**MAIN PUBLICATIONS**

**Photonic Materials**


**Biophotonics**


**Atomic physics**


**RESEARCH, INNOVATION AND DISSEMINATION CENTERS (RIDC)**

**MAIN RESEARCHERS**
Cleber Renato Mendonça
Jarbas Caado de Castro Neto
Luis Gustavo Marcassa
Antonio Ricardo Zanatta
Sérgio Carlos Zilio
Maximo Siu Li
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**Partner Institutions**
State University of Campinas (Unicamp)
- Gleb Wataghin Physics Institute
- Electrical and Computing Engineering School
- Chemistry Institute
- School of Medical Sciences
- University of São Paulo (USP)
- São Carlos Physics Institute
- São Carlos School of Engineering
- Ribeirão Preto School of Medicine
- Institute of Energy and Nuclear Research (Ipen)
- Laser and Applications Center

**Other Institutions**
EMBRAPA Instrumentation Center
Amaral Carvalho Hospital

Under the general rubric of Basic Research, the RIDC currently animates the following three major themes. In addition, the Center supports eleven research partnerships with various dental, medical and veterinary schools pursuing research and treatment in medical dentistry, oncology and crop diseases.

Specific research programs in Molecular and Optical (MO) physics concentrate on quantum condensed matter, cold atomic and molecular collisions as well as quantum atomic fluids like Bose-Einstein condensate, and the development of state-of-the-art time and frequency standards by using atomic clocks.

The Photonic materials program develops polymers and other organics, applies ultrashort light pulses for manufacturing and analysis, and characterizes optoelectronic thin films. Biophotonics investigates new noninvasive optics-based diagnostic tools, cancer therapies involving light (photodynamic therapy), early photodiagnosis of plant and crop diseases, and environmental issues such as pesticide degradation and pollution of ground waters.

These research programs are imbedded in partnering agreements with professional schools in the São Carlos region. Because of its unique expertise in optics, materials, and device development, the Center is planning a new basic research thrust into the multidisciplinary area of plasmonics and nanophotonics.

The Innovation axis develops new devices, interfaces with local high-technology enterprises, and creates spin-off companies to commercialize new applications developed at the Center. This activity is concentrated at the new LAT Laboratory-Laboratory for Applied Technology and has resulted in the creation of thirty optics-based companies in São Carlos, three new spin-off companies alone in 2006.

The Outreach program involves educational activities at all levels from elementary school to post-graduate continuing education. The Week of Optics, SEMOPTICA, has become a major annual event in the school calendar all over the State of São Paulo. The Center broadcasts on Educational Television not only university level courses, but also programs popularizing important developments in optics-based science and technology. The Center has developed a Mobile Science Unit, a specially prepared bus to visit schools for the purpose of presenting scientific demonstration and expositions.

**Optics and Photonics Research Center (CEPOF)**
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**MAIN RESEARCH TOPICS**

**Atomic physics**
- Bose-Einstein condensate of Rb and coherent modes
- Cold atomic collisions
- Time and frequency metrology

**Photonic materials**
- Nonlinear spectroscopy in organic materials
- Coherent control of light
- Crystallization of a-Si
- Optoelectronics of doped a-Si
- Photo-structural changes in chalcogenides

**Collaborative network**
- Clinical implementation of photodynamic therapy
- *In vivo* studies to optimize PDT
- Development of a real time dosimetry for photodynamic therapy
- Microbial control using photodynamic reactions
- Investigation of photobleaching in dental whitening
- Optics applied to agriculture and environment

**Optics and Photonics Research Center at São Carlos**

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**SUMMARY OF RESULTS TO DATE AND PERSPECTIVES**

The photodynamic therapy and optimization projects of this procedure have obtained as a result an optimized dosimetry process that allows for the real time evaluation of the process. As a consequence of this, we have been successful in attaining a higher rate of success than usual in eliminating tumors. The development of new instruments based on LED and lasers have enabled us to perform superficial and interstitial procedures more efficiently.

The project Optical Fluorescence Diagnosis of Cancer and Other Lesions has developed both techniques and equipment that permit biopsy results with sensitivity higher than 94%. Still as far as determining UV-caused skin lesions is concerned, we are able to identify the onset of threatening lesions capable of evolving to tumors.

An optical fluorescence evaluation technique, such as the one we have developed, is used for assaying the viability of organs to be transplanted. Also finished are the methodology and clinical prototype, both of which have been successfully employed for clinical purposes for the first time. The project for optical detection of pathologic tissue conditions has achieved and precision levels higher than 90% in determining time of death.

We have also developed a new technology that conjugates both ultrasound and light for improving the cure efficiency of composite dental resins in more than 20%. Our work has also borne fruit in dental photobleaching, resulting in marketable systems, as well as the development of a new gel based on coal nanoparticles, which yields higher photobleaching efficiency. By using photodynamic therapy techniques, we have developed prototypes that are now being clinically employed in periodontics for mouth and dental prostheses disinfection. We have been able to attain up to nine logarithmic orders in bacterial and fungal reduction. The systems developed are being used in immunosuppressed, transplanted and elderly patients, who do not tolerate the aggressivity of most fungicidal agents.