

| REPORT DOCUMENTATION PAGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                              |                                       |                                                | Form Approved OMB No. 0704-0188                                   |                                                                        |
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| <b>4. TITLE AND SUBTITLE</b><br><br>COIL Workshop                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                              |                                       | <b>5a. CONTRACT NUMBER</b><br>FA8655-09-1-3024 |                                                                   |                                                                        |
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| <b>6. AUTHOR(S)</b><br><br>Dr. Willy L Bohn                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                              |                                       | <b>5d. PROJECT NUMBER</b>                      |                                                                   |                                                                        |
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| <b>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</b><br>BohnLaser Consult<br>Weinbergweg 43<br>Stuttgart 70569<br>Germany                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                              |                                       |                                                | <b>8. PERFORMING ORGANIZATION REPORT NUMBER</b><br><br>N/A        |                                                                        |
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| <b>13. SUPPLEMENTARY NOTES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                              |                                       |                                                |                                                                   |                                                                        |
| <b>14. ABSTRACT</b><br><br><div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p>This report results from a contract tasking BohnLaser Consult as follows: US Air Force has a very important interest in the research on chemical oxygen iodine lasers.</p> <p>1. Organization of the COIL R&amp;D Workshop in Stuttgart for Fall 2009.</p> <p>2. A final report summarizing the results of these activities.</p> </div> <div style="width: 48%;"> <p>The anticipated tasks for this effort are as follows:</p> <p style="text-align: right;">COIL R&amp;D Workshop</p> <p>The Workshop is to be held at the International Community Center (Internationales Begegnungszentrum, IBZ) of the University of Stuttgart, a facility to which this proposer has free access. This location, formerly the home of the German scientist and space pioneer Eugen Saenger, holds 30 to 40 people and provides the necessary conference infrastructure including catering facilities. Separate rooms for private negotiations are available, if necessary. The Telekom hotel which offers inexpensive accommodations is situated within walking distance. Organizational activities will include developing a list of topics to be discussed during the workshop, developing a list of potential speakers, contacting these speakers and soliciting abstracts from them, coordinating with EOARD and AFRL with on dates for the Workshop, generating a list of attendees, distributing a general announcement to the list of attendees, reserving the conference center, coordinating catering for the Workshop, coordinating social events for the workshop, and hosting the workshop.</p> </div> </div> |                              |                                       |                                                |                                                                   |                                                                        |
| <b>15. SUBJECT TERMS</b><br>EOARD, Chemical oxygen iodine lasers, Optical Components                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                              |                                       |                                                |                                                                   |                                                                        |
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| <b>a. REPORT</b><br>UNCLAS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>b. ABSTRACT</b><br>UNCLAS | <b>c. THIS PAGE</b><br>UNCLAS         |                                                |                                                                   | <b>19b. TELEPHONE NUMBER</b> (Include area code)<br>+44 (0)1895 616205 |

## **Final Report on COIL R & D Workshop**

**Contract FA8655-09-1-3024**

13-14 October 2009  
Stuttgart

### **Executive Summary**

The COIL Workshop was attended by 25 participants from 7 countries:

|                  |          |
|------------------|----------|
| China 2          | Russia 2 |
| Czech Republic 4 | UK 1     |
| Israel 2         | USA 9    |
| Germany 5        |          |

In 2 days 15 oral presentations were given with 12 contributions related to COIL and 3 contributions dealing with EOIL (the electric oxygen iodine laser).

The most outstanding feature of this workshop was the participation of 2 representatives from the Dalian Institute of Chemical Physics (DICP), China. Unique insights into the Chinese COIL Research and related Optics were given.

The US scientists provided a comprehensive overview of the laser activities of the Directed Energy Directorate of the AFRL with special emphasis on recent COIL efforts. Extensive COIL modeling and simulation as well as diagnostic investigations were presented. A special highlight has been the presentation of the Extended User Evaluation related to the Advanced Tactical Laser which also included a video. Current efforts in pressure recovery were also presented and widely discussed among the participants.

The Group from the Czech Republic showed novel aspects in oxygen and iodine generators. Hereby the centrifugal spray type singlet oxygen generator was of particular interest. Besides the chemical generation of molecular iodine the group has extended its research to the production of either iodine or singlet oxygen in electric discharges which leads to the field of EOIL.

The Stuttgart group from DLR presented the latest work in laser resonators aimed at high beam quality for COIL using a hybrid unstable/stable optical cavity in order to match the optical criteria with the flow geometry of the laser. In addition a short overview was given of the newly installed laser test range at the Lampoldhausen site.

The Ben-Gurion University group concentrated on modeling of lasing with unstable resonators and iodine dissociation in supersonic COIL which was still a subject of intense discussion among the participants.

The Russian participants (Lebedev Moscow and Samara) presented results from generation of singlet oxygen and iodine in electric discharges (glow or RF).

Finally the workshop ended with an animated discussion on major technical COIL issues and the perspective of the chemical laser in front of the tremendous progress achieved by solid-state and fiber lasers in recent years.

**COIL R & D Workshop**  
**Stuttgart**  
**13 – 14 October 2009**

**List of participants**

| <b>Name</b>                                                                                              | <b>Institute/Company</b>                                                                                                 | <b>E-mail address</b>                                                                                                                                                                                              |
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## **Tuesday, 13 Oct 2009**

**09:00**      Registration

**09:20**      Welcome Address

*Session I    Chair: Susan Thornton*

**09:30            COIL Research Activities in DICP**

Yuqi Jin, Xinmin Han, Fengting Sang, Dalian Institute of Chemical Physics (DICP), CAS

**10:00            Recent Gas Laser Activities at AFRL, a General Overview**

Timothy Madden, Directed Energy Directorate, Air Force Research Laboratory

**10:45            Break**

*Session II    Chair: Andrey Ionin*

**11:15            Review of COIL Research Activities at the Institute of Physics,  
Prague**

Jarmila Kodymová, Institute of Physics, AS, Prague

**11:45            Research on Centrifugal Spray Singlet Oxygen Generator for a  
COIL**

O. Špalek, V. Jirásek, J. Hrubý, M. Čenský, J. Kodymová, Institute of Physics, AS, Prague

**12:15            An Investigation of a Gas Laser Pressure Recovery System  
Diffuser**

Carrie Noren, Theodore Ortiz, Michael Wilkinson, & Timothy Madden  
Directed Energy Directorate, Air Force Research Laboratory

Wade Klennert, Boeing LTS, Albuquerque, NM

Richard Chan & H. Wilhelm Behrens, Northrop Grumman Space  
Technology, Redondo Beach, CA

Robert Walter, Schafer Corporation, Albuquerque, NM

Robert Decker, USAFA, Colorado Springs, CO

**12:45**      **Lunch**

*Session III    Chair: Yuki Jin*

**14:00**      **R&D of Optics in COIL**

Long Sun, Gang Li, Wanfa Liu, Dalian Institute of Chemical  
Physics (DICP), CAS

**14:30**      **Modified Negative-Branch Unstable Resonator in Different  
Configurations**

Carsten Pargmann, Thomas Hall, Jürgen Handke, DLR Institute of  
Technical Physics, Stuttgart

**15:00**      Depart for Porsche Museum

**16:30**      Guided visit of the Porsche Museum

**18:00**      Informal Get Together

**Wednesday, 14 Oct 2009**

*Session IV Chair: Jarmila Kodymová*

**09:00 Chemical Generation of Molecular Iodine for a COIL**

V. Jirásek, M. Čenský, O. Špalek, J. Kodymová, Institute of Physics, AS, Prague

**09:30 I<sub>2</sub> Dissociation in Supersonic Chemical Oxygen-Iodine Lasers: Recent Kinetic-Fluid Dynamics Modeling"**

K. Waichman, B.D. Barmashenko and S. Rosenwaks, Department of Physics, Ben-Gurion University of the Negev, Beer Sheva

**10:00 Singlet Delta Oxygen Generator with a Slab Transverse Gas Flow RF Discharge for DOIL**

A.Ionin, Yu.Klimachev, I.Kochetov, A.Napartovich, O.Rulev, D.Sinitsyn, and L.Seleznev, Lebedev Physical Institute, Moscow

**10:30            Break**

*Session V    Chair: Wally Clark*

**11:00            Modeling of Lasing in Chemical Oxygen-Iodine Lasers with Unstable Resonators**

B.D. Barmashenko, Department of Physics, Ben-Gurion University of the Negev, Beer-Sheva

**11:30            RF Discharge Dissociation of Various Iodine Donors for a COIL/DOIL**

V. Jirásek, J. Schmiedberger, M. Čenský, J. Kodymová, Institute of Physics, AS, Prague

**12:00            Latest Development of Hybrid DC/RF Plasma Jet Generator of O<sub>2</sub> (<sup>1</sup>Δ) for a DOIL**

J. Schmiedberger, K. Rohlena, V. Jirásek, M. Čenský, J. Kodymová, J. Gregor, P. Křenek, M. Hrabovský, Institute of Physics, AS, Prague

**12:30            Lunch**

**14:00            Iodine Generation in a Glow Discharge**

P. A. Mikheyev, V. N. Azyazov, Lebedev, Physical Institute, Samara Branch, Samara

**15:00            Post Deadline Presentation:**

### **First year of DLR-test range at Lampoldshausen**

Jürgen Handke, Karin Grünewald, DLR Institute of Technical Physics,  
Stuttgart

Round Table

End of Workshop

**16:00**      Discussion Groups

**18:30**      Dinner at Restaurant “Klösterle”, Stuttgart Bad Cannstatt

## Acknowledgement:

We wish to thank the following for their contribution to the success of this conference:  
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