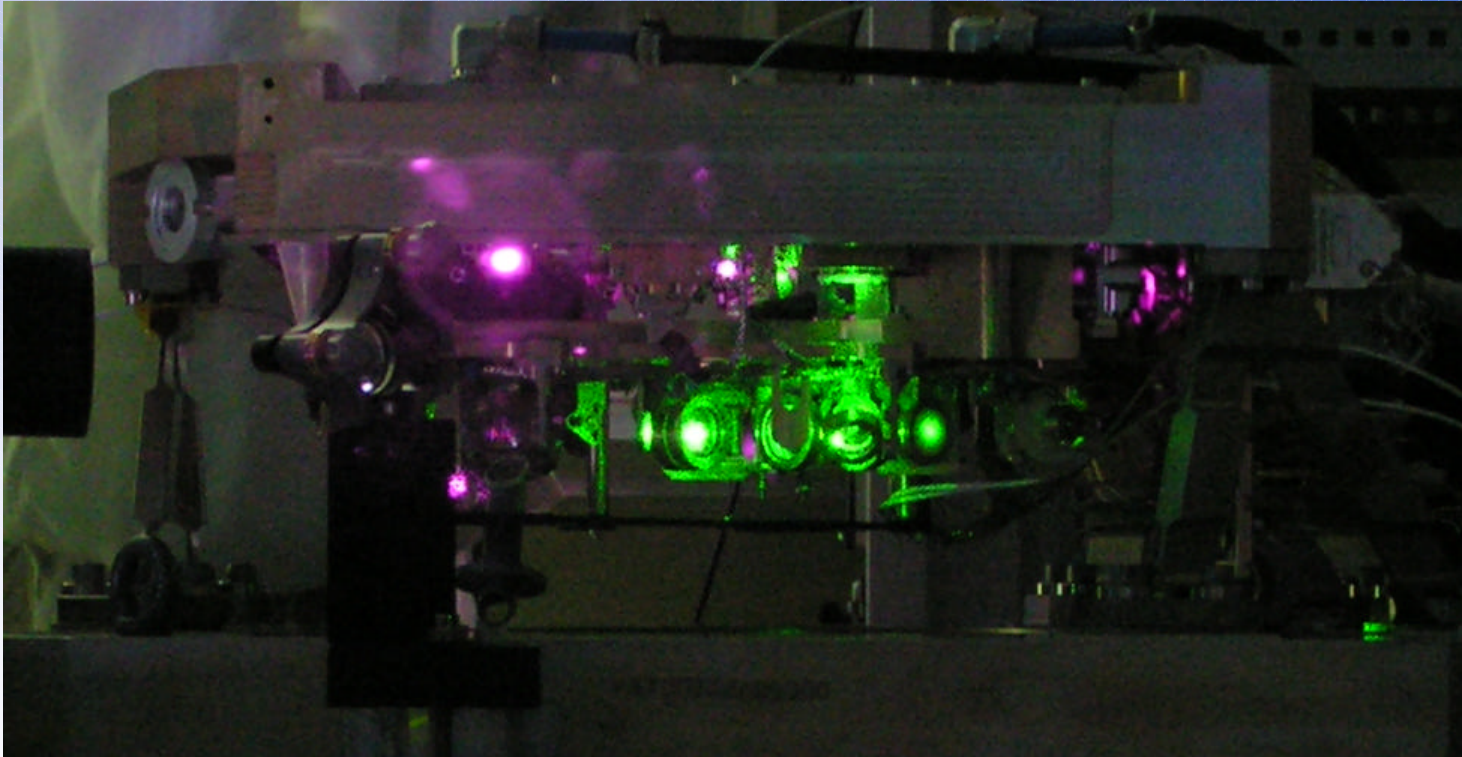


# UV CHARACTERIZATION OF ENGINEERING QUALIFICATION MODEL OF ALADIN LASER TRANSMITTER

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**INTERNATIONAL CONFERENCE ON SPACE OPTICS 2006**

**Nordwijk 27 JUNE 2006**

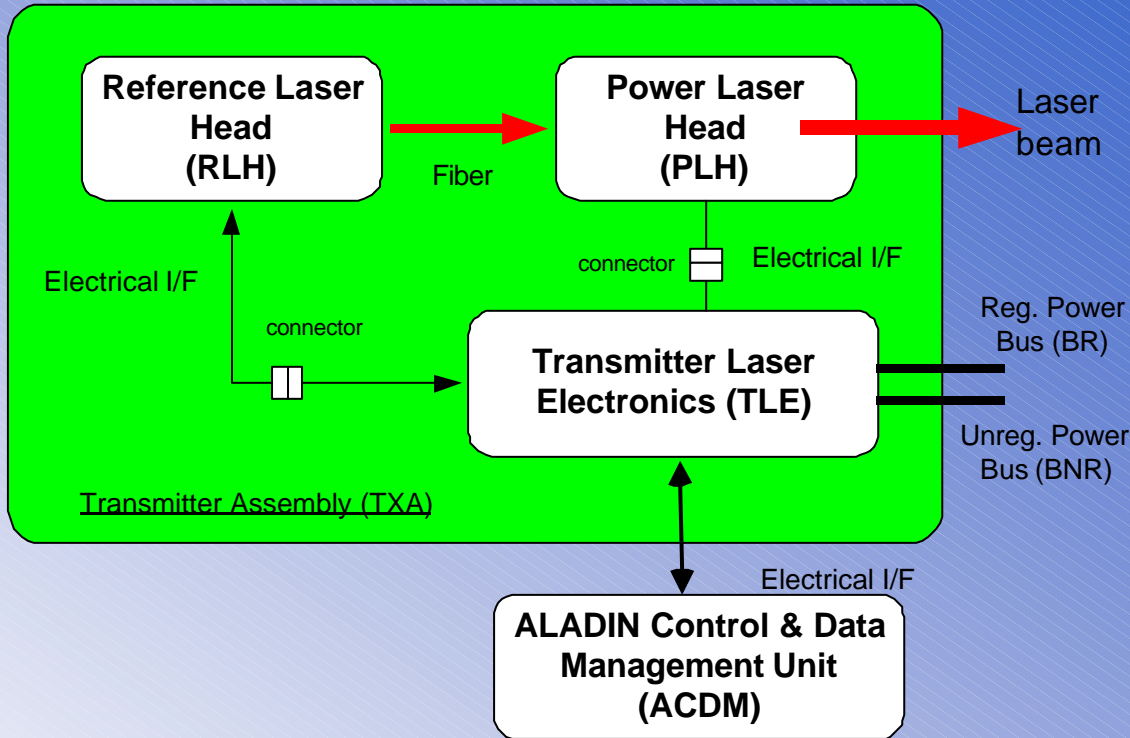
# ALADIN instrument-Transmitter Laser Assembly (TXA)

Laser Output Requirements

Parameter	Aladin TXA
Energy/pulse	> 150 mJ
Polarisation	Linear, better than 100:1
$M^2$	< 3.5
Pulse duration	$\leq 100$ ns FWHM
Pulse linewidth	$\leq 50$ MHz FWHM
Spectral purity	99% of the pulse energy within 90 MHz
Frequency stability	< 4 MHz rms over the measurement time
Tunability	$\pm 7.5$ GHz for adjustm. $\pm 5$ GHz in calibr. mode
Tuning accuracy	< 1 MHz rms over 28 min (noise) < 1.7 MHz rms over 28 min (slow drift)

Physical & Environmental Requirements

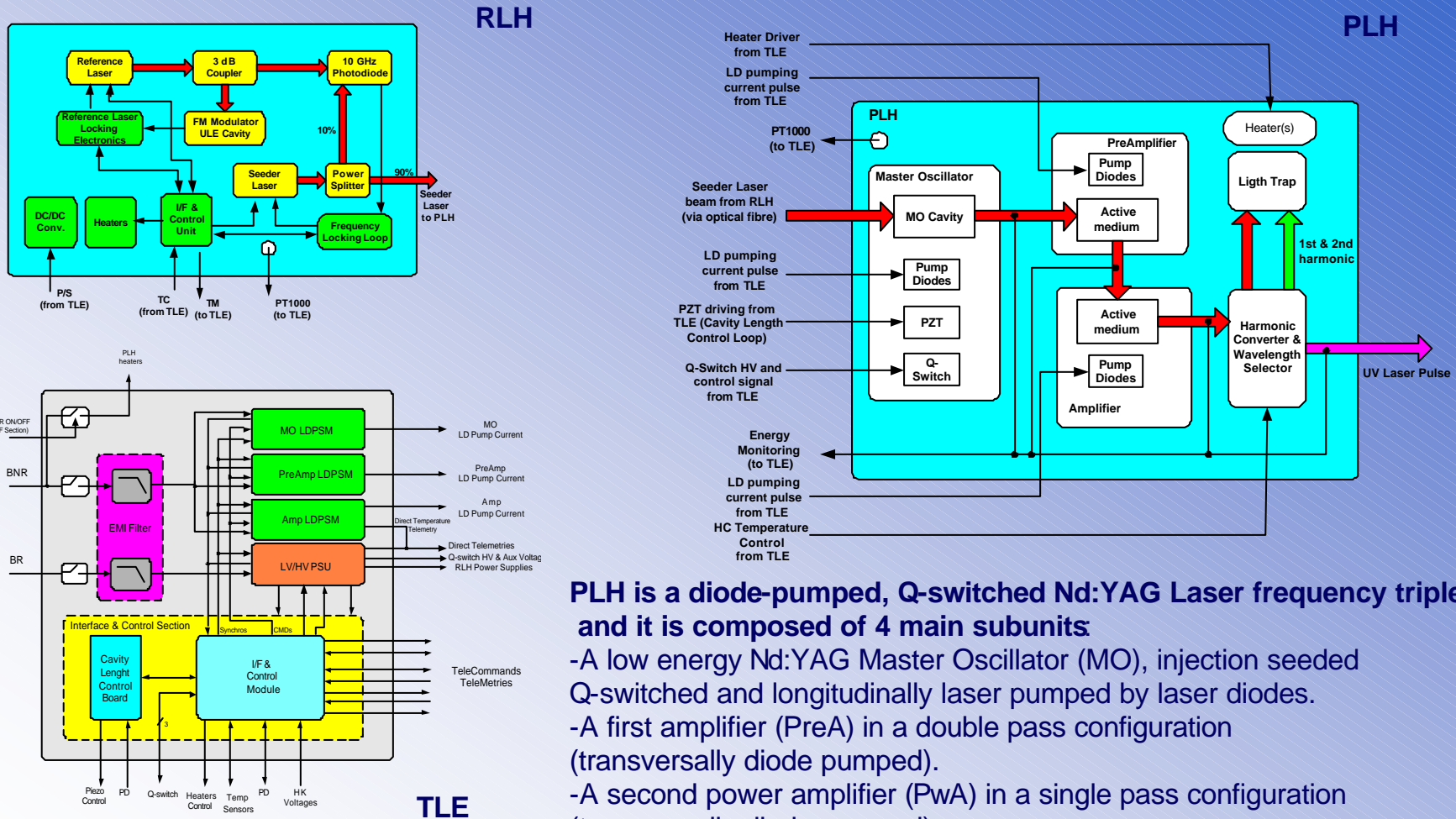
Parameter	Aladin TXA
Mass	PLH +RLH < 31 kg TLE < 23 kg
Stiffness (first eigen-frequency for rigid boundary conditions)	PLH > 140 Hz RLH > 300 Hz TLE > 300 Hz
Single side conductive cooling cold plate interface temperature	$22^\circ\text{C} + 1^\circ\text{C}$
Average power consumption	< 470 W



Most stringent requirements :

- Frequency stability and tuning accuracy.
- Environmental requirements, especially mass, stiffness and thermal I/F with Aladin instrument.
- Lifetime.

# ALADIN instrument-TXA Functional Block Diagram



**PLH is a diode-pumped, Q-switched Nd:YAG Laser frequency tripled and it is composed of 4 main subunits**

- A low energy Nd:YAG Master Oscillator (MO), injection seeded Q-switched and longitudinally laser pumped by laser diodes.
- A first amplifier (PreA) in a double pass configuration (transversally diode pumped).
- A second power amplifier (PwA) in a single pass configuration (transversally diode pumped).
- A Harmonic Section (HS) employing two non-linear crystals.



# ALADIN instrument- Laser Transmitter Units

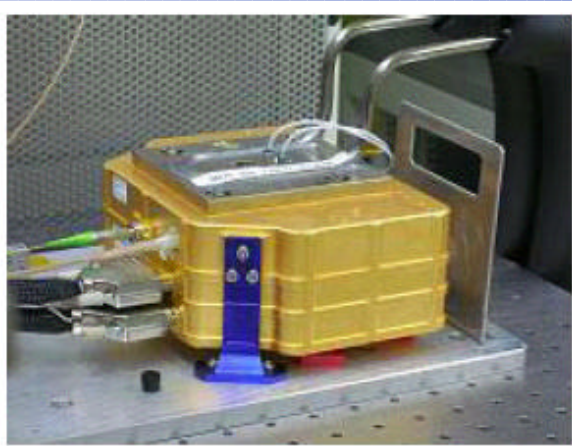


Fig. 1. RLH Unit.

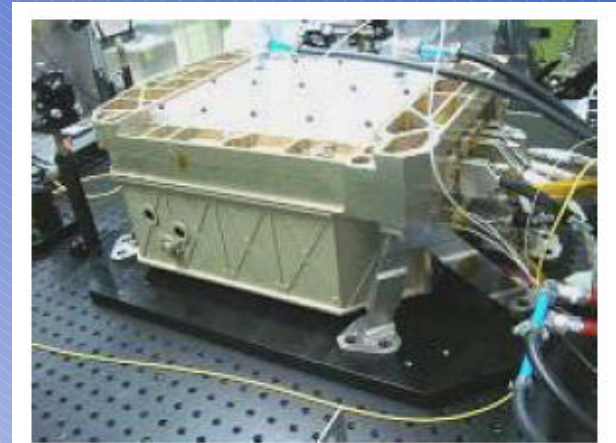


Fig. 2. PLH Unit.

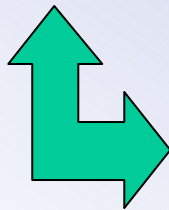
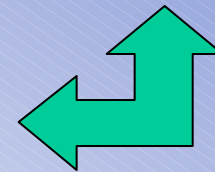
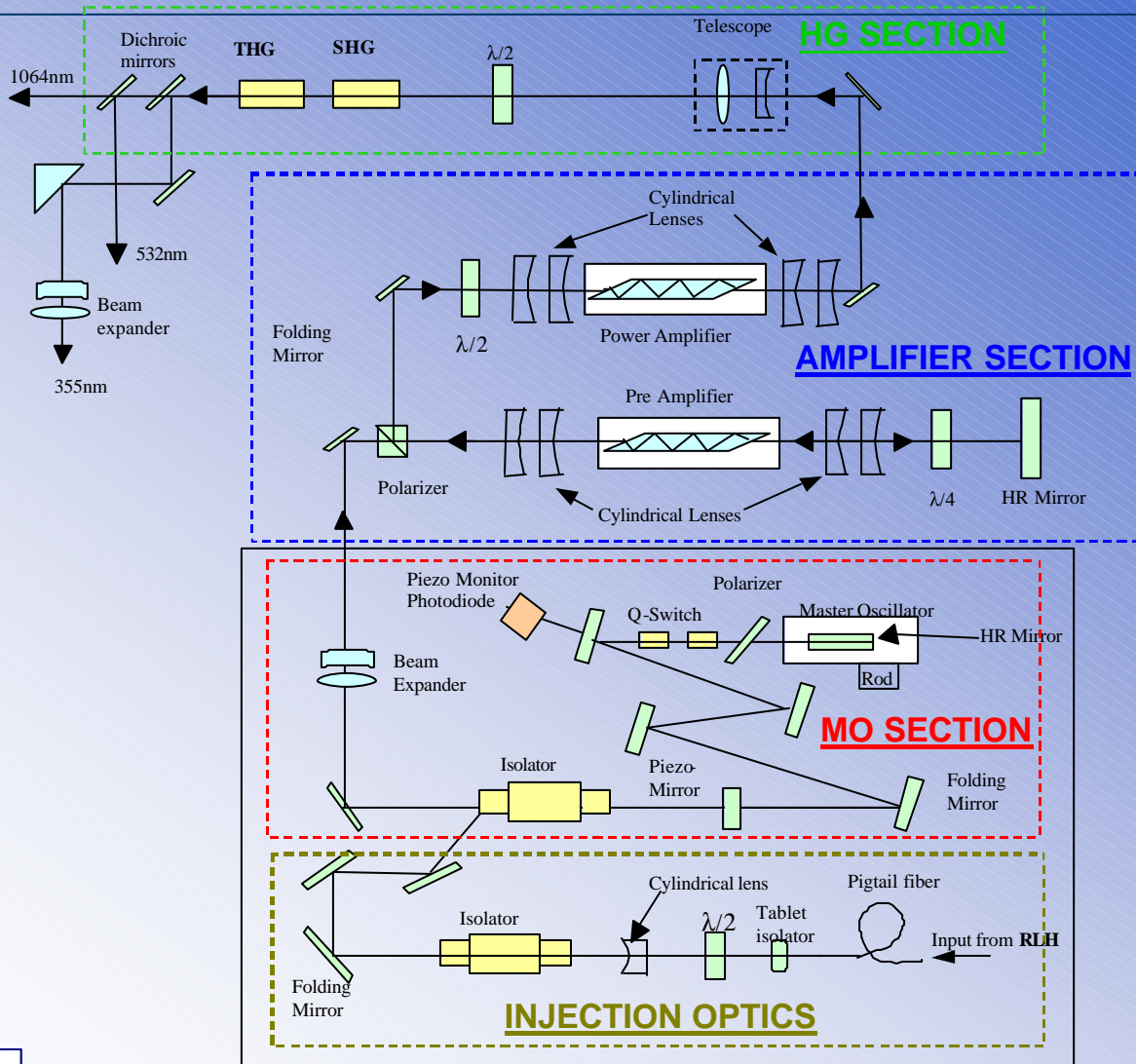


Fig. 8. TLE Unit.



# ALADIN instrument- PLH Optical Lay-Out





# ALADIN instrument- PLH Mechanical Structure

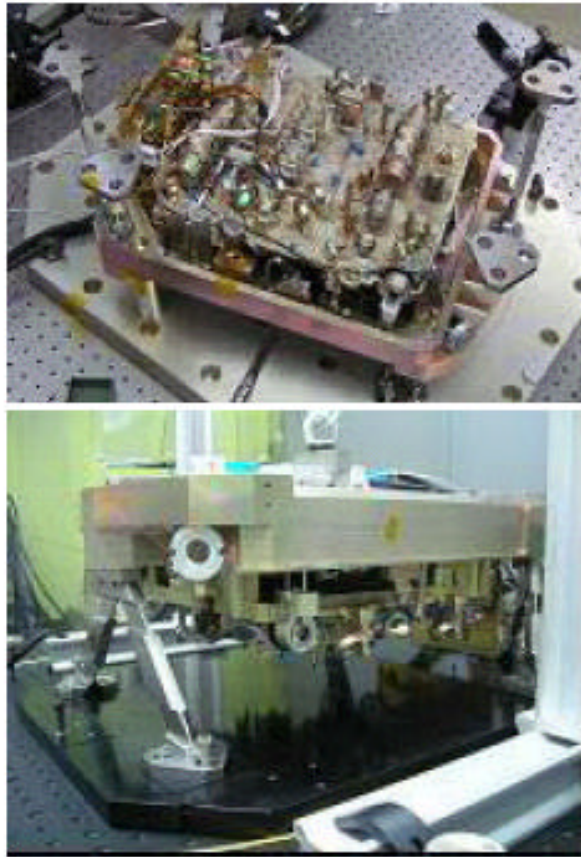
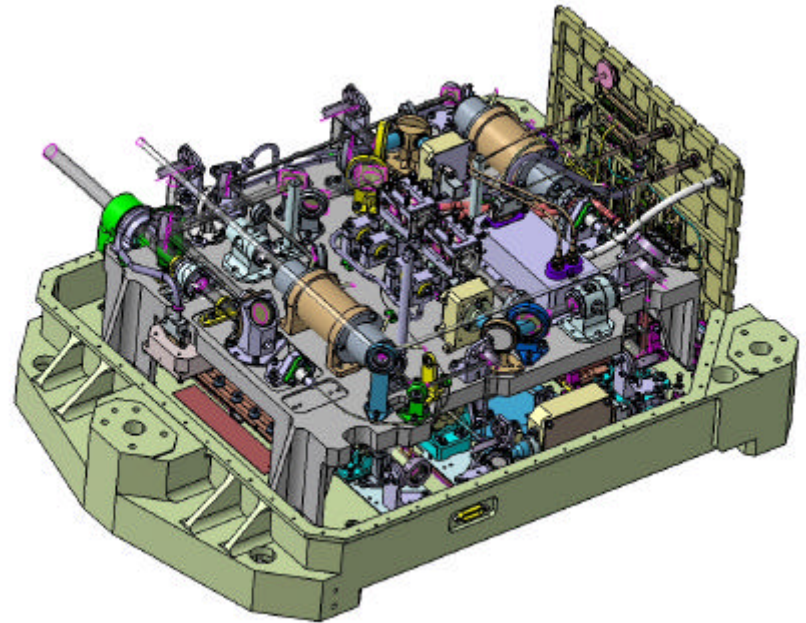
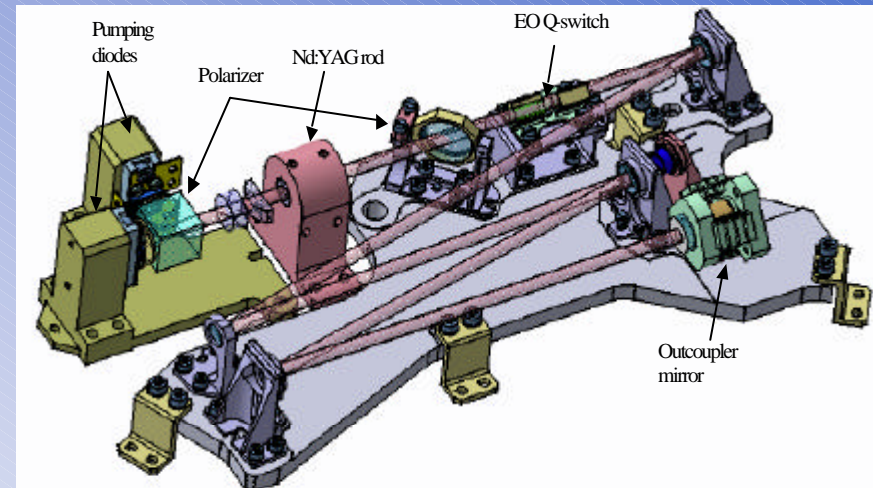


Fig. 7. PLH Unit: On-Ground integration configuration (upper), Testing/In-Flight configuration (lower) without cover.

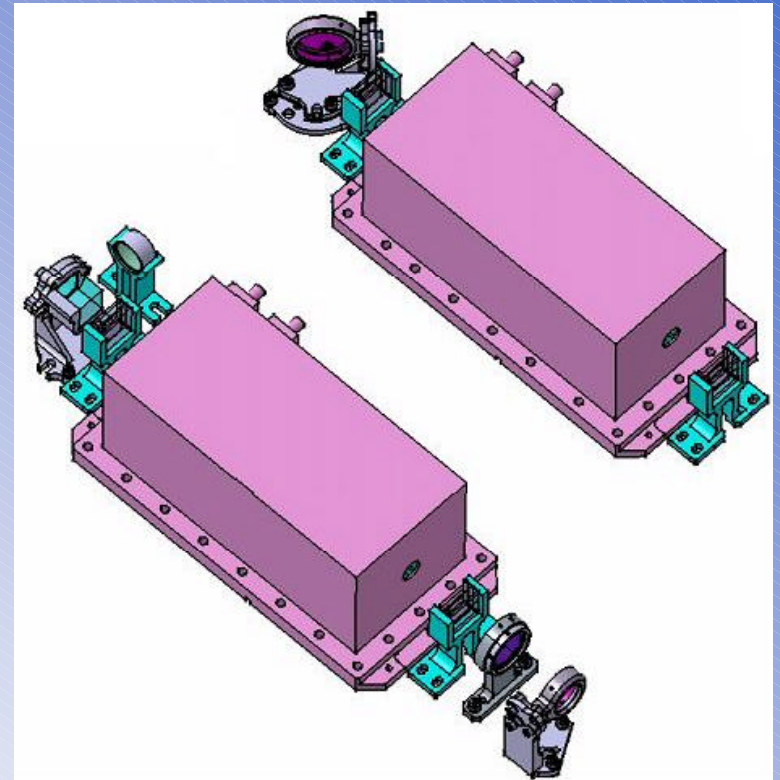
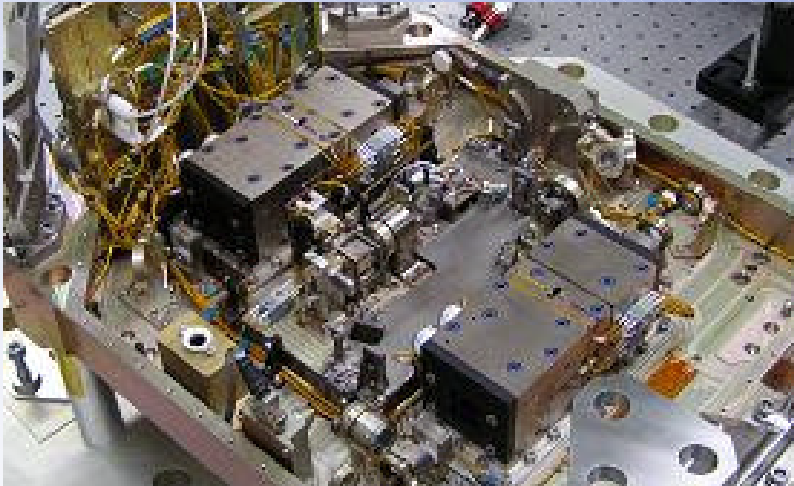


# ALADIN instrument-PLH Main Subassemblies: MO



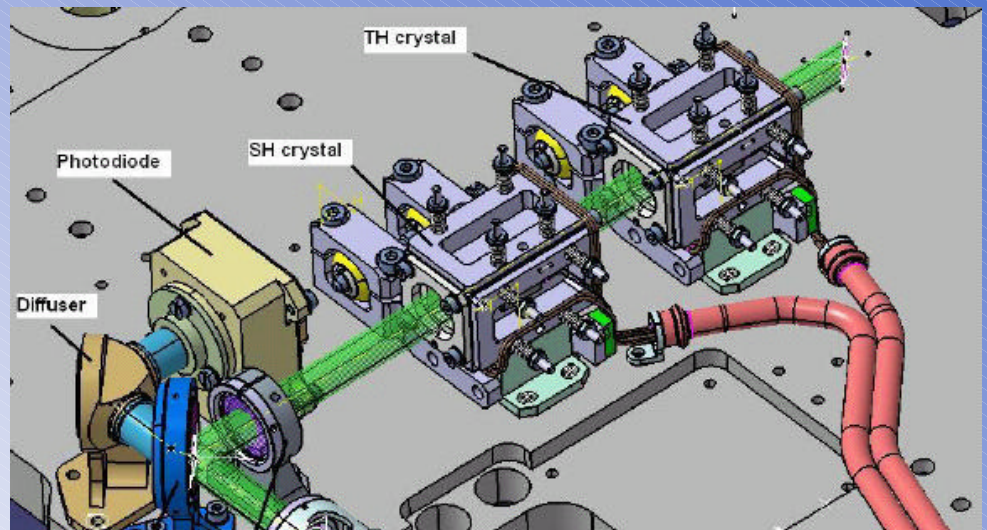
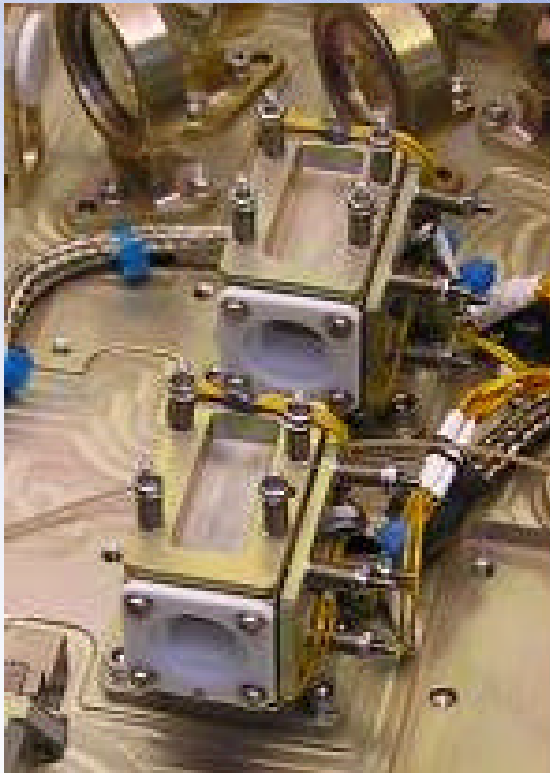


# ALADIN instrument-PLH Main Subassemblies: AMPLIFIERS





# ALADIN instrument-PLH Main Subassemblies: HARMONIC SECTION



# TXA EQM EXPERIMENTAL RESULTS

Table 1. Main UV Laser Output Performance

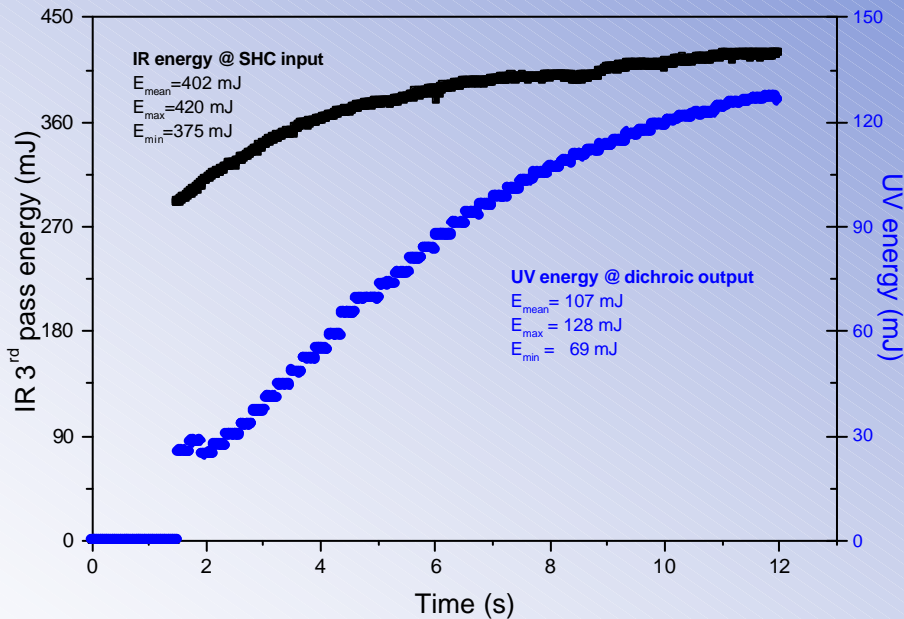
Parameter	EQM Measurement
Energy/pulse	107 mJ (mean during ON period)
$M^2$	$\leq 3$
Pulse duration	18.4 ns (FWHM)
Beam Angular Stability	24.4 $\mu$ rad X (zig-zag plane) 28.7 $\mu$ rad Y (orthogonal to zig-zag plane)
Spectral linewidth	40 MHz (FWHM)
Frequency stability	3.7 MHz (rms value)

Table 1. Physical Data & Budgets

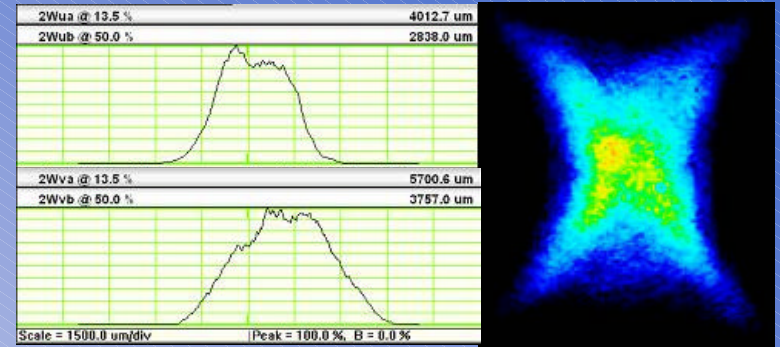
Parameter	EQM Measurement
Mass	PLH EQM = 27.3 kg RLH EM = 2.4 kg TLE EM < 22.2 kg
Volume	PLH = 450x350x215 mm <sup>3</sup> RLH < 150x120x75 mm <sup>3</sup> TLE < 450x345x230 mm <sup>3</sup>
Stiffness	PLH Resonance frequency X axis 182 Hz Y axis 288 Hz Z axis 251 Hz RLH Resonance frequency X axis 347 Hz Y axis 342 Hz TLE Resonance frequency X axis 220 Hz Y axis 430 Hz Z axis 510 Hz
Cold Plate	24 $\pm$ 1 °C
Power consumption	440 W (measured average value)



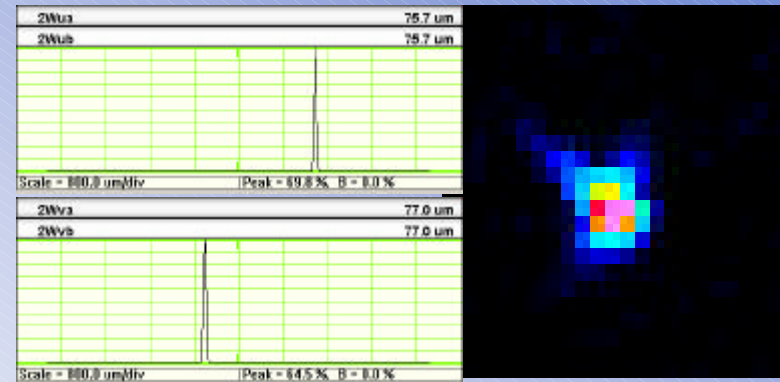
# TXA EQM EXPERIMENTAL RESULTS



IR/UV Energy during 12 s. The reported values refer to last 7 s useful period

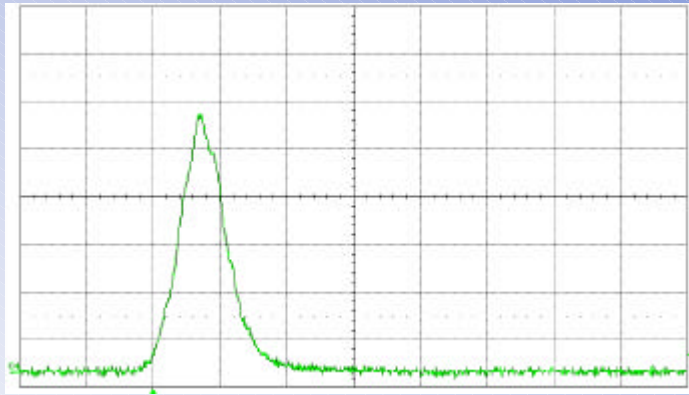


Typical UV Near Field profile

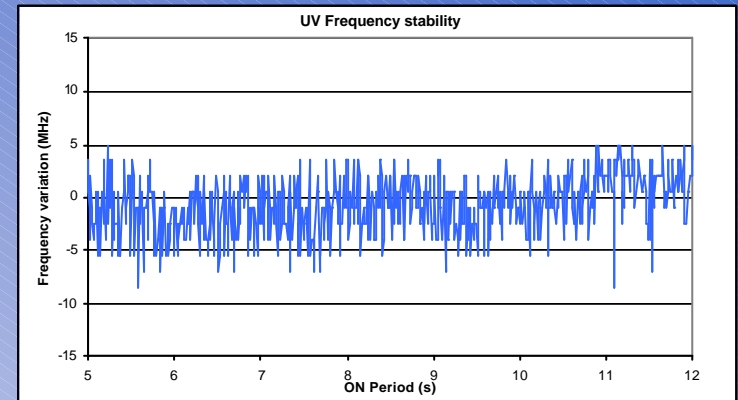


Typical UV Far Field profile

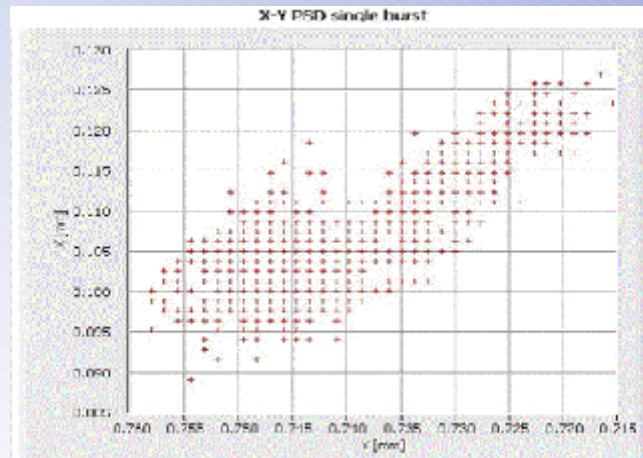
# TXA EQM EXPERIMENTAL RESULTS



Typical UV pulse temporal profile



Optical frequency stability



UV beam angular stability during a burst



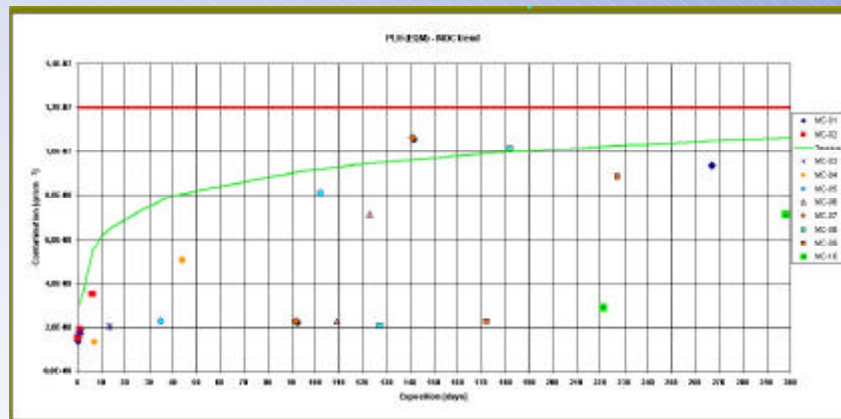
# TXA SPECIFIC PROVISIONS

## Cleanliness/Contamination

$$\text{PFO} = 0.069 \times [\text{Cleanroom class}]^{0.72} \quad [\text{ppm./day}]$$

this implies, as rough assessment:

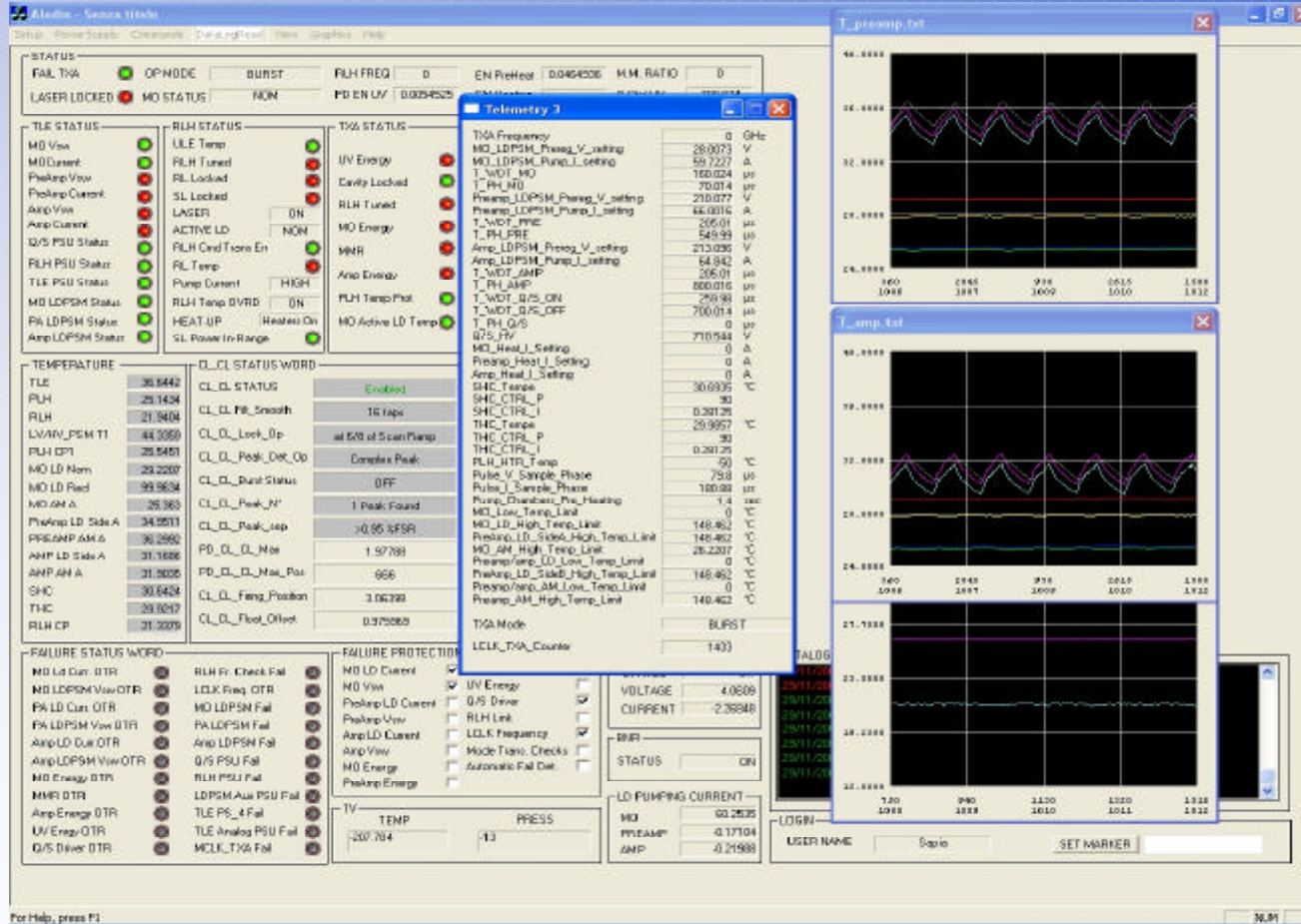
- ◆ CR, class 100.000 (M6.5)  $\Rightarrow$   $\approx 275$  [ppm./day]
- ◆ CR, class 10.000 (M5.5)  $\Rightarrow$   $\approx 53$  [ppm./day]
- ◆ CR, class 100 (M3.5)  $\Rightarrow$   $\approx 2$  [ppm./day]



MOC exposition PLH EQM curve

# TXA SPECIFIC PROVISIONS

## In-Flight monitoring and control





# TXA SPECIFIC PROVISIONS

## TXA functional mode diagram and mode control parameters

