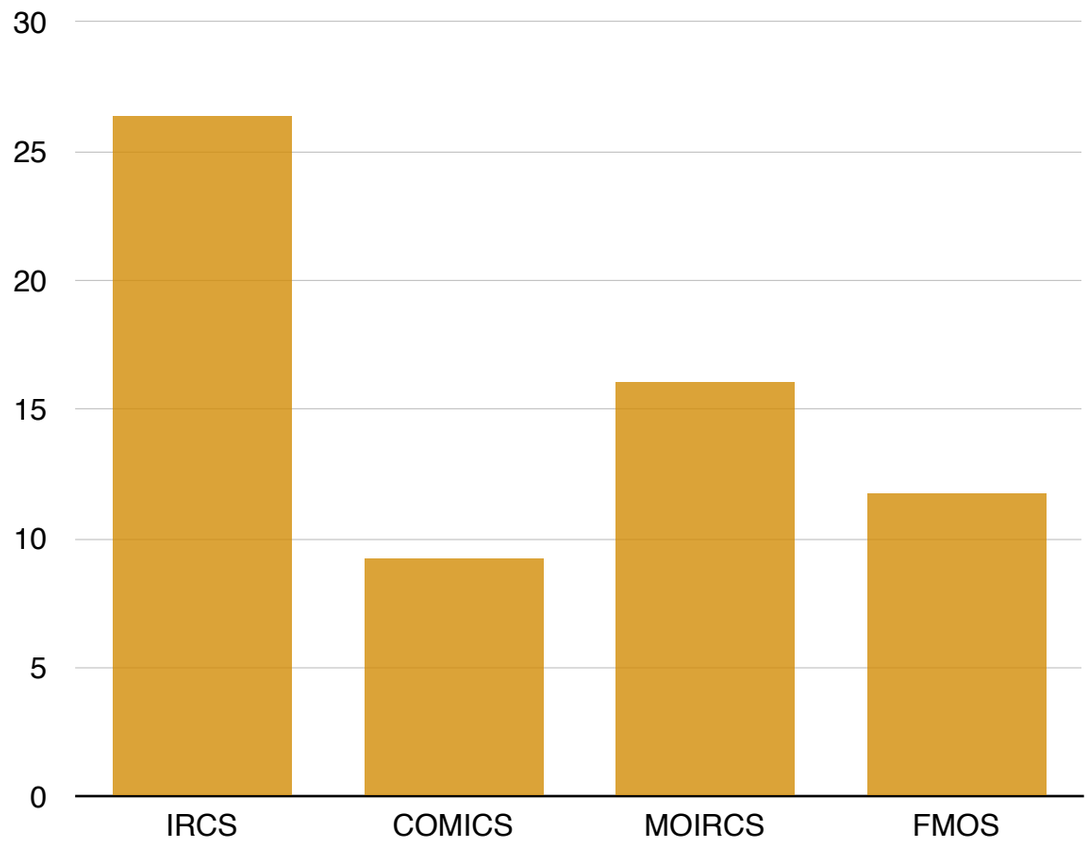
Instrument Radar Charts

- Demand - From number of submitted proposals from S10A to S14B
- Performance - From results of publication survey
- Competitiveness - From proposal referee scores (fraction of proposals with score >=6)
- Troubles - From nightlog reports from S10A - S14B
- Work loads - Day crews and instrument division / SA works
- Uniqueness - Existence of alternative instruments in Keck / Gemini / TAO

- Scores: 5 (good) - 1 (bad)

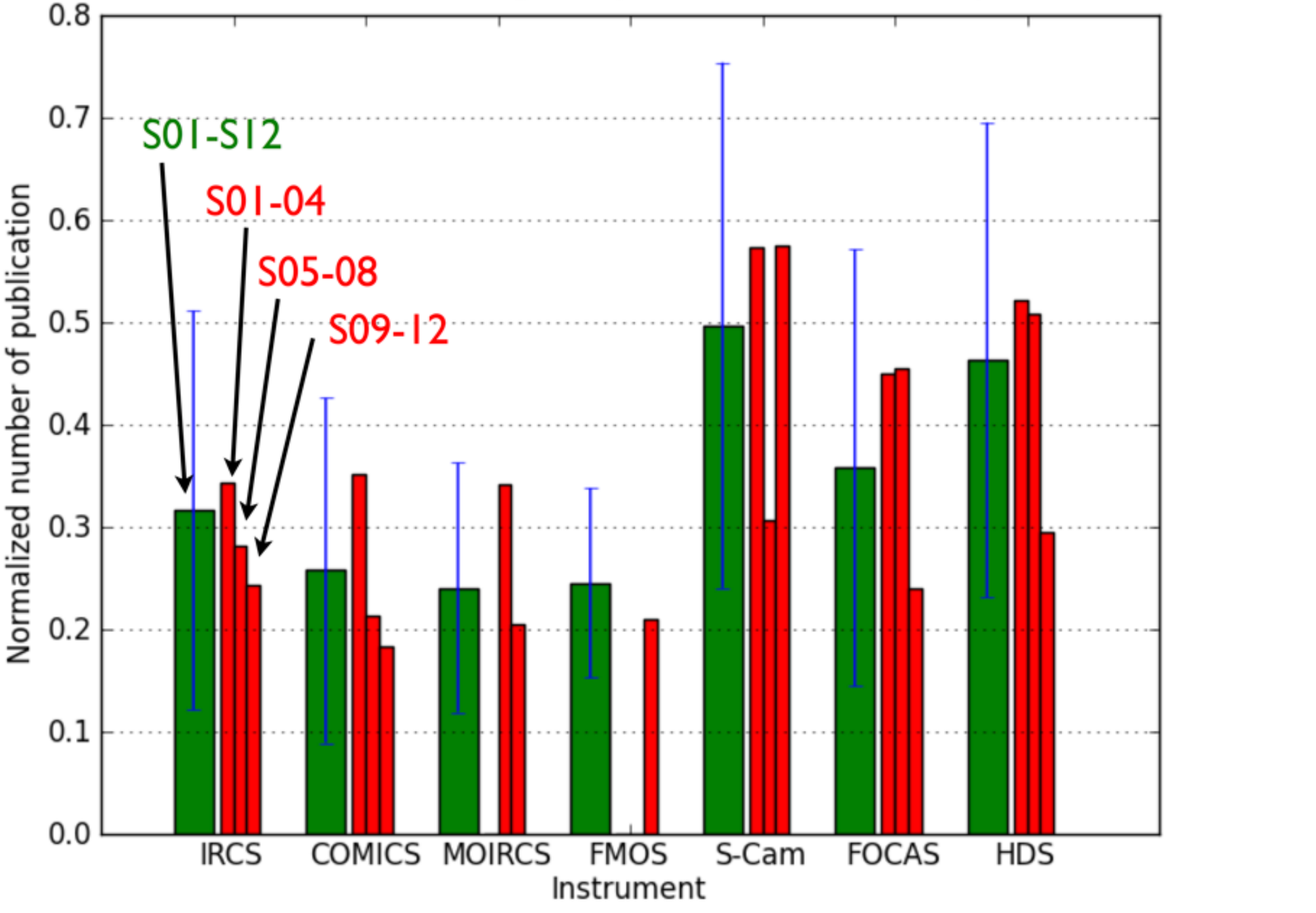
Number of Proposals, S10A - S14B (average)





Masaomi Tanaka-san

Publication/night (time evolution)



Imanishi-san

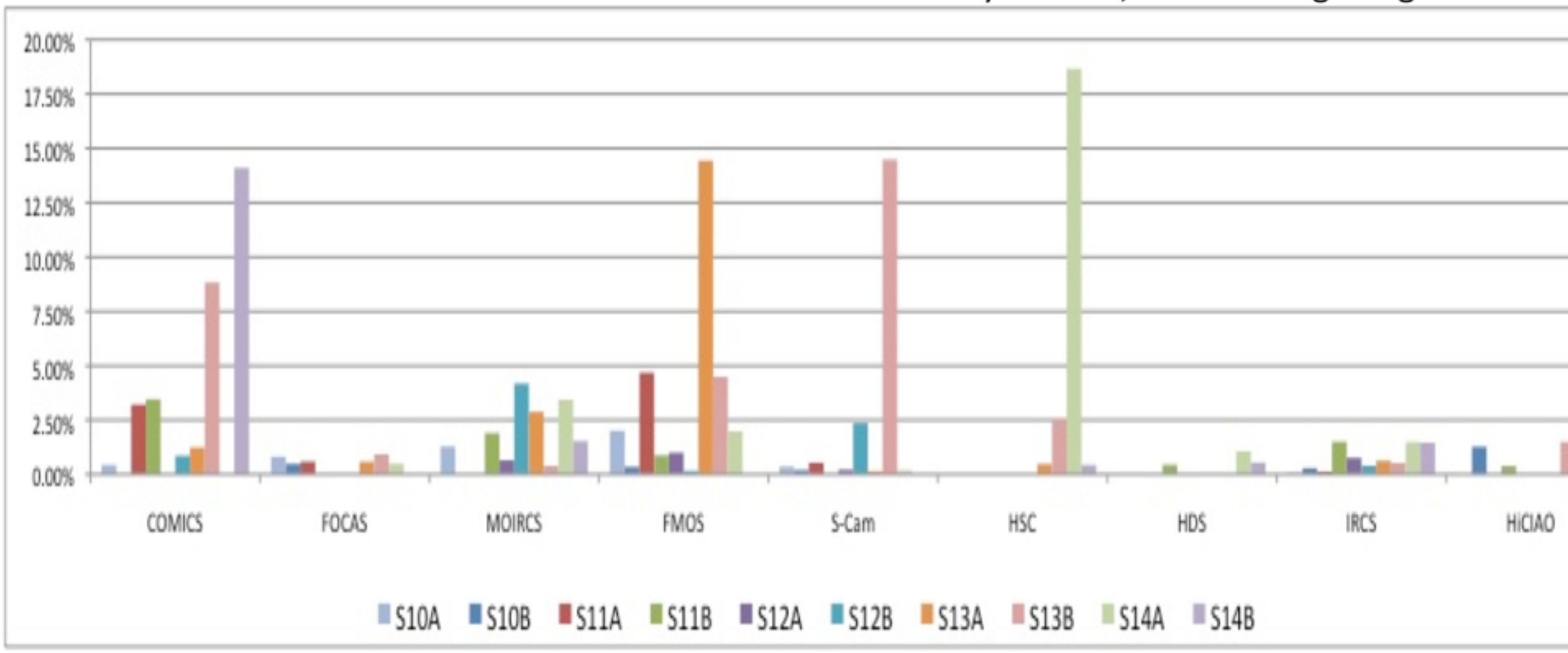
Competitiveness: Fraction of proposals with high referee scores (>=6)

- #1 group (~40%): HDS, SCam, Keck, HSC
- #2 group (~35%): FMOS, IRCS
- #3 group (~30%): MOIRCS, COMICS, FOCAS
- #4 group (~25%): Gemini

Imanishi-san

Instrument Troubles

By Nakano, based on night log



In addition to this,

One spectrograph was not used many times (2011-2013) for FMOS

One array was not used many times (2007-2013) for MOIRCS

Hattori-san

Regular Workload

(FTE-Days/Year)

	IA/SA	ID tech	DC	Total
COMICS	3.3	10.5	30.6	44.4
FMOS	12.4	2.7	19.5	34.6
IRCS+AO	11.7	21.2	19.3	52.3
MOIRCS	15.8	44.8	33.3	94.0
FOCAS	12.4	2.7	19.5	34.6
HDS	10.6	0.5	22.1	33.2
SCam	20.8	7.0	36.0	63.9

* this does not include Prep work in Hilo and sudden troubles, which often occupies most man power (but very difficult to quantify).

Alternatives / Uniqueness

Subaru	Keck	Gemini	TAO
IRCS	OSIRIS NIRC2 NIRSPEC	GNIRS NIFS	
COMICS		TEXES	MIMIZUKU
MOIRCS	MOSFIRE	NIRI GSAOI FLAMINGOS-2	SWIMS
FMOS			
HSC			
FOCAS	LRIS DEIMOS ESI	GMOS	
HDS	HIRES		
HiCIAO		GPI	

Narita-san & Kashikawa-san

Subaru -IRCS	Keck			Gemini	
	OSIRIS	NIRC2	NIRSPEC	GNIRS	NIFS
Imaging 0.9-5.6 um FOV 21''+ 54'' Pixscale 20mas+52mas	1.0-2.5um 20.”4 20mas	0.9-5.3um 10”-40” 10-40mas	0.95-2.5um 46” 0.”18	1.0-2.5um 24”x16” (20mas?)	
Low-R Spec. 0.9-2.5 um R=100-2000		LOWRES 1.0-2.2um R=2400-11000	Low-R Spec. 0.95-5.5um R~2000		
NA	IFU 1.0-2.4um R~3800 0.”32x1.”28 ~3.”2x6.”4	NA	NA	NA	IFU 0.9-2.5um R~5000 FOV 3”x3”
High-R Spec. 0.9-5.6 um R~20000	NA	MEDRES 1.0-2.2um R=4000-20000	High-R Spec. 0.95-5.5um R~25000	High-R spec. 0.85-6.0um R~5000-20000	NA

Narita-san & Kashikawa-san

	Subaru-COMICS	Gemini-TEXAS	TAO-MIMIZUKU
wavelength	7.5-25um	5-25um	2-38um
Imaging FoV Pix scale	42” x 32” 0.13”/pix	No	2’ x 2’ (1’ x 2’ x 2 field) 0.11”/pix
Spectroscopy R	250,2500,8500	4000-100000	60-230

Narita-san & Kashikawa-san

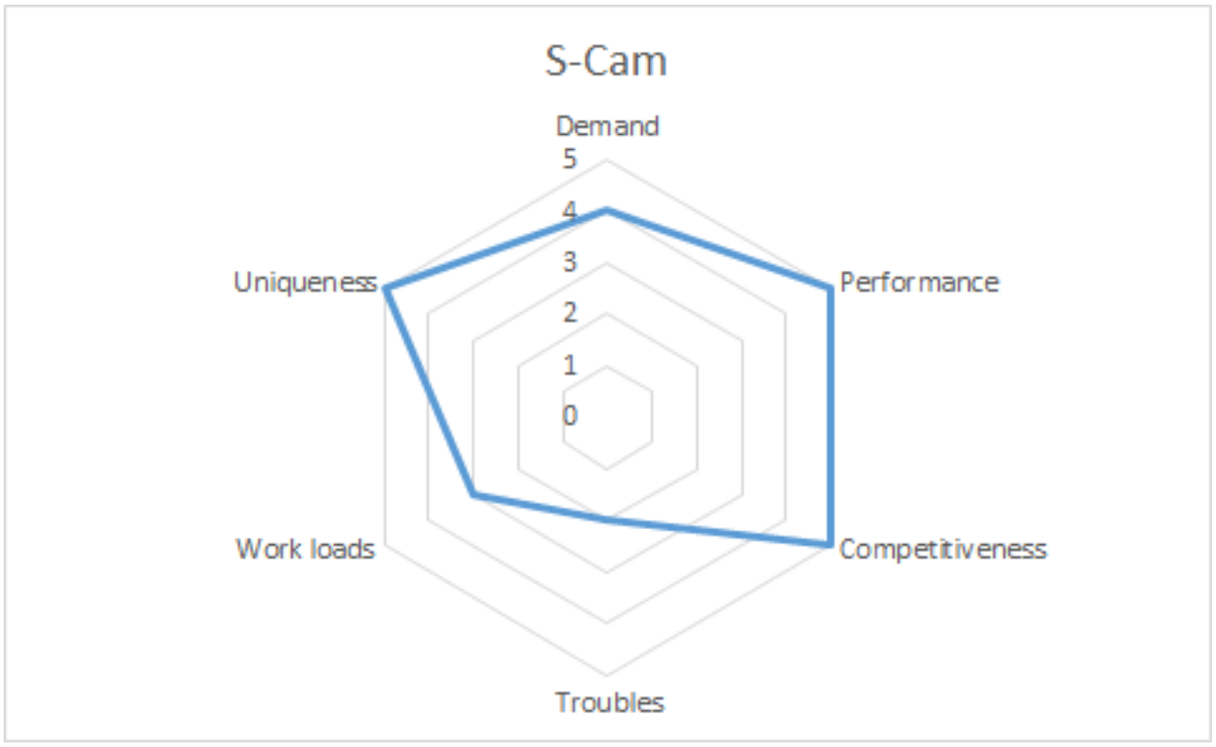
Subaru MOIRCS	Keck	Gemini-North	Gemini-South		TAO
	MOSFIRE	NIRI	GSAOI	FLAMINGOS-2	SWIMS
Imaging 0.9-2.5 um FOV 4' x 7' 0."117/pix	0.9-2.3um 6.'1 □ 0."18/pix	1-5 um 2' □ / 22" □ 0."117pix /0."022pix	0.9-2.5um 1.'4 □ 0."02pix	0.95-2.4um 6.'2 Φ / 2' Φ 0."18pix / 0.09pix	0.9-2.5um 9.'6 Φ 0."126/pix
Spectroscopy 0.9-2.5 um R=500-3000	0.9-2.5um R=3000-4000	1-5.45 um R=460-1650	NA	0.95-2.4um R=400-3000	0.9-2.5um R=500-1000
MOS FOV 6'Φ 15masks	6.'1x3' tunable	NA	NA	2' x 6.'1 9masks	9.'6 x 6' 24masks
IFU:planned	NA	NA	NA	NA	NA
NA	NA	NA	MCAO	MCAO	NA

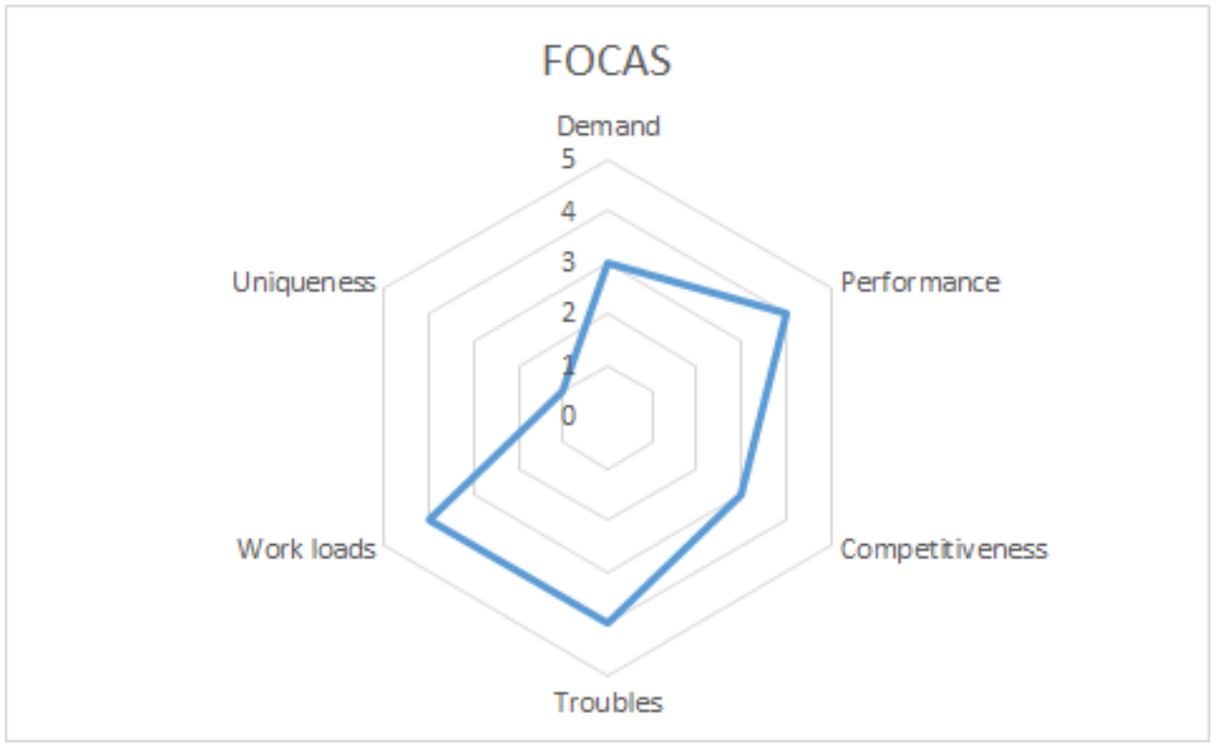
Narita-san & Kashikawa-san

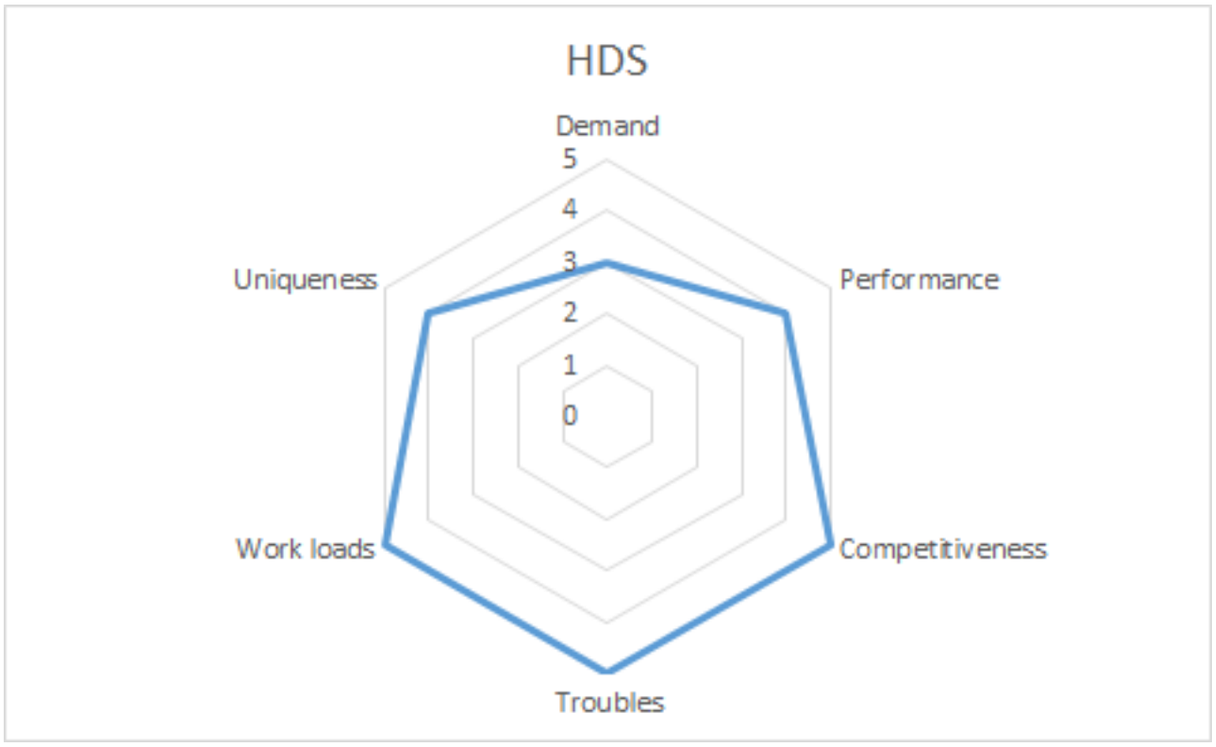
Subaru -FOCAS	Keck			Gemini
	LRIS	DEIMOS	ESI	GMOS
Imaging 0.37-1.0 um FOV 6'Φ 0."104/pix	0.32-1.0um 6'x7.'8 0."135/pix	0.4-1.05um 16.'7 x5.'0 0."119/pix	0.39-1.1um 2'x8' 0."154/pix	0.36-0.94um 5.'5x5.'5 0."07-0."08/pix
Spectroscopy 0.37-1.0 um R=250-7000	0.32-1.0um R=300-5000	0.4-1.0um R=2400-11000	0.39-1.1um R=13000 R=1000-6000	0.36-0.94um R=600-4400
MOS FOV 6'Φ 10masks	6'x7.'8	16.'7 x5.'0 10masks	NA	5.'5x5.'5 18masks
Polarimetry	yes	NA	NA	NA
NA	NA	NA	NA	IFU 0.4-1.1um 5"x7" 250-1000elements

Narita-san & Kashikawa-san

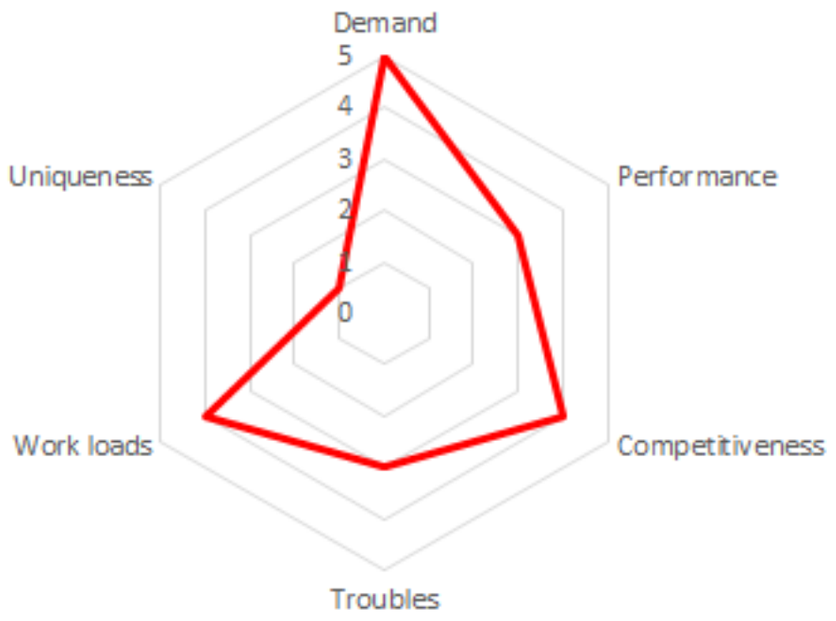
	Subaru -HDS	Keck-HIRES
wavelengths	0.3 – 1.0 microns	0.36 - 1.0 microns
R	~165 000	25,000 - 85,000
Slit width	0.2 - 4''	0.2-1.”7
Slit length	2 - 60''	1-28”
Pix scale	0.138 ''/pixel	
efficiency	0.03@3000A 0.13@6000A 0.04@8000A	0.15@3500A 0.19@6000A 0.13@8000A


S-Cam
Demand
5
4
3
2
1
0
Performance
Competitiveness
Troubles
Work loads
Uniqueness

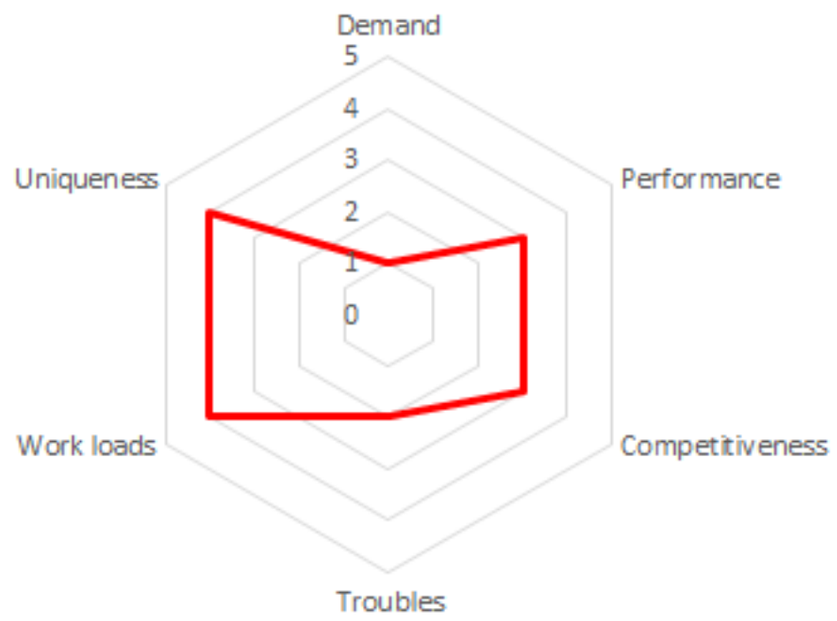

FOCAS
Demand
5
4
3
2
1
0
Performance
Competitiveness
Troubles
Work loads
Uniqueness


HDS
Demand
5
4
3
2
1
0
Performance
Competitiveness
Troubles
Work loads
Uniqueness

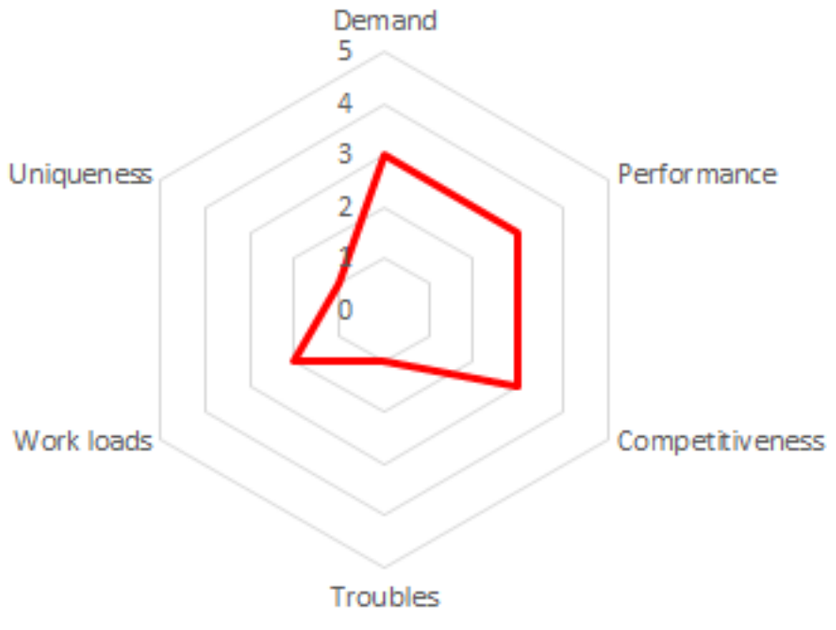
IRCS



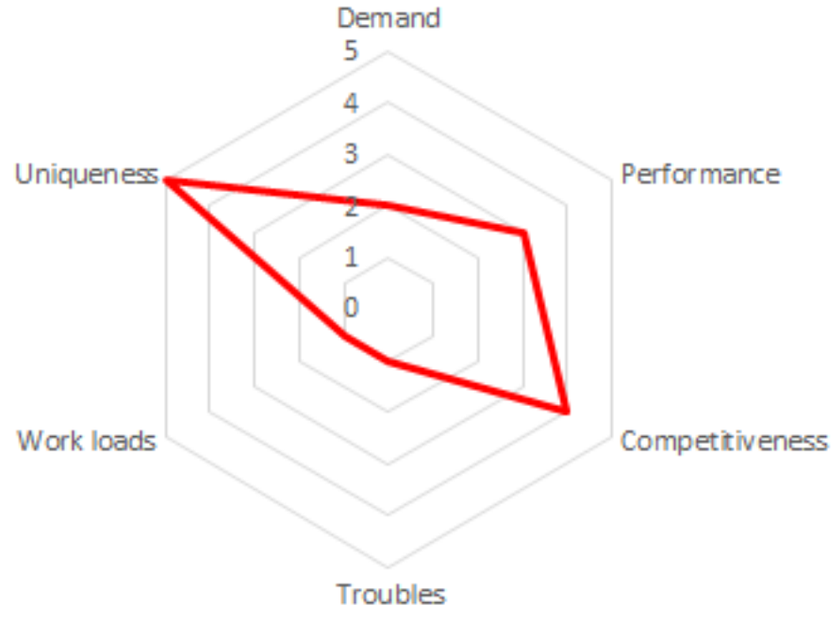
COMICS



MOIRCS



FMOS



Radar Chart Scores

	S-Cam	HSC	FOCAS	HDS	IRCS	COMICS	MOIRCS	FMOS
Demand	4	3	3	3	5	1	3	2
Performance	5		4	4	3	3	3	3
Competitiveness	5	5	3	5	4	3	3	4
Troubles	2	2	4	5	3	2	1	1
Work loads	3	1	4	5	4	4	2	1
Uniqueness	5	5	1	4	1	4	1	5
Score	24		19	26	20	17	13	16
Score (normalized)	0.94		0.78	1.05	0.81	0.68	0.51	0.61

Instrument Plans

Prime Focus

- HSC and PFS
- FMOS: will be decommissioned once PFS feasibility is confirmed and agreed
  - Continue operation at least till the end of S15B
  - We need to remove FMOS spectrographs from IR-TUE floor soon after decommission
- Suprime-Cam: will be decommissioned once HSC operation becomes stable
  - Continue operation at least till the end of S15B
  - Will be kept as a back-up of HSC

Nasmyth IR

- AO188+IRCS
  - High demand
  - Similar instruments available at Gemini and Keck but they are as old as IRCS
  - [Proposal] Keep IRCS+AO188+LGS operational at least in 2010s to maintain general AO capability - until GLAO commissioned?
- AO188+SCExAO+CHARIS, AO188 + IRD
  - SCExAO review in 2016

Nasmyth Opt

- HDS: Moderately high demand, Good publication performance, Stable operations
  - MOS capability commissioned in 2015
  - Uniqueness: higher throughput at shorter wavelength compared to Keck/HIRES and Gemini/CFHT/GRACES
- Discussions on transfer to other telescopes stalled
  - Gemini is planning GHOST (N or S undetermined)
  - Fibre: Lower throughput in shorter wavelength - would spoil HDS's strength
- [Proposal]
  - Keep HDS at least in 2010s
  - Decommission of Red Image Rotator to reduce loads for PA/MA
  - Recoating of Blue Image Rotator to boost HDS's strength
  - Operation with NsOpt for >1 week operations
  - Consider decommission if IRMS operation with Subaru is found to be realistic (in 2020s)

Cs - PI-type instruments

- SWIMS (proposal):
  - Test in Hilo - Dec. 2015 - May 2016
  - Test at Summit - Sept. 2016 - Dec. 2016
  - Performance Verification - Dec. 2016 - March 2017 (?)
  - Science Observation - March 2017 (?) - June 2018
  - Transfer to TAO - June 2018-
- MIMIZUKU (proposal):
  - Test in Hilo - Feb. 2016 - July 2017
  - Test at Summit - Dec. 2016 - March 2017
  - Performance Verification - March 2017 - June 2017 (?)
  - Science Observation - June 2017 (?) - Sept. 2018
  - Transfer to TAO - Sept. 2018-

Cs - COMICS

- can be unique even in 2020s
- Publication performance is comparable to other IR instruments
- Small user groups, fewer allocated nights
  - Relatively frequent instrument troubles
- Commissioning of MIMIZUKU (Subaru PI-type instrument => TAO)
  - Southern hemisphere
- [Proposal]
  - Hibernate operation during commissioning / operations of MIMIZUKU
  - Decommission or Resume after MIMIZUKU
    - PI-type instrument?

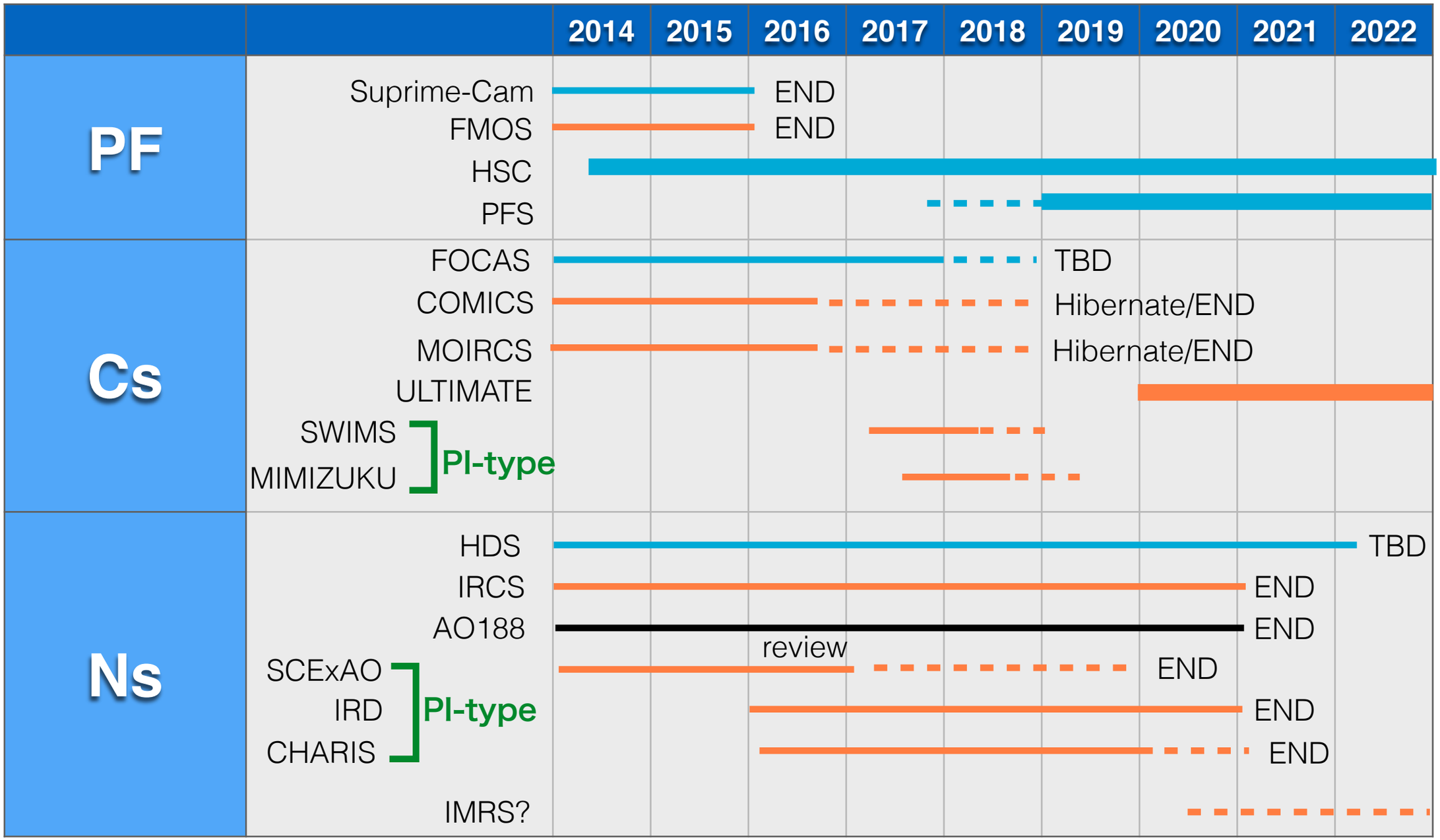
Cs - MOIRCS

- Frequent troubles - loss of nights, large workloads
- MOSFIRE has better sensitivity
- Upgrade (‘nuMOIRCS’) on-going
  - Detector replacement (H2 to H2RG), IFU, Stability improvement
- Possibility of ‘recycle’ as spectrograph for ‘Phase-0.5’ of ULTIMATE-SUBARU
- [Proposal]
  - Hibernate operation during commissioning / operations of SWIMS
  - Decommission of continuation of upgrade will be discussed.

Cs - FOCAS

- Similar instruments available at Gemini and Keck
  - need to check performance of LRIS polarimetry mode
  - provides very basic observation modes in optical wavelength
- Demand and publication performance are moderately high
- Use of CsOpt requires an extra Top Unit Exchange
- [Proposal]
  - Need further investigation on human resource requirements for PFS
  - Hibernate operations but keep FOCAS as a back-up instrument?

Timeline (draft)



Discussion items

- If we accept SWIMS and MIMIZUKU:
  - Hibernate MOIRCS and COMICS?
- The case without accepting SWIMS and MIMIZUKU?
- Plan for FOCAS?
- The case without ULTIMATE?

PI-type Instrument Schedule

https://docs.google.com/a/naoj.org/spreadsheets/d/1dXQl3xyz-p-VudRPrrLIIe38QJFhavV7DY6obvKVO84/edit?usp=sharing

Instrument	PI	PI institute	08A	08B	09A	09B	10A	10B	11A	11B	12A	12B	13A	13B	14A	14B	15A	15B	16A	16B	17A	17B	18A	18B	19A	19B	20A	20B	
Cs Instruments																													
K3D2 (Cs)	H. Sugai	IPMU																											
MIMIZUKU	T. Miyata	U. Tokyo																											
SWIMS	K. Motohara	U. Tokyo																											
Ns/Other Instruments																													
HiCIAO	M. Tamura	U. Tokyo																											EFL: 2008/12/21
K3D2+AO188	H. Sugai	IPMU																											EFL: 2012/04/02
SCExAO	O. Guyon	Subaru																											EFL: 2011/08/09
RAVEN	C. Bradley	U. Victoria																											EFL: 2014/05/13
IRD	M. Tamura	U. Tokyo																											
GIGMICS	Y. Hirahara	Nagoya U.																											
CHARIS	N. J. Kasdin	Princeton U.																											

cf. Facility Instrument

PFS	H. Murayama	IPMU																											

Science Operation Phase
Engineering Phase
TBD