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## IMRA Nature Article: Yb Fiber Comb Lasers Enable Extreme Ultraviolet Spectroscopy

**February 2<sup>nd</sup>, 2012- Ann Arbor, MI** - IMRA America, Inc. (IMRA) announces the world's first direct comb spectroscopy in the extreme ultraviolet (XUV) (see *Nature*, volume 482, pages 68 – 71 (2012) - <http://www.nature.com/nature>); a crowning achievement resulting from a five-year collaboration between IMRA and JILA, the National Institute of Standards and Technology (NIST) and University of Colorado at Boulder, CO. The XUV spectral region can now be reached with a revolutionary spectroscopy tool based on IMRA's heralded ultrafast fiber lasers. The system is based on a 80 W precision fiber frequency comb as recently developed at IMRA, which is coupled into a high-finesse enhancement cavity, boosting the comb average power to a world record of nearly 10 kW, allowing for efficient intra-cavity high harmonic generation with inert gases such as xenon and krypton. The high harmonic output is subsequently crossed with an atomic beam to probe the atomic transitions of argon and neon in the 60 – 80 nm spectral range.

Optical spectroscopy has been one of the most important tools in advancing our understanding of atoms and the formulation of quantum mechanics since the 19<sup>th</sup> century. With the development of tunable single frequency diode lasers in the 1970's and frequency comb technology in 2000, optical spectroscopy has established itself as one of the most precise measurement tools in physics with a possible measurement accuracy at or below 1 part in 10<sup>19</sup> across the optical spectrum. Despite this tremendous progress, the XUV spectral region remained mostly unexplored due to a lack of high-resolution light sources. The new source overcomes both obstacles by providing a series of evenly spaced lines of precisely known XUV wavelengths (an XUV "frequency comb").

The present spectroscopy tool will generate a wealth of new information about atoms and molecules and will be invaluable for testing the foundations of quantum electrodynamics. Further breakthroughs can be expected in precision metrology when using these systems for probing of nuclear transitions in the XUV spectral range. With further advancements in fiber comb technology, XUV combs in the important 13 nm spectral region and in the water window below 2.5 nm can be envisaged, offering novel applications in biological imaging and the study of time dependent phenomena in crystallography.

Mr. Takashi Omitsu, the president of IMRA, commenting on this latest advance, said, "IMRA has been dedicated to researching ultrafast laser technology and hundreds of our lasers have been used for laser machining, but using lasers as an energy source is only utilizing a portion of benefits of our technology. We want to fully utilize the benefits by using lasers as a "wave" source. The XUV spectroscopy is a good example of using lasers as a wave. We want to help researchers access new areas and enhance their body of knowledge by providing new cutting edge research tool using our laser technology."

### About IMRA America

IMRA America, Inc., founded in Ann Arbor, Michigan in 1990, is dedicated to the development of ultrafast fiber laser technologies for commercial applications. IMRA's technology portfolio includes over 150 US and international patents and patent applications. The company's pioneering technologies, rigorous quality control and high volume manufacturing operation make IMRA's products the sound choice for scientific, OEM and industrial use. IMRA's femtosecond fiber lasers are ideal for a host of applications ranging from ultrafast measurement instruments to industrial material processing and refractive surgery. The company's visionary philosophy was inspired by Mr. Minoru Toyoda, honorary advisor to IMRA's parent corporation, Aisin Seiki: "World Harmony through the Development and Sharing of Science and Technology."

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