VPH grism for Subaru Telescope

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Soma Optics Co.Ltd., Hiroshima University, University of Tokyo,
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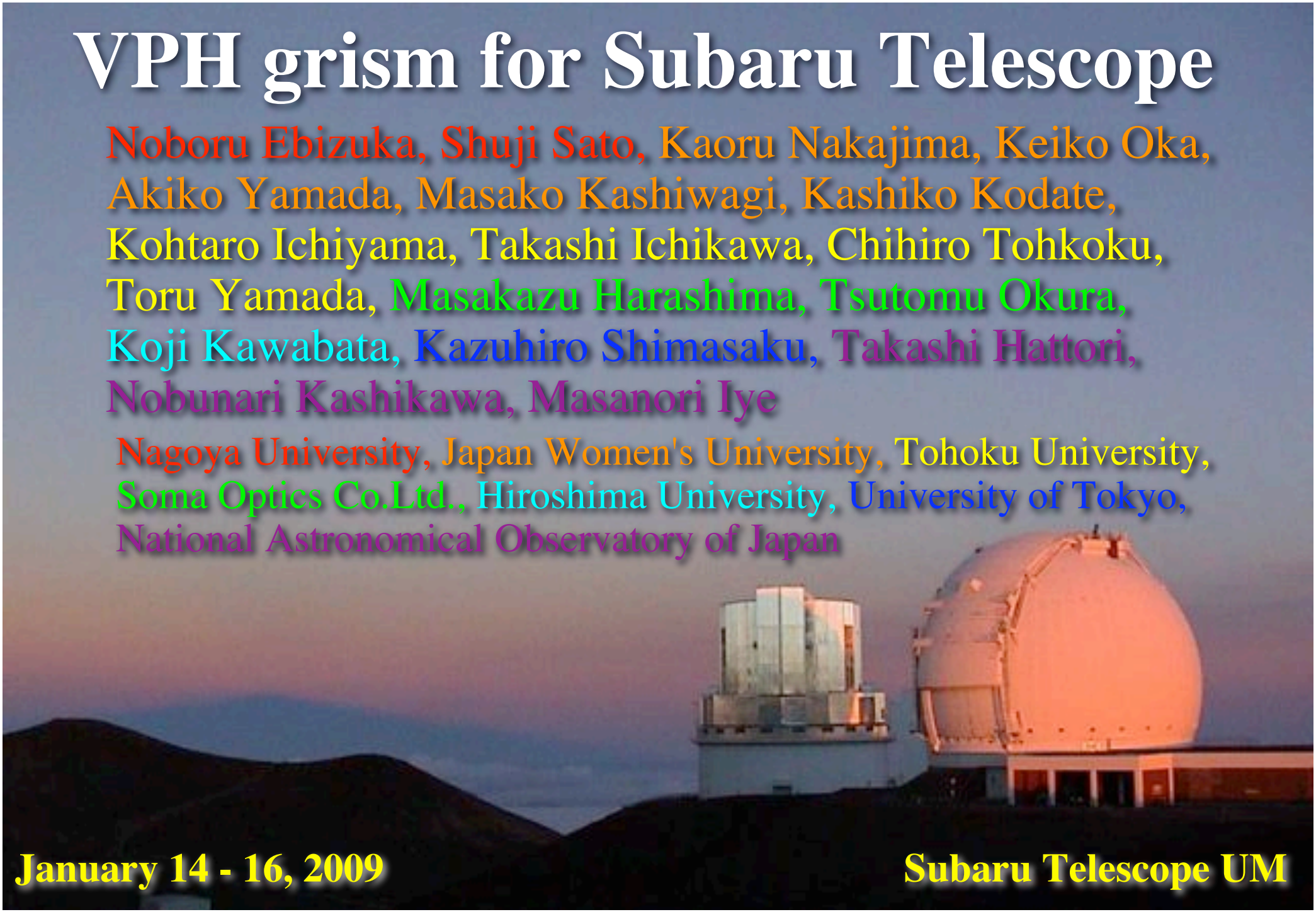
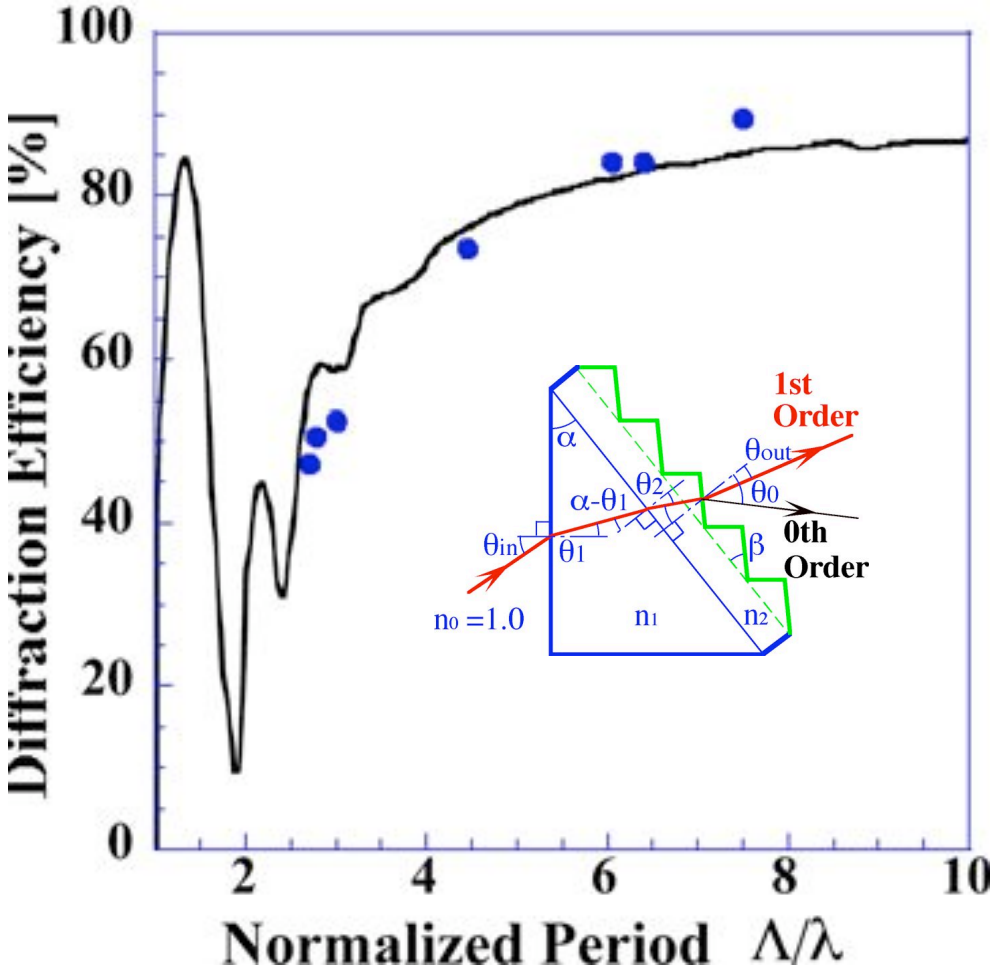
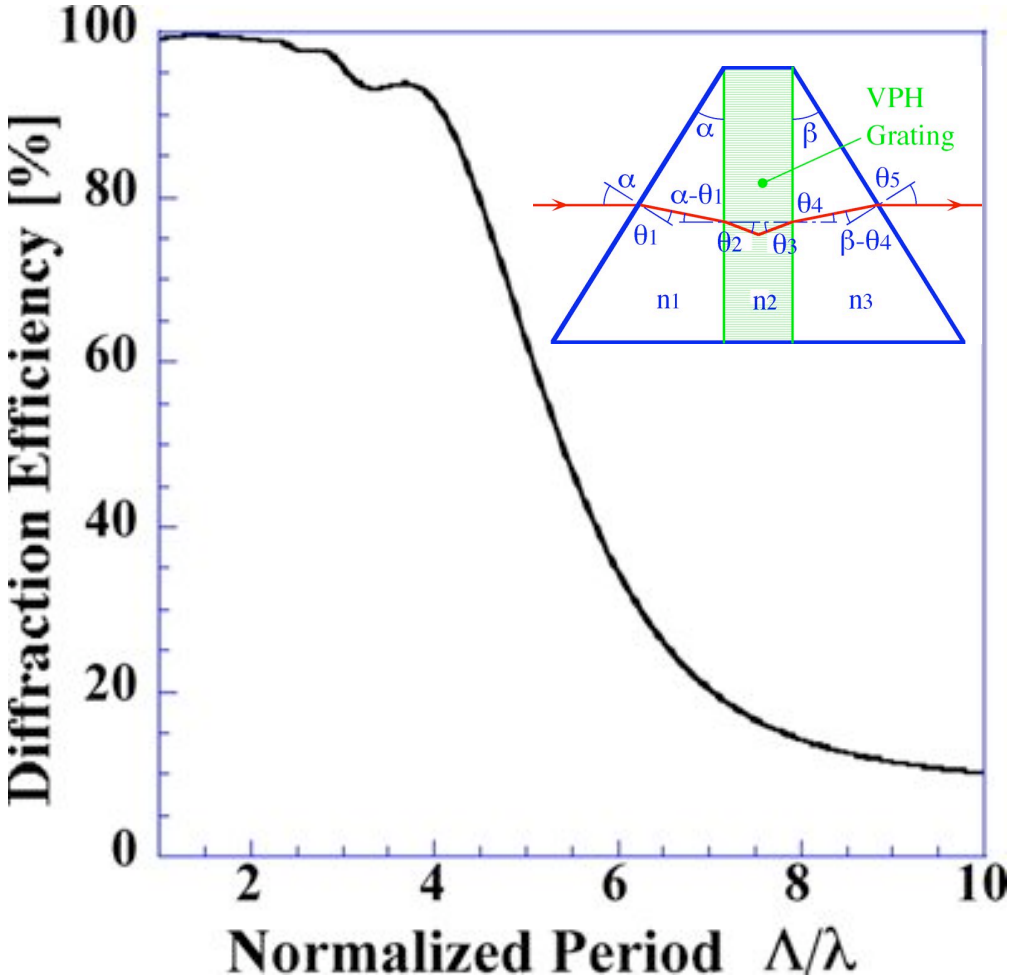


January 14 - 16, 2009 **Subaru Telescope UM**

Diffraction Efficiency of Gratings



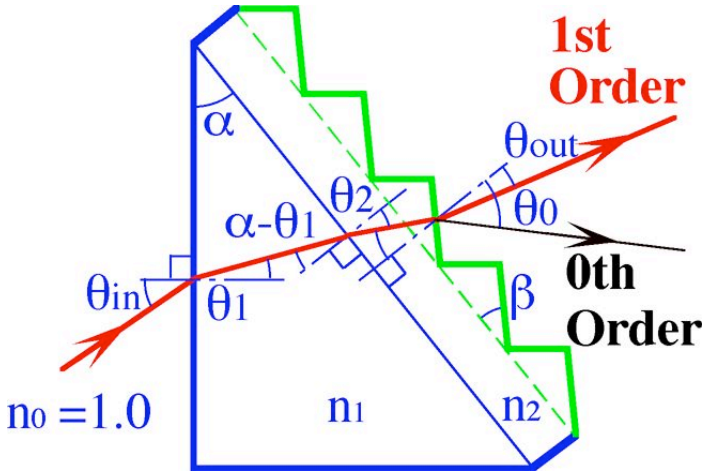
Surface relief grating

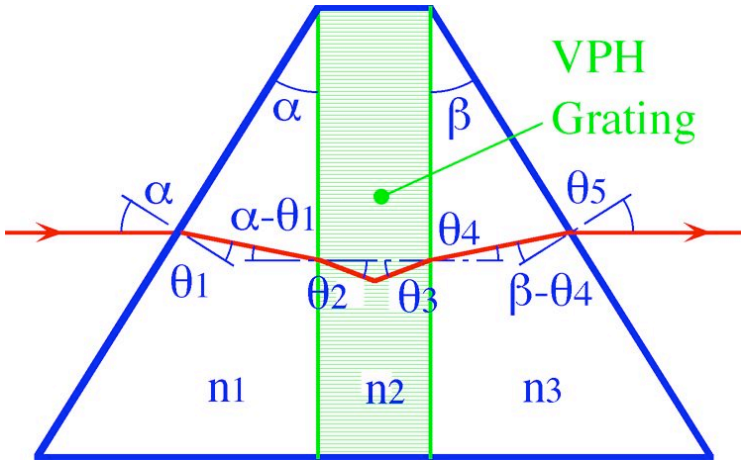


VPH grating

[K. Oka et. al., SPIE 5005, 2003]

Grism with High Index Prisms





Critical angle of refractive indices 2.6 and 1.5 is 35.2 degree ($\theta in = 0$, $\alpha = 35.2$).

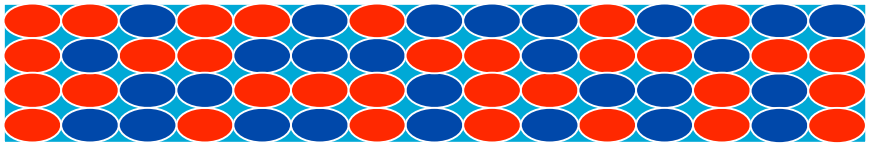
Grism with VPH or Quasi-Bragg grating is less sensitive to critical angle.

[Ebizuka et. al., SPIE 4842, 2002]

Resin for Volume Hologram

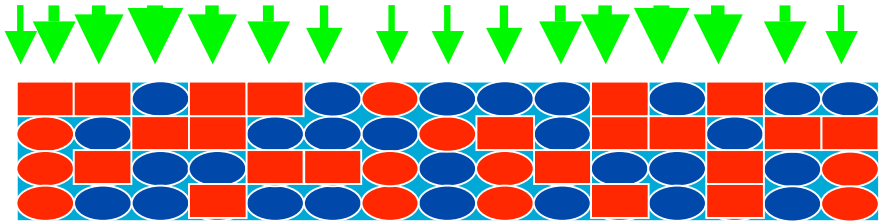
- **RPM: Radical polymerization monomer, Polymerized by UV and 460 - 600 nm.**
- **CPM: Cation polymerization monomer, Polymerized by UV.**
- **RPP: Radical polymerization polymer.**
- **CPP: Cation polymerization polymer.**

①



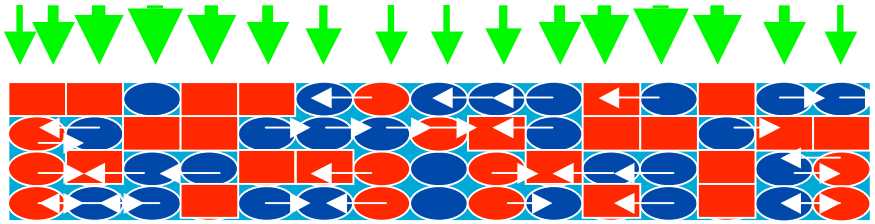
②

Laser Exposure



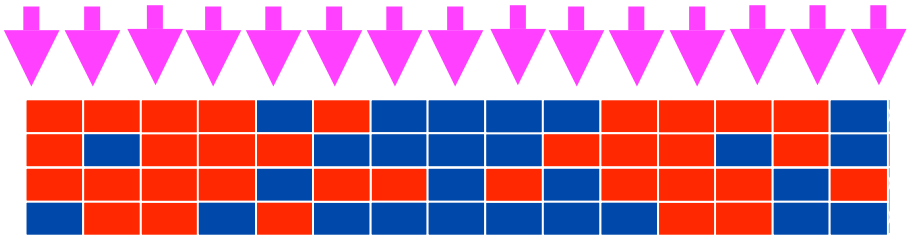
③

Laser Exposure



④

UV exposure



Nippon Paint Co.Ltd.

Hologram Plate Making

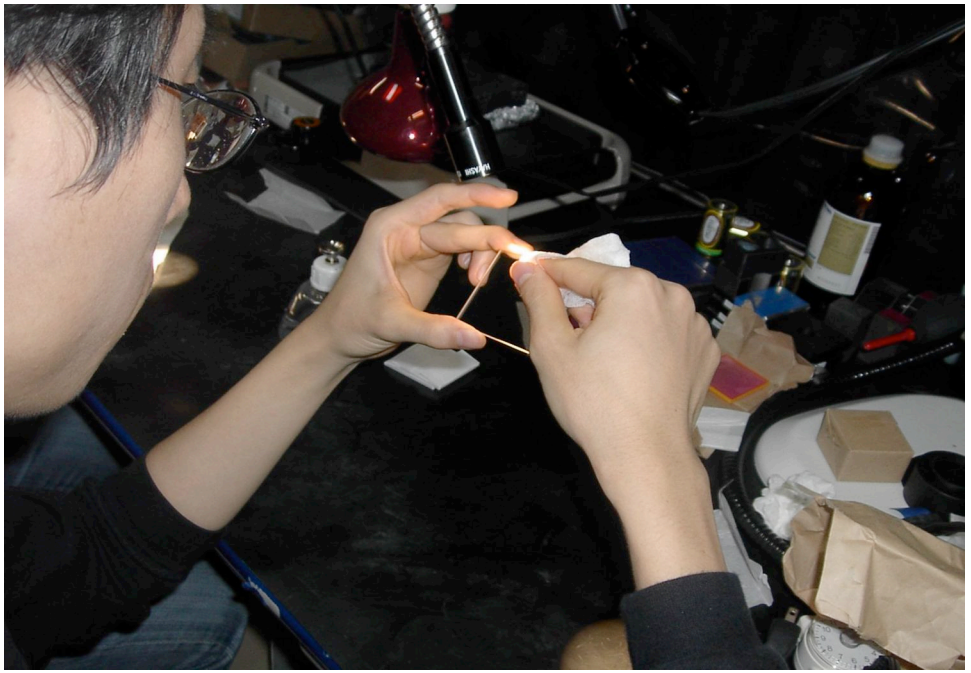
Cleaning of glass substrates.

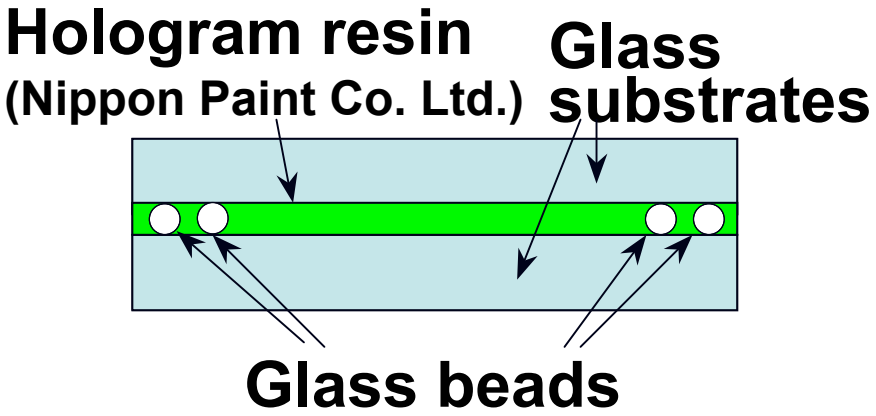
▼

Dropping resin (liquid) on a substrate, heating up to 80℃.

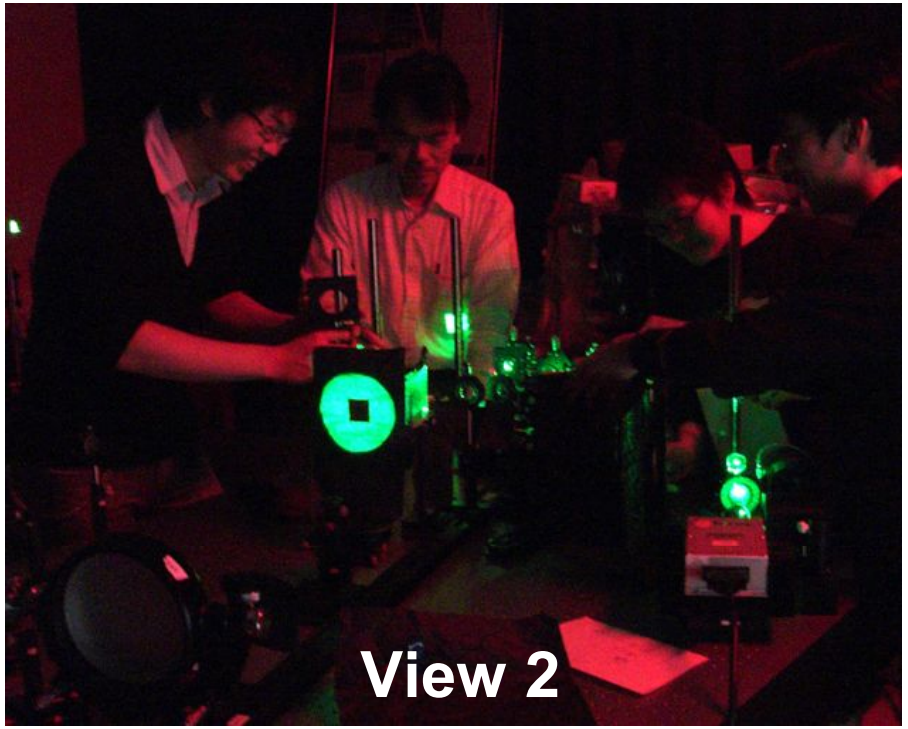
▼

Sandwich resin with substrate. Thickness is adjusted by glass beads.



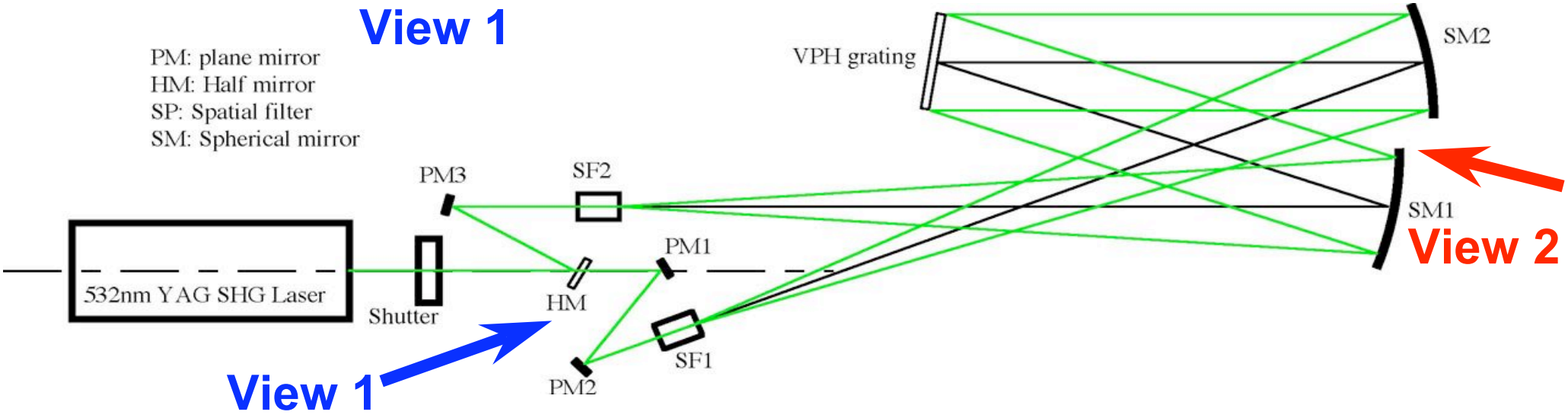


Optical System for Holographic Exposure



View 1

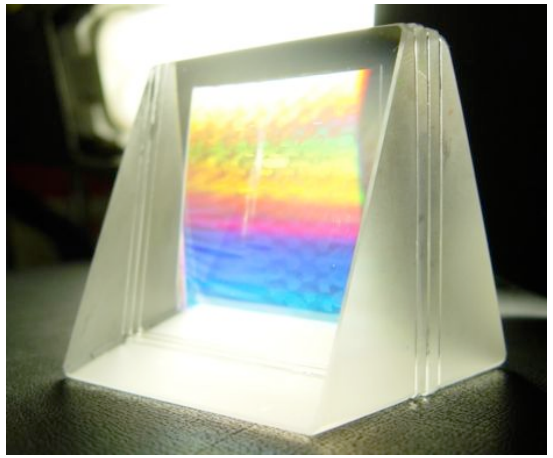
PM: plane mirror
HM: Half mirror
SP: Spatial filter
SM: Spherical mirror



VPH Grisms for FOCAS

(Faint Object CAmera and Spectrograph)

Band	Blaze [nm]	Range [nm]	R (λ/Δλ) @0.4" Slit	Developer
U-B	450	346 – 522	2,600	JWU
B-V	520	432 – 606	3,000	JWU
V-R	650	516 – 781	2,500	Ralcon
R*	680	631 – 725	7,200	JWU
R-z**	800	550 – 1,047	1,600	Nagoya Univ.
I*	800	741 – 856	7,000	Ralcon
I-Y**	950	792 – 1,104	3,100	JWU
z*	950	879 – 1,027	6,400	Ralcon



* ZnSe prisms.

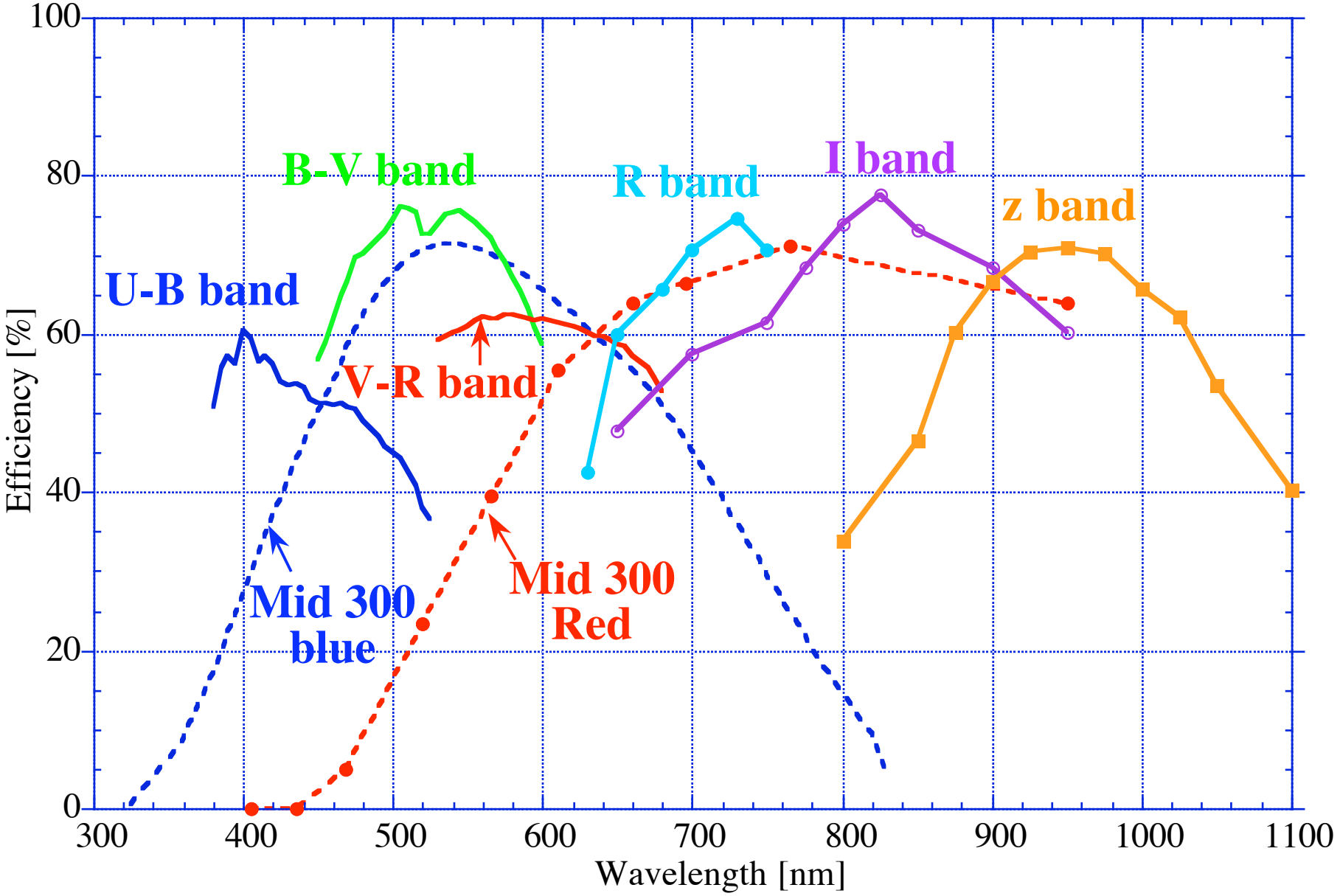
** Under development.

JWU: Japan Women's University

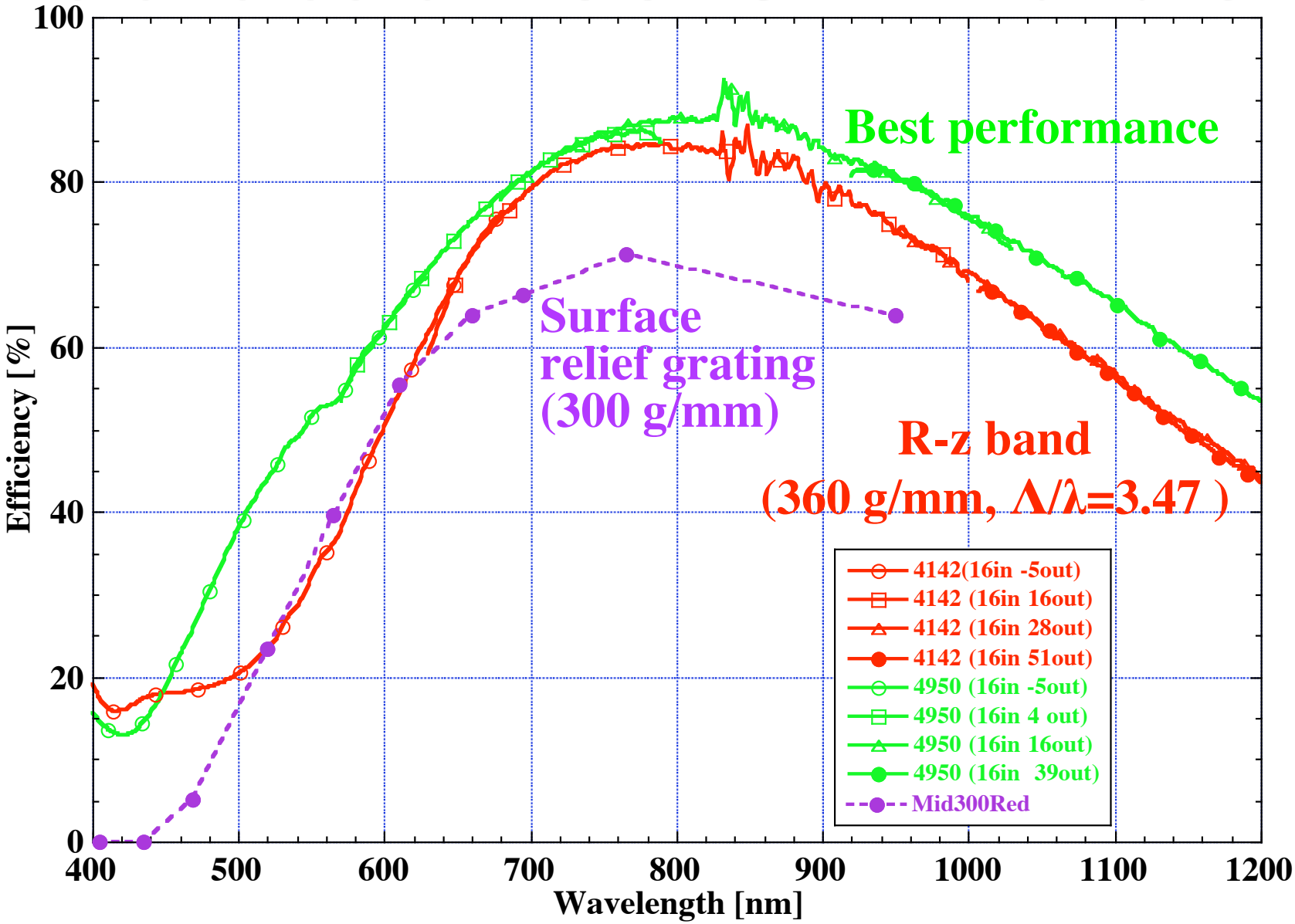
Size: 110 x 106 x 106 (max) mm

[M. Kashiwagi et. al., SPIE 5494, 2004; K.S. Kawabata et. al. SPIE 4841, 2003]

Efficiencies of FOCAS VPH Grisms



Efficiencies of FOCAS R-z Band Grism



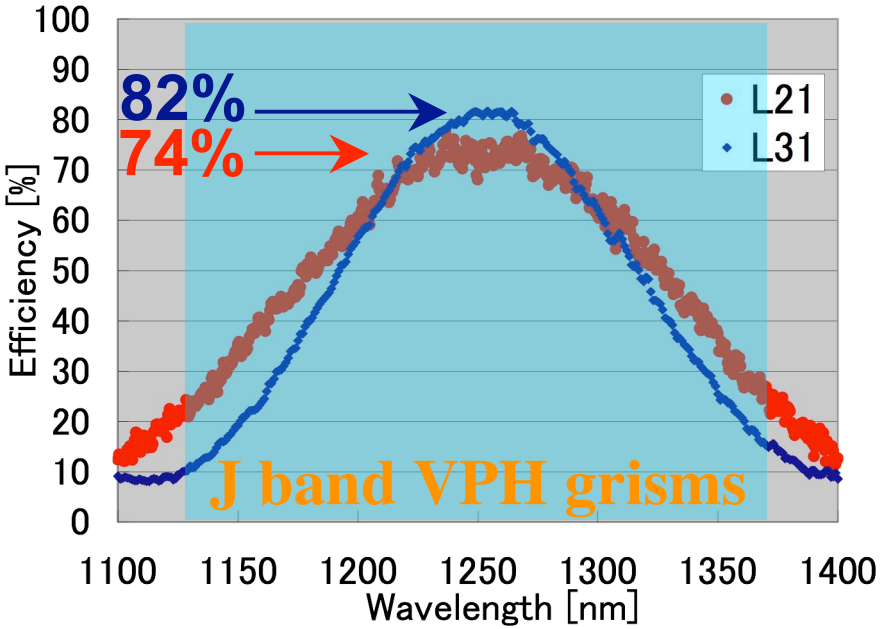
VPH grism is versatile for mideum dispersion !

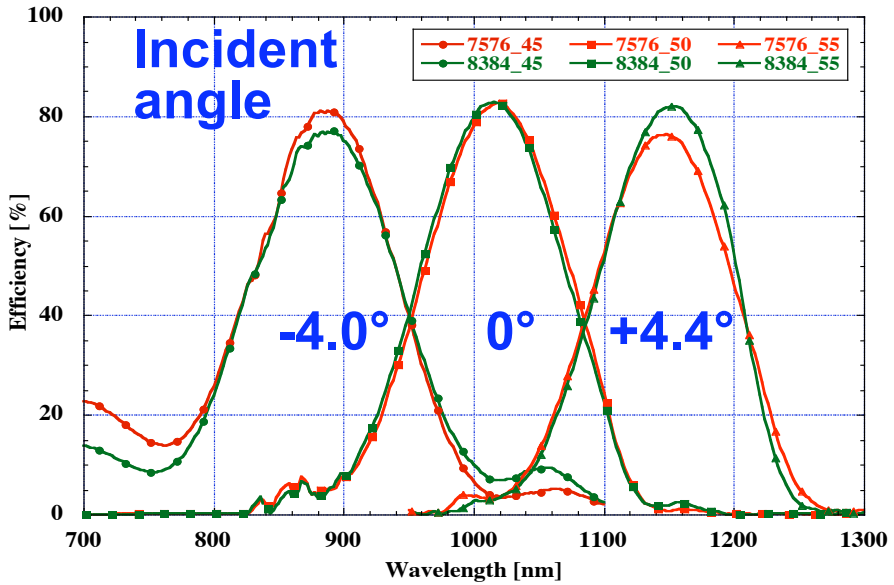
VPH Grisms for MOIRCS

(Multi-Object InfraRed Camera and Spectrograph)

Band	Blaze [μm]	Range [μm]	R@0.5" Slit	Efficiency (Max)	Developer
Y	1.02	0.94 – 1.09	3,200	~ 0.80	Soma Optics
J	1.25	1.13 – 1.37	3,100	0.82, 0.74	Tohoku Univ.
H	1.65	1.52 – 1.78	3,000	~ 0.75	Tohoku Univ.
K*	2.20	2.00 – 2.40	2,600	> 0.90	JWU

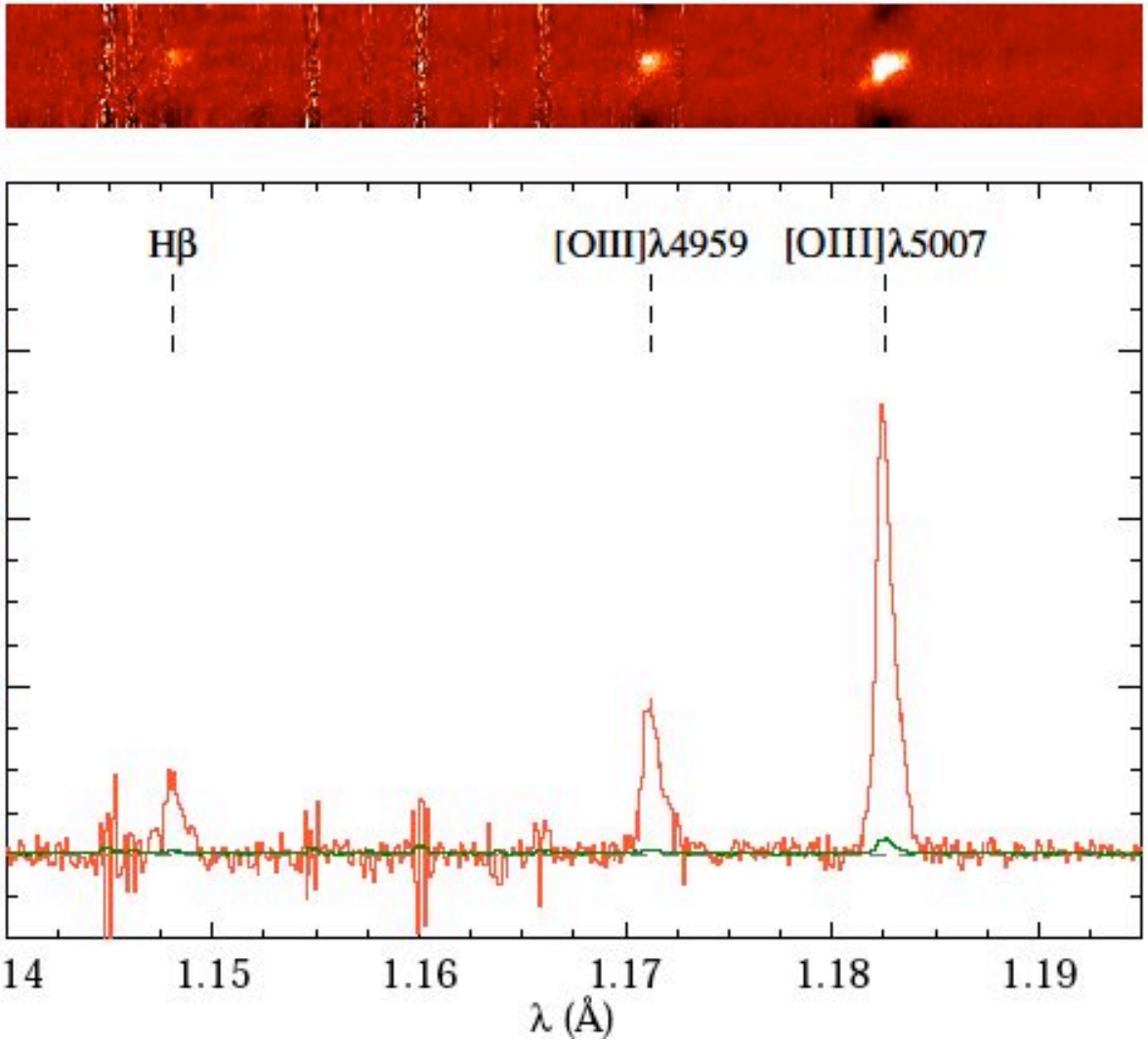
* Under development.

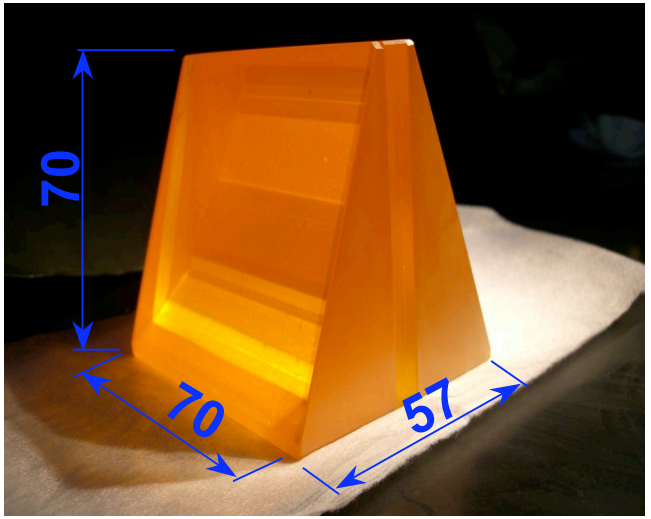




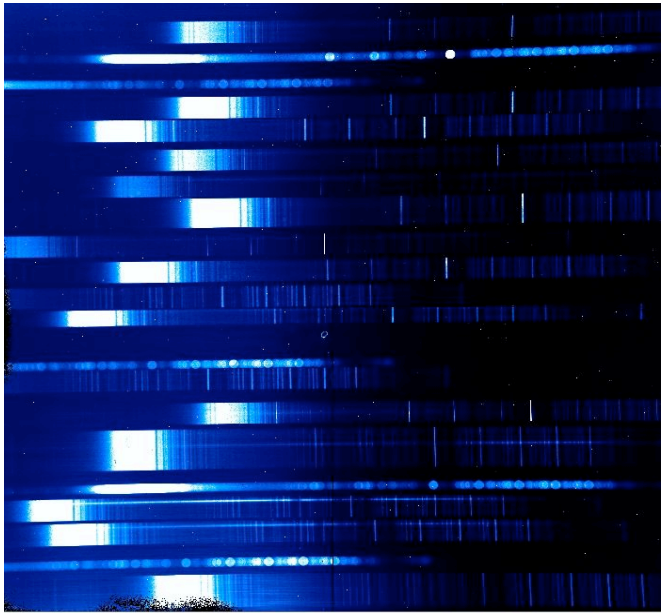
Y band VPH grisms

Spectrum of a galaxy (z = 1.618)





Size: 70 x 70 x 57 (max) mm.



MOIRCS, J band VPH grism, 0”.8 slit
[Onodera in private communication].

[T. Ichikawa et. al., SPIE 7014, 2008]

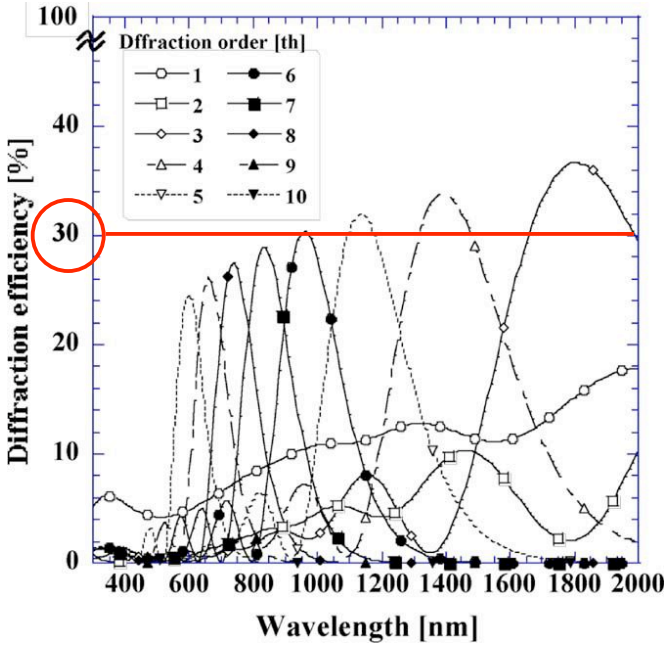
Conclusions

- **U-B, B-V, V-R, R, I and z band grisms for FOCAS, and J and H band grism for MOIRCS are available.**
- **Y band grism for MOIRCS is ready for installation.**
- **R-z and I-Y band grisms for FOCAS, and K band grism for MOIRCS are under development.**

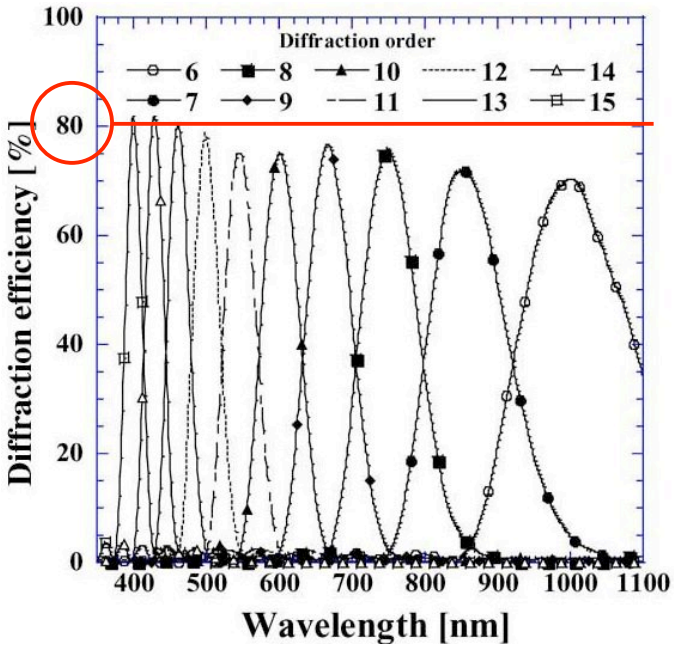
We appreciate Mr. Kawabata and Mr. Teranishi of Nippon Paint Co.Ltd. for providing hologram resin. These works had partially supported by the grant-in-aid of RIKEN for practical use of research results.

Quasi-Bragg grating

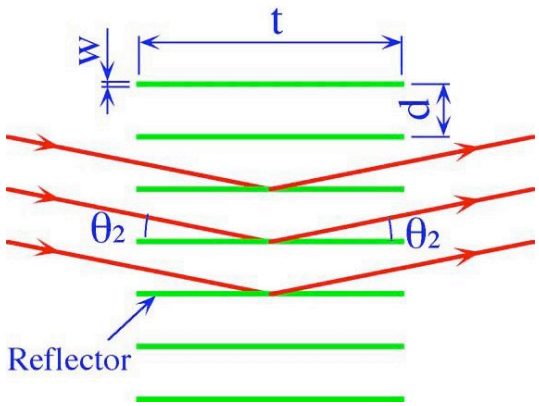
- Echelle mode, a higher order grating with a cross disperser, effectively utilizes 2 dimensional detector.
- Diffraction efficiency of a VPH grating decreases at higher orders.
- Diffraction efficiency of a surface relief grating changes slightly.



Diffraction efficiency of VPH grating of higher order

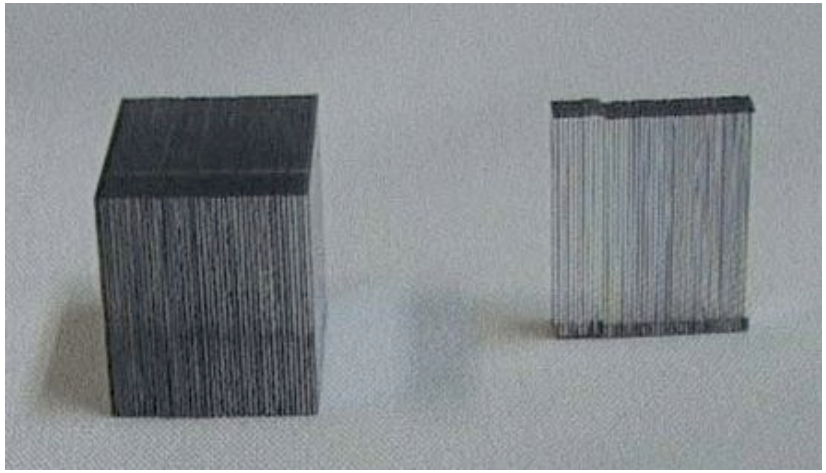


Diffraction efficiency of Quasi-Bragg

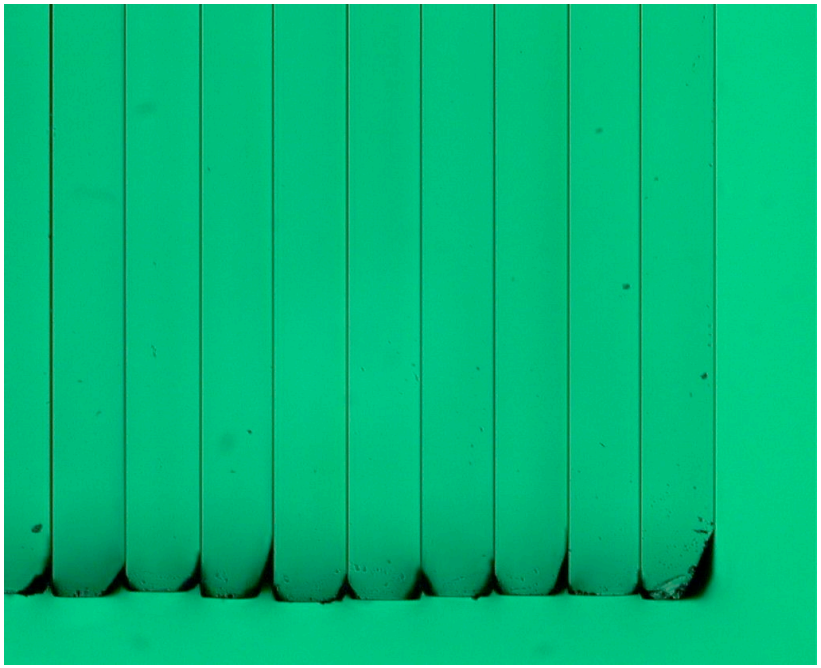


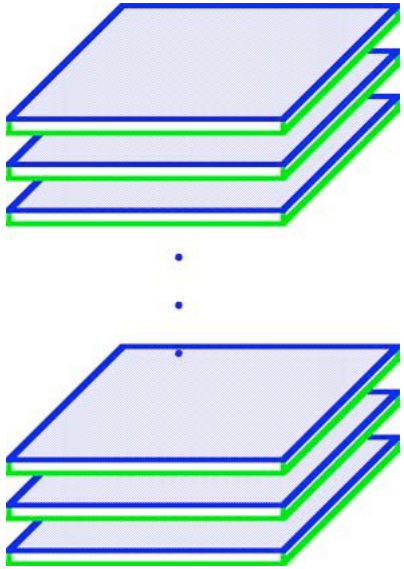
[K. Oka et. al., SPIE 5290, 2004]

Trial Fabrication of Quasi-Bragg Grating

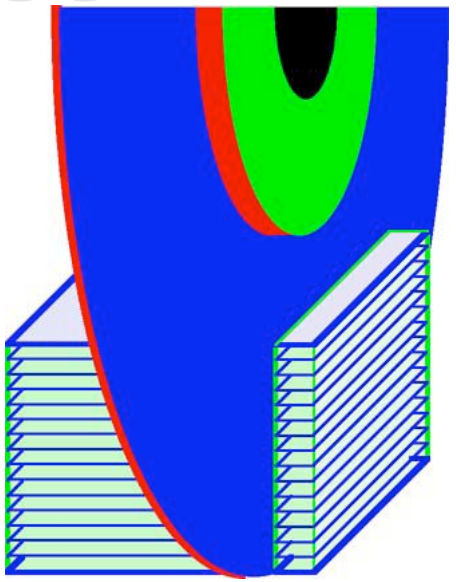


A: 10 x 10 x 0.2 x 40 pcs (left),
B: 1.5 x 10 x 0.2 x 40 pcs (right)

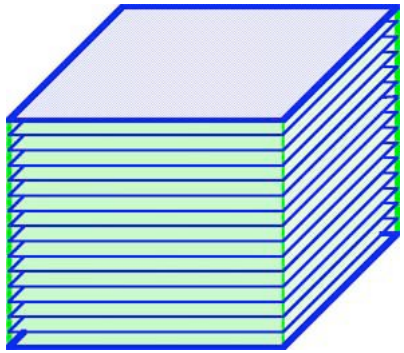


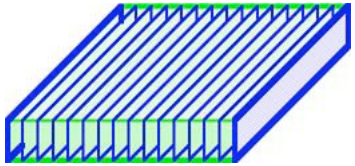


Laminating of Mirror Plate

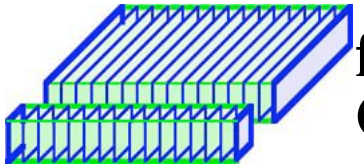


Cutting



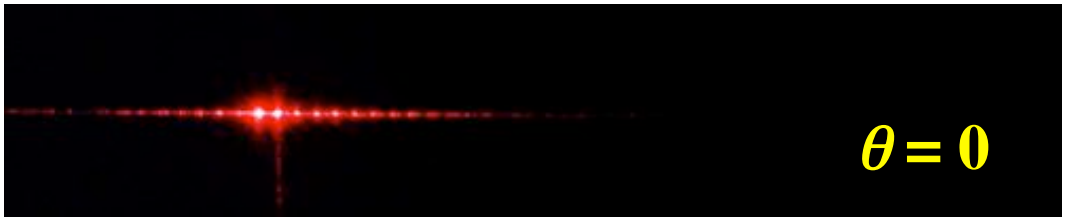


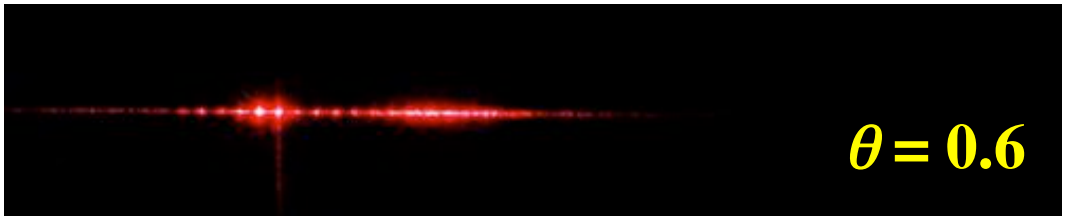
Lapping and Polishing

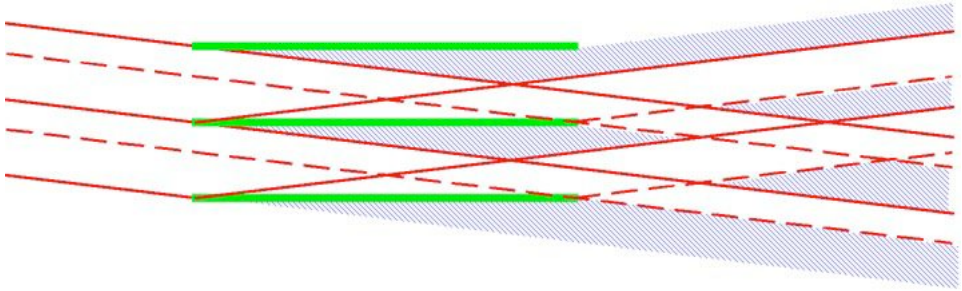


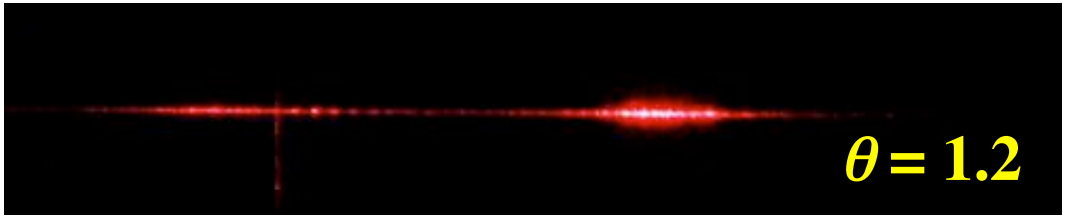
for Wave Guide

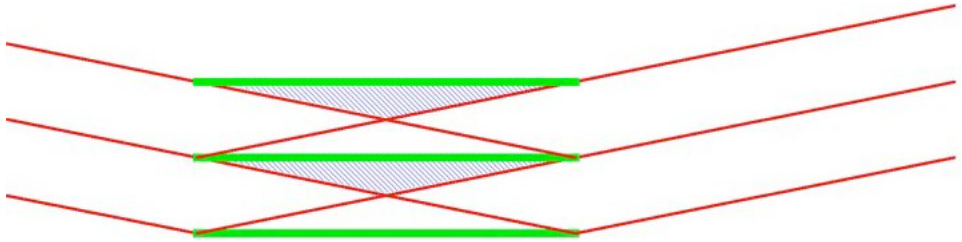
Diffraction of Quasi-Bragg Grating

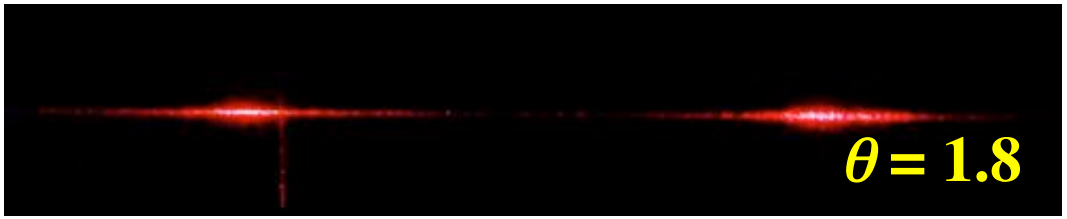


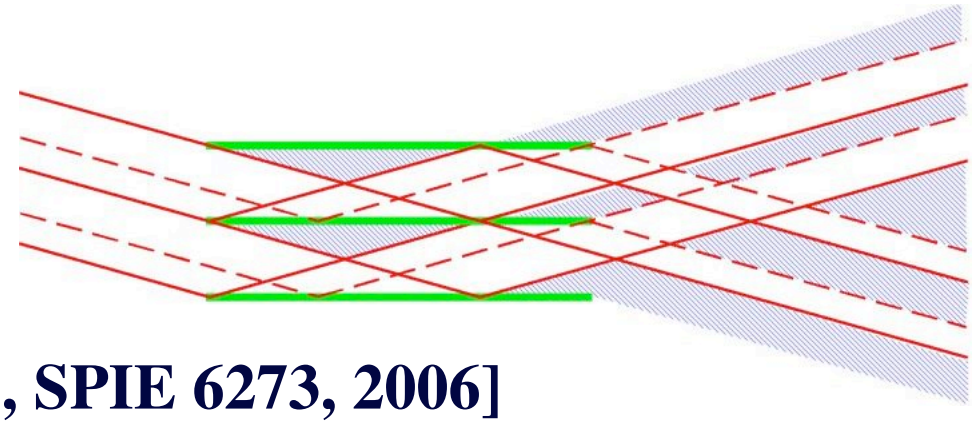












[N. Ebizuka et. al., SPIE 6273, 2006]