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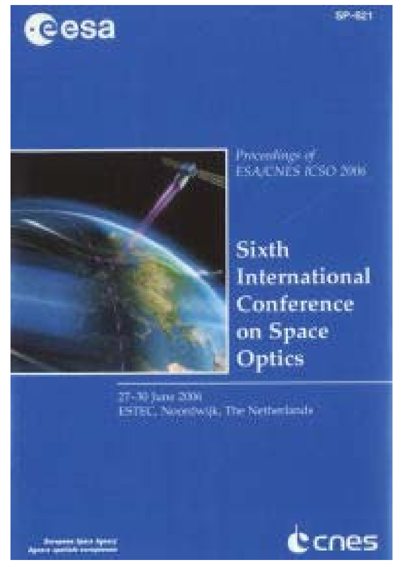

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CONDUCTION COOLED COMPACT LASER FOR THE CHEMCAM INSTRUMENT

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ABSTRACT

A new conduction cooled compact laser for laser induced spectroscopy on the Mars Science Laboratory (MSL) to be launched in 2009 is presented. An oscillator combined to amplifiers generates 30mJ at 1μm with a good spatial quality. Development prototype of this laser has been built and characterized. Environmental testing of this prototype is also reported.

1. INTRODUCTION

This communication describes a conduction cooled diode pumped laser. This laser to be used in the ChemCam instrument on MSL 2009, is representative of the flight model in terms of volume, mechanical, thermal and electrical interfaces. It is a compact laser, designed to work in burst mode on a rover to do laser induced spectroscopy of mars rocks. It necessitates no active cooling, neither for the laser diodes nor for the laser medium

2. LASER ARCHITECTURE AND PERFORMANCES DATA

Fig. 1 shows a picture of the development prototype of the laser. Due to the mission constraints, compactness and weight were two driving factors of the mechanical design, keeping the necessary stiffness at the same time. Laser dimensions are about ϕ55 x 220 mm and weight is about 600 g.

The laser runs in the nanosecond regime, at a repetition rate of 10Hz maximum. Its architecture is based on an oscillator followed by two slab amplifiers. The oscillator is designed to provide a high beam quality. The output energy is enhanced in the amplifiers while keeping good spatial beam characteristics.

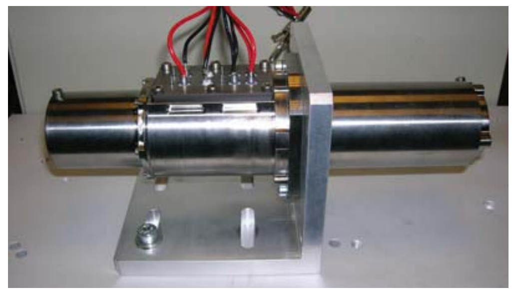

Fig. 1 Picture of the development prototype

2.1 The oscillator

Oscillator is based on a Nd : KGW rod longitudinally pumped by a diode stack. The very wide spectral acceptance of the Nd : KGW rod provides very small absorption variations over wide temperature ranges. This allows both the diode and the rod to be conductively cooled and run on large temperature ranges of the mars rover. Oscillator is Q-switched with a RTP pockels cell to produce the nanosecond pulses needed for LIBS.

Oscillator is linear, closed on one side by the rod and by the outpout coupler on the other side. Reflectivity of the outpout coupler is 60%. A polarizer, wave-plate and pockels cell Q-switch the cavity. The oscillator provides an output energy of about 10mJ with a pulse duration < 10ns and a beam quality factor < 3.

2.2 The amplifier

Amplifiers are based on transversally diode pumped Nd : KGW slabs. Two identical amplifiers increase the energy at the oscillator output. Each amplifier is pumped by a 700W stack. An energy in excess of 30 mJ is obtained at the laser output, with a M^2 factor < 3.

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2.3 Environmental testing
The laser has been placed in a climatic chamber for temperature testing. Temperature tests were performed for an output energy of 25mJ at ambient (see Fig. 2). Energy remains over 20mJ when temperature changes between 10°C and 40°C. Pulse duration is less than 8ns on the same temperature range. Even if performances change more rapidly on extended temperature ranges, this laser was fired on temperature ranges as large as 60°C. It recovered its initial performances at ambient after the extended range of temperatures (see Fig.2).
As stated before, these results have been obtained with a completely passively cooled laser, without temperature control neither on the pump diodes nor on the crystals. Absence of temperature control drastically reduces electrical consumption of the laser (less than 2 W).

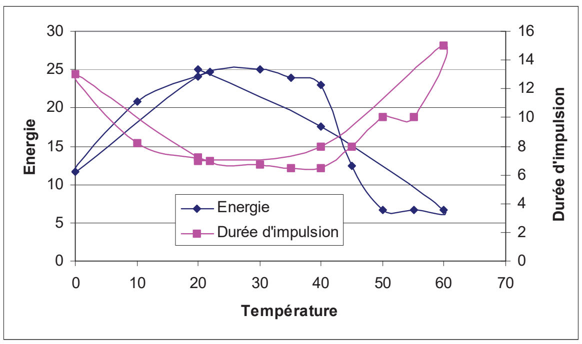

Fig. 2 : Energy and pulse duration versus temperature

Conclusion
A passively cooled laser able to work on large temperature ranges has been built. It emits more than 30 mJ in burst mode at 1 µm in a short pulse with high beam quality. This laser will be used on the ChemCam instrument to do LIBS of martian rocks.

Acknowledgement
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