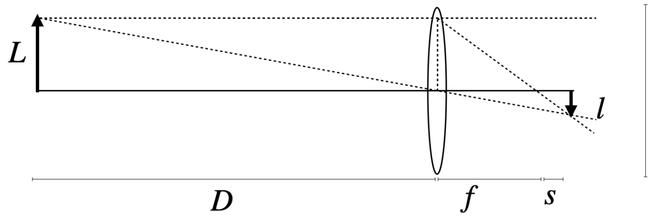
NEWS

CYGNO MEETING - 17/02/22

Solid angle

With Giorgio and Rafael we cross-checked the formula



L = side of area to acquire
l = side of sensor
d = lens effective diametre
D = lens-object distance
f = lens focal length
$\frac{f}{d}$ = # = lens aperture
$\frac{l}{L}$ = de-magnification

$$\frac{L}{f} = \frac{l}{s} \Rightarrow s = \frac{l}{L} f$$

$$\frac{L}{D} = \frac{l}{(f+s)} = \frac{l}{(f+\frac{l}{L}f)} \Rightarrow$$

the distance needed to acquire an area with a side L is $D = (\frac{L}{l} + 1)\, f$

The fraction of photons that is collected is:

$$\epsilon = \frac{\pi(d/2)^2}{4\pi D^2} = \frac{d^2}{[4f((L/l)+1)]^2} = \frac{1}{[4\#((L/l)+1)]^2}$$

https://github.com/CYGNUS-RD/WIKI-documentation/blob/main/omega.pdf

Solid Angle

According to a physics optic book on photography, the calculation of the flux of photons reaching the sensor and emitted from a dA on the optical axis is

$$\Phi = \pi L \cdot dA \cdot u^2$$

- L photons emitted by the source per second and unit of area
- u angular component, actually equal to $\frac{(\frac{d}{2})}{s}$

So the solid angle can be evaluated by integrating on a sphere as

$$\Omega = \frac{\Phi}{L \cdot dA} = \pi \frac{(\frac{d}{2})^2}{s^2}$$

Now, this is the solid angle that can be covered by the lens and has to be divided by the solid angle of emission that in theory could be calculated as before. However, in our case the source is emitting isotropically in 4π, thus one can obtain

$$\Omega_f = \frac{\pi \cdot (\frac{d}{2})^2}{4\pi \cdot s^2}$$

where s is the distance of the object to the lens and d is the diametre of the lens aperture. Then, from optics, the magnification I is

$$I = \frac{y'}{y} = \frac{s'}{s}$$

with y' the dimension of the image (aka the sensor dimension), y the field of view size (aka the dimension of the object seen by the camera) and s' is the distance between the lens and the image. Also from

$$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f}$$

f focal length, and

$$N = \frac{d}{f}$$

where N is the f-number one can merge the equations and obtain:

$$s' = I \cdot s$$
$$\frac{1}{s} + \frac{1}{I \cdot s} = \frac{1}{f}$$
$$\frac{1}{s}\left(1 + \frac{1}{I}\right) = \frac{1}{f}$$
$$\frac{1}{s} = \frac{1}{f \cdot (1 + \frac{1}{I})}$$
$$\Omega_f = \frac{1}{(4(\frac{1}{I}+1) \cdot N)^2}$$

Sensor side length:

1.3312 cm FLASH

1.4976 cm FUSION

Fraction of photons	
0,000177	FLASH on LEMON
0,000124	FUSION on LIME
0,000853	FUSION on MANGO

Working Distance:

623 mm for the FUSION from LIME

230 mm for the FUSION from MANGO

525 mm for the FLASH from LEMON

Low radioactivity - lens

LOBRE srl

Report Studio Fattibilità

Progetto S21-003 – Ottica Low Rad

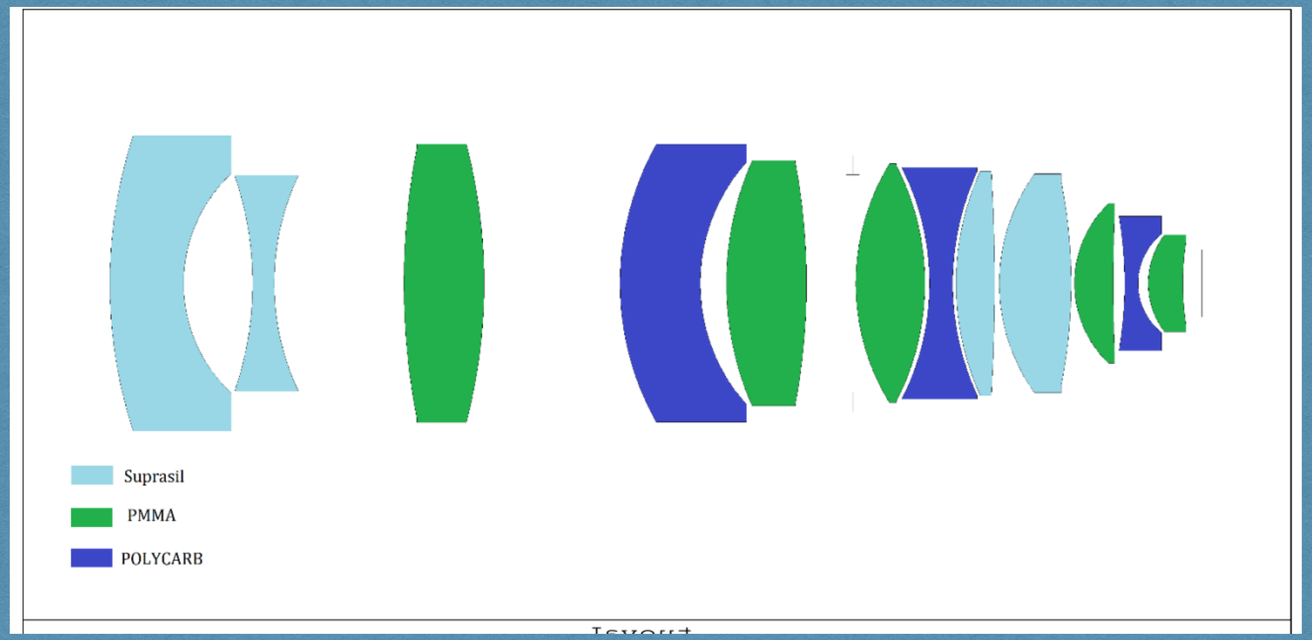


Tabella riassuntiva

	Requisito	Prestazione teorica
WD	600 mm	600 mm
Apertura	0.95	0.947
Materiali	Suprasil, PMMA, Policarb.	Suprasil, PMMA, Policarb.
EFL	25 mm	24.93 mm
Risoluzione	Non specificato	~50 lp/mm adeguato a sensore

Requisito rispettato	Requisito modificato	Requisito non rispettato

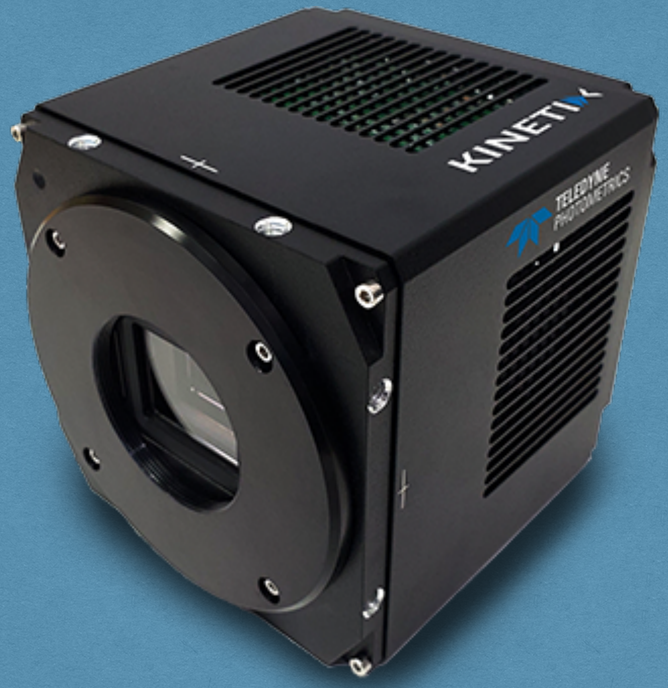
Lobre provided us a report on a possible solution for a lens based on low radioactiive materials.

It seems theoretically promising.

Next step:

Quantify the costs and produce a first prototype to test (probably on bench).

Low radioactivity - sensor



- 498 Frames per Second
- 29.4 mm Diagonal Field of View
- 0.7 e- Read Noise
- 95% Quantum Efficiency
- 6.5 µm x 6.5 µm Pixel Area

Teledyne (not - hamamatsu) “sensor must have been contamination as the sensor manufacturer has assured us there is nothing included in the manufacturing process that would lead to the reading you got.”

On this basis they sent us a 2nd sensor to test;

It should arrive in a few days.

CYGNO at next LNGS

We've been invited to present a report to Gran Sasso SC

Elisabetta is going to report about the current commissioning activities for LIME and the plans for CYGNO_04:

- availability of Hall-F
- solution to fit there
- costs and sustainability of the project

Agenda LVII meeting of the Gran Sasso Scientific Committee

Fermi and Majorana halls

April 11 - 12, 2022

11:20 - 19:00	**CLOSED SESSION – MAJORANA HALL**
11:20 – 12:00	Committee discussion (40')
12:00 - 12:30	CYGNO (15' + 15')