Design of a static spectropolarimeter

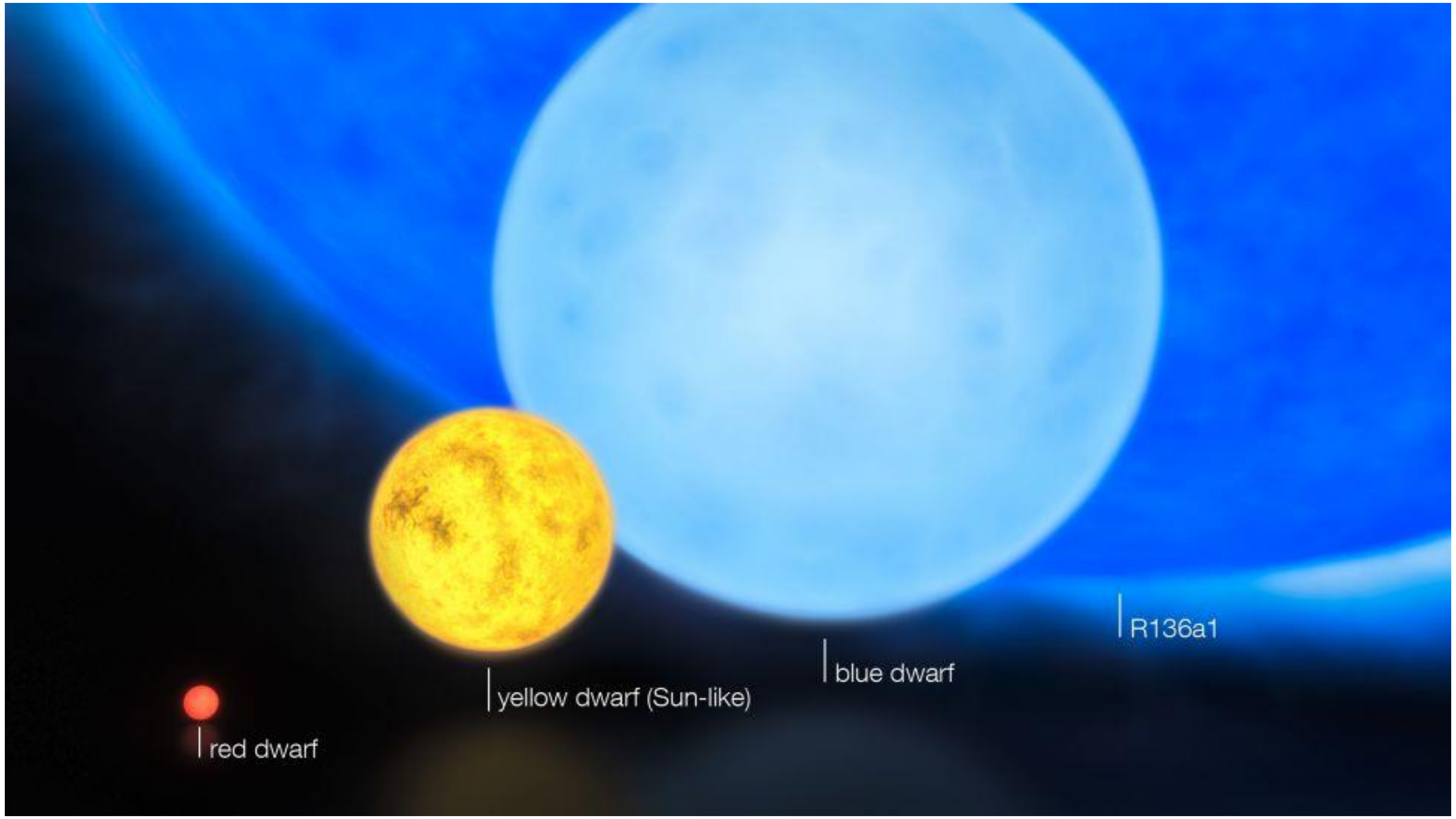
Bogdan Vasilescu

Supervisor: Prof. Jérôme Loicq

The objective

- **To improve the technique for the massive stars observation**

➢ Massive stars:



R136a1 $\sim 256M_{\odot}$

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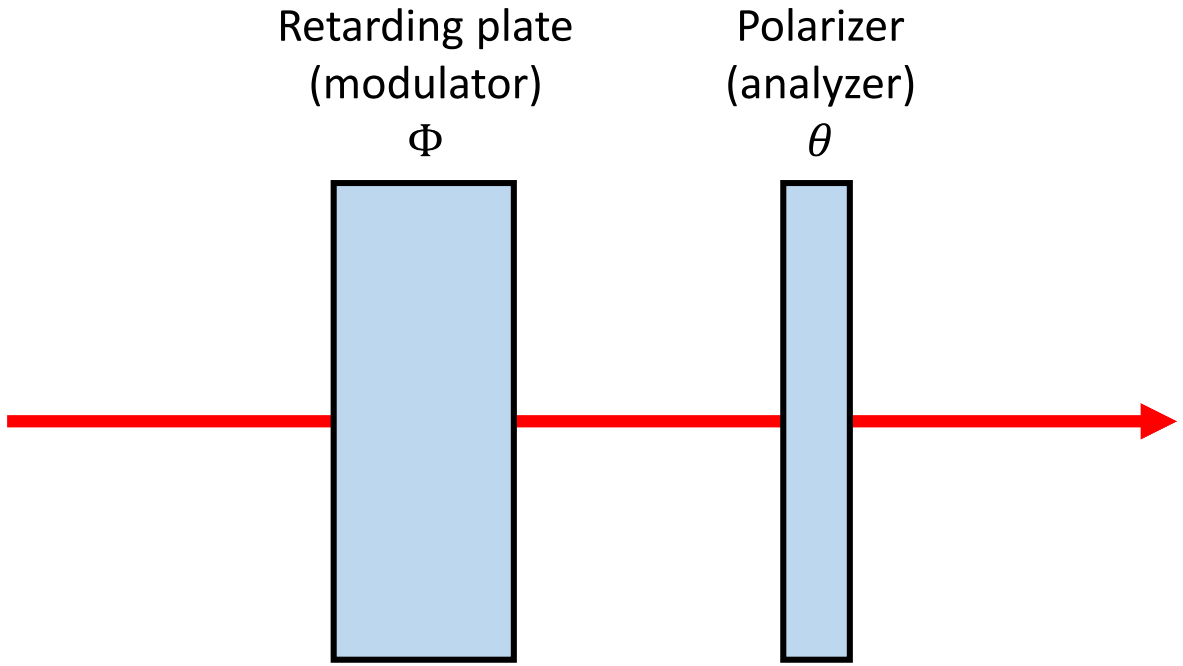
- Masse > $10M_{\odot}$
- Luminosity: $10^5 - 10^6 L_{\odot}$ (UV max.)
- Masse loss rate (strong stellar winds): $10^{-7} - 10^{-4} M_{\odot} yr^{-1}$
- 10% strong, inclined magnetic field ($\sim hG \ - kG$)

The measurement

$$S_{in} = \begin{bmatrix} I_{in} \\ Q_{in} \\ U_{in} \\ V_{in} \end{bmatrix}$$



$$S_{out} = \begin{bmatrix} I_{out} \\ Q_{out} \\ U_{out} \\ V_{out} \end{bmatrix} = MS_{in}$$

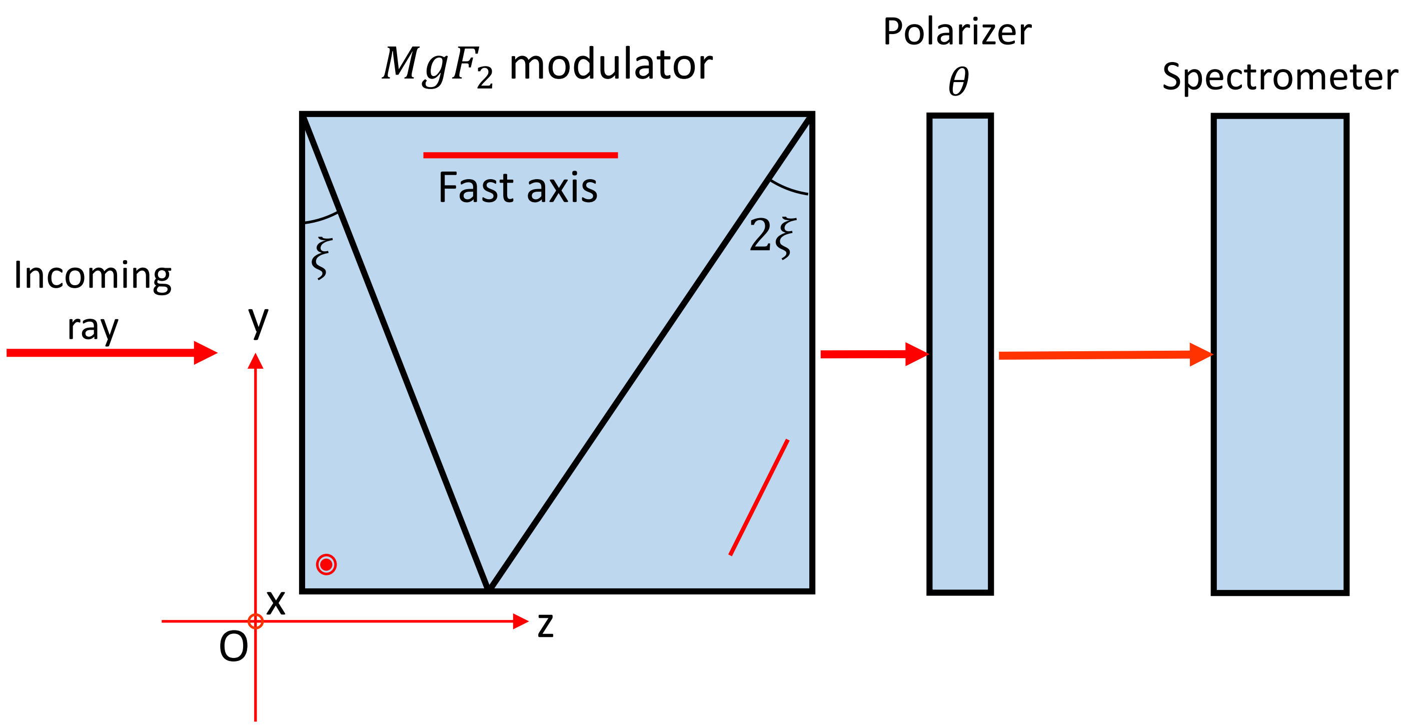
M: the Mueller matrix of the system

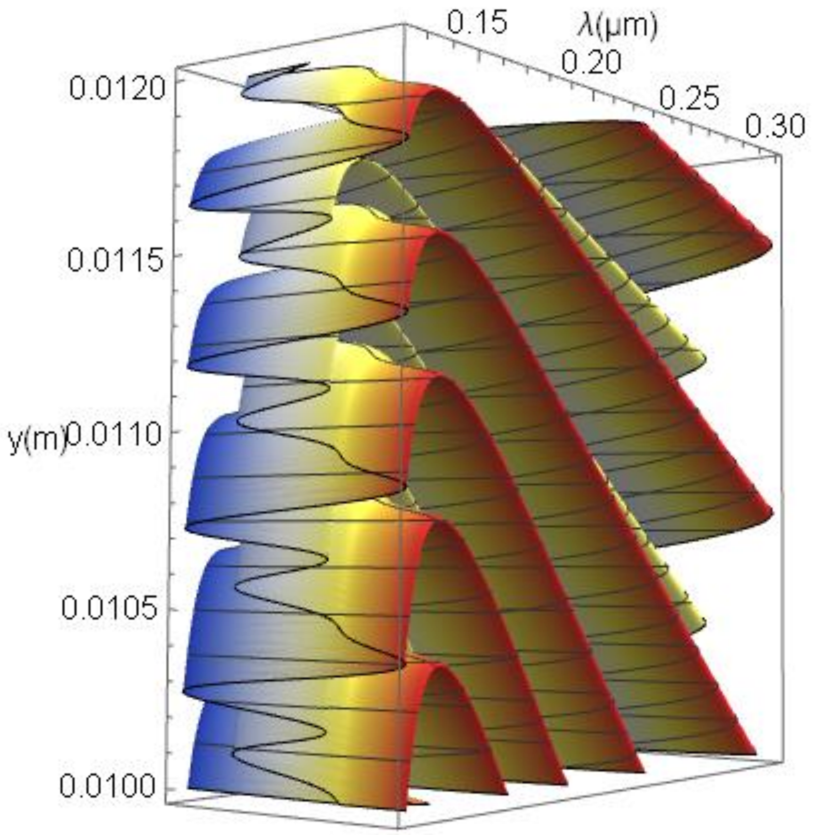
$$I_{out} = M_{00}(I_{in} + h_1(x;t) \cdot Q_{in} + h_2(x;t) \cdot U_{in} + h_3(x;t) \cdot V_{in})$$

x: spatial modulation (beam splitting) : LARGE VOLUME

t: temporal modulation (rotation; piezo-elastic modulation) : FAILURE, HIGH VOLTAGE

The new principle





$$S = [1, 0.4, 0.3, 0.5]^T$$

Preliminary study

- Outgoing signal:

$$I_{out}=\frac{1}{2}(I+Q\cdot m(y,\lambda)+U\cdot n(y,\lambda)+V\cdot p(y,\lambda))$$

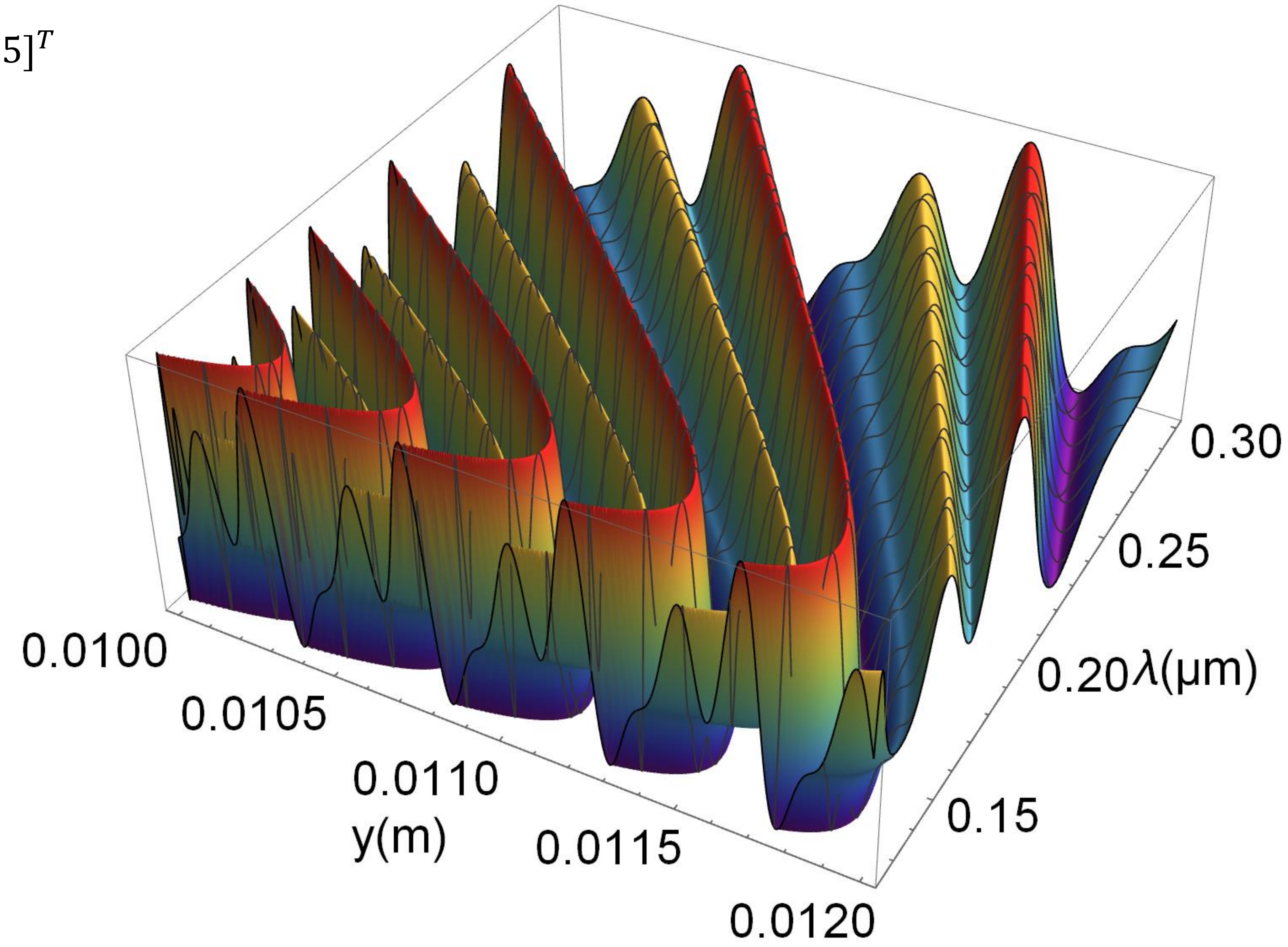
$$\boxed{I_{out}=M_{00}(I_{in}+h_1(x;t)\cdot Q_{in}+h_2(x;t)\cdot U_{in}+h_3(x;t)\cdot V_{in})}$$

$$\mathrm{m}(y,\lambda)=\cos(2\theta)\cos(\Delta\varphi_2)$$

$$\mathrm{n}(y,\lambda)=\sin(2\theta)\cos(\Delta\varphi_1)+\cos(2\theta)\sin(\Delta\varphi_1)\sin(\Delta\varphi_2)$$

$$\mathrm{p}(y,\lambda)=\cos(2\theta)\cos(\Delta\varphi_1)-\sin(2\theta)\sin(\Delta\varphi_1)$$

$S = [1, 0.4, 0.3, 0.5]^T$



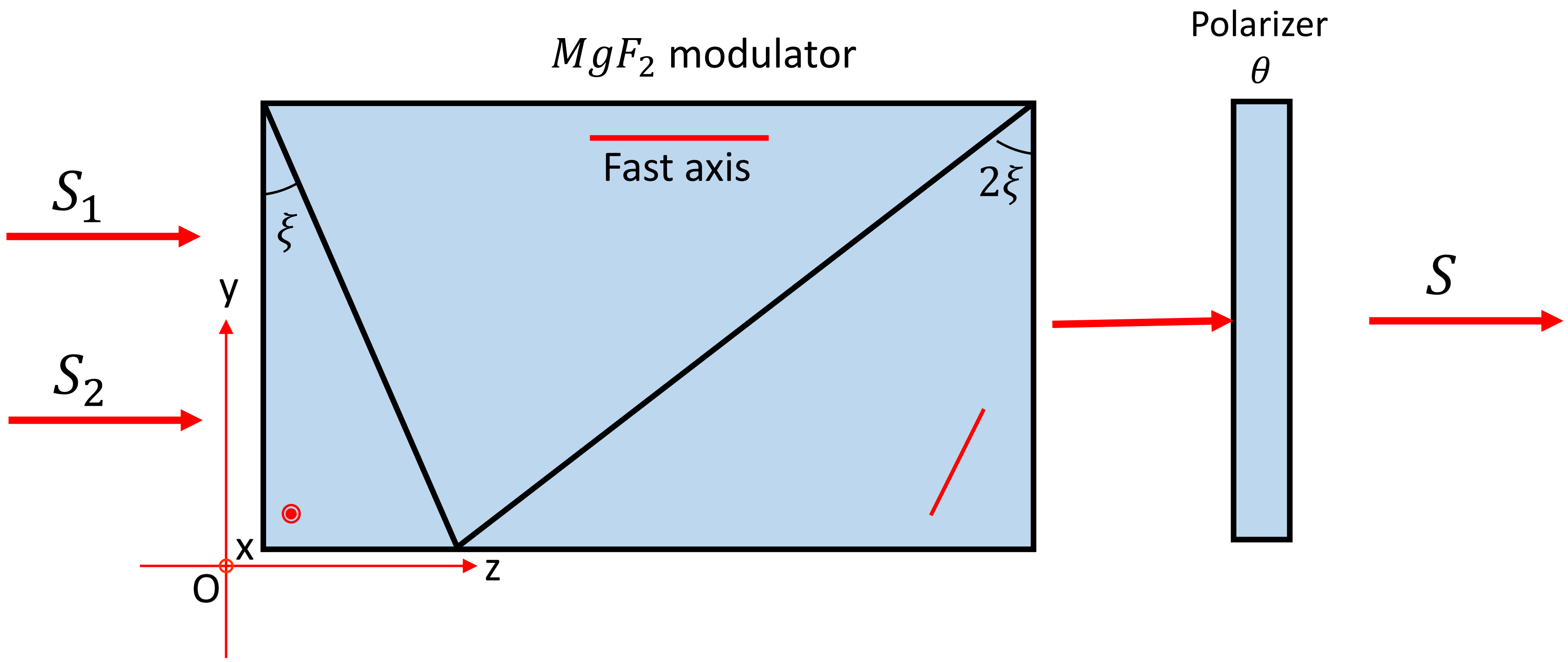
Objectives

Functioning in:

I. Ideal conditions
II. The presence of noise

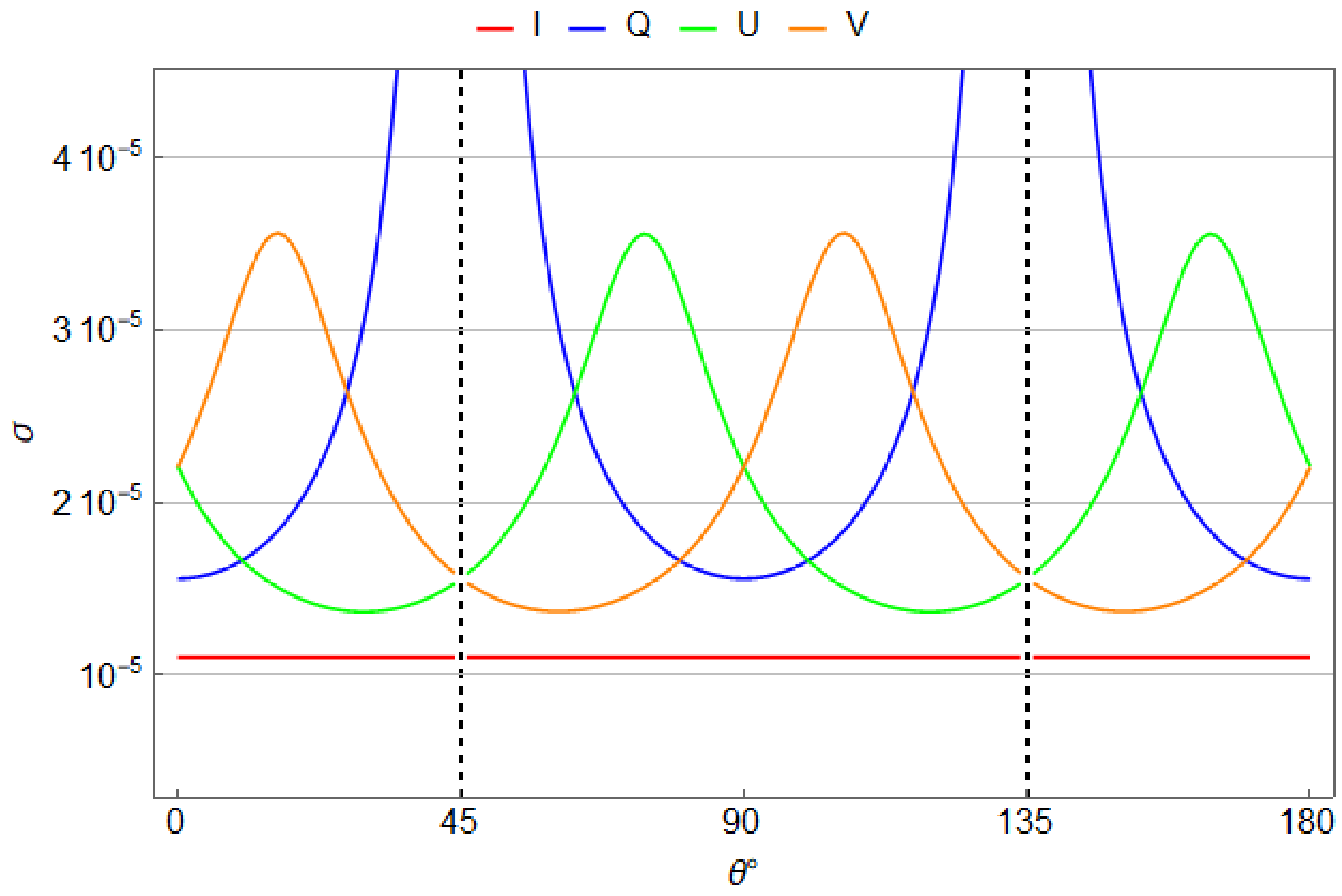
Preliminary results

- Behaviour in ideal conditions: unicity of the solution



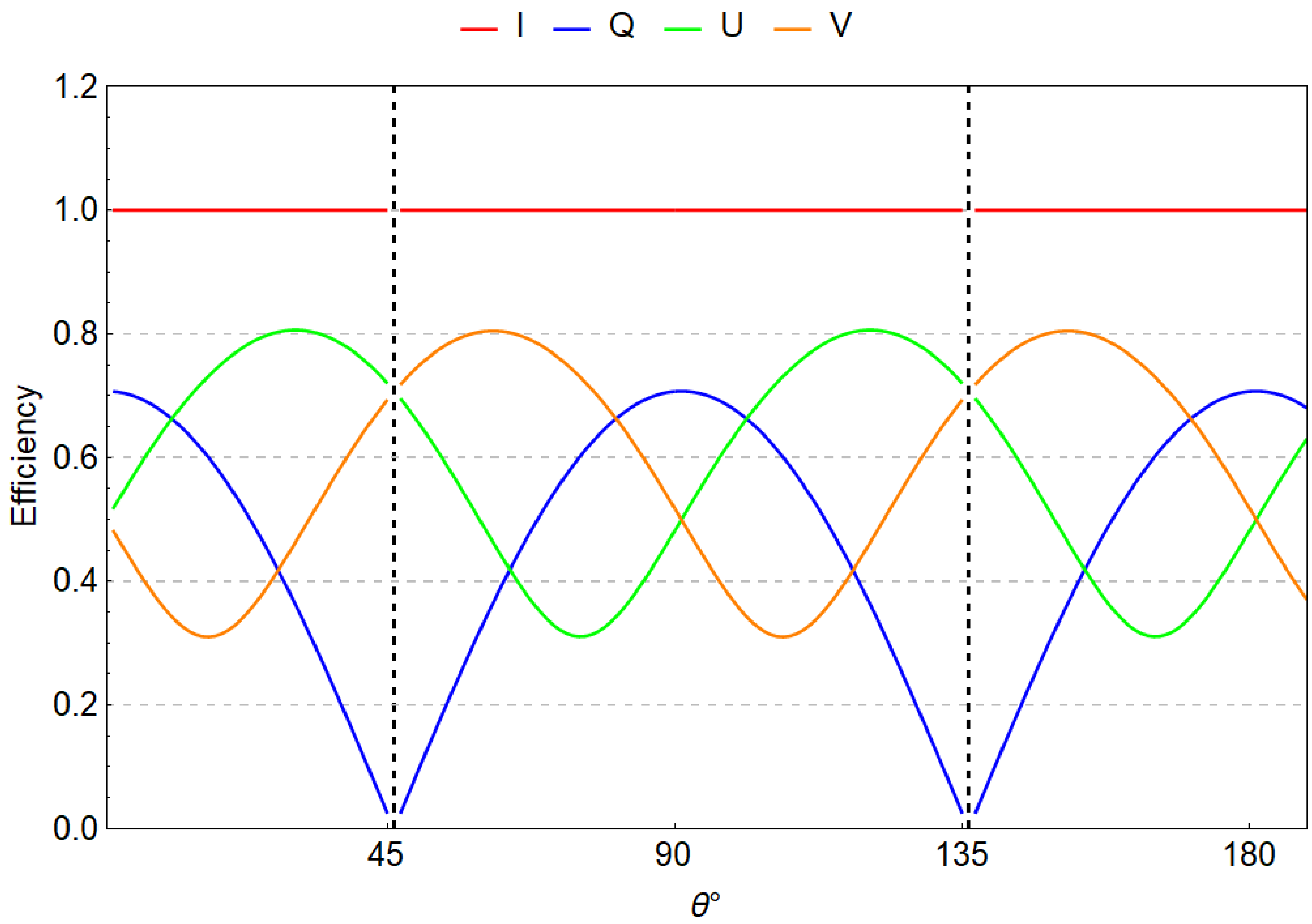
Preliminary results

- Behaviour in simulated real conditions: SNR dependent
  - Optimization of the analyzer (minimization of the χ^2 distribution)



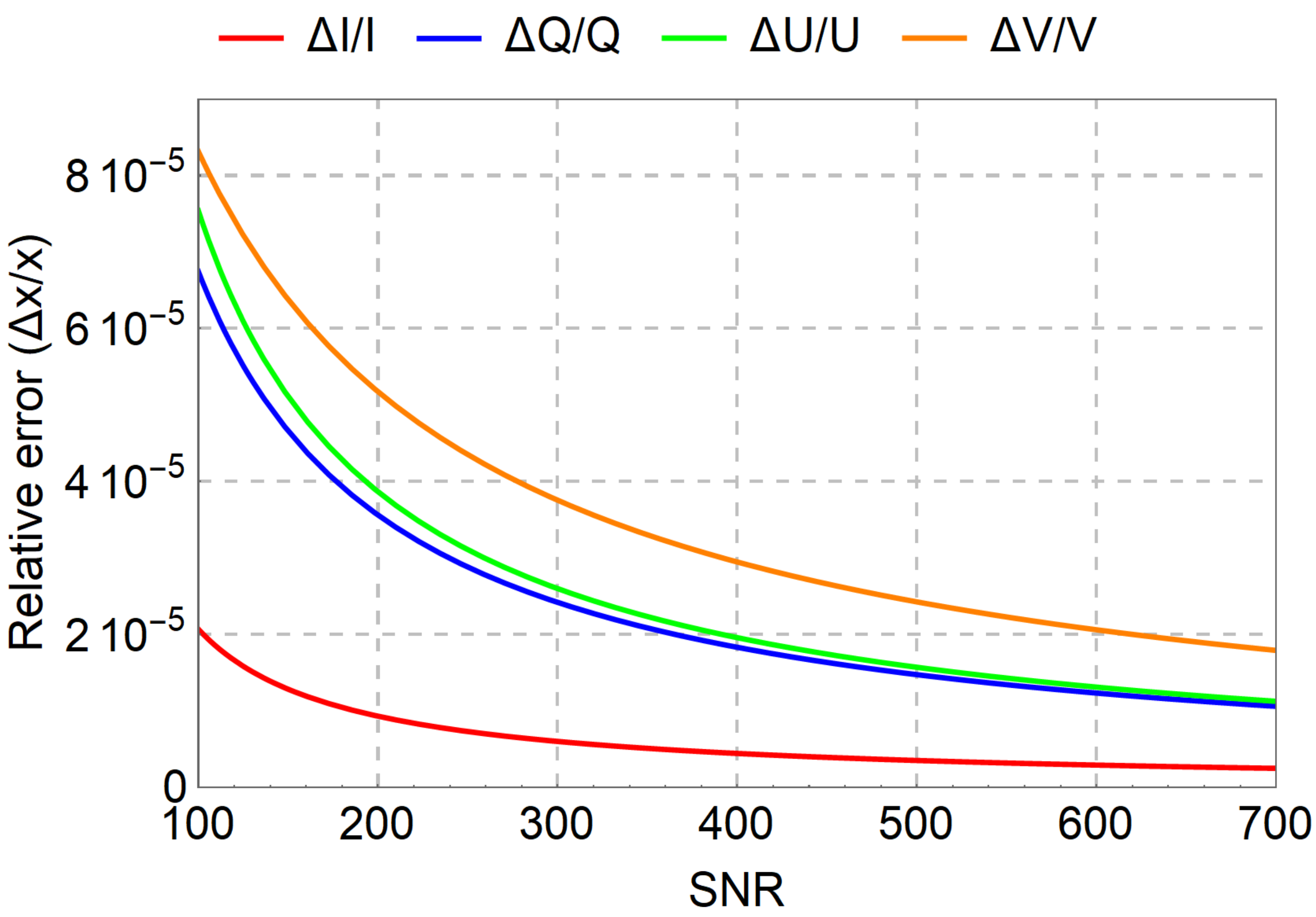
Preliminary results

- Efficiency of the modulation (after Toro Iniesta, 2003)



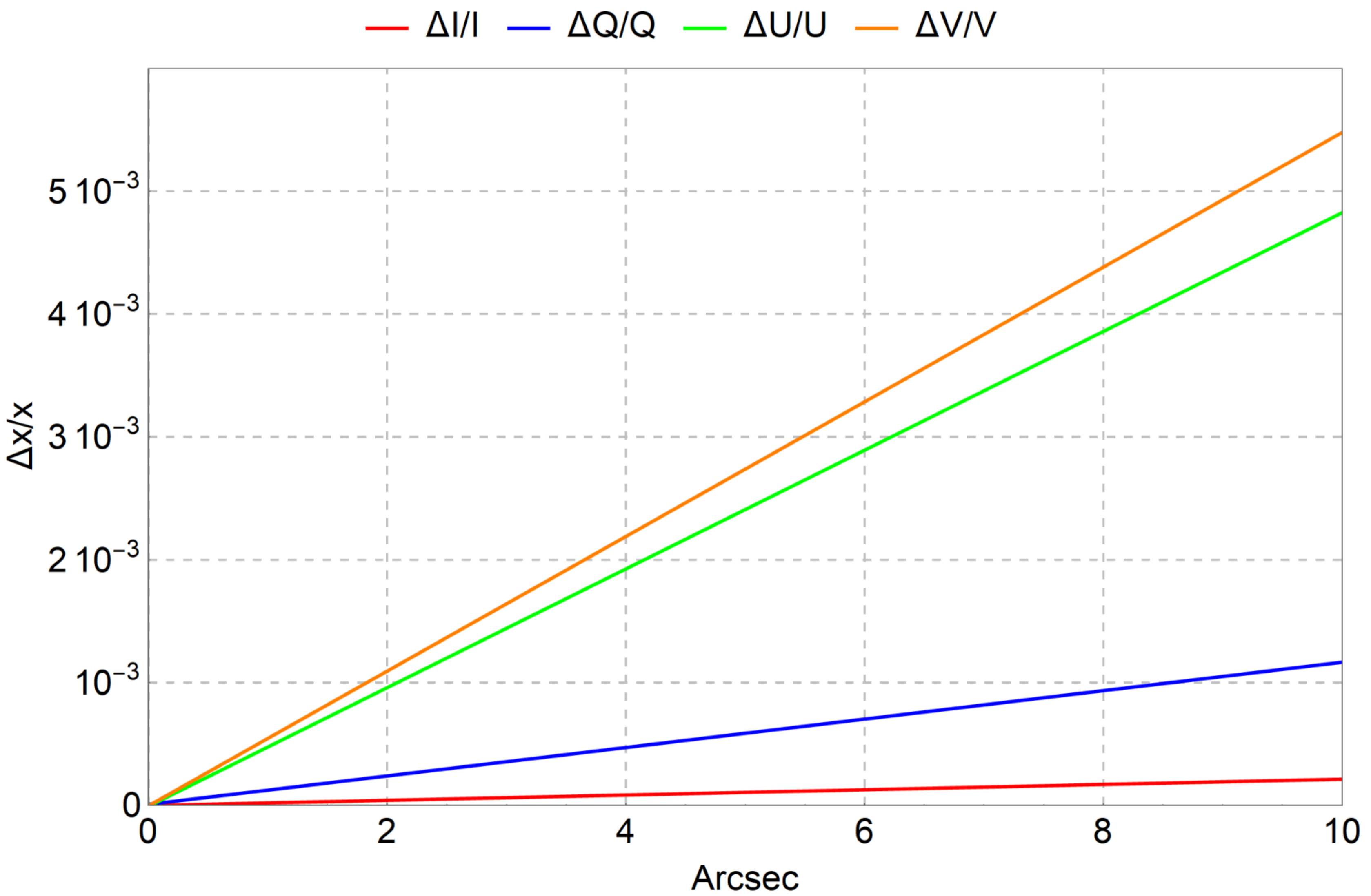
Preliminary results

- Behaviour in simulated real conditions: SNR dependent
  - Relative error & standard deviation ($\theta = 109^{\circ}, S = [1, 0.4, 0.3, 0.5]^T$)



Preliminary results

- Behaviour in simulated real conditions: oblique rays ($\theta = 90^{\circ}$, $S = [1, 0.4, 0.3, 0.5]^T$)



Thank you for your attention!