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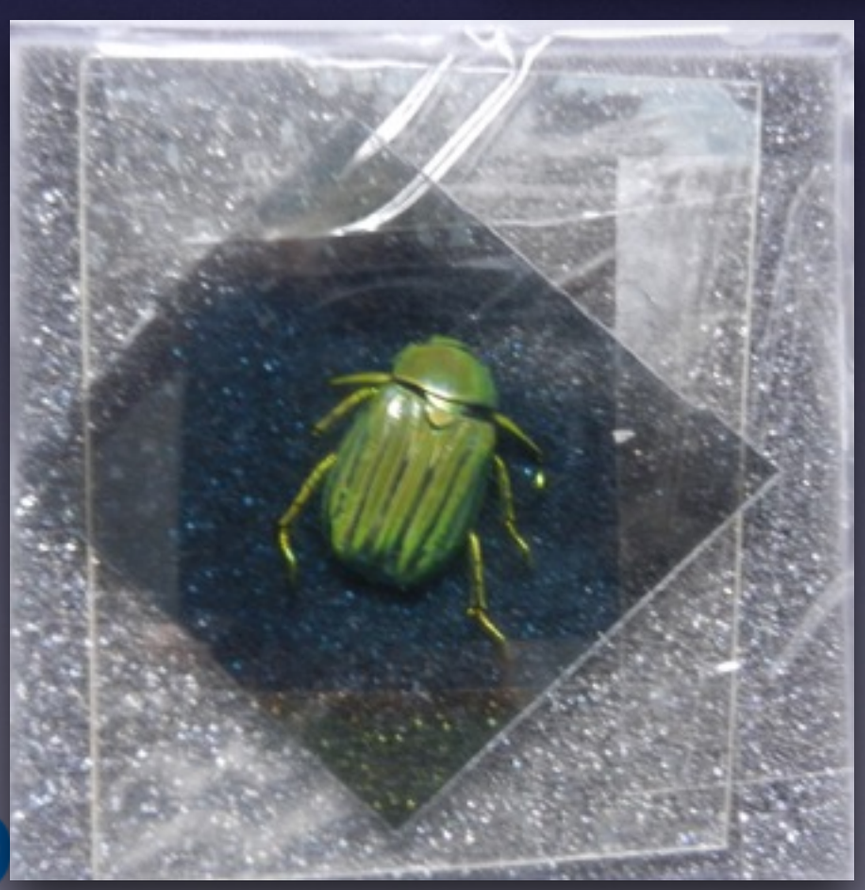

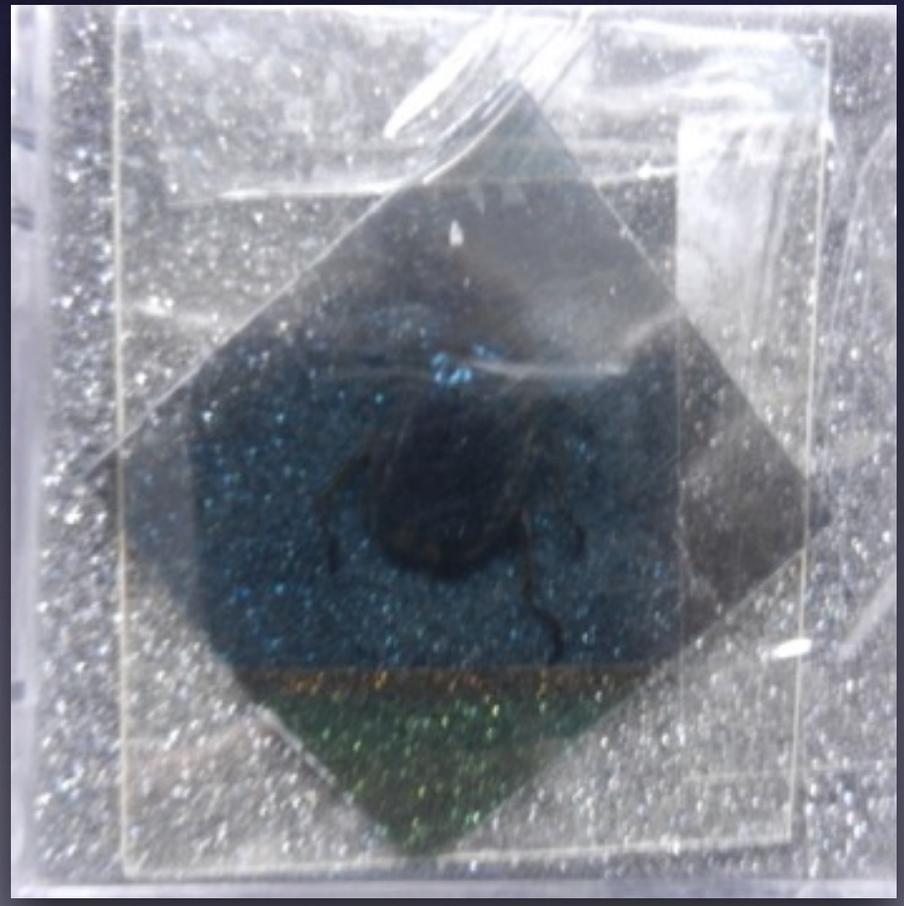

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Principe de mesure

L’état de polarisation de la lumière est décrit par le vecteur de Stokes

$$\vec{I} = \begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix}$$

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Principe de mesure

Pour mesurer, nous allons transformer ce vecteur de Stokes. Par exemple:

$$\mathbf{M}\begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix} = \frac{1}{2}\begin{pmatrix} I+Q \\ I+Q \\ 0 \\ 0 \end{pmatrix}$$

La matrice qui transforme les vecteurs de Stokes entre eux est appelée matrice de Mueller

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Principe de mesure

Pour mesurer, nous allons transformer ce vecteur de Stokes. Par exemple:

$$\mathbf{M}\begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix} = \frac{1}{2}\begin{pmatrix} I+Q \\ I+Q \\ 0 \\ 0 \end{pmatrix}$$

Le nouveau vecteur de Stokes à droite, a comme intensité (I+Q)

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Principe de mesure

Alors on peut imaginer deux transformations

$$\mathbf{M_1}\begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix} = \frac{1}{2}\begin{pmatrix} I+Q \\ I+Q \\ 0 \\ 0 \end{pmatrix} \qquad \mathbf{M_2}\begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix} = \frac{1}{2}\begin{pmatrix} I-Q \\ I-Q \\ 0 \\ 0 \end{pmatrix}$$

Si on soustrait les intensités on a la mesure de 1 des paramètres de Stokes

$$\frac{1}{2}(I+Q) - \frac{1}{2}(I-Q) = Q$$

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Axiome de la polarimétrie de Semel

$$\mathbf{M_1}\begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix} = \frac{1}{2}\begin{pmatrix} I+Q \\ I+Q \\ 0 \\ 0 \end{pmatrix} \qquad \mathbf{M_2}\begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix} = \frac{1}{2}\begin{pmatrix} I-Q \\ I-Q \\ 0 \\ 0 \end{pmatrix}$$

$$\frac{1}{2}(I+Q) - \frac{1}{2}(I-Q) = Q$$

Les deux mesures, doivent être identiques sauf dans le signe

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Deux composantes: l'analyseur et le modulateur

$$\mathbf{M_1} \begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix} = \frac{1}{2} \begin{pmatrix} I+Q \\ I+Q \\ 0 \\ 0 \end{pmatrix}$$

Toute composante dont l'effet est de modifier l'intensité par la polarisation est appelé analyseur. Les polariseurs (partiels ou totaux) sont des analyseurs potentiels.

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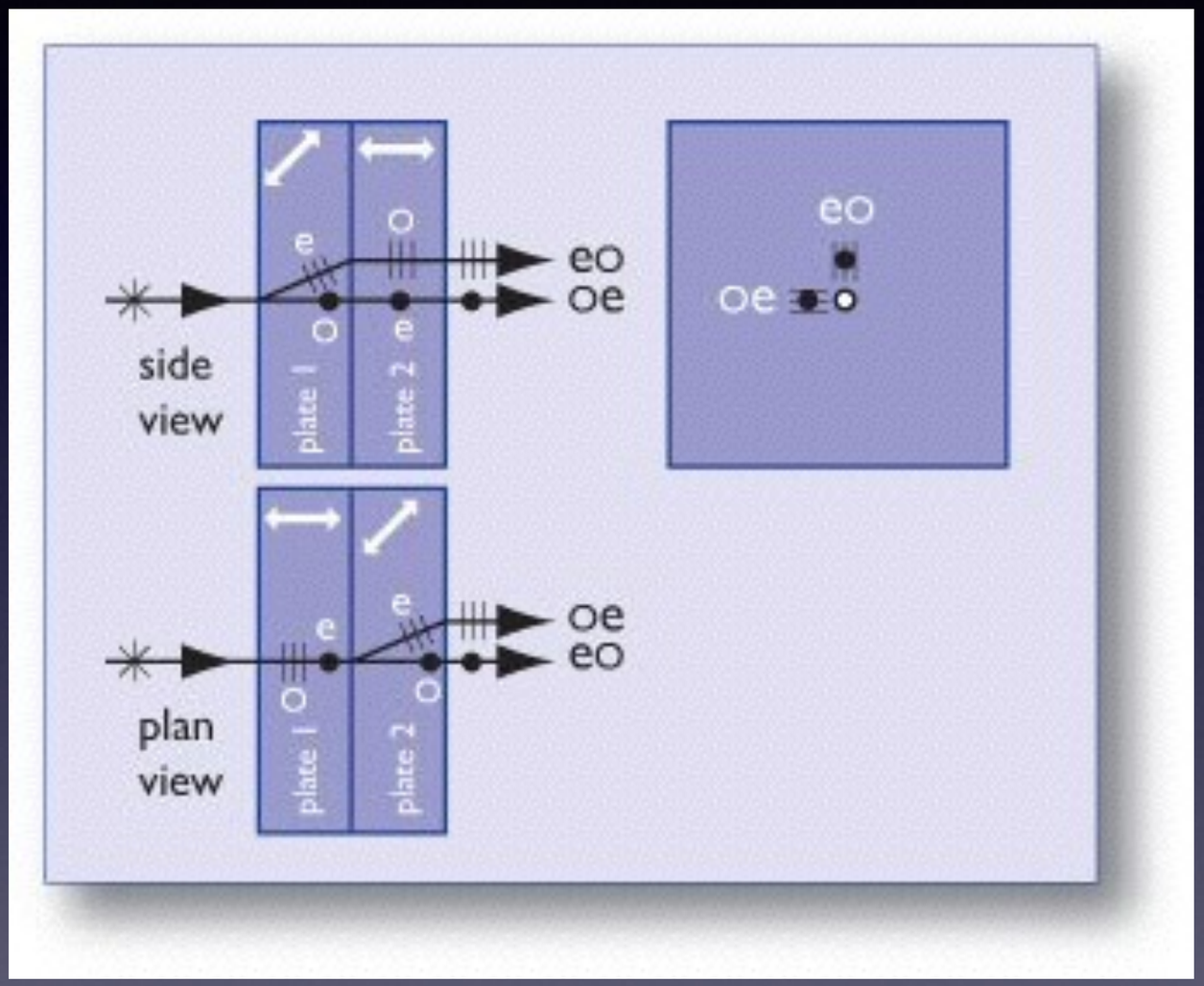
Polarimetry

A. López Ariste



$$\mathbf{M_1} \begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix} = \frac{1}{2} \begin{pmatrix} I+Q \\ I+Q \\ 0 \\ 0 \end{pmatrix}$$

$$M = \begin{pmatrix} 0.5 & 0.5 & 0 & 0 \\ 0.5 & 0.5 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

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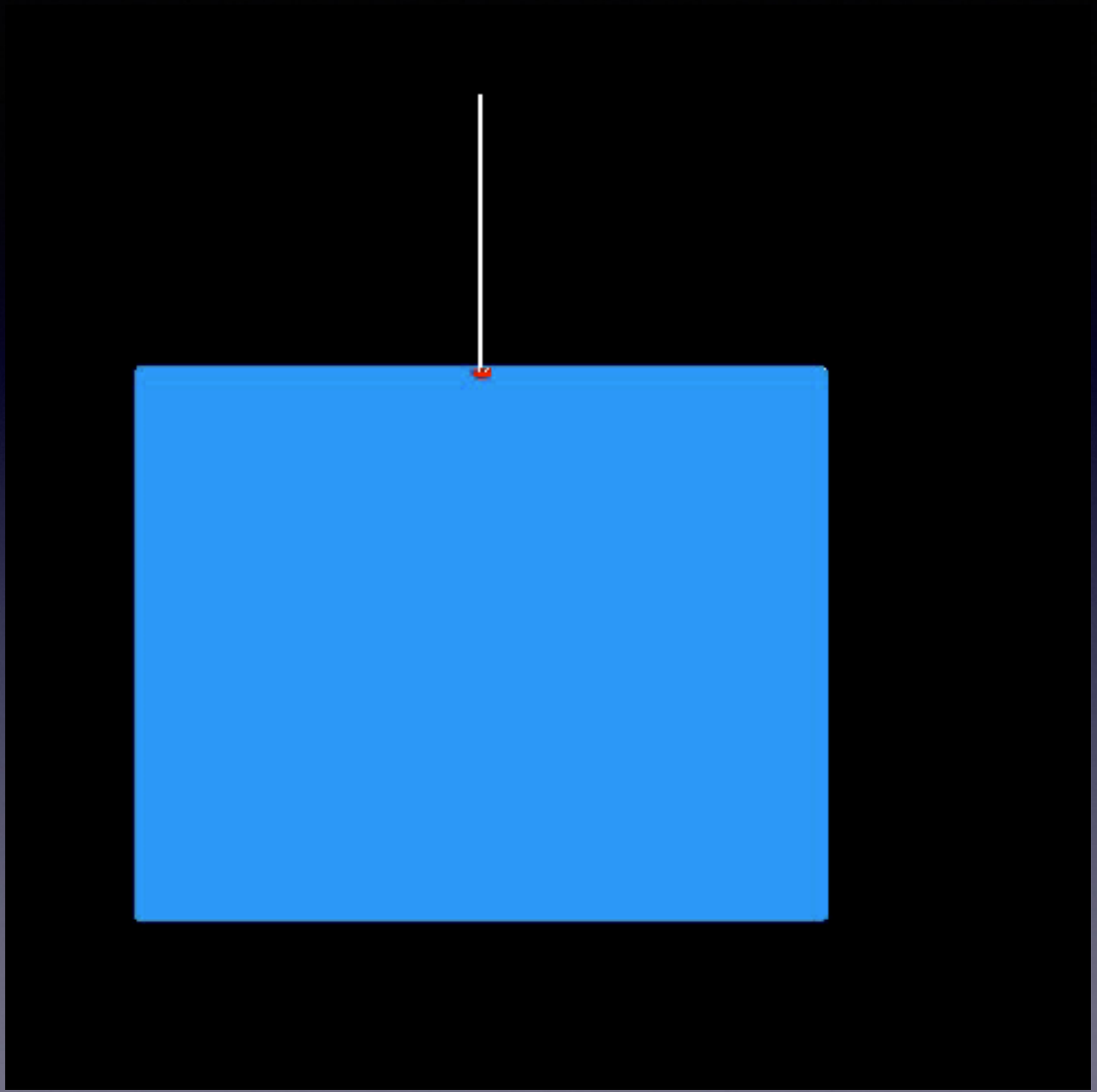

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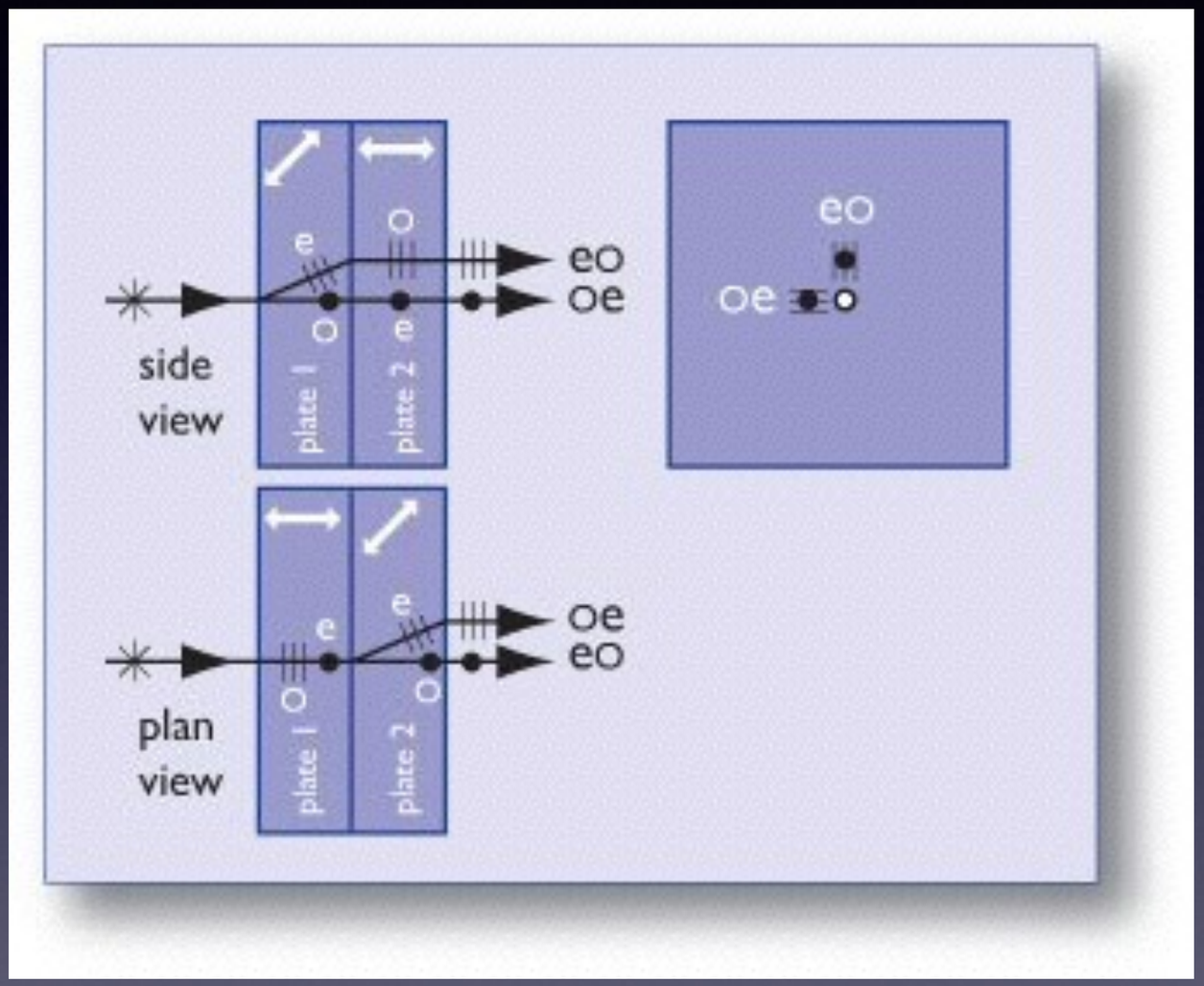

$$\mathbf{M_1} \begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix} = \frac{1}{2} \begin{pmatrix} I+Q \\ I+Q \\ 0 \\ 0 \end{pmatrix}$$

$$M = \begin{pmatrix} 0.5 & 0.5 & 0 & 0 \\ 0.5 & 0.5 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

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Deux composantes: l'analyseur et le modulateur

$$\mathbf{M} \begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix} = \begin{pmatrix} I \\ V \\ Q \\ U \end{pmatrix}$$

Toute composante dont l'effet est de tourner les polarisations entre elles est appelé modulateur.
Les lames de retard sont des modulateurs

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$$M = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & \cos\delta & \sin\delta \\ 0 & 0 & -\sin\delta & \cos\delta \end{pmatrix}$$

$$\mathbf{M} \begin{pmatrix} I \\ Q \\ U \\ V \end{pmatrix} = \begin{pmatrix} I \\ V \\ Q \\ U \end{pmatrix}$$

$$M = R(\theta) \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & \cos\delta & \sin\delta \\ 0 & 0 & -\sin\delta & \cos\delta \end{pmatrix} R^{-1}(\theta) = ?$$

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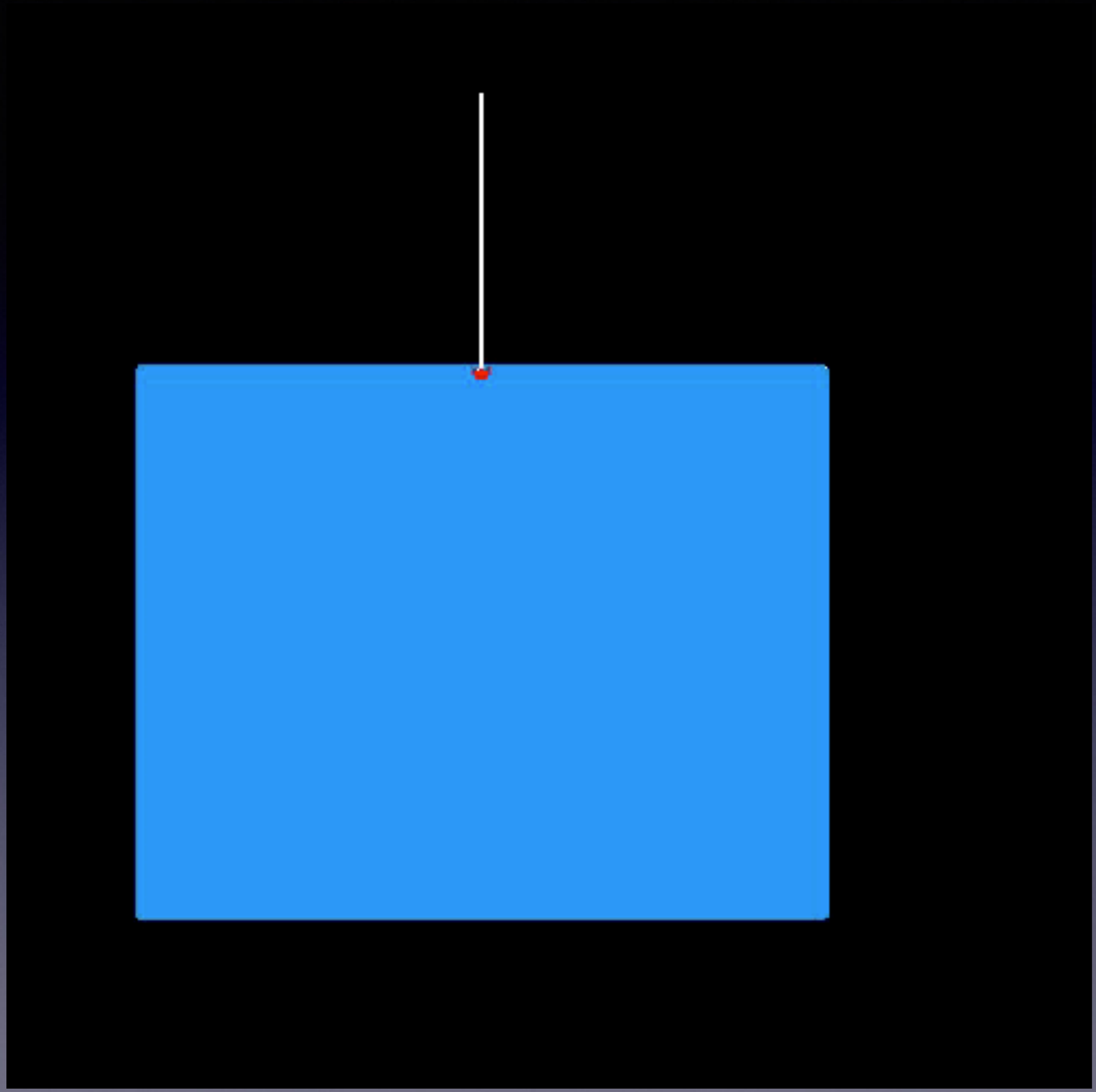

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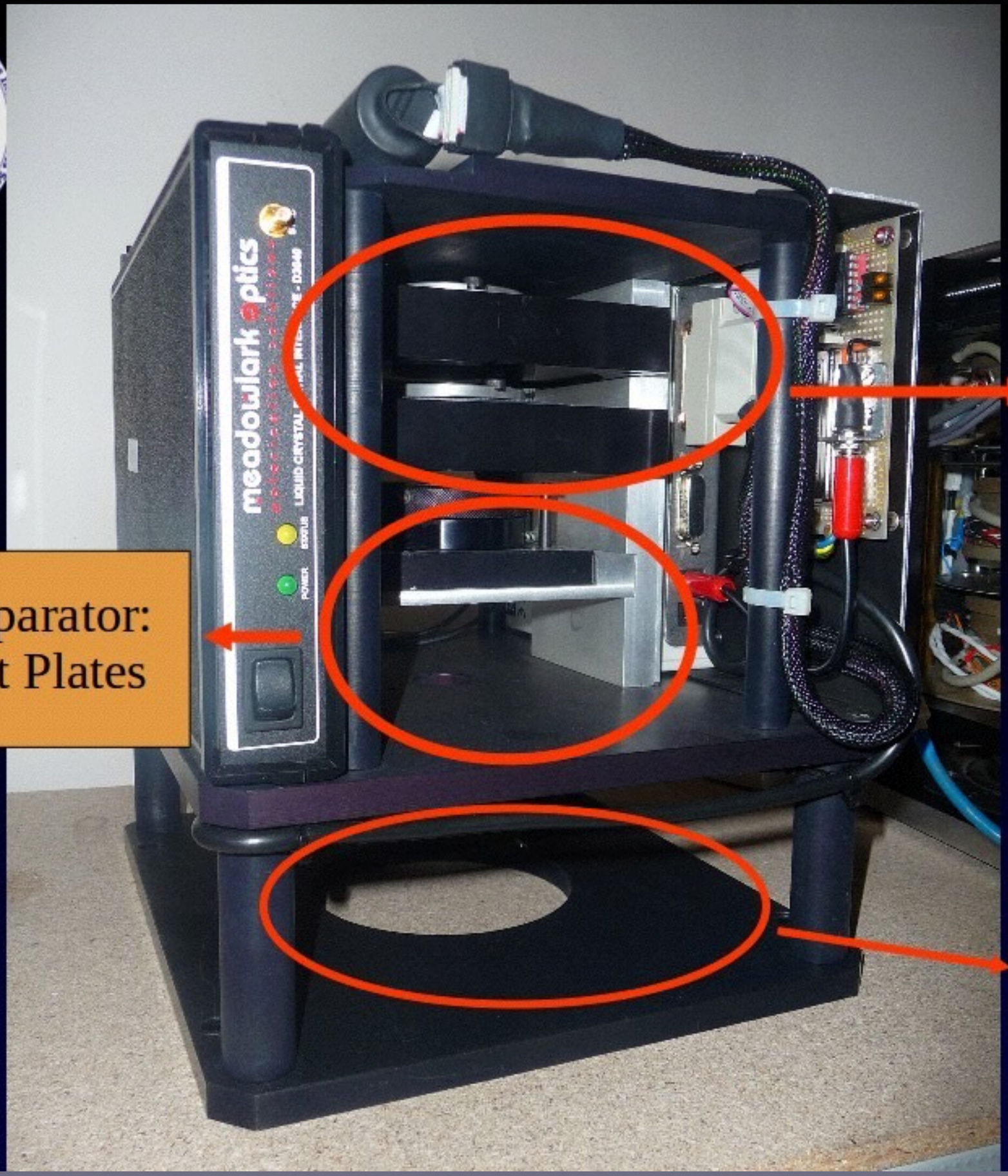
POL3

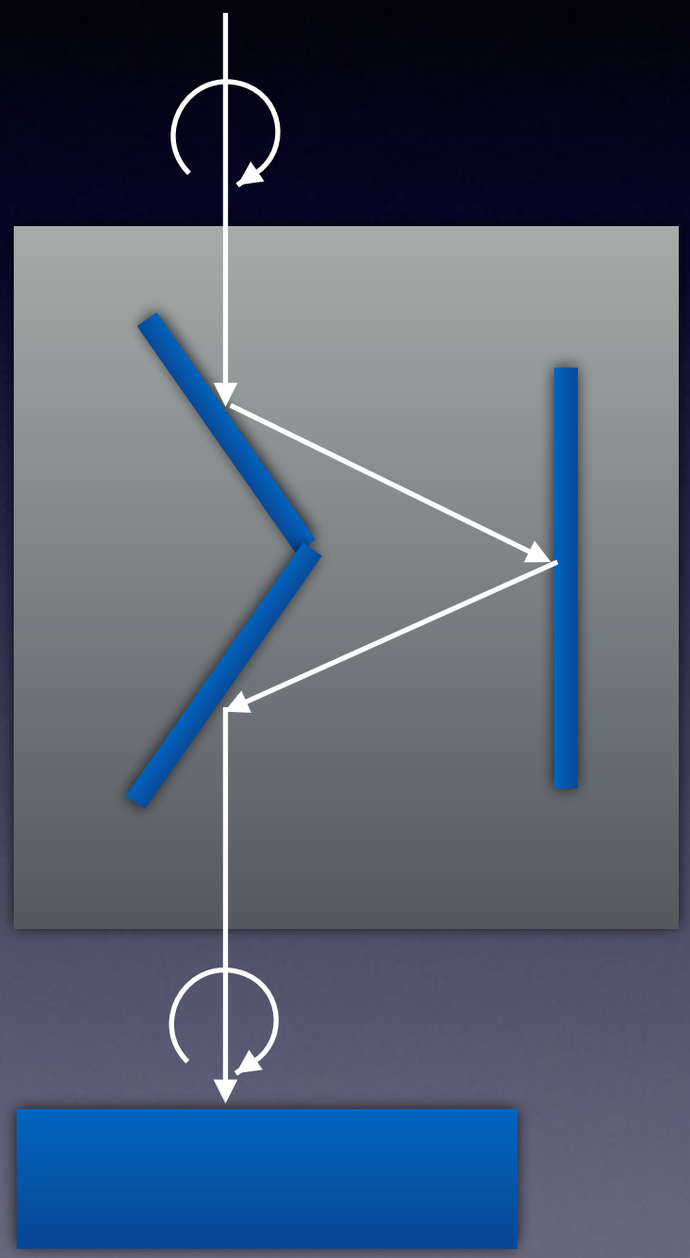


Anti-separator:
4 Savart Plates

Functionally achromatic fast modulator

Tackler
2 crystalline
λ/4

Un modulateur à miroirs pour LUVOIR



Modulator

Analyser

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Axiome de la polarimétrie de Semel

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$$\frac{1}{2}(I+Q) - \frac{1}{2}(I-Q) = Q$$

Les deux mesures, doivent être identiques sauf dans le signe

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How to combine the channels (before line addition)

Three Demodulation schemes:

- Crude difference: $V = \frac{1}{2}\left[(I+V) - (I-V)\right]$

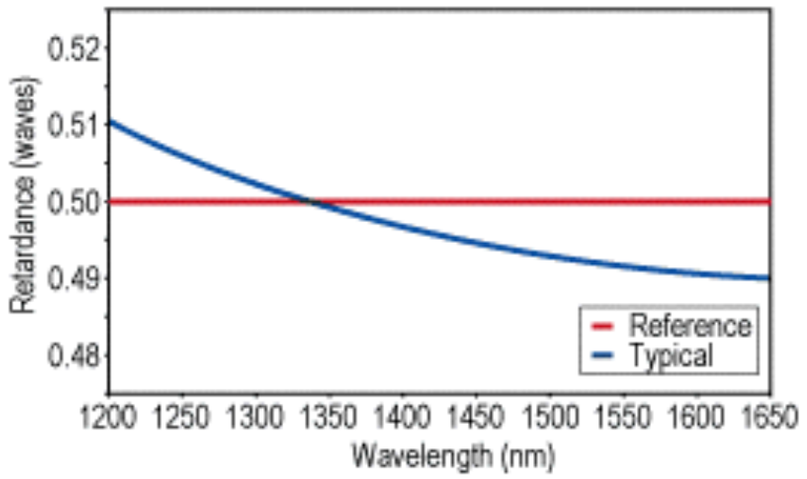
- Semel's beam exchange: $1 + 4\frac{V}{I} \approx \frac{(I+V)_1 \times (I+V)_2}{(I-V)_1 \times (I-V)_2}$

- Spatio-temporal demodulation:

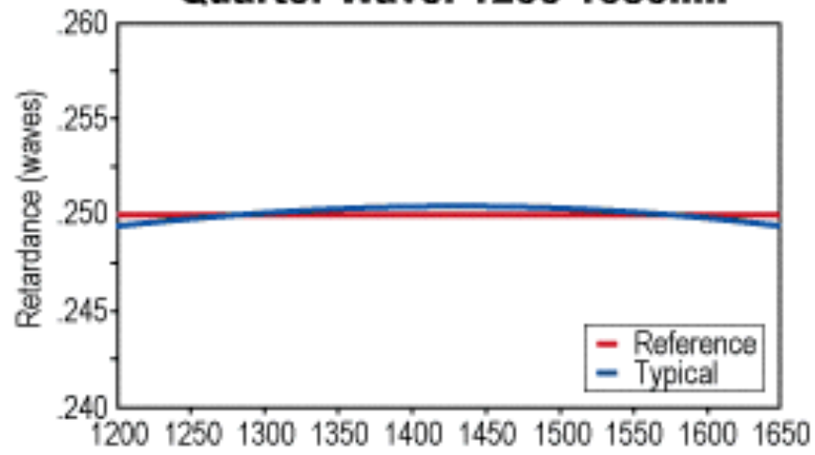
$$R^2 = \frac{(I+V)_1 (I+V)_2}{(I-V)_1 (I-V)_2} \qquad \frac{V}{I} = \frac{R-1}{R+1}$$

Achromatic Waveplates

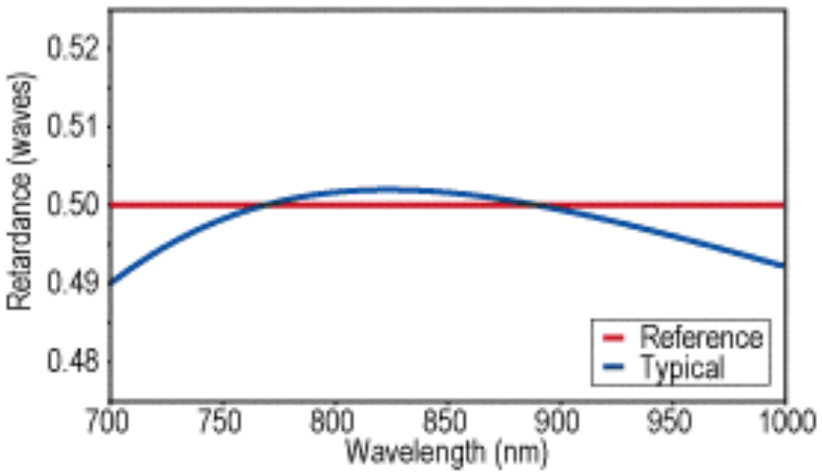
Half Wave: 1200-1650nm



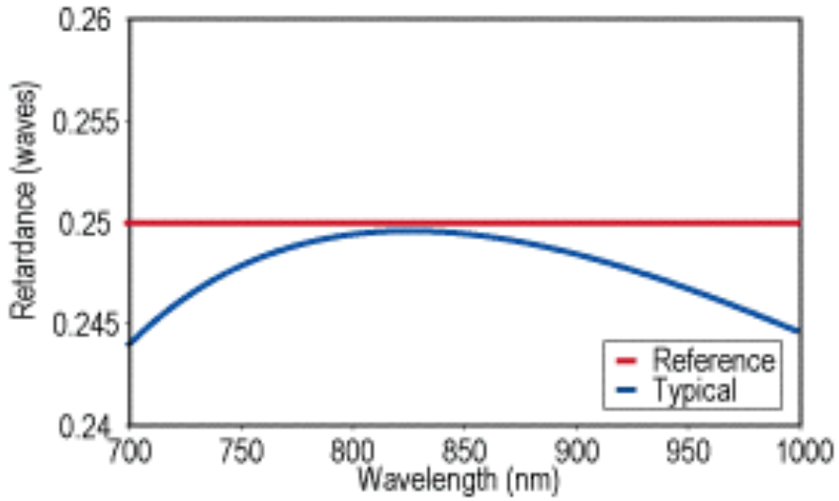
Quarter Wave: 1200-1650nm



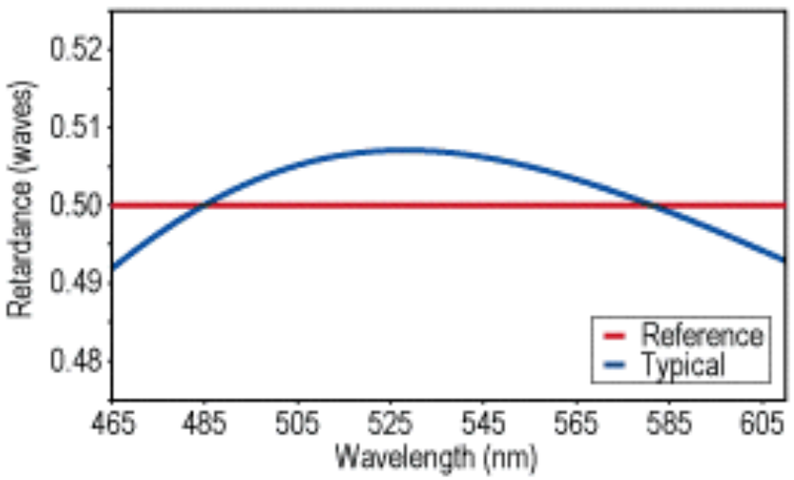
Half Wave: 700-1000nm



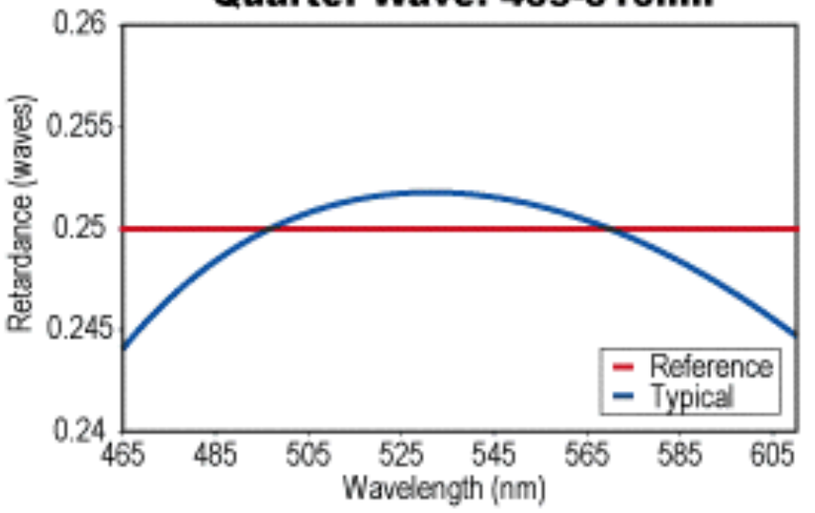
Quarter Wave: 700-1000nm



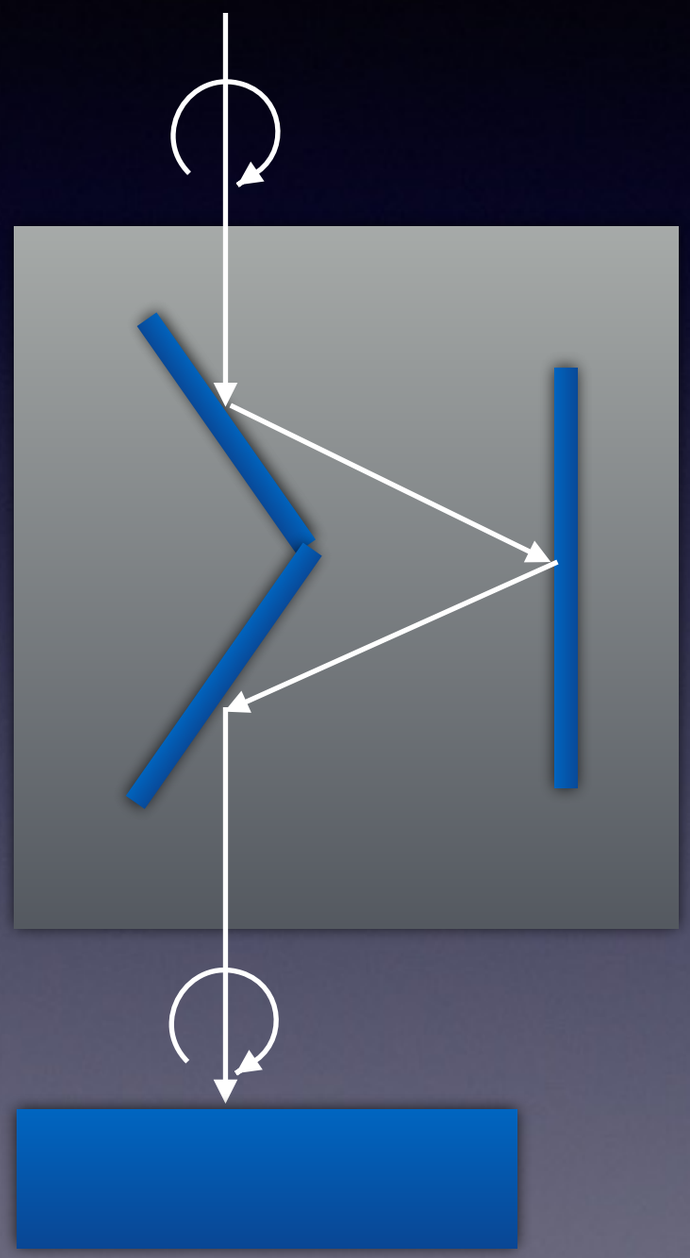
Half Wave: 465-610nm



Quarter Wave: 465-610nm



Un modulateur à miroirs pour LUVOIR



Modulator

Analyser

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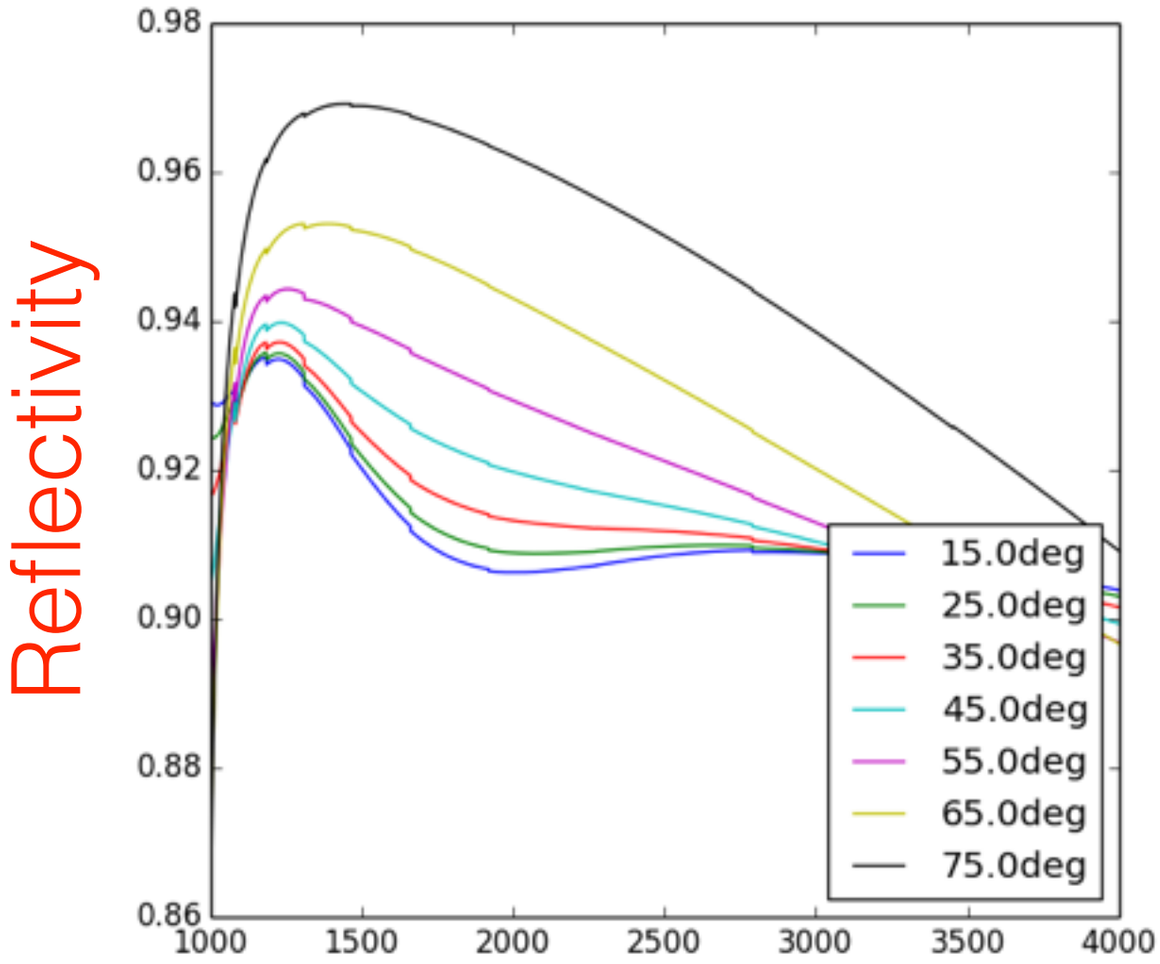
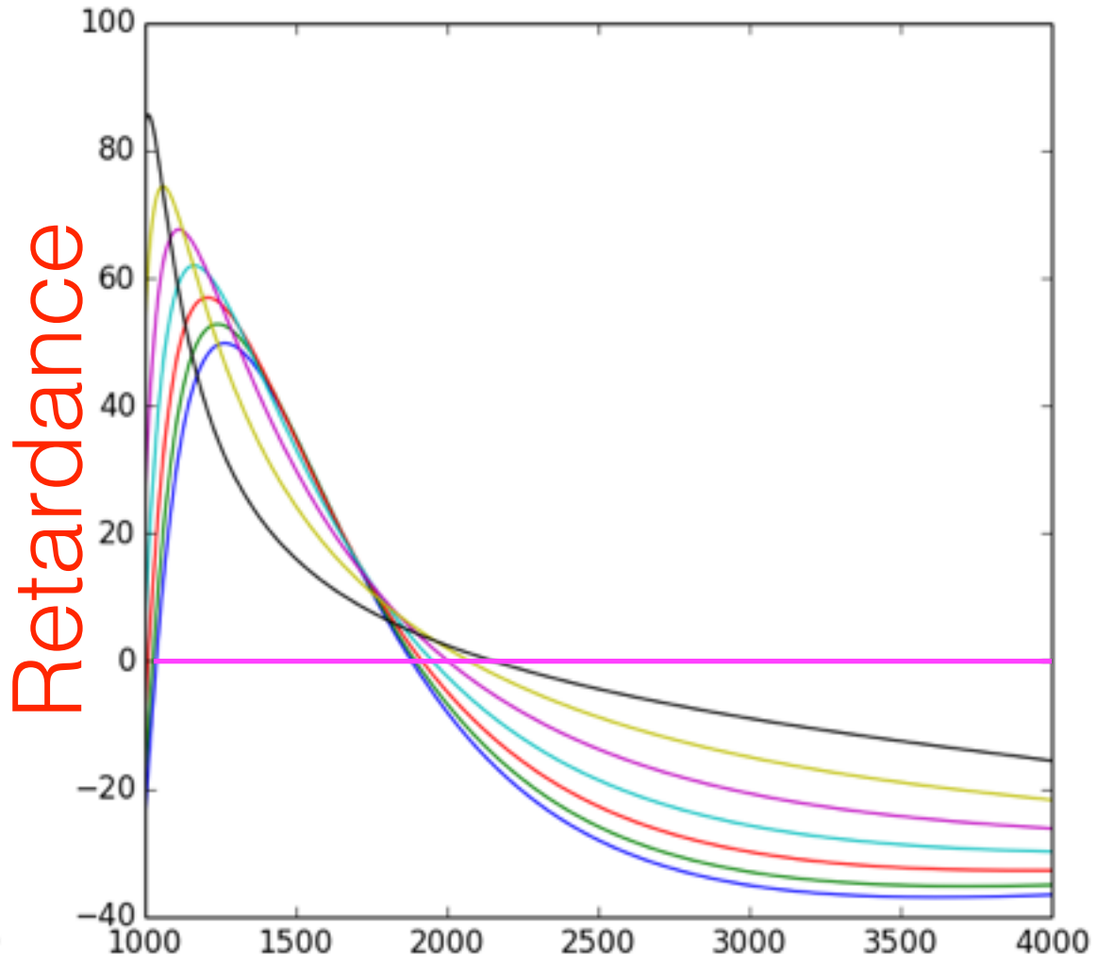
NUV 123-400





Miroirs en Al + LiF

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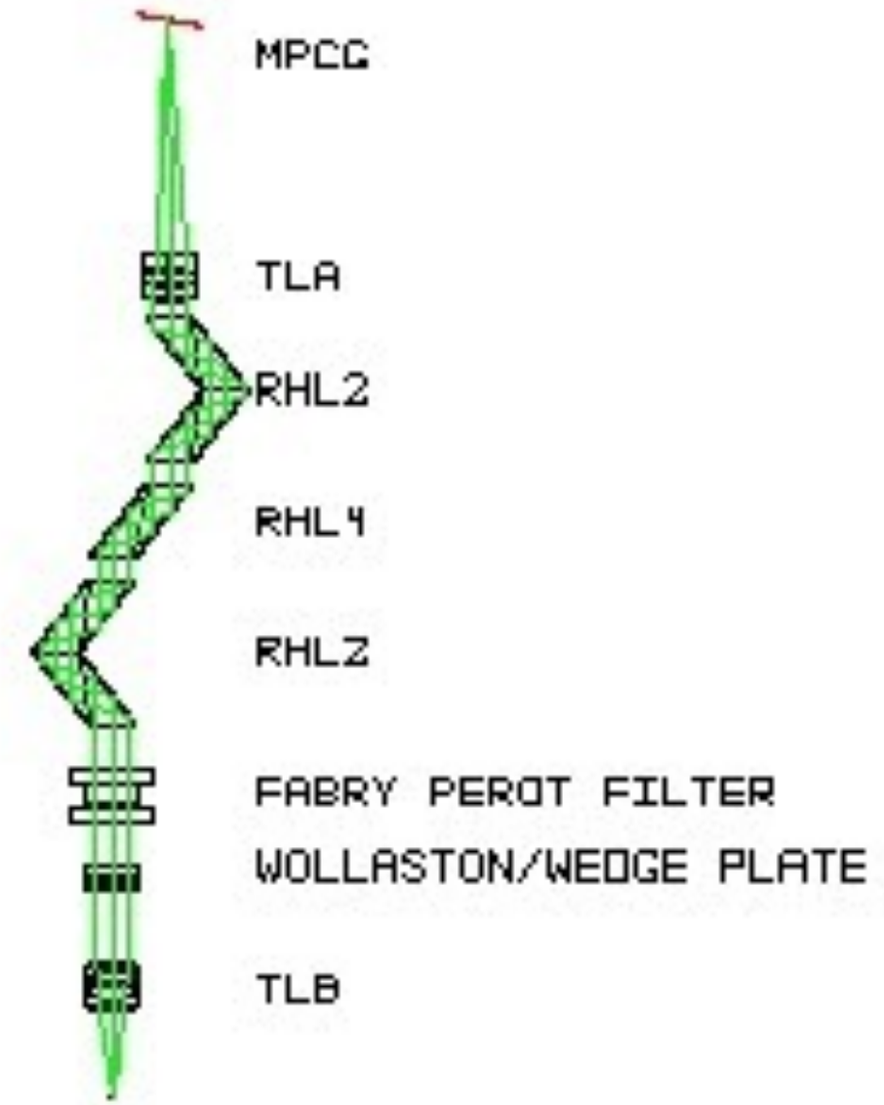


3D LAYOUT

POLARIMETER

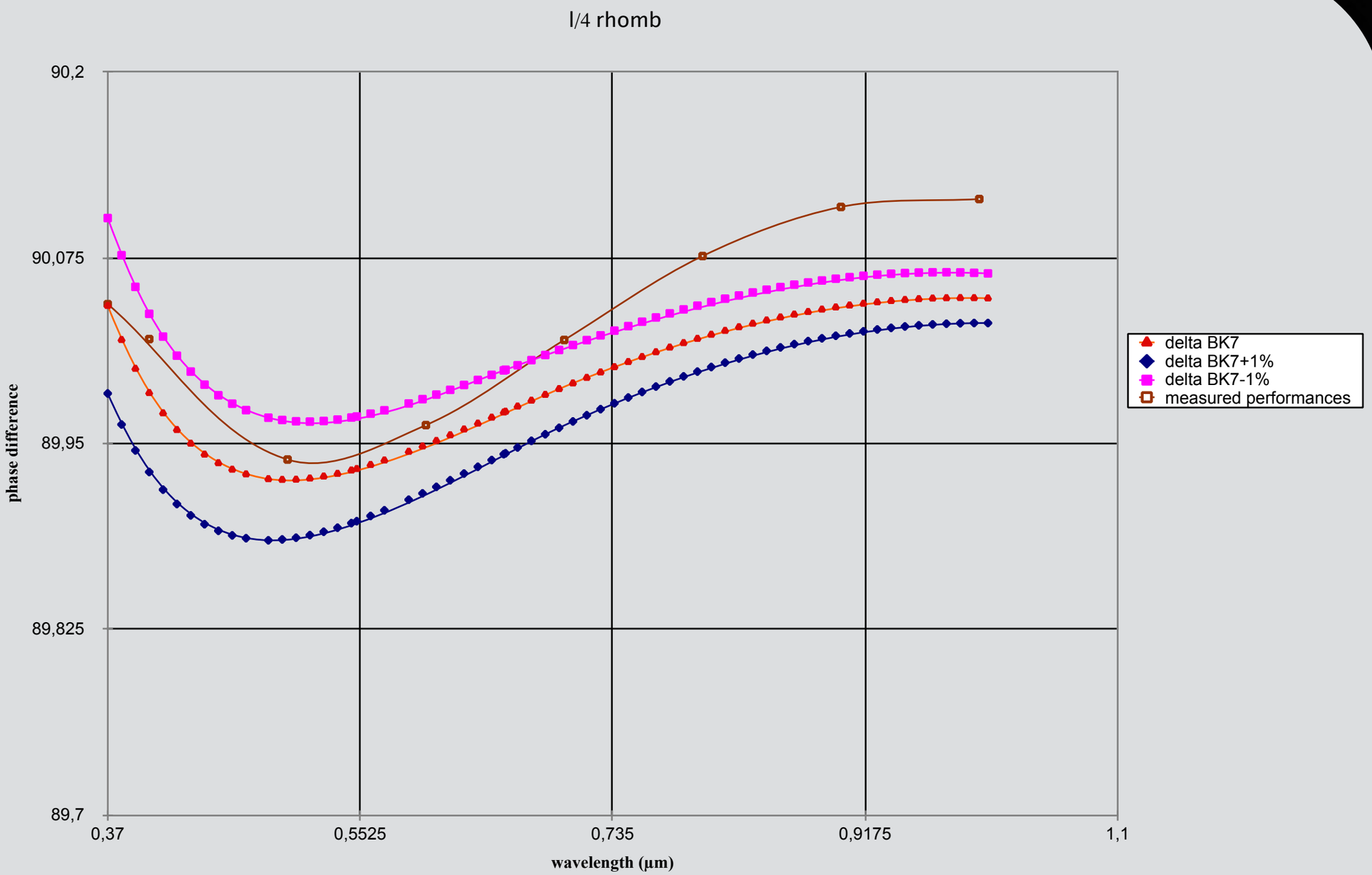
SCALE: 0.5000

40.00 MILLIMETERS

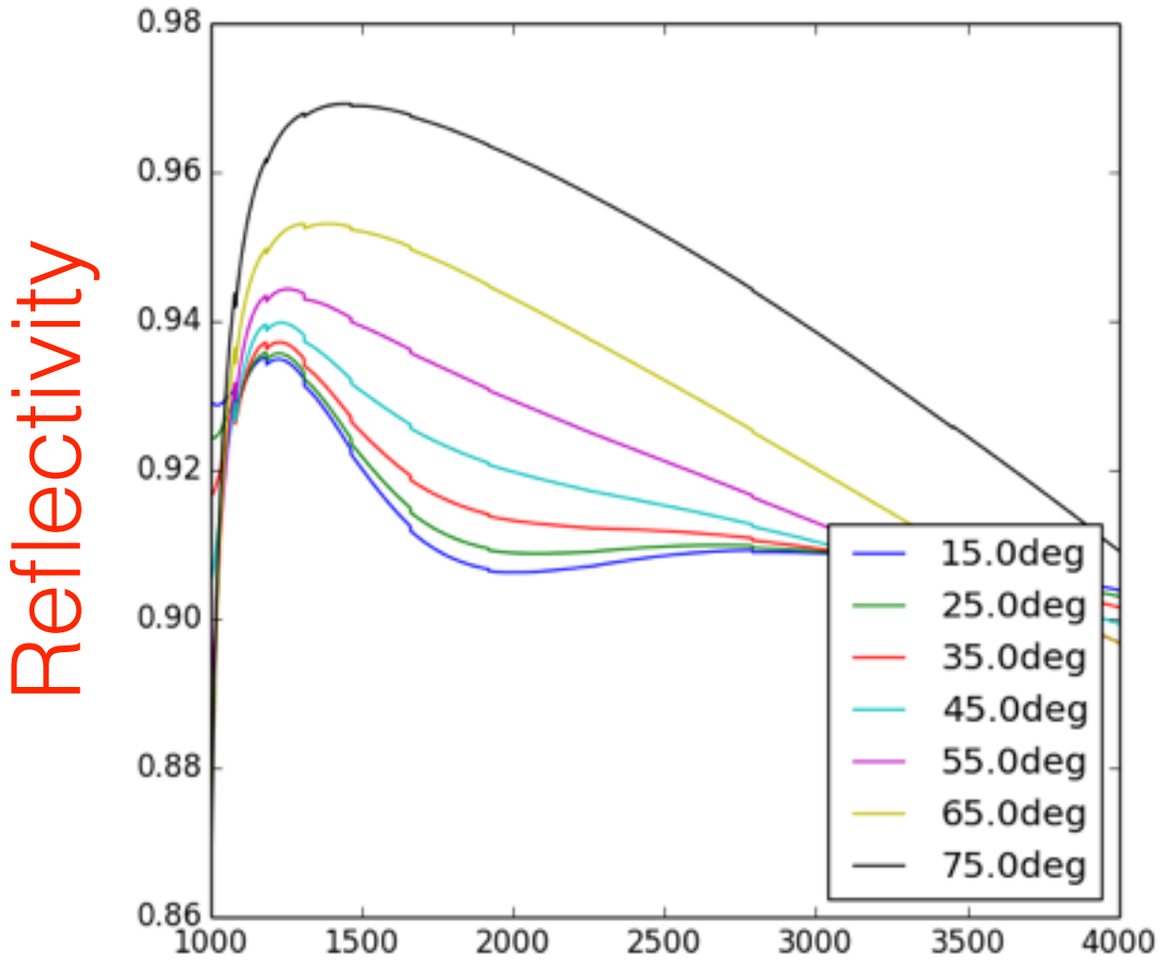
OBSERVATOIRE MIDI PYRENEES

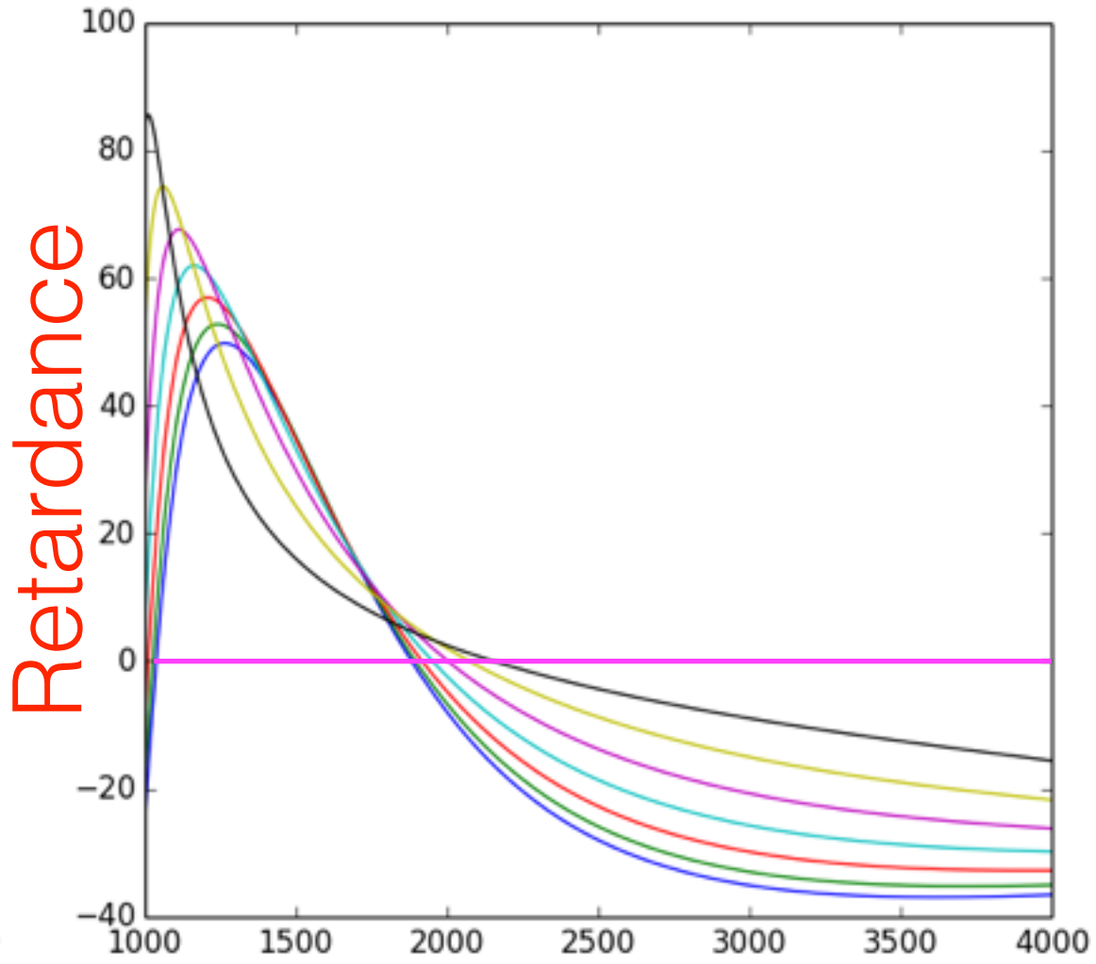
LABORATOIRE D ASTROPHYSIQUE DE TOULOUSE

LAURENT PARES CICT


l/4 rhomb
90,2
90,075
89,95
89,825
89,7
0,37
0,5525
0,735
0,9175
1,1
phase difference
wavelength (µm)
delta BK7
delta BK7+1%
delta BK7-1%
measured performances

NUV 123-400





Miroirs en Al + LiF

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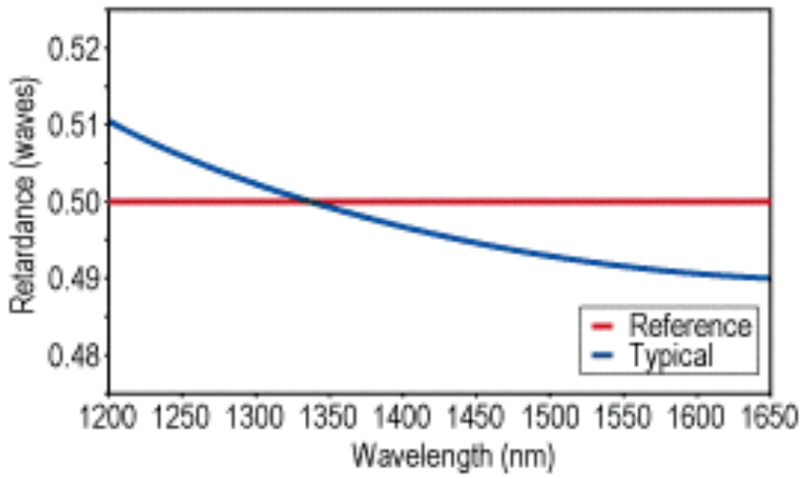
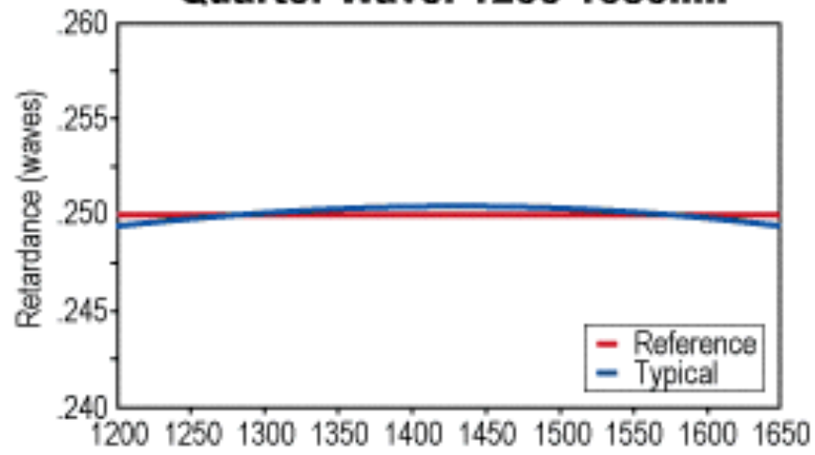
Achromatic Waveplates

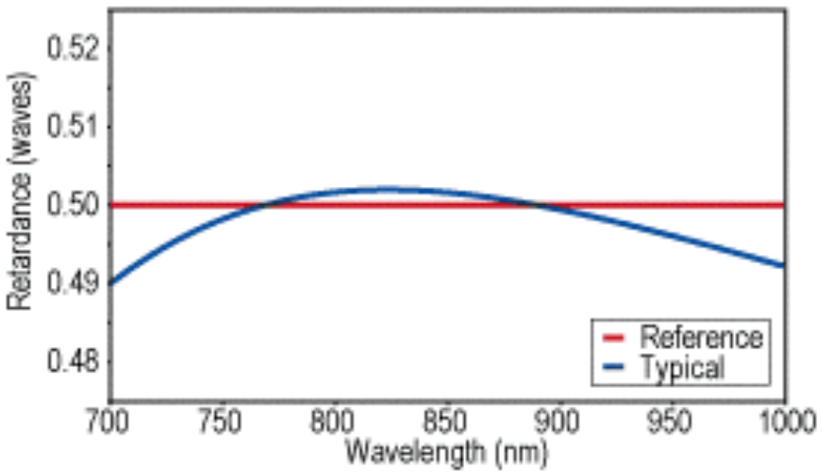
Half Wave: 1200-1650nm



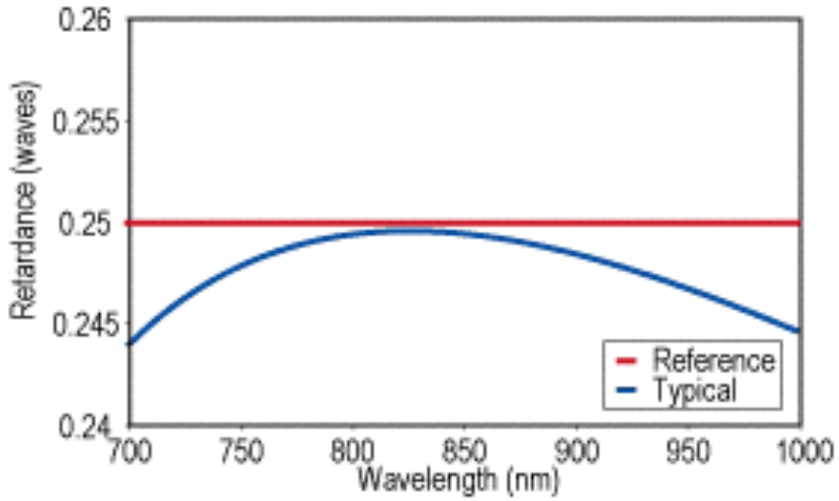
Quarter Wave: 1200-1650nm



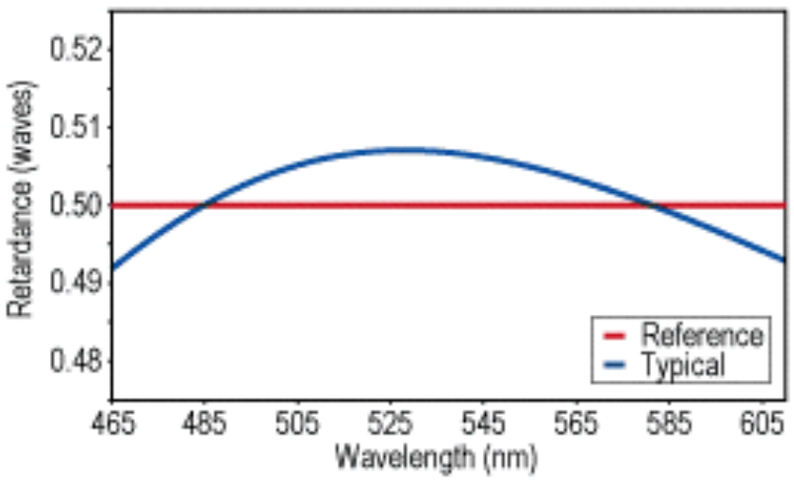
Half Wave: 700-1000nm



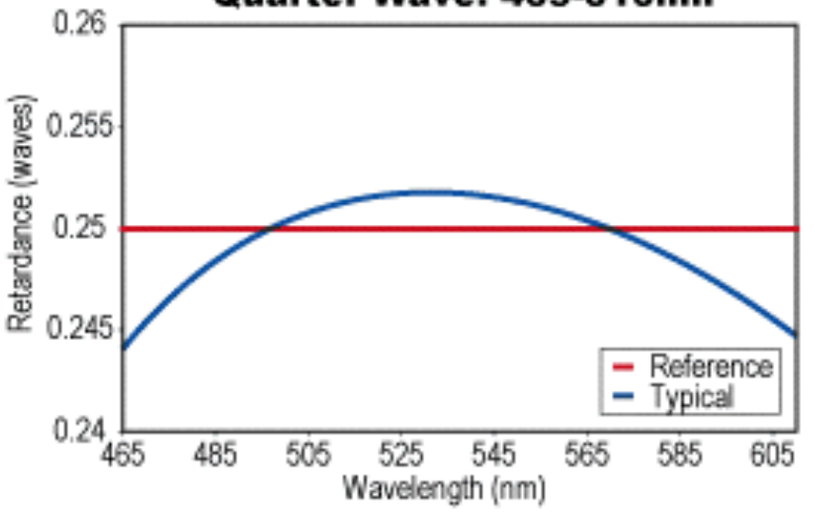
Quarter Wave: 700-1000nm

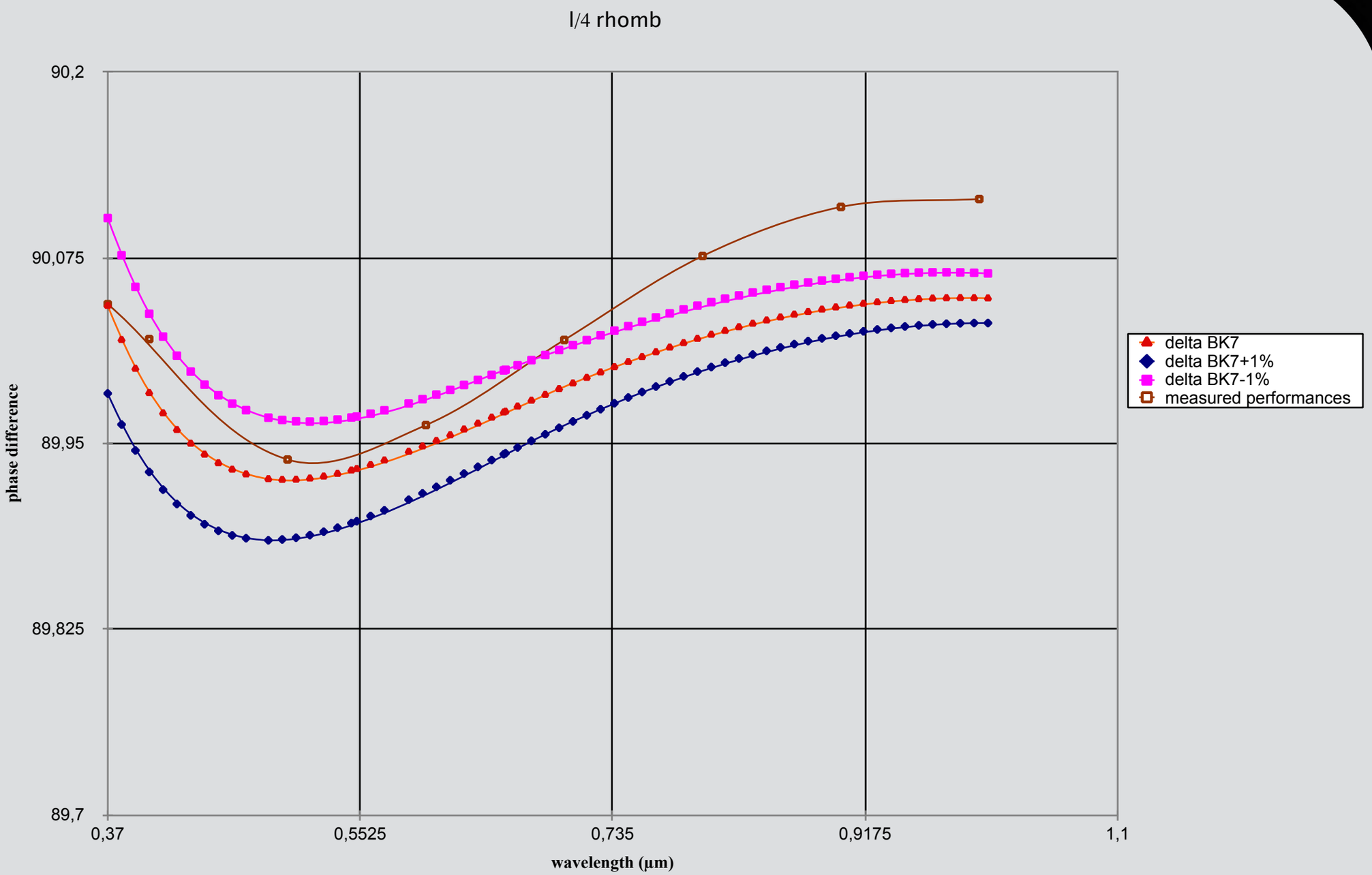


Half Wave: 465-610nm



Quarter Wave: 465-610nm




l/4 rhomb
90,2
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0,37
0,5525
0,735
0,9175
1,1
phase difference
wavelength (µm)
delta BK7
delta BK7+1%
delta BK7-1%
measured performances

Preliminaires

Three Demodulation schemes:

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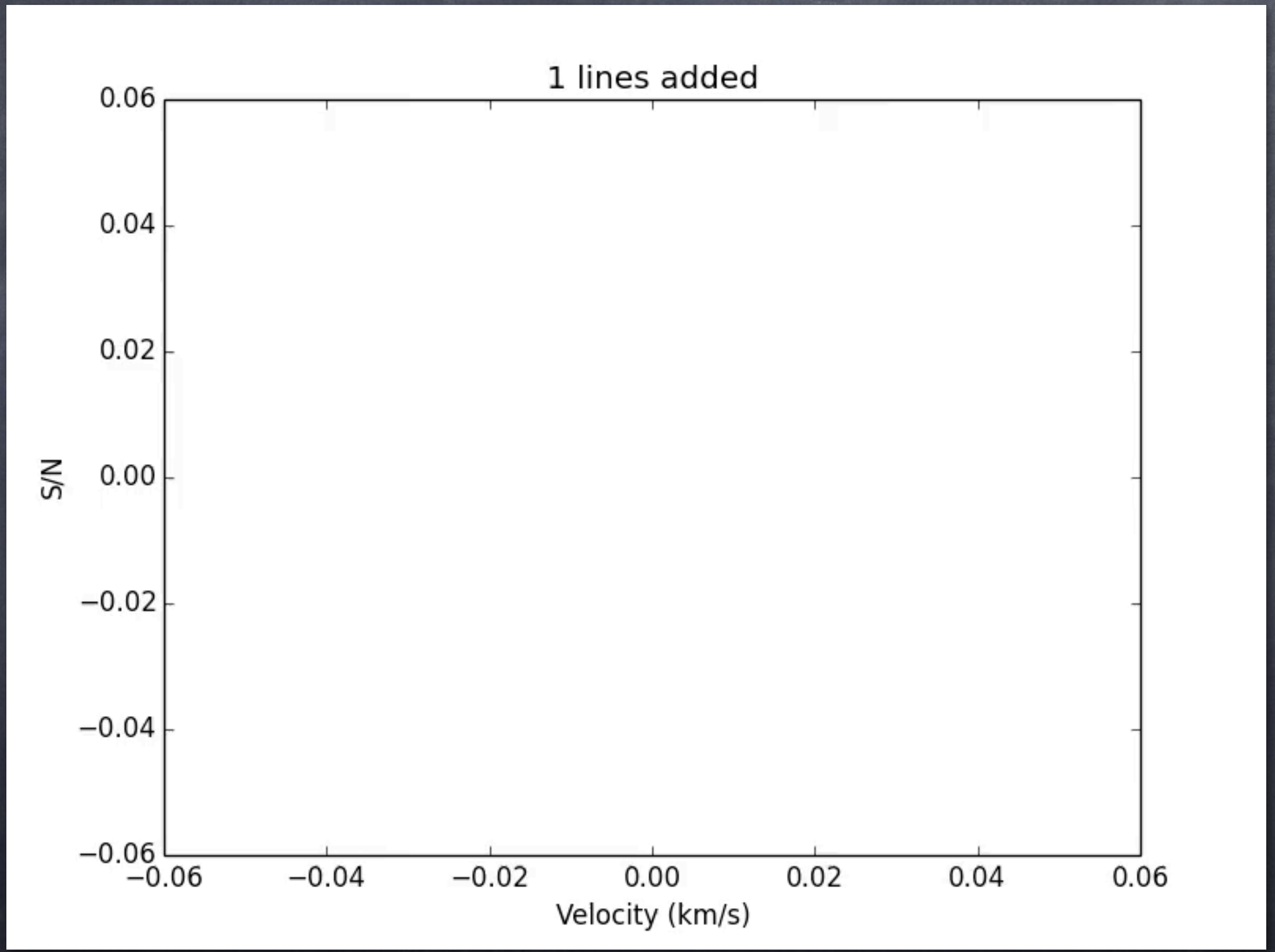
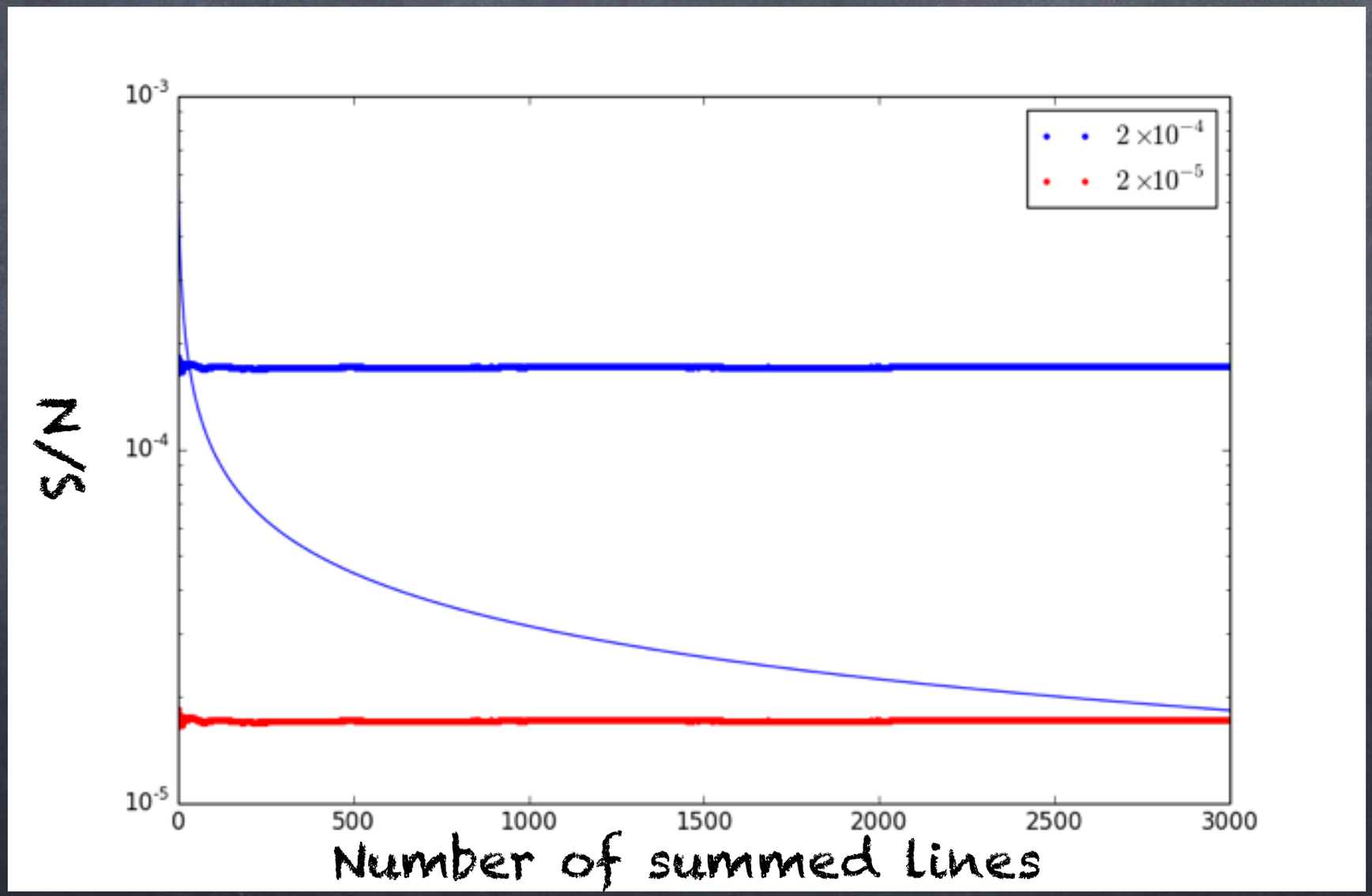
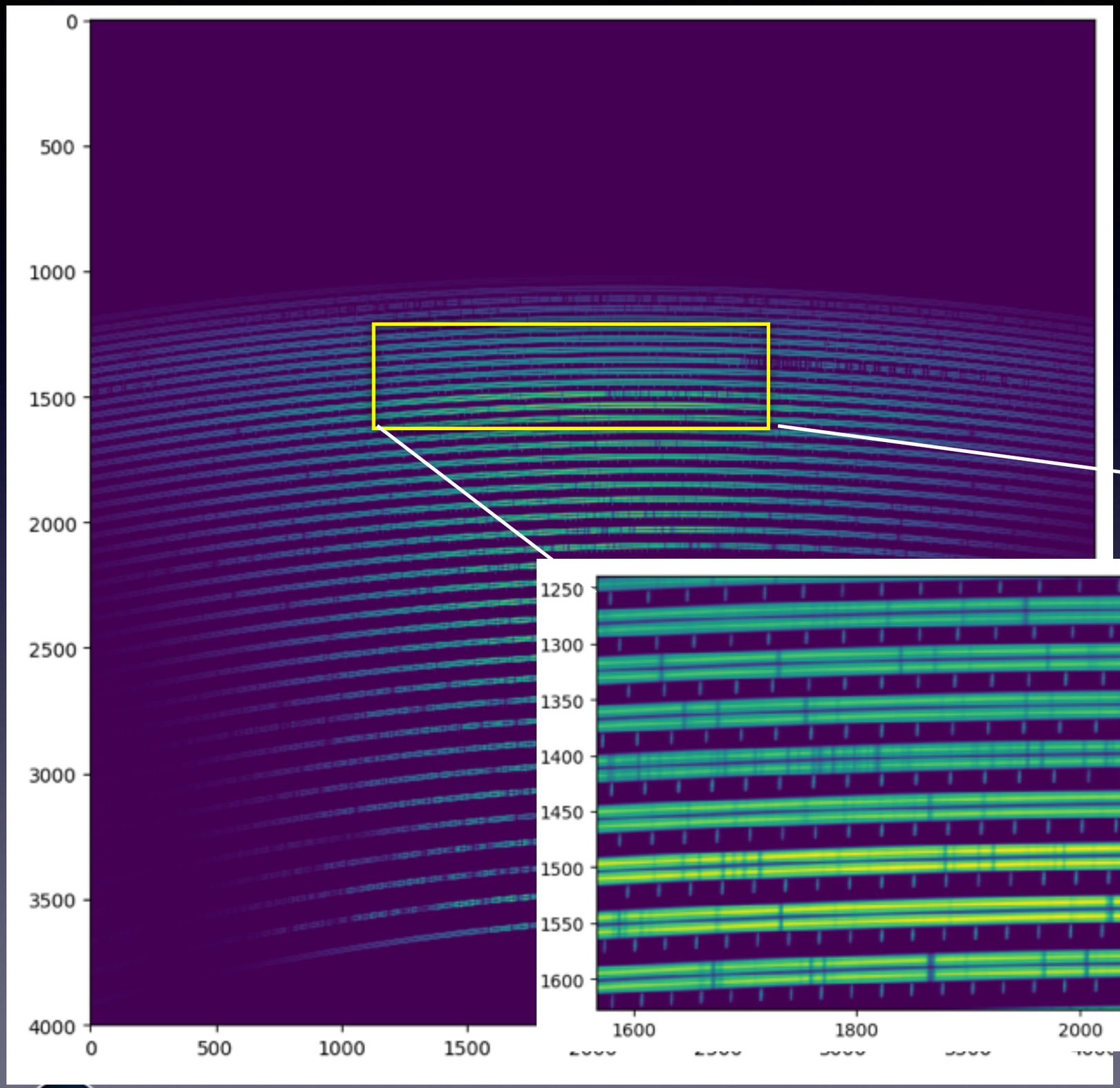
Line addition

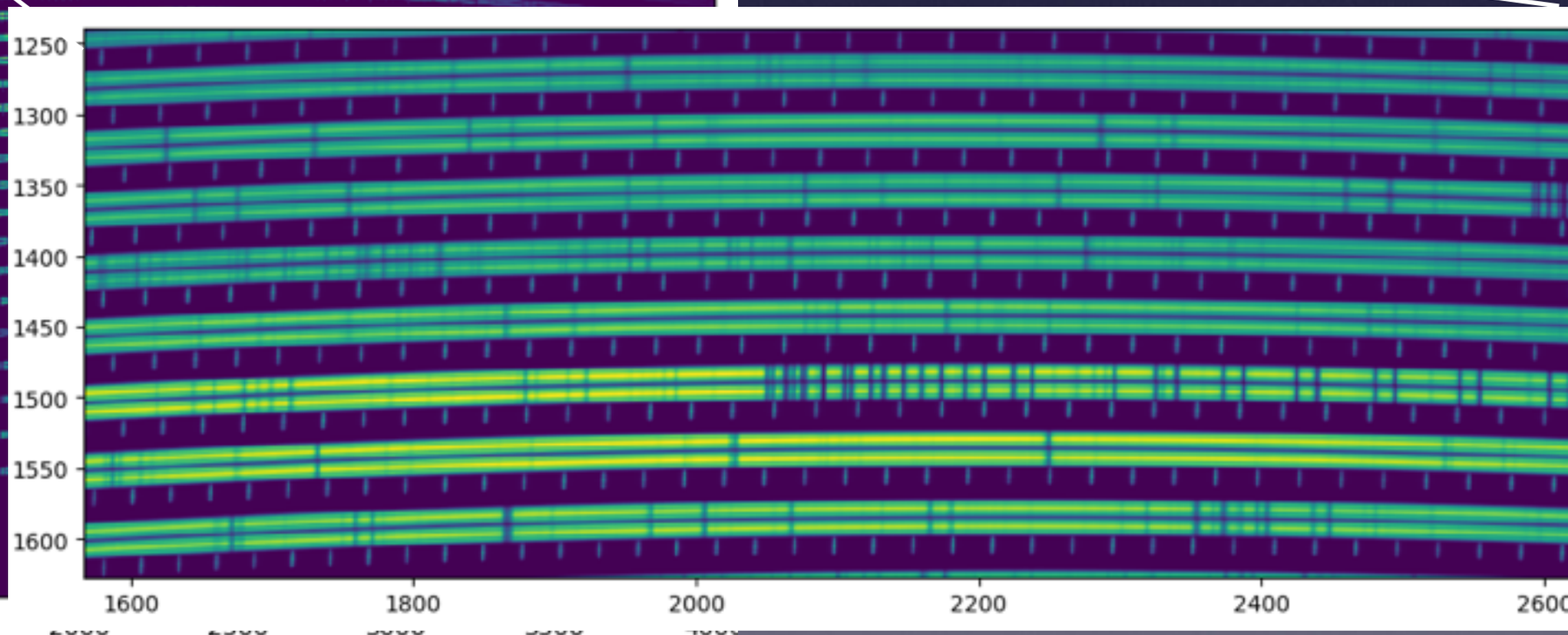


Line addition: Signal adds coherently, Noise shrinks with 1/√N



Neo-NARVAL





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