

A Concept Design of the Optics of a Prime Focus Camera for a 60cm Telescope of the Midanak Observatory

Hiroshi Ohtani (kyoto Univ)

Fumi Yoshida (NAOJ)

Toshifumi Yanagisawa (JAXA)

Shinobu Ozaki (NAOJ)

Requirements for Observations of Asteroids

Physical obs Survey Obs (F.Y) (T.Y)

FoV	10' sq	1° sq
lim mag	19mag	19mag
exp time	3min	multiple short
color band	B,V,R,I,y	R, white

Current system

Telescope 60cm

Focus Cassegrain

Camera FLI-IMG1001E

F.O.V. 11'sq

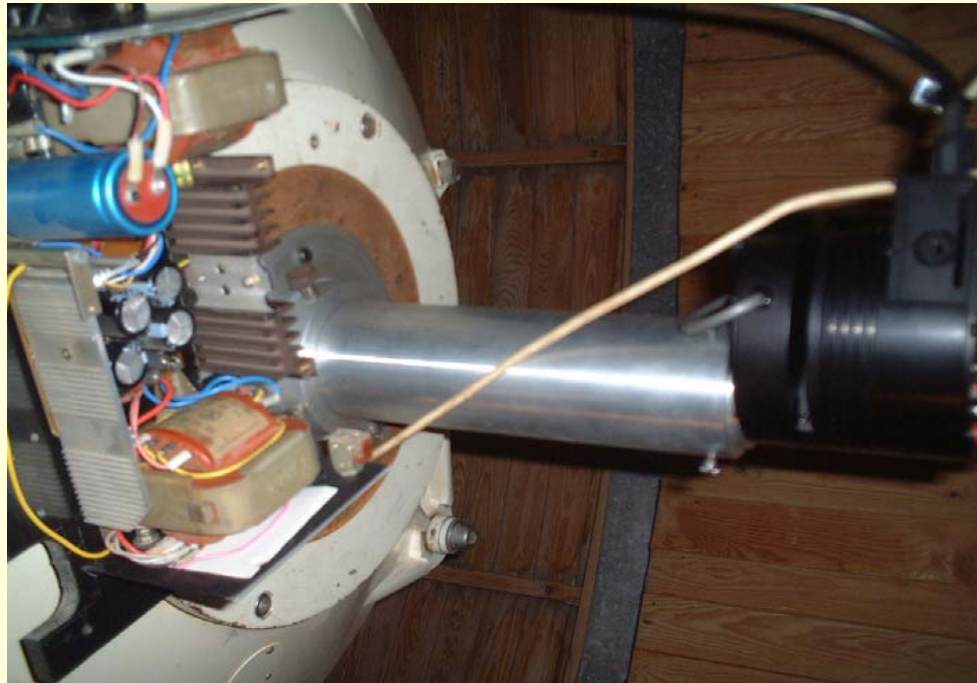
Obs type

FoV

**Physical
Survey**

**Required ~ Actual
Required >> Actual**

**For a wider field of view,
a ready-made focal-reducer was
tested.**



Test image (Mar '05)

Reducer NGW0.5X + CCD ST9XE

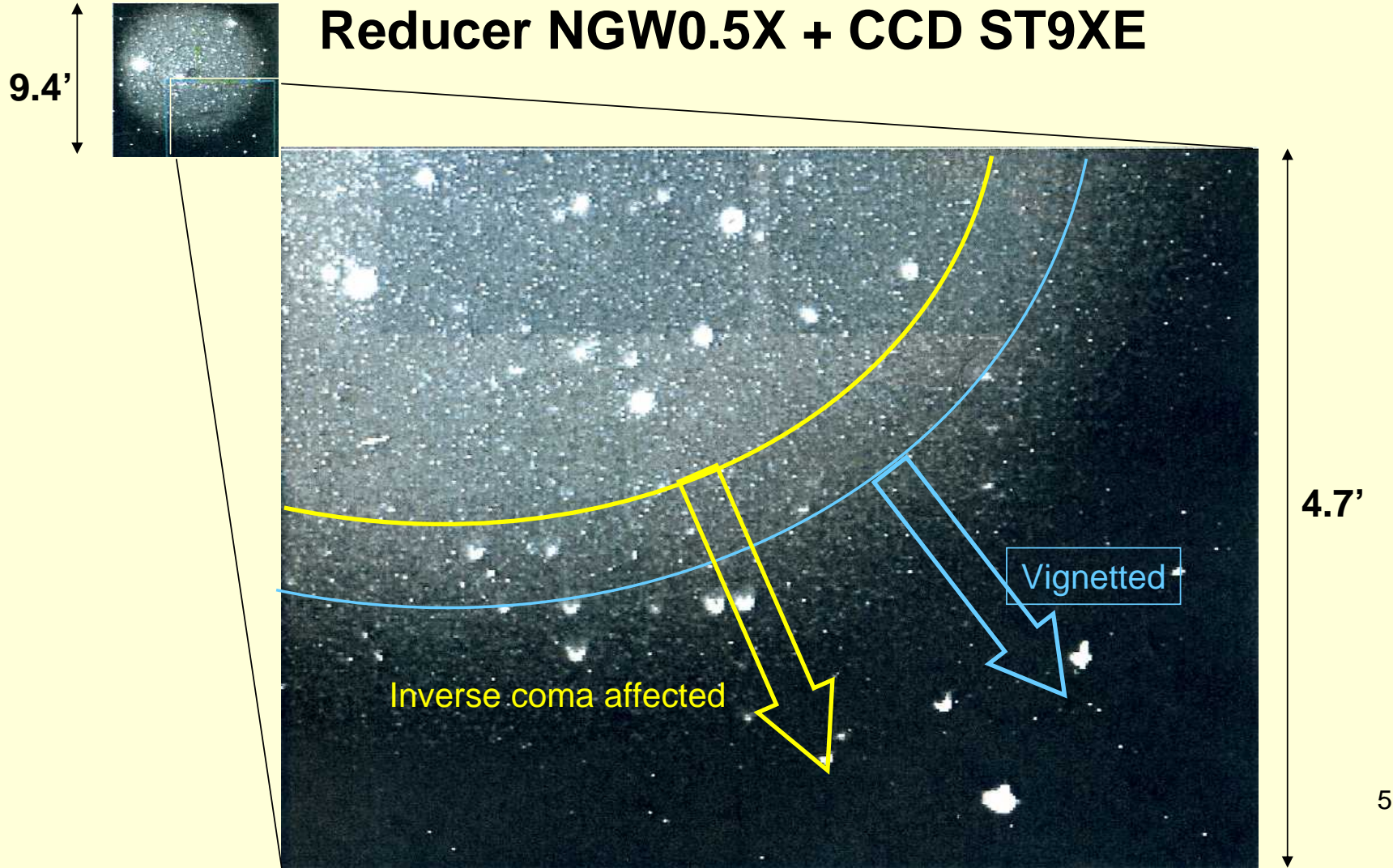


Image with the reducer

Aberration free FoV is $\phi < 5'$

due to the optimization for F/10

Vignetted FoV is $\phi > 6'$

due to the camera adapter (?)

**Vignetting by the Cassegrain hole
limits FoV to less than $37'$.**

Cass focus cannot make 1° FoV.

Utilizing the Prime Focus

vignetting : apparently no
optical parameters

$$D = 600 \text{ mm}$$

$$f = 2400 \text{ mm}$$

F/4

plate scale 0.012mm/arcsec
 41.9 mm/deg

Comatic aberration

$$L = (16/3)F^2 C \quad (\text{Bowen, 1967})$$

L : angular distance from optical axis

C : angular size of coma

F : focal ratio

Cass (F/12.5) **$C'' = 0.072L'$** **$L' = 14C''$**

Prime (F/4) **$C'' = 0.70L'$** **$L' = 1.4C$**

At the prime , for $c'' = 0.69''$ (seeing)

$L \sim 1'$ i.e., FoV $\sim 2' \ll$ requirement

Then, a corrector is necessary.

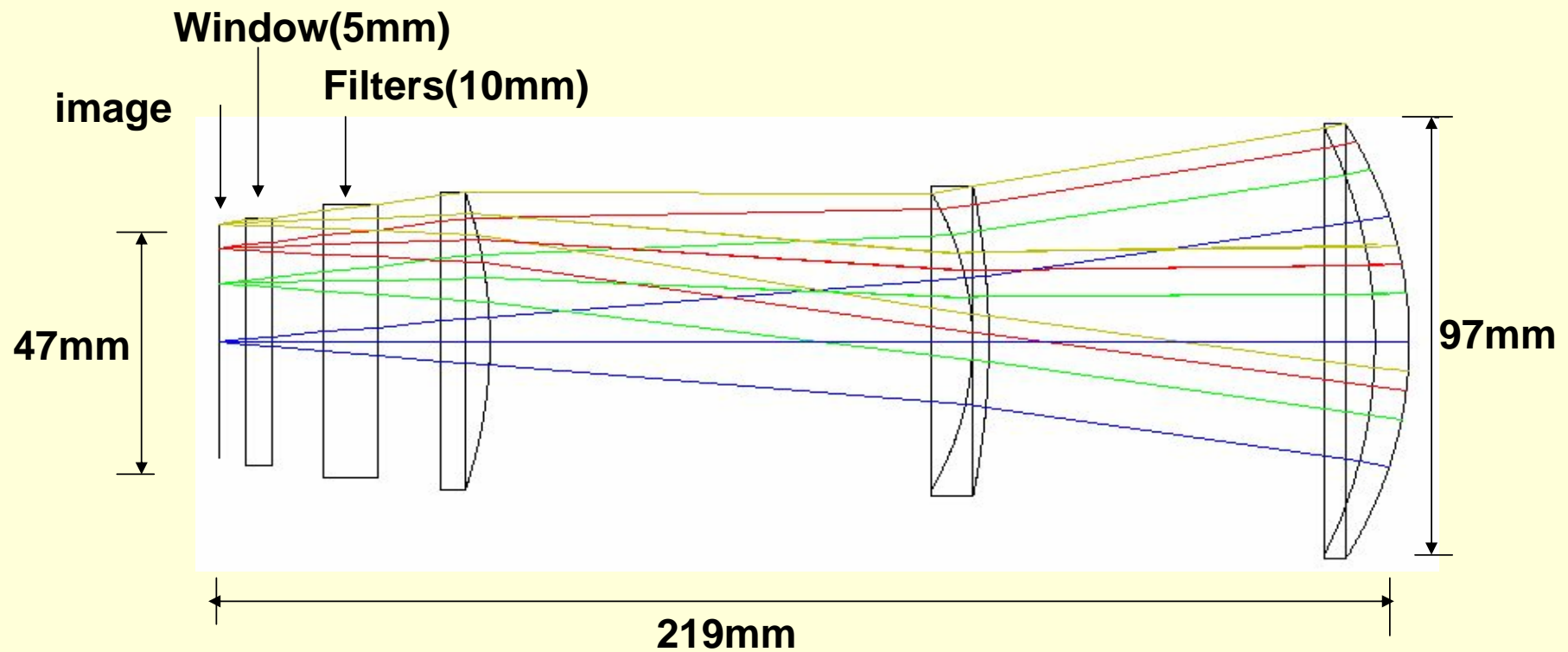
Basic requirements for design

FoV $\phi = 1^\circ$
Color range U(365nm)~I_c (880nm)
Image quality $\leq 6 \mu\text{m}$ (80% energy)

Type Wynne type (Wynne 1974)
Material UBK7
Figure all spherical surfaces

Corrector layout

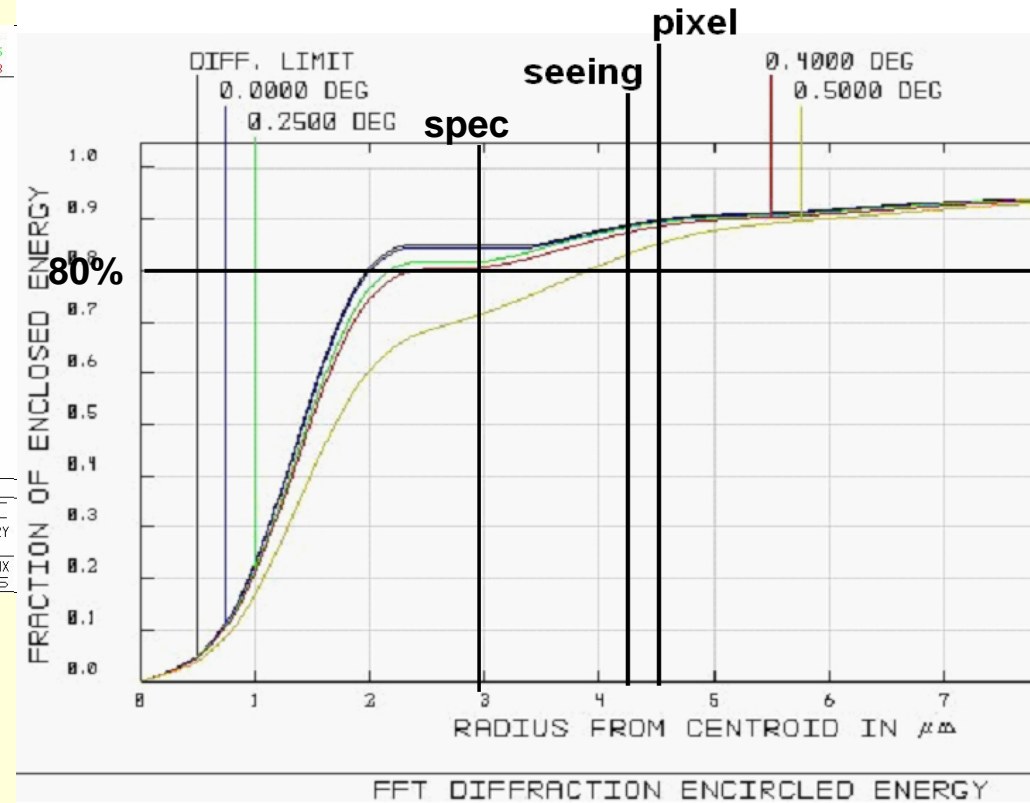
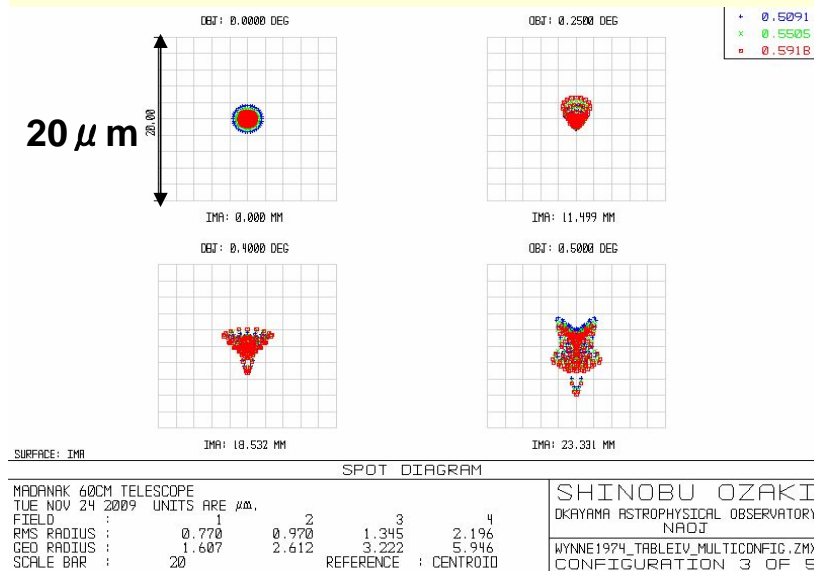
material UBK7, all spherical surfaces



White light (U~Ic)

Spot diagrams

Encircled energy



CCD Camera (candidate)

Model FLI ML16803 (Optec Inc.)

Format 4K sq

36.9mm sq (diagonal 52.2mm)

Pixel 9 μ m sq

At the prime focus

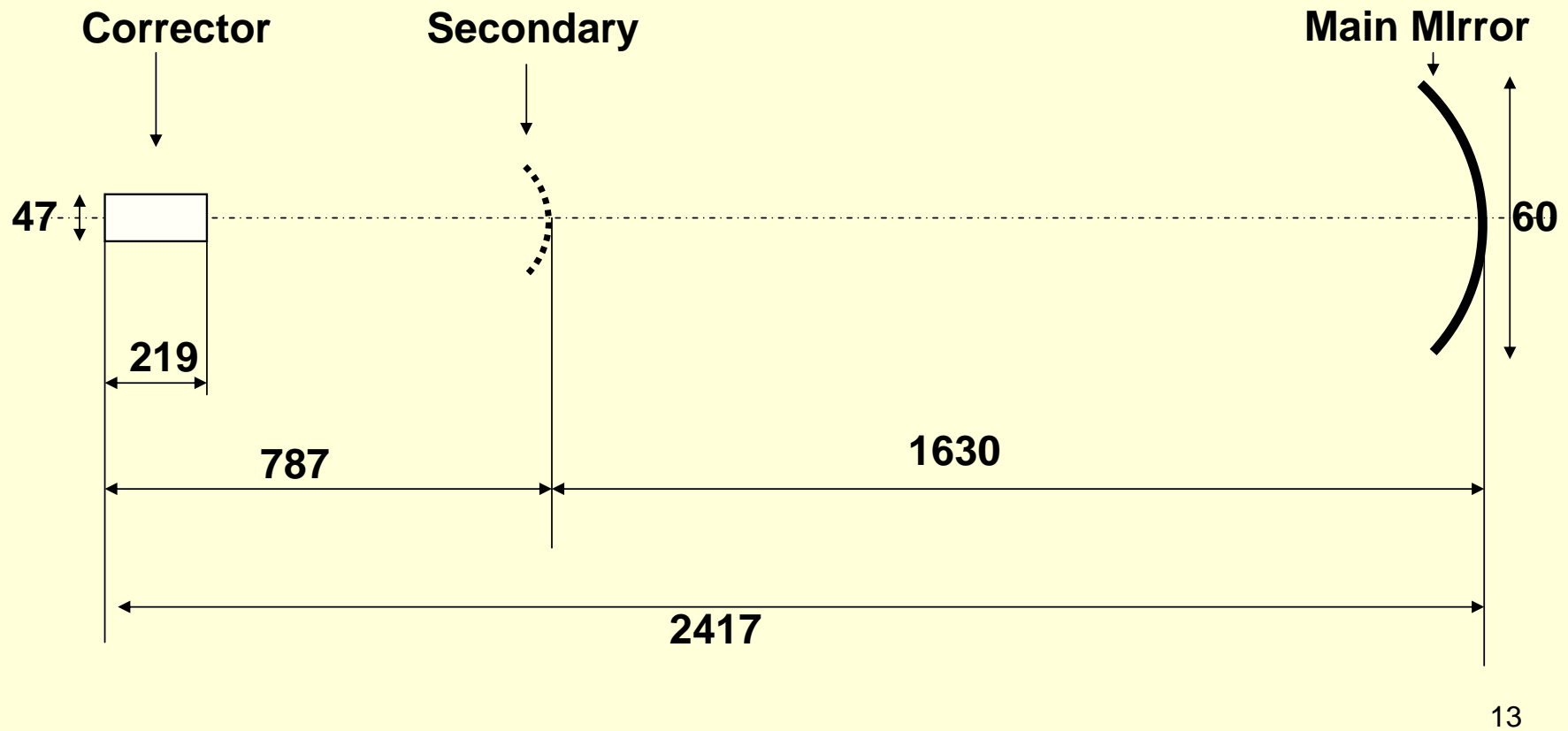
FoV = 52' sq <~ required

seeing(0.69")=8.3 μ m ~ pixel

(Photometric accuracy may be degraded)

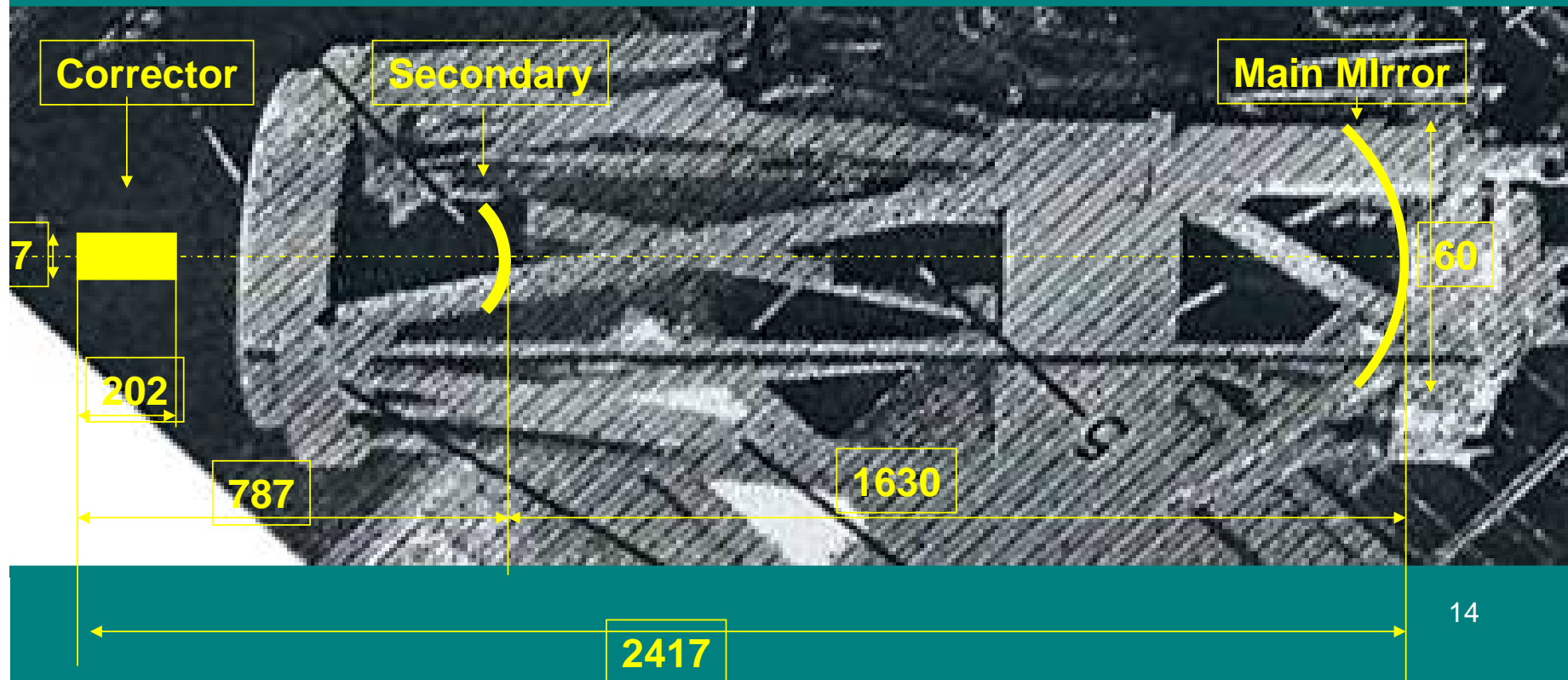
Layout of whole system

(Scale in mm)



Mechanical Feasibility

Overlay of the optics layout on a photo of the telescope tube



Cost estimate

Corrector	¥3M (\$30T)
CCD	¥2M (\$20T)
Mechanics	?
Total	¥5M(\$50T)+?

Conclusion

- **We examined a possible method of a wide field survey with a 60cm telescope.**
- **Use of the primary mirror is proposed.**
- **A concept design of a corrector has been made.**
- **The cost was roughly estimated.**