2013 Jan 15 Subaru Users Meeting @ NAOJ Mitaka

Prime Focus Spectrograph – Status Report –

Hajime Sugai (Project office; Kavli IPMU)

PFS Summary

Optical + NIR Multi-object fiber spectrograph

- On Subaru prime focus (8.2m; F/2.2)
- Target sciences:
  - cosmology, Galactic Archaeology, galaxy/AGN evolution
- Basic parameters
  - Number of fibers 2400 (600 x 4)
  - Field of view: 1.3 deg
  - Wavelength: 0.38 - 1.26 μm
  - Spectral resolution: $\lambda/\delta\lambda \sim 3000$ (cf. Medium resolution mode)
- Now in Preliminary Design phase (PDR: 2013 Feb)
  - Conceptual Design Review succeeded 2012 March

PFS Project officeって普段何やってんの?

http://sumire.pbworks.comより

PFS Project Office

- Members and assignment
- PFS portal site (, including SPIE papers)
- PFS technical website

- PFS technical collaborators' weekly telecon
- Systems engineer group telecon
- Manager group telecon

- PFI - JPL/CIT ASIAA weekly telecon
- Spectrograph - LAM PU/JHU weekly telecon
- Data reduction software telecon
- Fiber configuration timing budget
- Spectral calibration system

- PFS throughput re-calculation (including README)
- Open issues/trade studies
- instrument components table

ハワイ観測所・国立天文台との連携は?

PFS NAOJ-IPMU連絡会議メンバ

ハワイ観測所・国立天文台

有本・大橋・臼田・高遠・岩田・高見

月例TV連絡会議
をしています。

PFSチーム

村山・菅井・田村・唐牛・相原

えーそんな。。PFSには楽しいイベントはないの?

いえいえ、
この1年いろいろありましたよ。

Endorsement by Japanese community	2011 Jan
MOU between NAOJ and Kavli IPMU	2011 Dec
Project CoDR (Conceptual Design)	2012 Mar
Project RR (Requirement)	2012 Oct
Project PDR (Preliminary Design)	**2013 Feb**
Project CDR (Critical Design)	2013 Dec
SIR/TRR (System Integration /Test Readiness)	2016 Feb
ORR (Operational Readiness)	2016 Nov
First Light (Engineering)	2017 Jan


PI: Hitoshi Murayama
3rd General Collaboration Meeting @ Caltech 2012 Aug
2nd General Collaboration Meeting @ Tokyo 2012 Jan
1st General Collaboration Meeting @ IPMU 2011 Jul

2012 Jul SPIE papers from PFS team

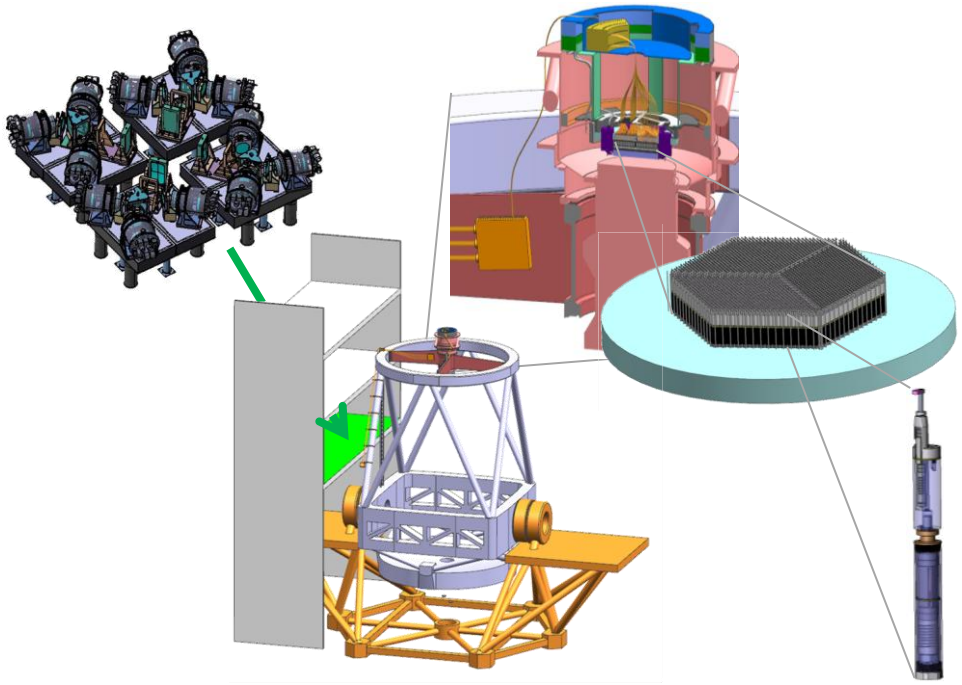
1.	Instrument overview	(Sugai et al.	8446- 32)
2.	Fiber system	(de Oliveira et al.	8446-183)
3.	Fiber positioner	(Fisher et al.	8450- 41)
4.	Spectrograph	(Vivès et al.	8446-181)
5.	Dewar & Detector	(Gunn et al.	8446-180)
6.	Metrology camera	(Wang et al.	8446-191)
7.	System software	(Shimono et al.	8451-136)

see PFS portal site http://sumire.ipmu.jp/en/2652

or arXiv 1210.2719, 2751, 2734, 2728, 2740, 2730, 2729

Prime Focus Spectrograph (PFS)概要

1. What is PFS ?
2. Science targets
3. Why on Subaru ?



PFSポータルサイト
http://sumire.ipmu.jp/2656

1. What is Prime Focus Spectrograph (PFS) ?

Optical + NIR Multi-object fiber spectrograph

- Number of fibers: 2400
  - 600 per Spectr. X 4 Spectrographs

- Fiber core diameter 128μm
  - Microlens attached to fiber input edge
  - fiber input F/2.2 -> F/2.8 (1".1 diameter per fiber)

- Field of view: 1.3 deg
- Wavelength: 0.38 - 1.26 μm

1. What is PFS ?

Optical + NIR Multi-object fiber spectrograph

- Each spectrograph: 3-color-arm design

Arm	Coverage[A]	Resolution[$\lambda/\delta\lambda$]	
Blue	3800 - 6400	2500	
Red	6400 - 9550	3200	(cf. Medium resolution mode)
NIR	9550-12600	4500	

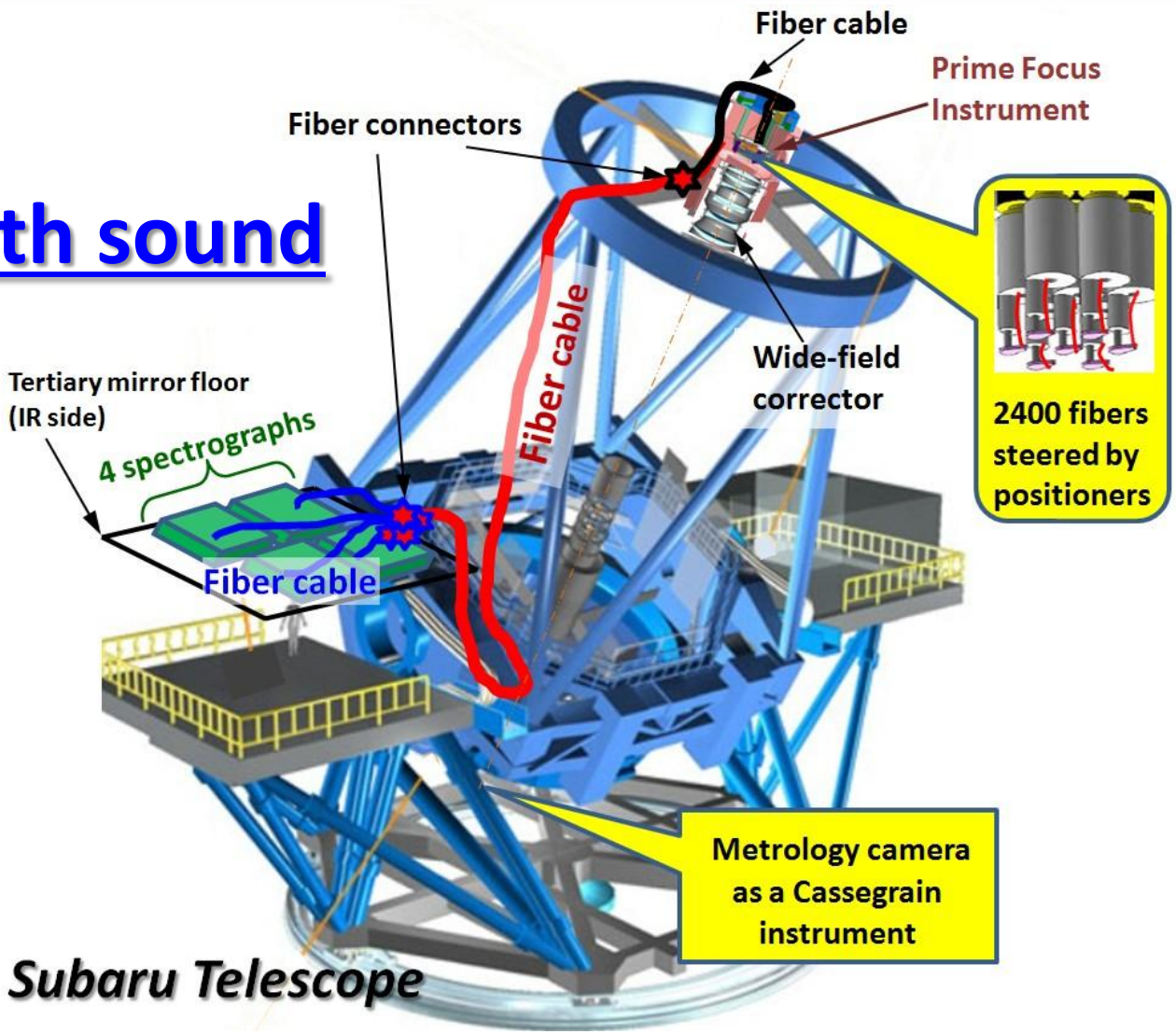
Spectrograph collimator F/2.5, camera F/1.1

Detector pixel 15μm (2Kx4K x 2 FDCCDs for each Blue/Red arm, 4Kx4K HgCdTe(1.7μm cutoff) for NIR arm)

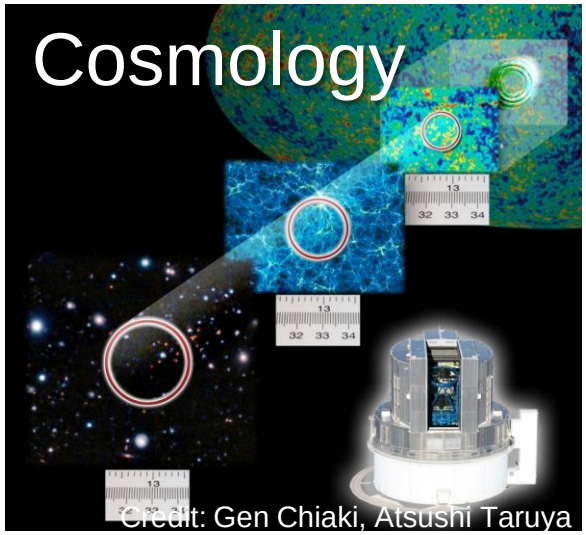
How the system works

movie

movie with sound

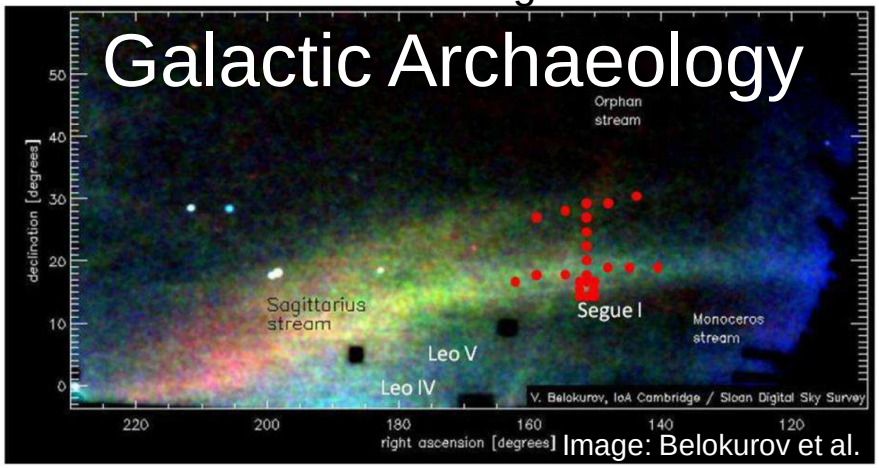


2. Science targets

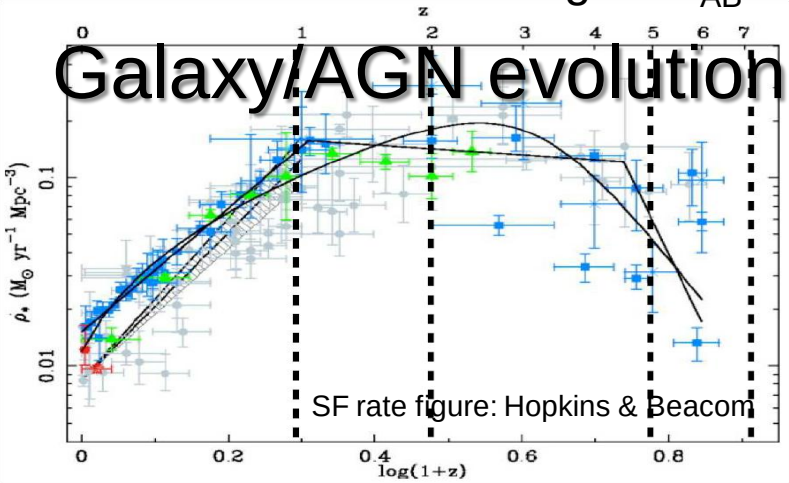


9.3 h^{-3} Gpc^3 in 0.8<z<2.4
1400 deg^2

Milky Way 17<V<21.5 390 deg^2
M31halo 21.5<V<22.5 65 deg^2

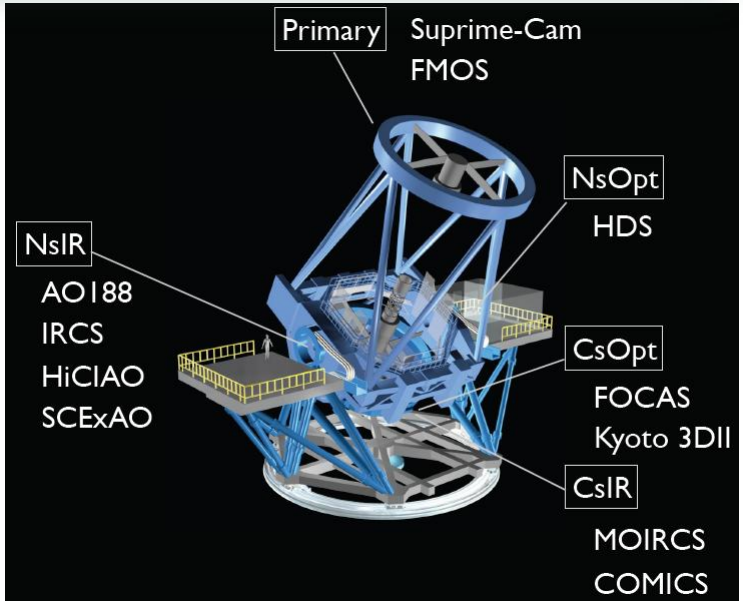


1<z<2 16 deg^2 to J_{AB}~23.4



See arXiv:1206.0737 “Extragalactic science and cosmology with Subaru PFS” Ellis et al. (2012)

3. Why on Subaru ?



Strengths of Subaru Telescope

Large Field of View

e.g., Suprime Cam

(Hyper Suprime Cam, Prime Focus Spectrograph)

Platescale (arcsec mm-1) $\propto 1/f \rightarrow$ prime focus

(rigid tel. structure)

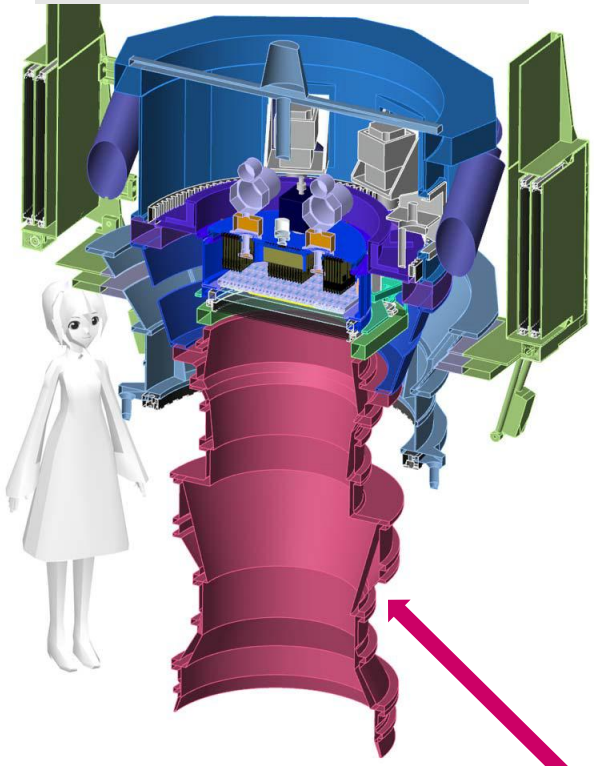
Excellent Image Quality

e.g., Kyoto 3DII (PI instr.: IFS,FP,etc.) + AO188 in optical wavelength

mirror surface, dome shape, rigid structure, tel. tracking

Sharing Wide Field Corrector with HSC

Hyper Suprime-Cam (HSC)



PFS case:

Optical interface with Wide Field Corrector

Field element

= 52-mm thickness flat plate

substitutes for filter + dewar window

http://www.eso.org/sci/facilities/eelt/fp7-elt-pub/wfi_workshop/pdffile/SMiyazaki.pdf

Wide Field Corrector (WFC)

開発のひとこま集(some topics)

Fiber Positioner Development by JPL-CIT

Dome seeing test using FMOS fibers

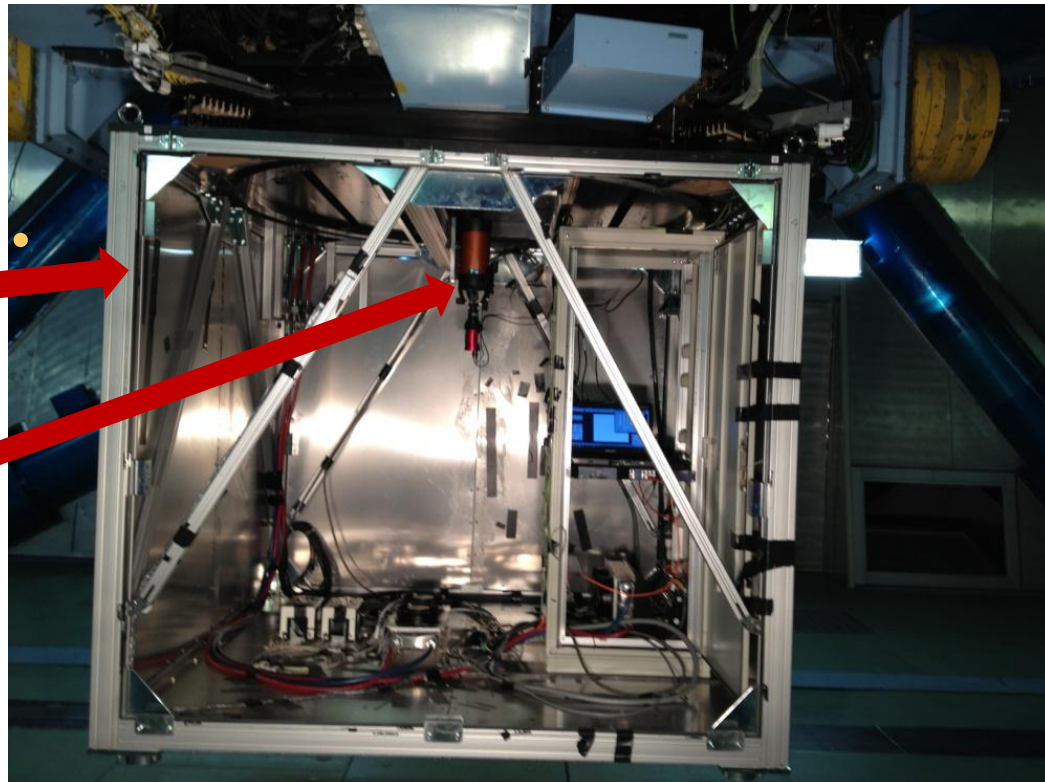
For PFS metrology camera

- understanding dome seeing effects by using back-illuminated FMOS fibers

2012 Decに
成功！

Cassegrain container
with Kyoto 3DII temporally removed

CCD camera: Atik 450
cooled to -10deg



新しいサプライズ？としては何かあったの?

そうだねー、
中分散モードがきたね！
銀河考古学研究者と分光器
チームががんばったね。

Summary from Project to Steering Committee on technical feasibility and additional cost estimation of Medium Resolution option

UTC 2012 Oct 16 6:45am version

Hajime Sugai et al. (PO),

based on studies by

Jim Gunn, Mike Carr, Robert Barkhouser (PU),

Steve Smee, Joe Orndorff (JHU),

Sebastien Vives, Marc Jaquet, Fabrice Madec, David Le Mignant (LAM)

0. Requirement from Galactic Archaeology WG

R~5000

7,100-8,850 A

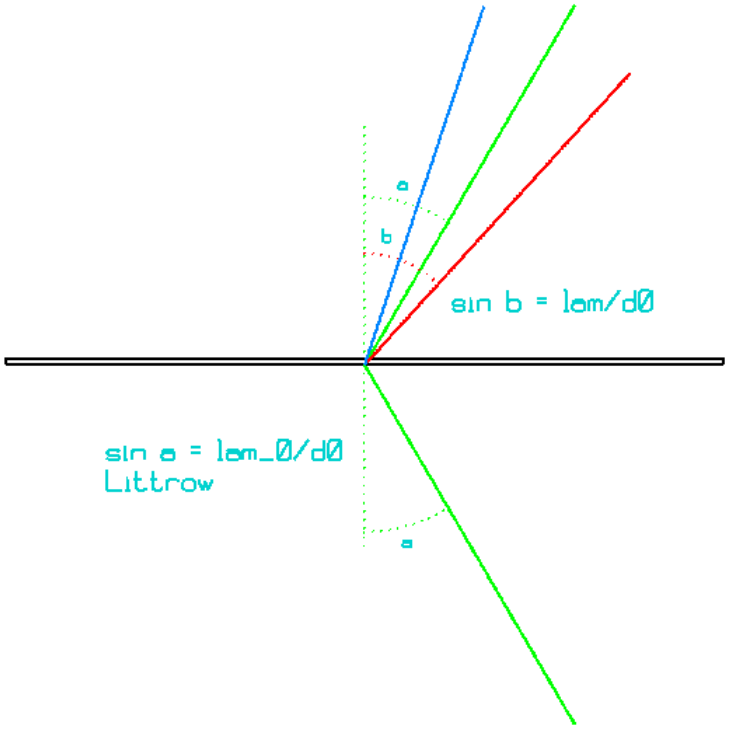
for 4 red arms

1. Summary of this report

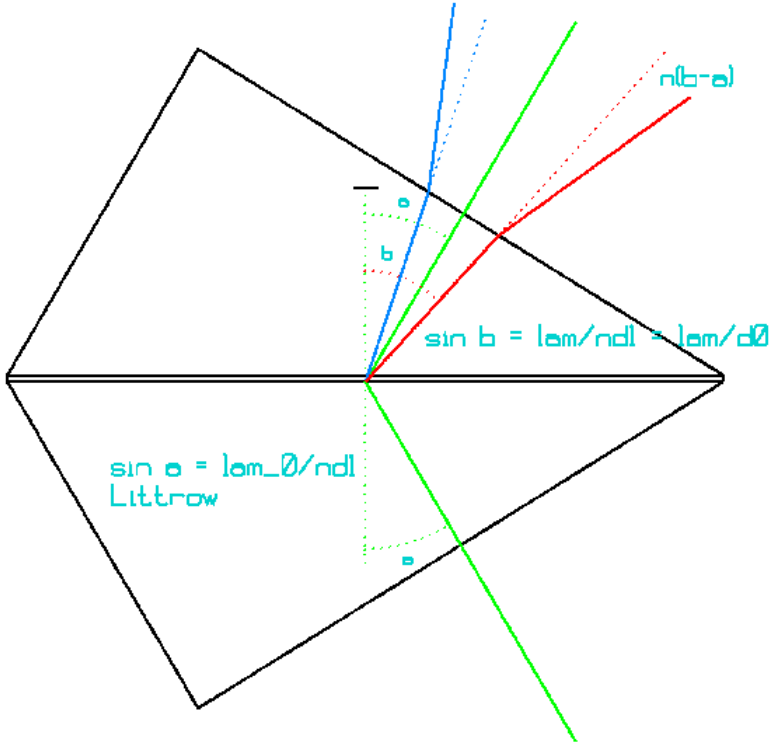
- technically feasible (though not easy)
  - grism feasible with available glass materials.
    best candidates: S-LAM2(n_{768}=1.733) (or S-LAL8(n_{768}=1.704))
    in terms of refractive index, coefficient of thermal expansion
    slightly (3-4degree) tilted configuration from Littrow to avoid ghosts
  - simple exchange mechanism possible in tight available space.
    use round-shaped prisms instead of squared
- additional cost

2. Technical feasibility

Low resolution - grating



Medium resolution - grism

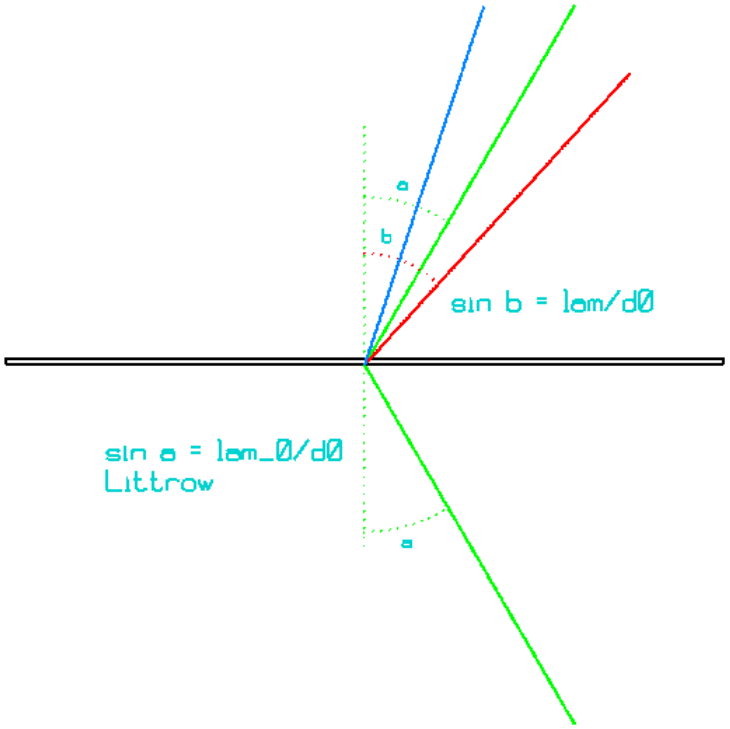


For same littrow angle at fixed wavelength,
d1=d0/n

Angular dispersion (resolving power) is increased by n with NO change in central angle.

2. Technical feasibility

Low resolution - grating



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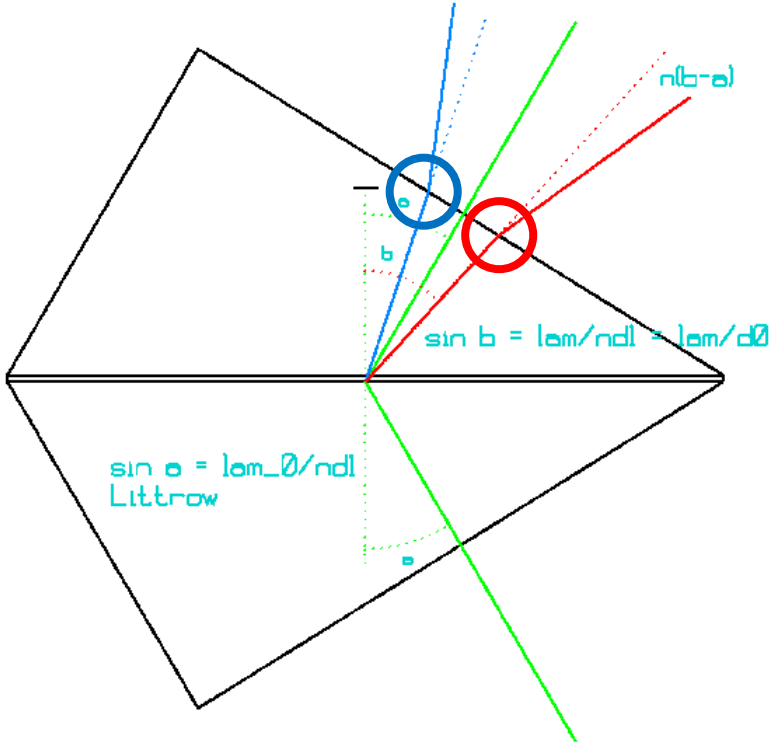

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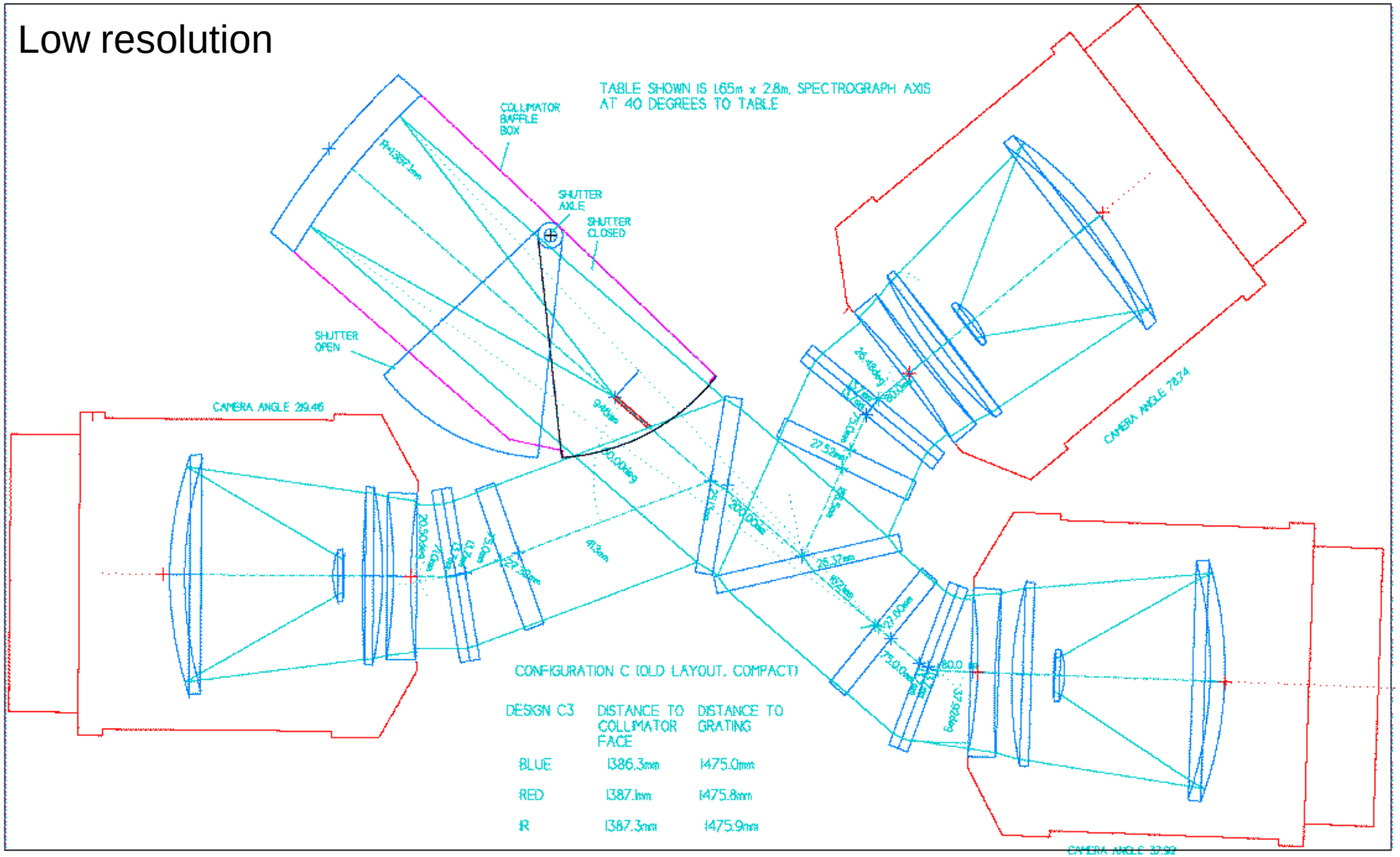
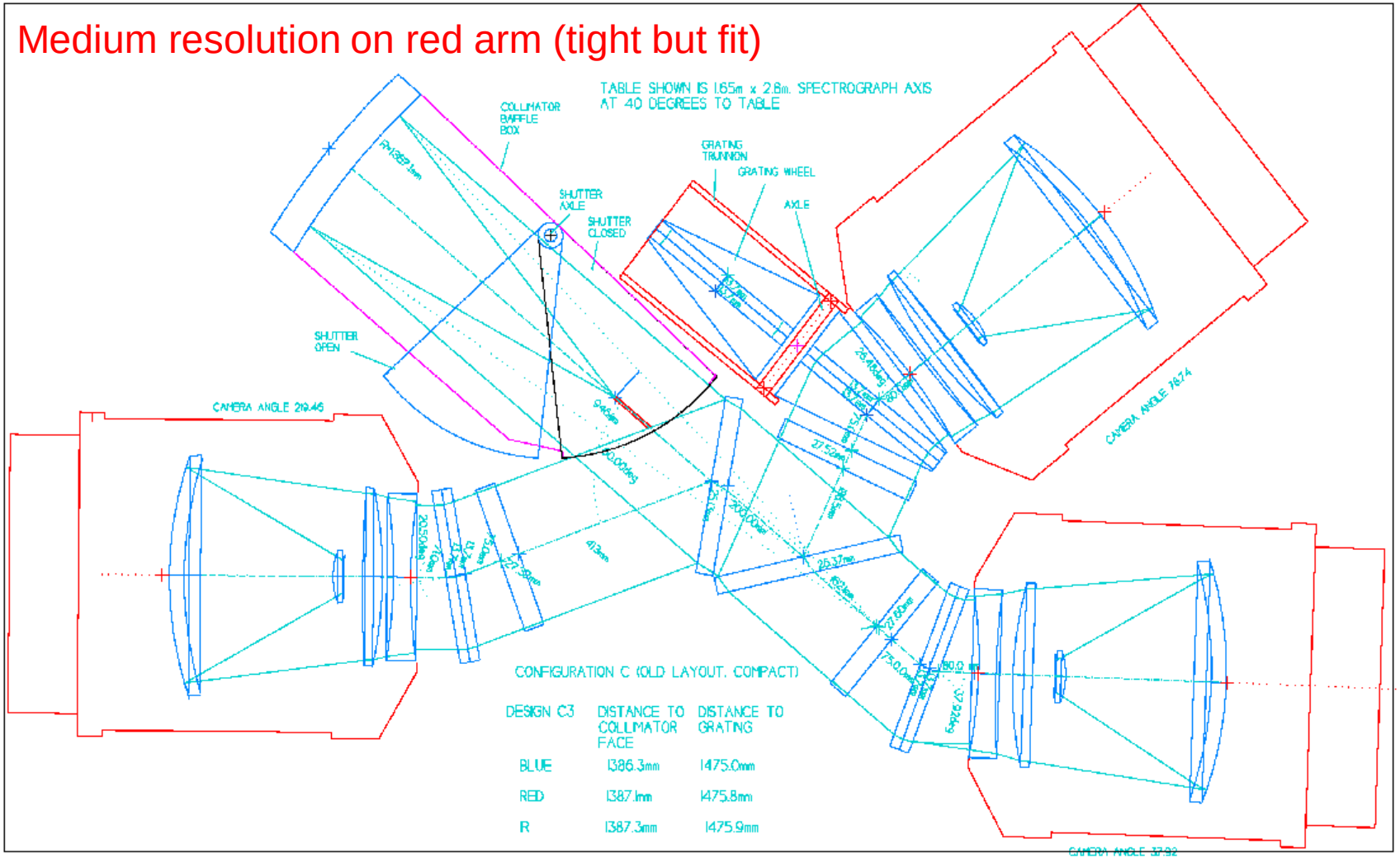
2. Technical feasibility

Low resolution



2. Technical feasibility

Medium resolution on red arm (tight but fit)



最後に何か“お得”な情報はないの!?

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