Laser for Califes

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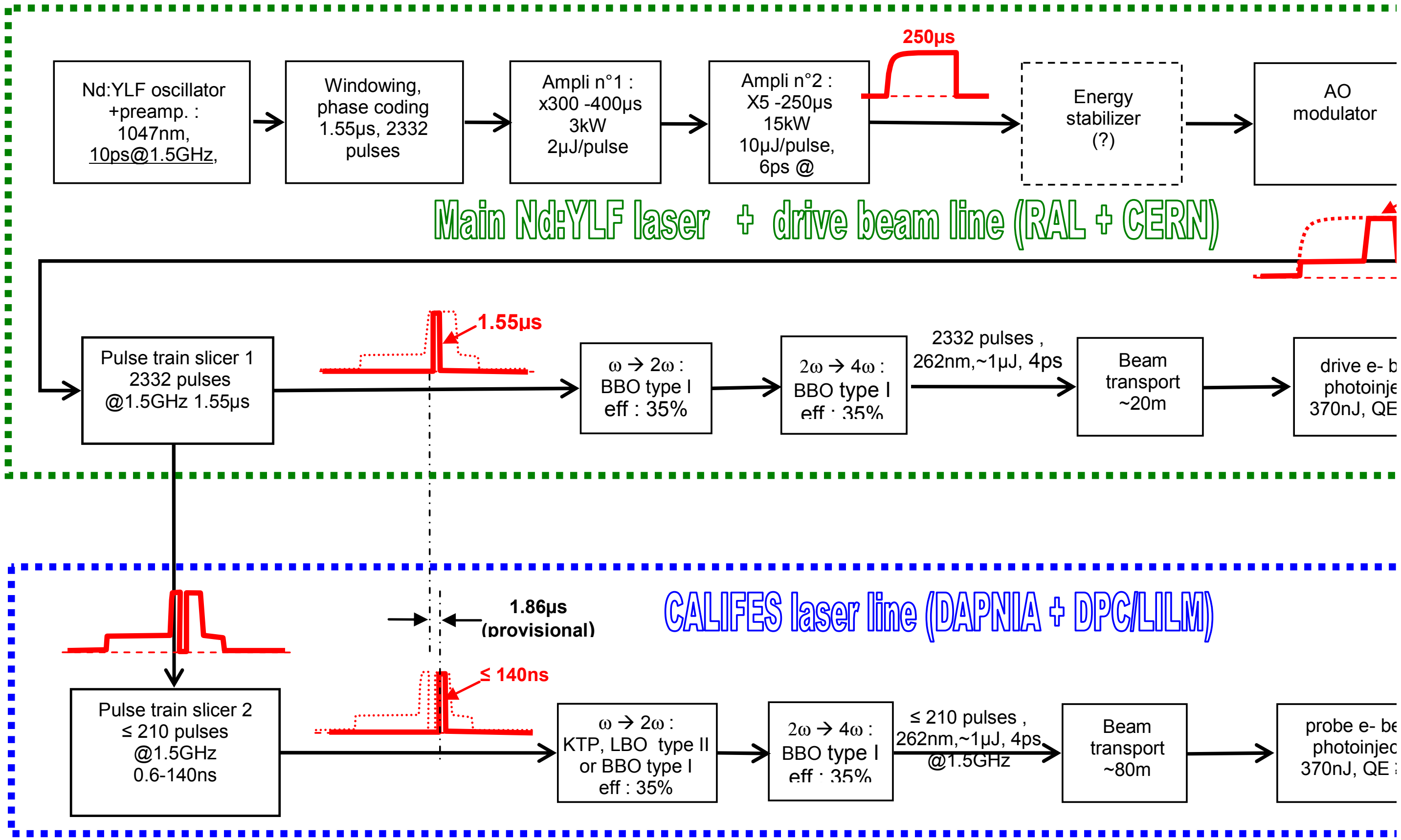
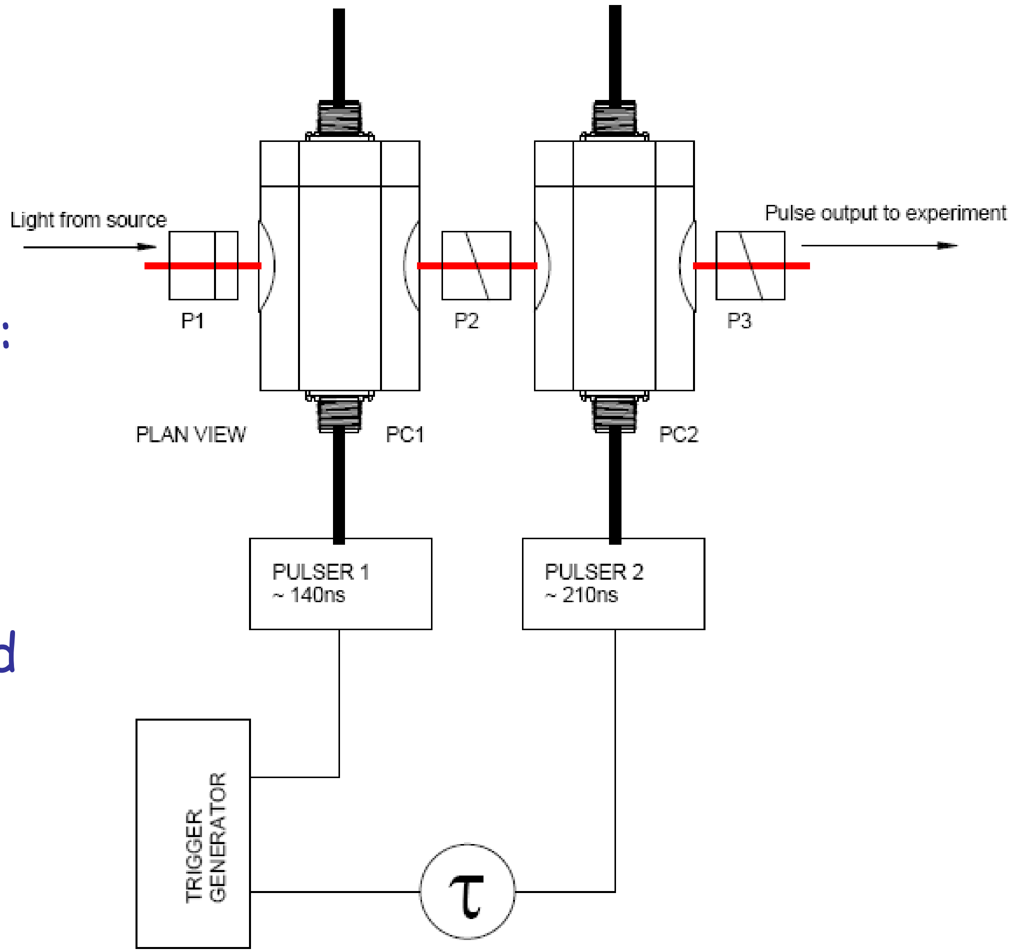
Global Scheme



Pulse picker: scheme

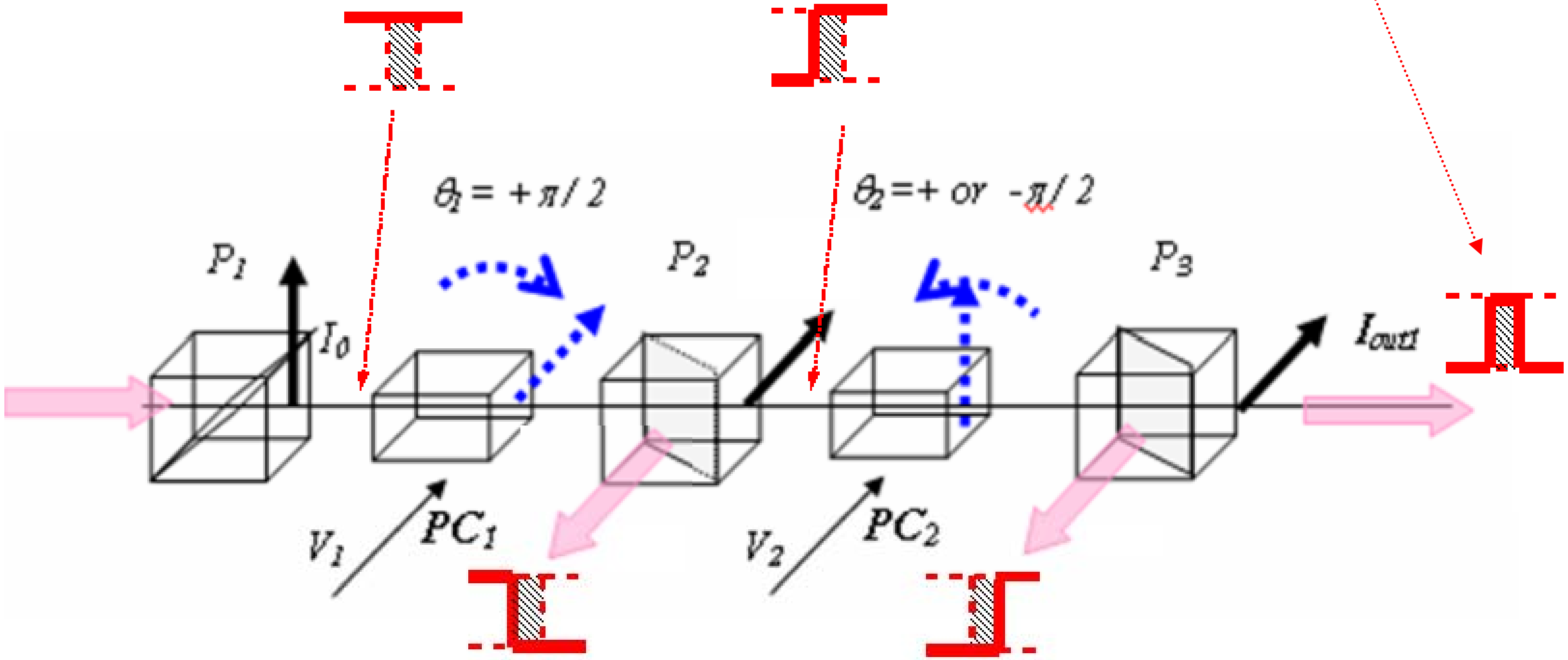
The pulse picker is made with:
- 2 pockels cells
- 3 polarisers
Each pockels cell is triggered by a HV pulser
Both HV pulsers are triggered by a generator



Pulse picker: how it works?

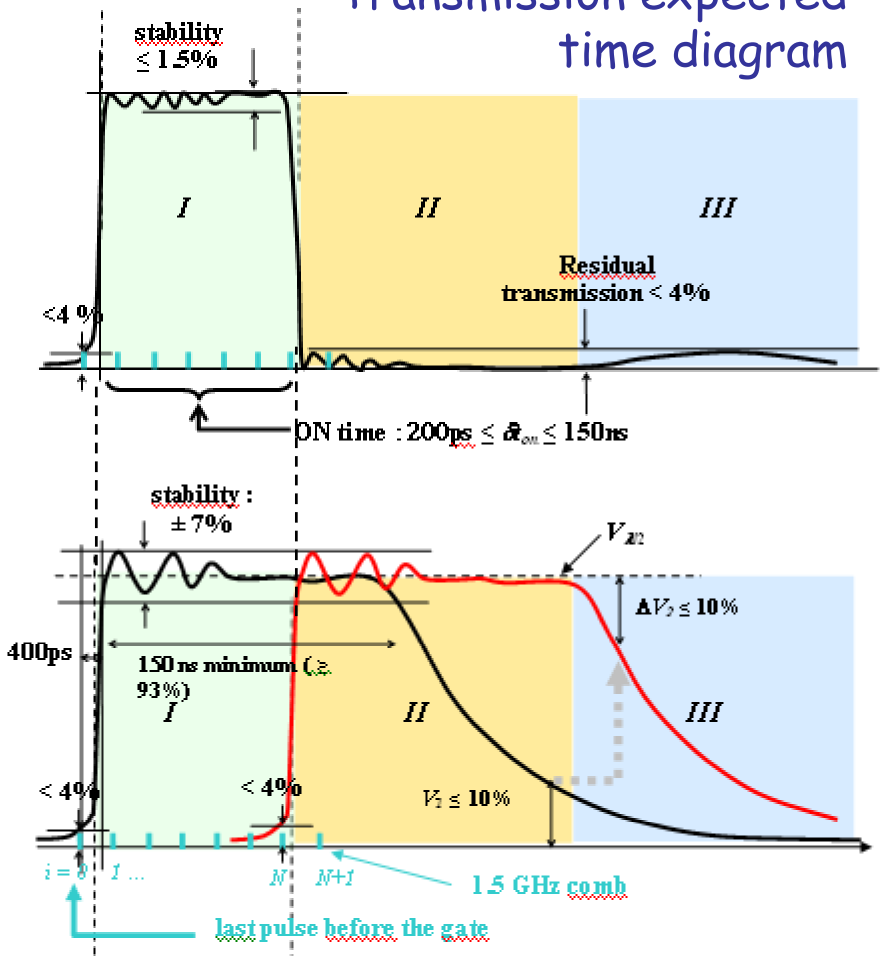
In red: the different temporal shapes of the pulse

Final shaped pulse



Pulse picker ordered to Leysop Ldt : specifications

Transmission expected
time diagram



Related specifications HV pulse

Mains specifications for the pulse picker:

- sharp rise time and fall time: less than 666ps → ~ 400 ps
- duration ~ 0.5 ns to 140 ns
- with stability better than ± 1.5%
- low transmission (< 4%) out of the pulse selected
- need for high transmission during the pulse

Pulse picker: Test Report on HV pulsers –Temporal response

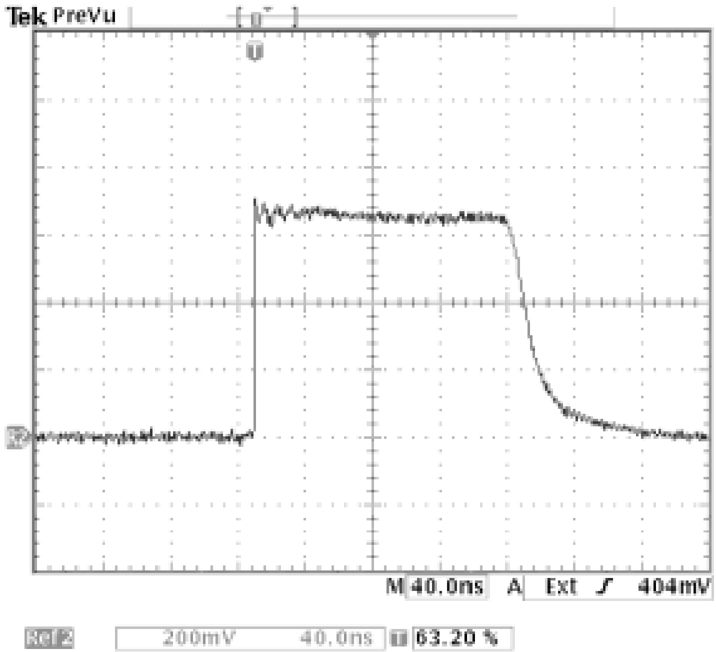


Figure 1: 140ns Long Pulse

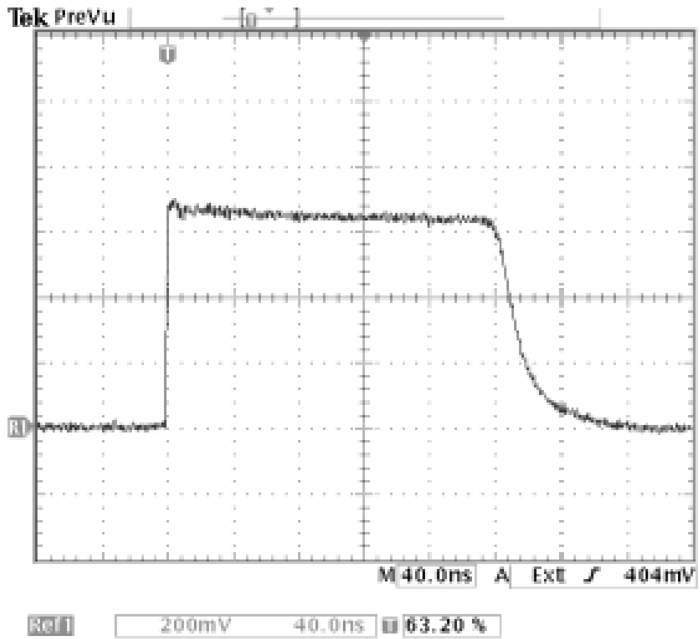
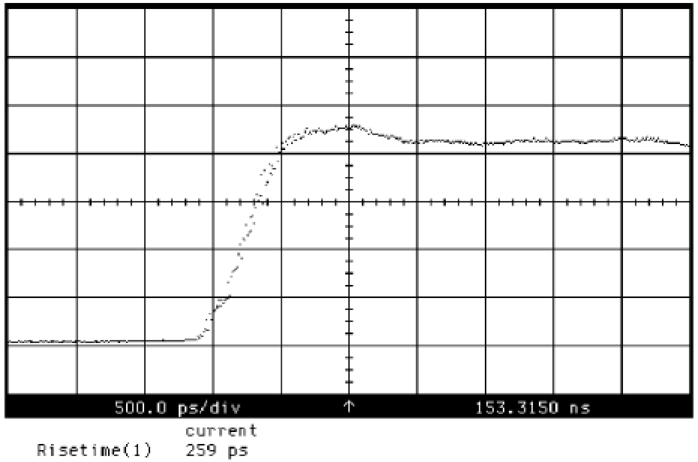
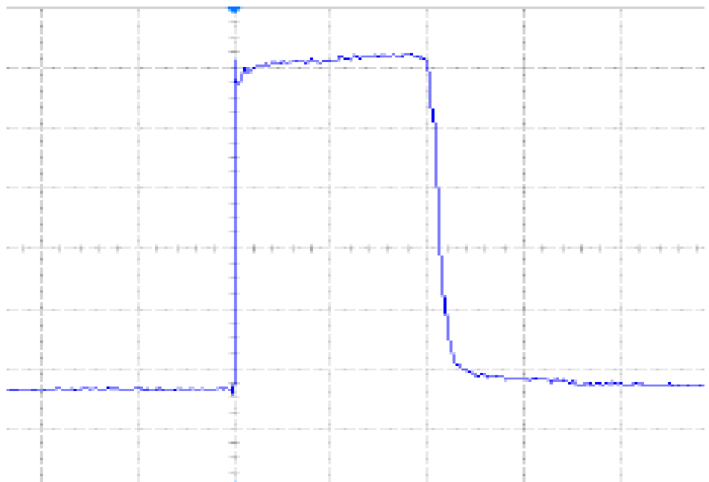


Figure 2: 210ns Long Pulse

The HV pulsers are in good agreement with specifications

Pulse picker: Test Report-Temporal rise time

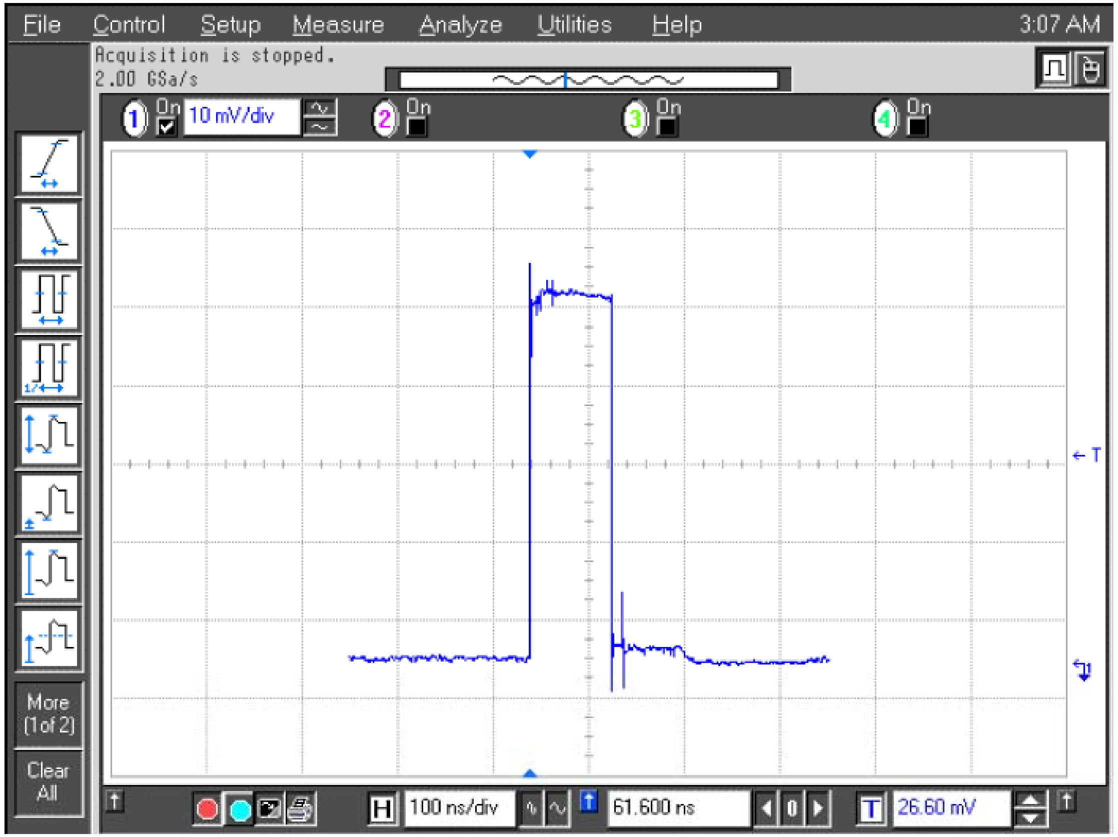




Out of the pulser:
measured rise time
~260ps

Out of one pockel cell:
measured rise time:
less than ~ 350ps

Pulse picker: Test Report- Chopped pulse



100ns Duration Chopped Pulse

Pulse picker: choise dry cell /fluid

Dry cell was finally prefered:

- less transmission (around 1% less per cell)
- theoretically less impedance adaptation, but tests in Leysop showed good performing of dry cell
- but no degradation of the fluid with peak power, (especially for a long running time).

Pulse picker: total transmission

Transmission:

-Transmission of Pockels cell was measured around 92% per cell, less than expected.

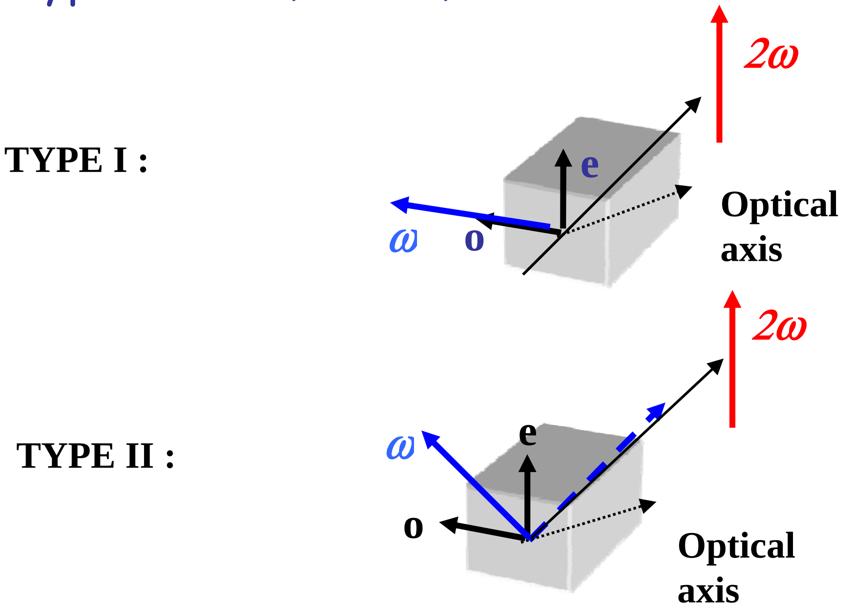
- Transmission of plate polariser: Tp > 95 % (exact value to be confirmed)

→ Total transmission for the pulse picker: ~ 75%

Frequency conversion – crystals considered

With only one direction of polarisation (since the 3 GHz option has been given up), we can now choose either a Type 1 or Type 2 crystal for doubling:

ω → 2ω	type II: KTP, LBO ; type I: BBO, LBO
2ω → 4ω	type I: BBO, CLBO, KDP



Frequency conversion – 1047→523 - calculations

Nominal parameters for optimisation:

- entering beam parameters: 10µJ, 6ps, 1047 nm, M^2 (beam quality factor) =1
- CE (conversion efficiency) =35% *(→ 12% for ω -> 4ω)*

	KTP (II)	LBO (I)	BBO (I)
λ_ω incident (nm)	**1047**	1047	1047
d_{eff} :non linearity coeff (pm.V)	**3.0**	0.83	2
L : length of crystal (cm)	**0.6**	1.5	0.8
Φ_{1/e^2}: diameter (mm)	**1.8**	1.5	1.8
Tolerance: *Critical if tolerance parameter approach 1.*			
Angular acceptance: $\xi_\theta = 2\theta / \Delta\theta_{acc}$	**0.028**	0.106	0.36
Walk-off : $\xi_\alpha = 2.\alpha_{max}.L / \Phi$	**0.038**	0.17	0.5
GVM : $\xi_{GVM} = GVM.L / Dt_{1/2}$	**0.44**	0.267	0.79

Frequency conversion – 523→262 - calculations

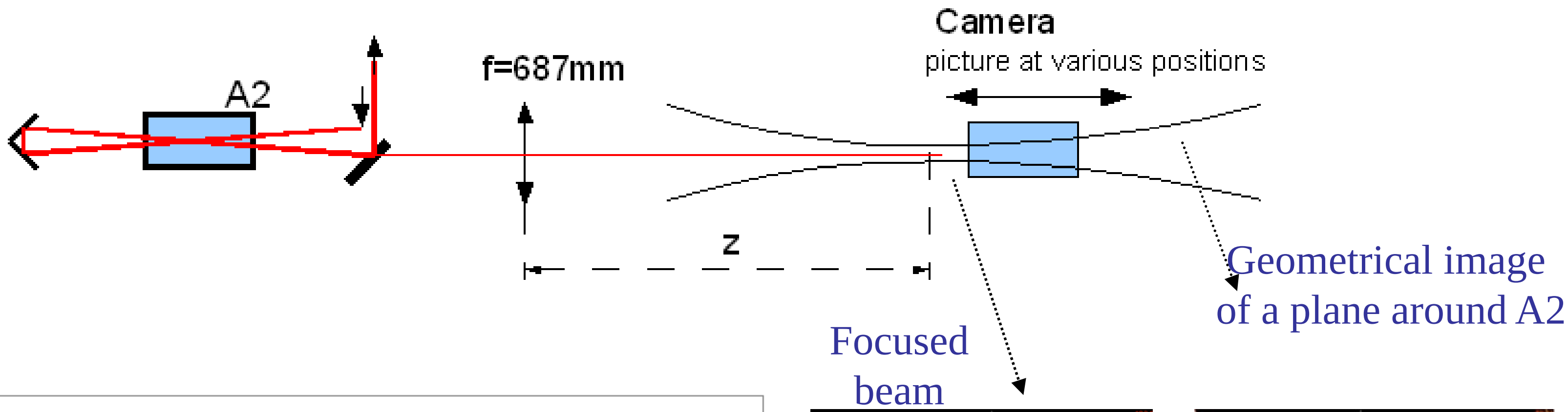
Typical parameters and tolerances

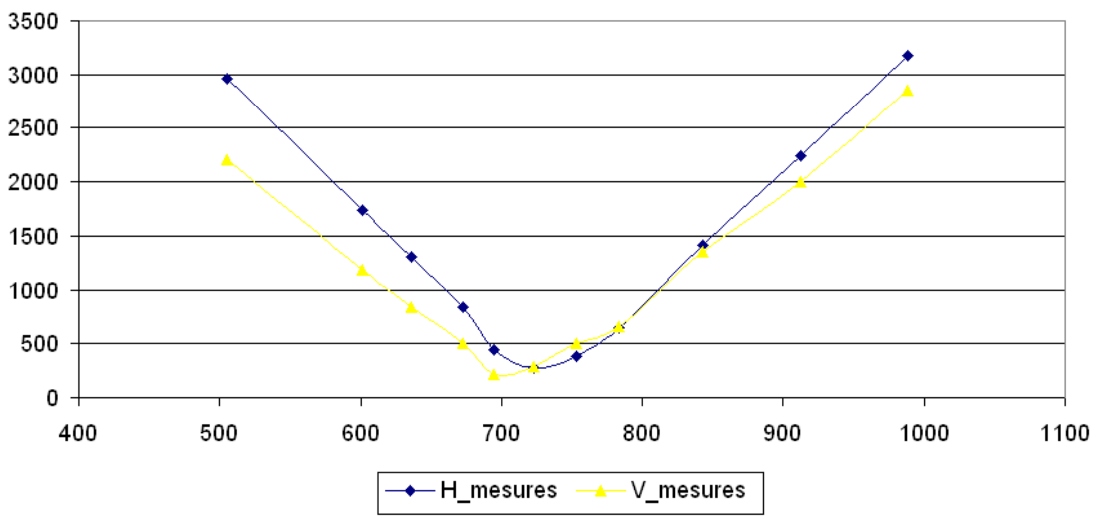
calculations for entering beam parameters: 10µJ, 6ps, 1047 nm, M^2 (beam quality factor) =1

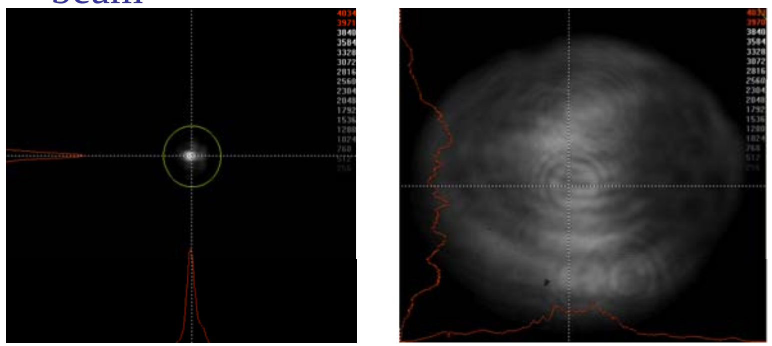
and for CE (conversion efficiency) =35% *(→ 12% for ω -> 4ω)*

	BBO (I)	CLBO (I)	KDP
λ_ω incident (nm)	**523**	523	523
d_{eff} :non linearity coeff (pm.V)	**1.74**	0.8	0.47
L : length of crystal (cm)	**0.8**	1.5	2
Φ_{1/e^2}: diameter (mm)	**2.04**	2.1	0.94
Tolerance: *Critical if tolerance parameter approach 1*			
Angular acceptance: $\xi_\theta = 2\,\theta / \Delta\theta_{acc}$	**0.48**	0.32	0.2
Walk-off : $\xi_\alpha = 2.\alpha_{max}.L / \Phi$	**0.67**	0.44	0.285
GVM : $\xi_{GVM} = GVM.L / Dt_{1/2}$	**0.97**	1.04	1.24

M^2 measured out of A2 amplifier







$M^2 \sim 2$ (1.5 to 2.6)
for the beam out of A2

Frequency conversion – crystal ordered

Crystals ordered:
- KTP (10mm)
- BBO (12mm)

Detailed calculations on the Report:

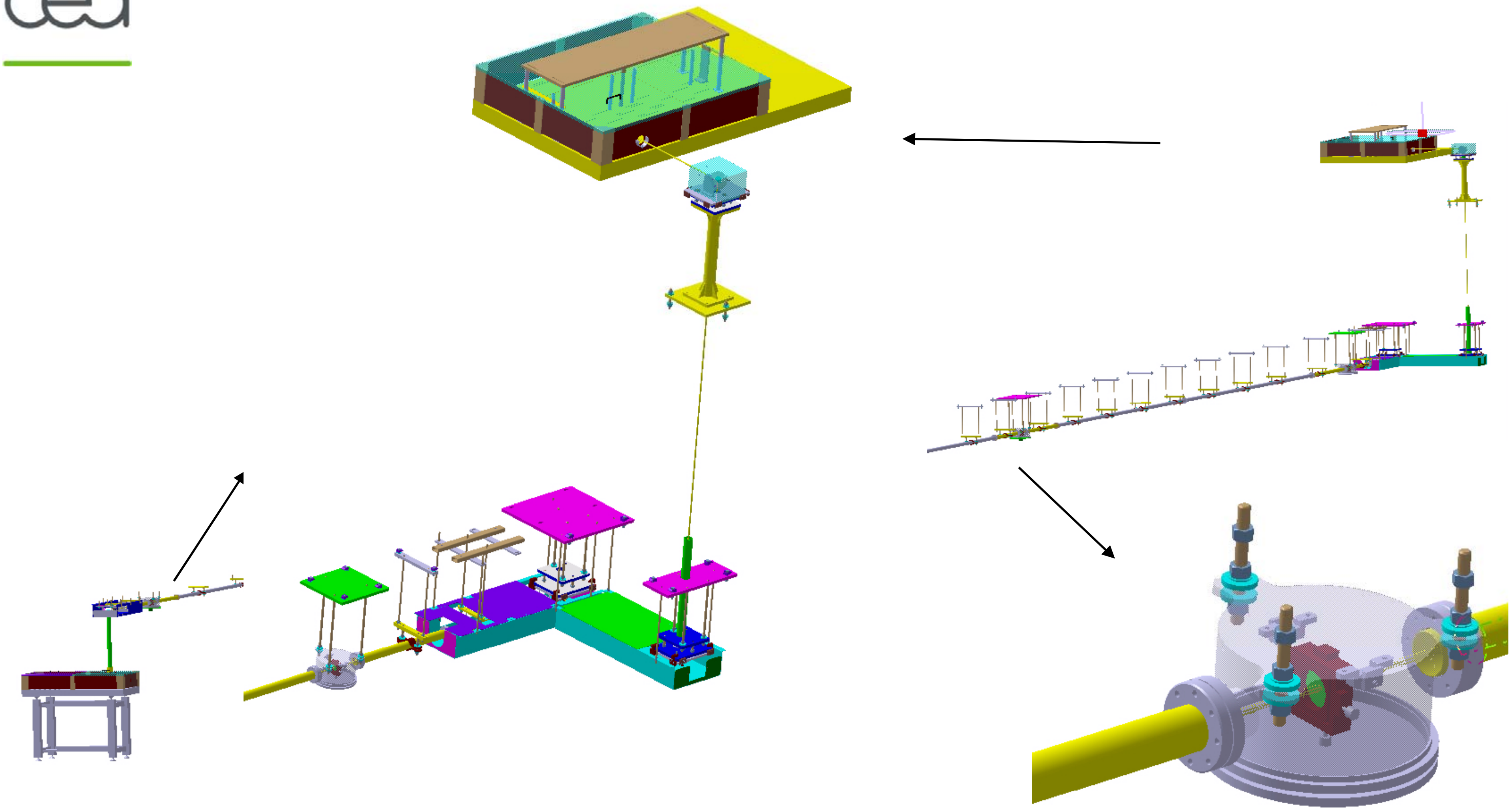
Ligne laser du photoinjecteur CALIFES (CERN).

Sélection d'impulsions (pulse picker)

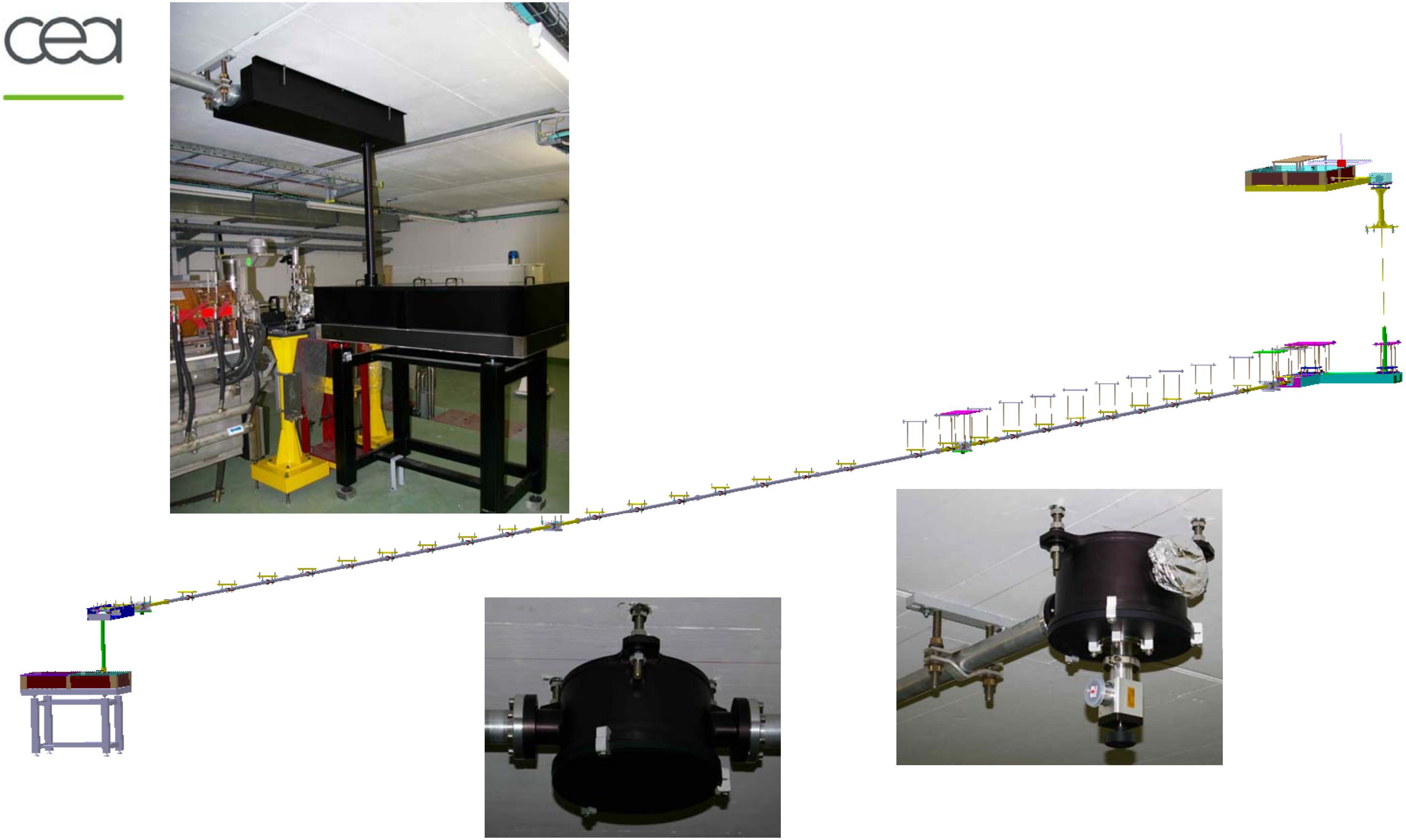
et conversion non-linéaire 1047nm → 262nm.

M.GILBERT, G.CHEYMOL

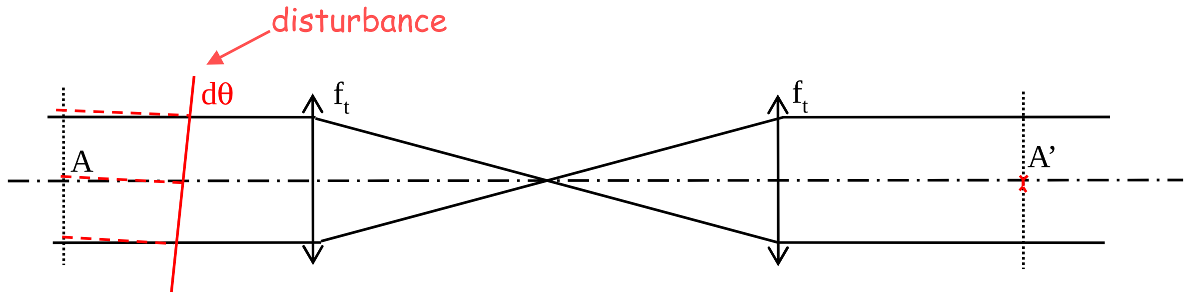
Transport- tables and mechanical supports



Transport- tables and mechanical supports

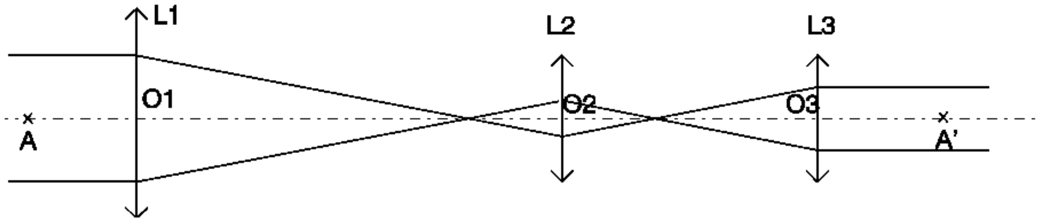


Optical relay /afocal system



Optical relay reduce consequences of mirror vibration, air turbulence in plane A'

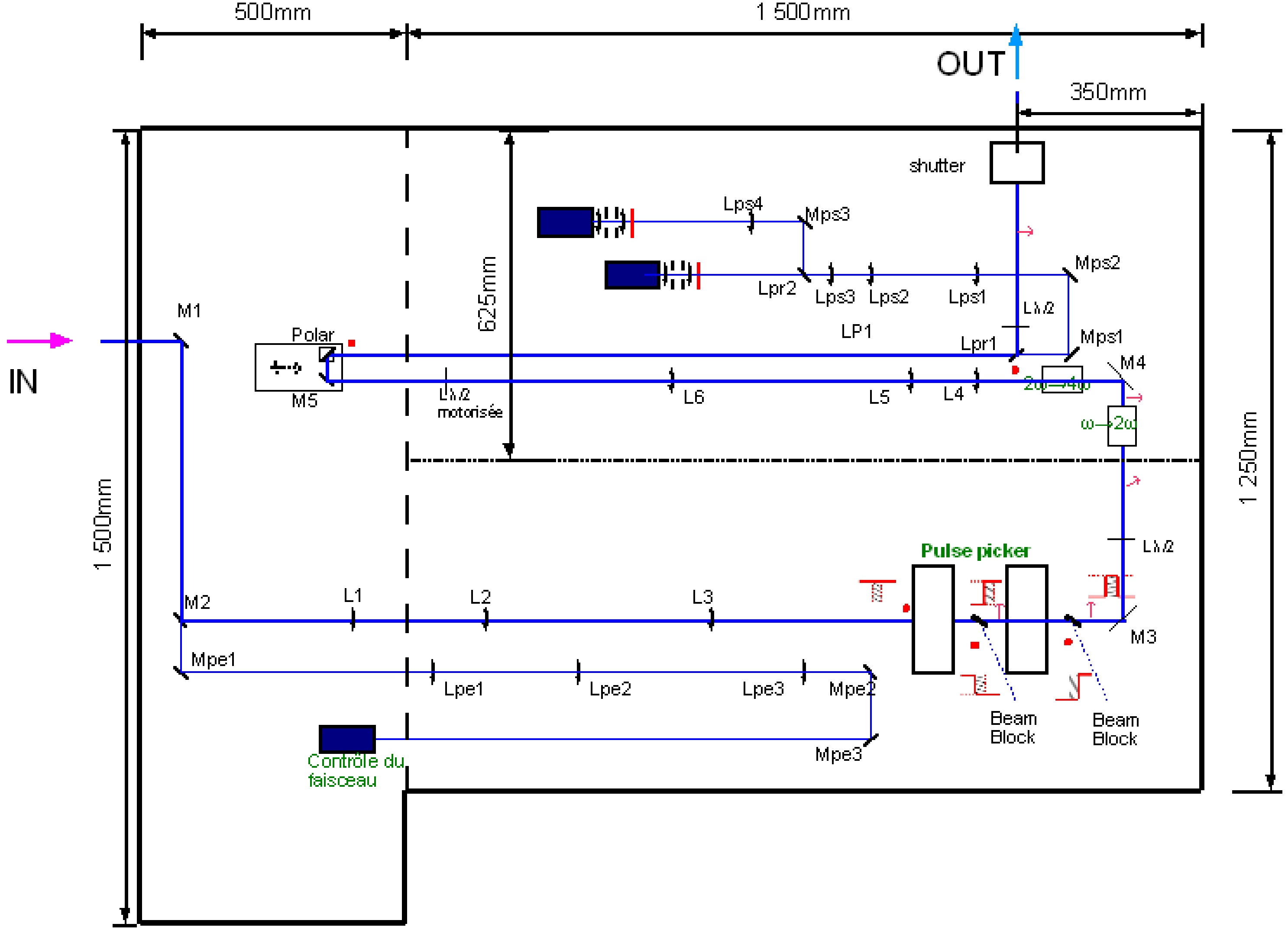
(A' geometrical image of A)



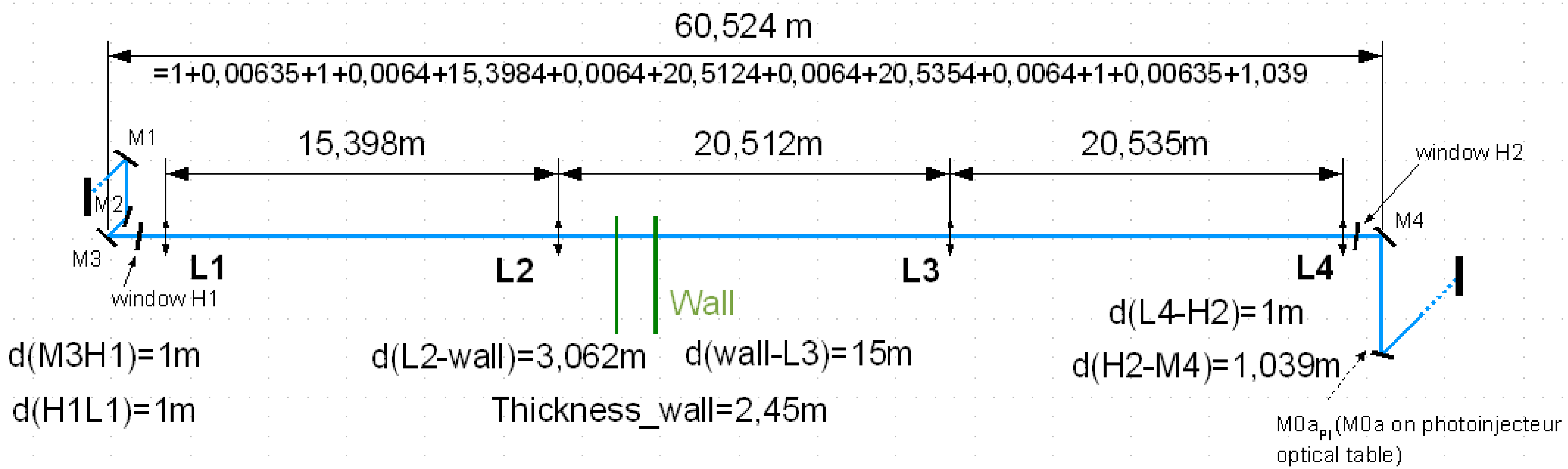
3 lenses afocal system allows to:

- decrease the footprint of the optical system for a given relay distance.
- change zoom factor and relay distance (to some extent)

Optical path on « laser table »



« under the roof » long distance beam delivery

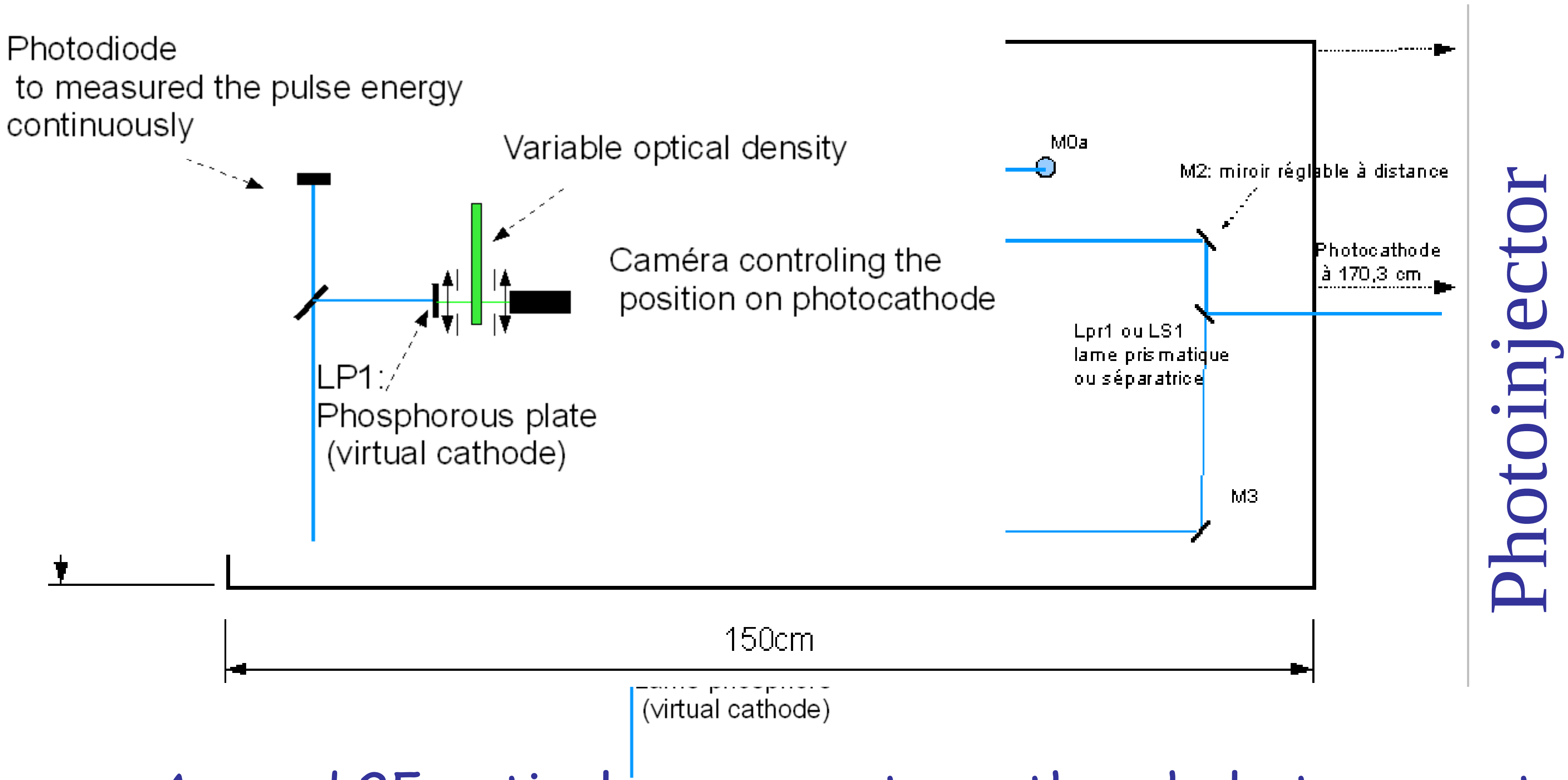


2 afocal optical relay:

L1-L2 with f~ 10 m

L3-L4 with f~ 7.5m

« photoinjector » optical table



Around 25 optical components on the whole transport

- Pulse picker quite correct

- Frequency conversion to be tested soon

- Total transmission and energy delivered to the photoinjector to be checked

End