

### Electro-optic decoupling of input and output ports in a regenerative Laser amplifier

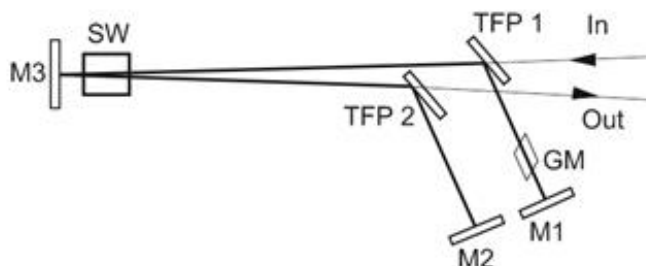
By folding a laser cavity in a way that the cavity axis intersects itself at least at one point and placing a switching element at the point of the intersection, geometrical decoupling of input and output ports of a regenerative laser amplifier is achieved without using an optical isolator.

#### BACKGROUND

Regenerative laser amplifiers with ultrashort pulses can provide high optical energy packed into extremely short time intervals and high brightness beams. There are numerous applications, ranging from scientific to industrial fields. In the traditional design of regenerative amplifiers, the input and output ports coincide spatially, which requires an optical isolator outside the laser cavity in order to separate output light from input light by its state of polarization. This leads to increased cost and complexity of the amplifier, so our target was to avoid the usage of an isolator.

#### TECHNOLOGY

We developed a method for spatial separation of input and output ports via the arrangement of the laser cavity itself. The laser cavity is formed by mirrors M1-3 and the thin film polarizers TFP1 and TFP2. TFP is a polarization sensitive optical element, which transmits light with linear polarization state PS1 and reflects light with linear polarization state PS2, orthogonal to PS1. Thus, TFP1 serves as input port and TFP2 as output port. TFP1 transmits pulses in the state PS1 from a laser oscillator into the cavity. TFP2 transmits pulses amplified in gain medium GM with polarization state PS1 out of the cavity.



In order to trap pulses in the cavity, their polarization state is changed to PS2 for the duration of the amplification cycle. This is done by an electro-optic switch SW. The cavity is arranged so that the cavity axis intersects with itself at at least one point. The alignment of SW along the bisector of intersection angle, along with keeping the intersection angle as small as allowed by the configuration of the cavity, helps minimizing losses introduced by imperfections of the switching.

As a result, this method does not need an external optical isolator and decreases the complexity of the laser cavity, while utilizing the same components as a conventional laser cavity.

#### ADVANTAGES

- No external optical isolator required for I/O separation
- Simple and effective cavity design

**REFERENCE:**  
M024/2016

#### APPLICATIONS:

- Investigation of light-matter interaction.
- Fine laser cutting.
- Atmospheric sensing.
- Medical non-invasive techniques.

#### KEYWORDS:

- Regenerative amplifier without an optical isolator;
- Electro-optic crystal non-collinear to cavity axis;
- Separated input/output ports of regenerative amplifier.

#### IPR:

Austrian (AT) Patent and PCT filed

#### OPTIONS:

- R&D - Cooperation
- License Agreement
- Patent sale

#### INVENTORS:

Giedrius ANDRIUKAITIS  
Andrius BALTUŠKA  
Audrius PUGŽLYS  
Edgar KAKSIS

#### CONTACT:

**Angelika Valenta**

TU Wien

Vienna, Austria

T: +43.1.58801.41538

[angelika.valenta@tuwien.ac.at](mailto:angelika.valenta@tuwien.ac.at)

[www.rt.tuwien.ac.at](http://www.rt.tuwien.ac.at)