Thermal management of high average power lasers

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PhD may follow: Yes

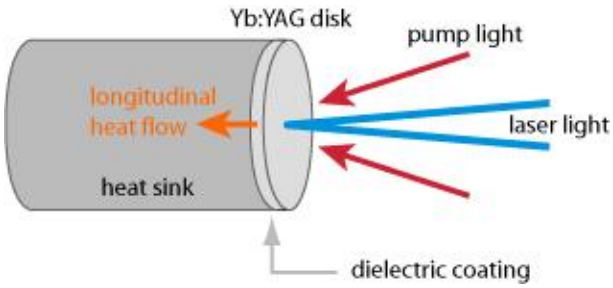
Summary :

The development of high average power lasers (high power density or high recurrence rate) is currently expanding both for fundamental physics (astrophysics, particle beam generation) and for industrial or medical applications (proton therapy). Thermal management of these lasers has been identified as an important issue to achieve better optical performance and to reduce thermal noise effects (loss of depolarization, thermal lensing, optical breaking). The cryogenic cooling of these lasers can improve the optical -optical conversion and reduce thermal distortion of the wavefront by improving thermo-mechanical and thermo-optical properties of the materials used. The proposed internship is the study of a cryogenic laser amplifier where high densities of heat flux will be present.

Full description :

Previous studies have shown promising for cryogenic lasers with high average power by highlighting improved thermo-mechanical and thermo-optical properties of laser materials used at cryogenic temperature. A thorough understanding of the thermo-optical and a perfect control of the thermohydraulics coupled with low temperatures are now required to ensure the increase of the optical-optical conversion and to limit distortions of their wavefronts. A cryogenic laser amplifier is actively cooled by a cold source which extracts high power (1 kW to 100 K) on reduced exchange surfaces (few cm Â²) leading to high densities of surface heat flows (tens of W/cm Â²) at the interface with the laser crystal.

The internship proposes to study the two-phase flow heat transfer applied to cryogenic laser amplifiers. The problem will be to ensure optimal heat transfer between the cold source and the laser crystal by minimizing the mechanical and thermal stresses on it. This study could be continued in a Ph-D.



Requested skills :

Knowledge of heat transfer and fluid mechanics (essential),

Competence on fluid dynamics software ANSYS CFX, Fluent or COMSOL (recommended),

Rigorous and autonomy.