Computational Study of Double Ionization in Intense Bicircular Fields

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Jan L. Chaloupka
Department of Physics & Astronomy
University of Northern Colorado
atomic unit of intensity

$3.5 \times 10^{16} \text{ W/cm}^2$
chirped pulse amplification

1. Short light pulse from a laser.
2. The pulse is stretched, which reduces its peak power.
3. The stretched pulse is amplified.
4. The pulse is compressed and its intensity increases dramatically.

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rescattering
HHG with two-color, counter-rotating fields

Generation of bright phase-matched circularly-polarized extreme ultraviolet high harmonics

Ofer Kfir, Patrik Grychtol, Emrah Turgut, Ronny Knut, Dmitriy Zisin, Dimitar Popmintchev, Tenio Popmintchev, Hans Nembach, Justin M. Shaw, Avner Fleischer, Henry Kapteyn, Margaret Murnane, and Oren Cohen

Polarization-dependent high-order two-color mixing

H. Eichmann, A. Egbert, S. Nolte, C. Momma, and B. Wellegehausen
Institut für Quantenoptik, Universität Hannover, Welfengarten 1, 30167 Hannover, Germany

W. Becker, S. Long, and J. K. McIver
Center for Advanced Studies, Department of Physics and Astronomy, University of New Mexico, Albuquerque, New Mexico 87131
(Received 1 December 1994)

High-order frequency mixing experiments using the radiation of a high-power Ti:sapphire laser and its second harmonic are described and discussed. Linearly and circularly polarized light fields with comparable intensities have been used. For the theoretical description a three-dimensional quantum-mechanical calculation with a δ-function potential has been applied, showing quite good agreement with the experiments.
two-color co-rotating fields

\[ E_x \]
\[ E_y \]
\[ \text{intensity} \]
\[ \text{time} \]
two-color counter-rotating fields
simple returning trajectory
classical ensemble approach

1 atom
10 fsec

$V \sim \frac{1}{\sqrt{r^2 + a^2}}$

softened Coulombic potential

1000 atoms
helium ionization yield curves

Chaloupka & Hickstein, Physical Review Letters (April 2016)

10^5 runs/point
1.4 × 10^6 runs/curve
9.8 × 10^6 runs total
high-performance computing cluster

Intel Xeon ES-2620 v3 2.4 GHz

15 NODES
12 CORES/NODE

GFORTRAN
MESSAGE PASSING INTERFACE (MPI)
double ionization yield

2×10^5 runs/point
10^7 runs/ratio
1.2×10^9 runs total
double ionization rescattering timing

10 Å  40 Å  60 Å

W/cm²

runs total

10¹⁶ W/cm²
3.6×10⁸ runs total
double ionization (co-rotating fields)

10^{16} \text{ W/cm}^2
1.9 \times 10^9 \text{ runs total}
thank you!