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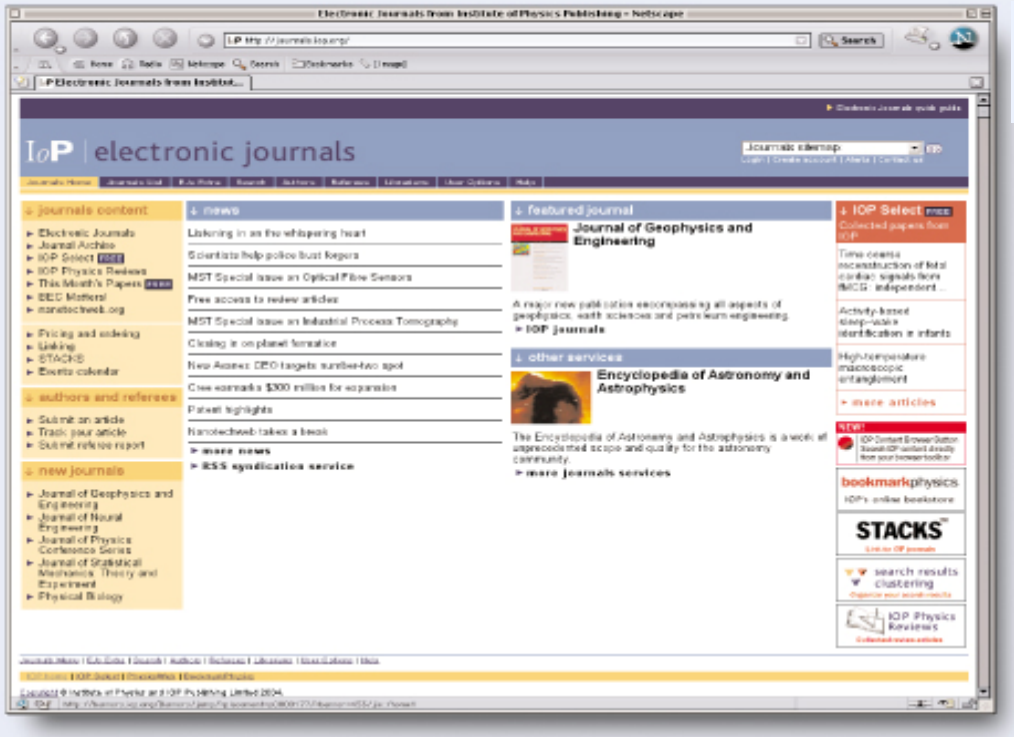


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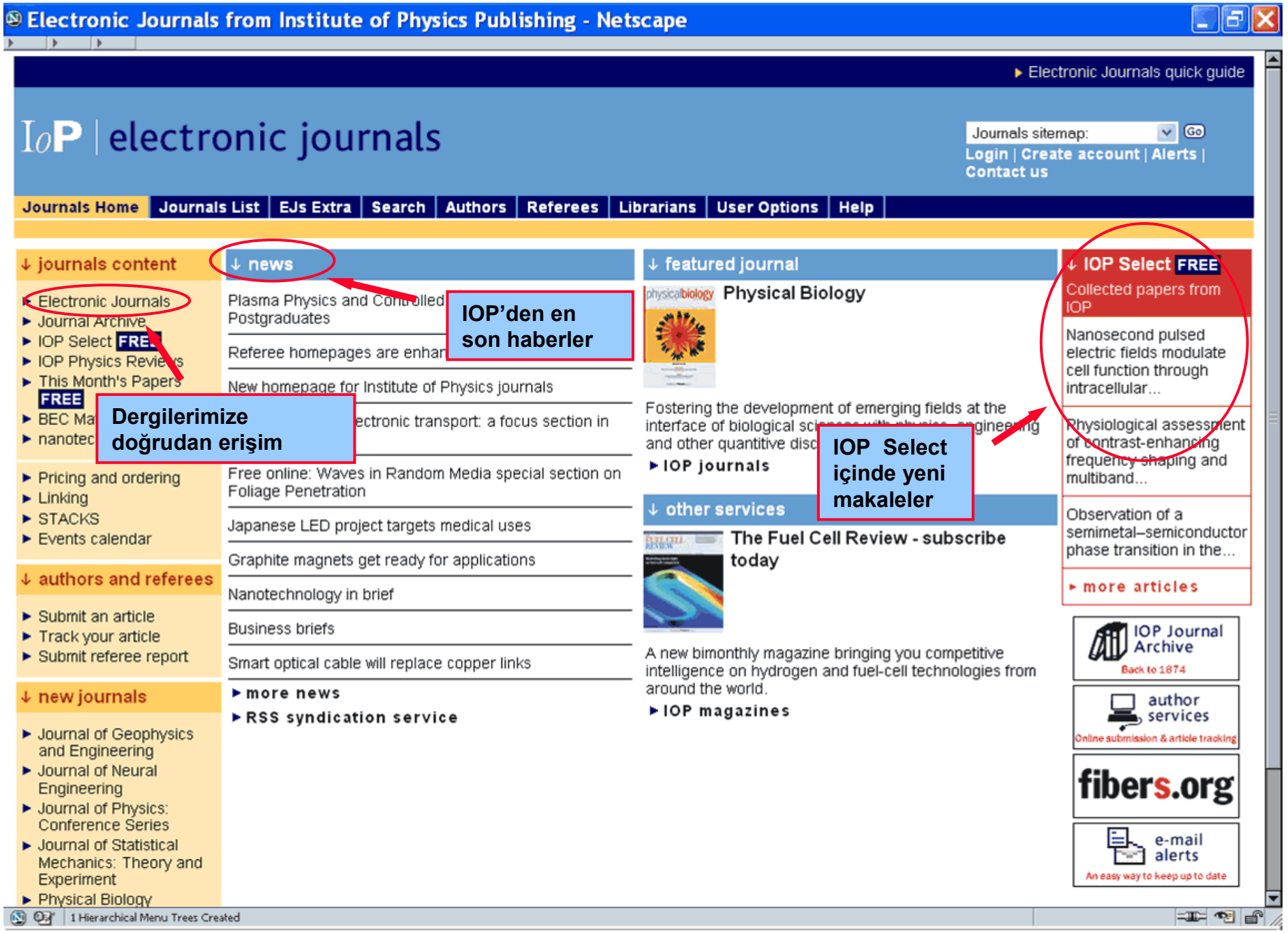
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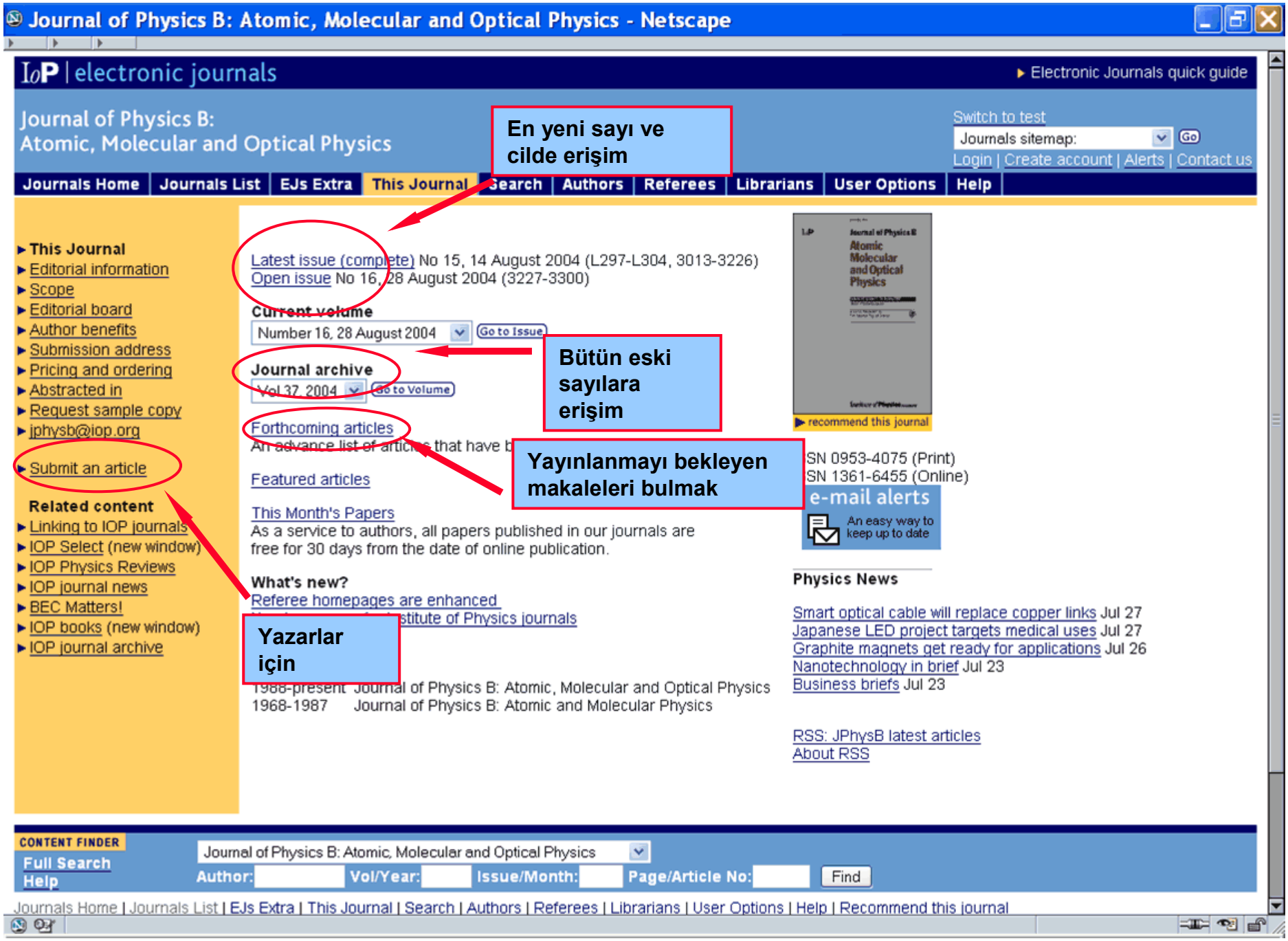

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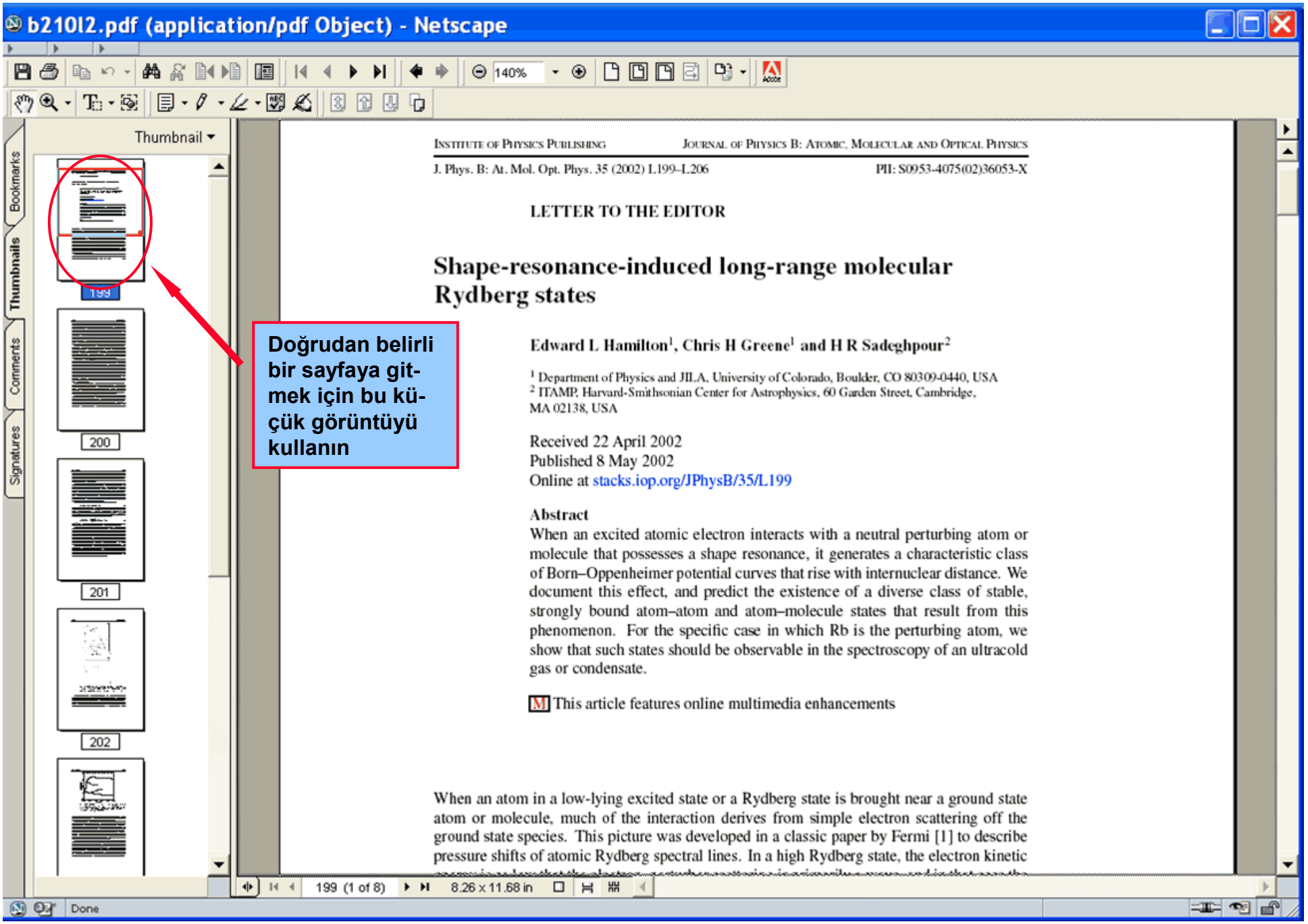


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LETTER TO THE EDITOR

# Shape-resonance-induced long-range molecular Rydberg states

**Edward L Hamilton[1], Chris H Greene[1] and H R Sadeghpour[2]**

[1] Department of Physics and JILA, University of Colorado, Boulder, CO 80309-0440, USA
[2] ITAMP, Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA

Received 22 April 2002
Published 8 May 2002
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**Abstract**

When an excited atomic electron interacts with a neutral perturbing atom or molecule that possesses a shape resonance, it generates a characteristic class of Born–Oppenheimer potential curves that rise with internuclear distance. We document this effect, and predict the existence of a diverse class of stable, strongly bound atom–atom and atom–molecule states that result from this phenomenon. For the specific case in which Rb is the perturbing atom, we show that such states should be observable in the spectroscopy of an ultracold gas or condensate.

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When an atom in a low-lying excited state or a Rydberg state is brought near a ground state atom or molecule, much of the interaction derives from simple electron scattering off the ground state species. This picture was developed in a classic paper by Fermi [1] to describe pressure shifts of atomic Rydberg spectral lines. In a high Rydberg state, the electron kinetic

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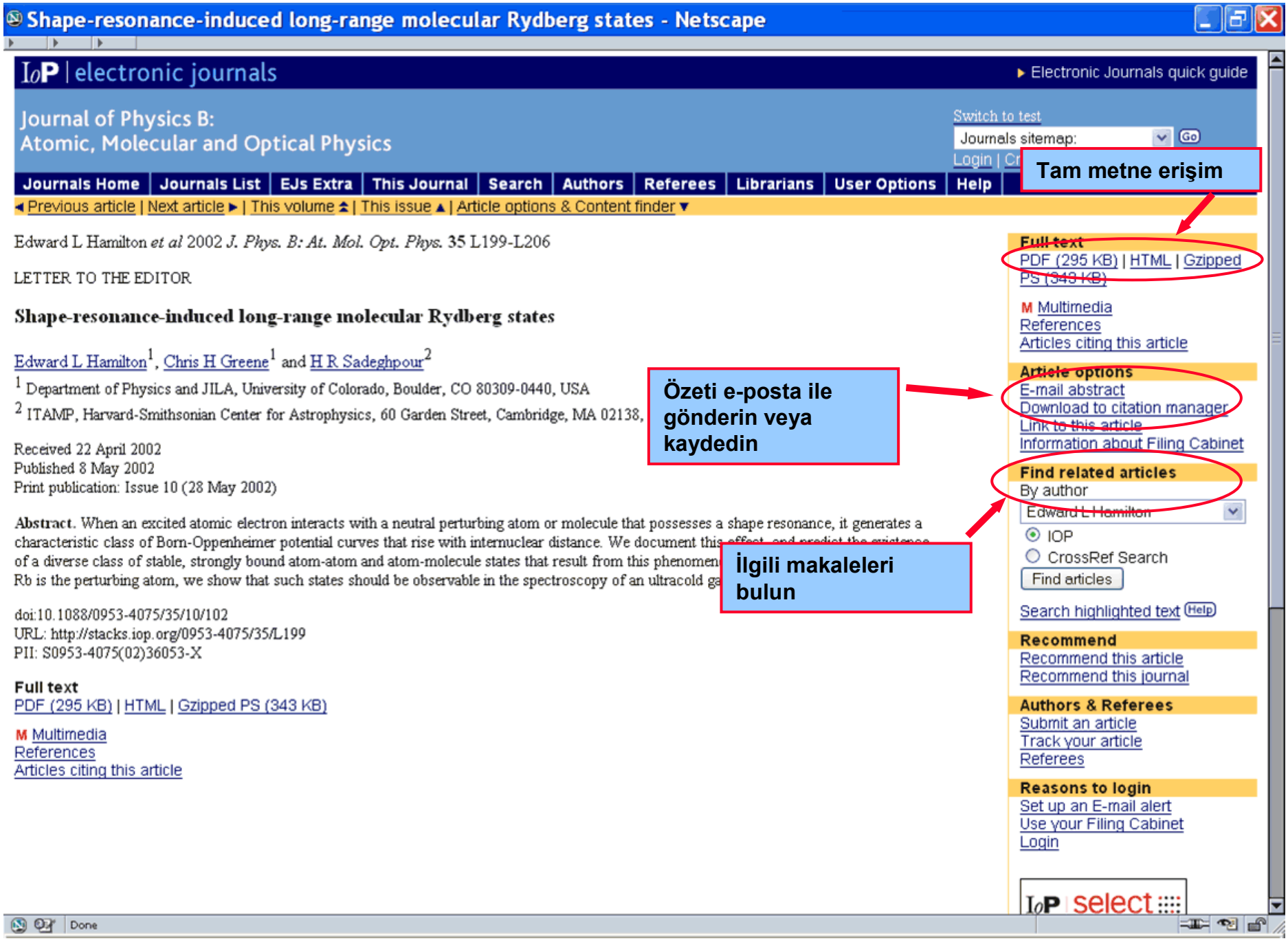

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LETTER TO THE EDITOR

## Shape-resonance-induced long-range molecular Rydberg states

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[1] Department of Physics and JILA, University of Colorado, Boulder, CO 80309-0440, USA

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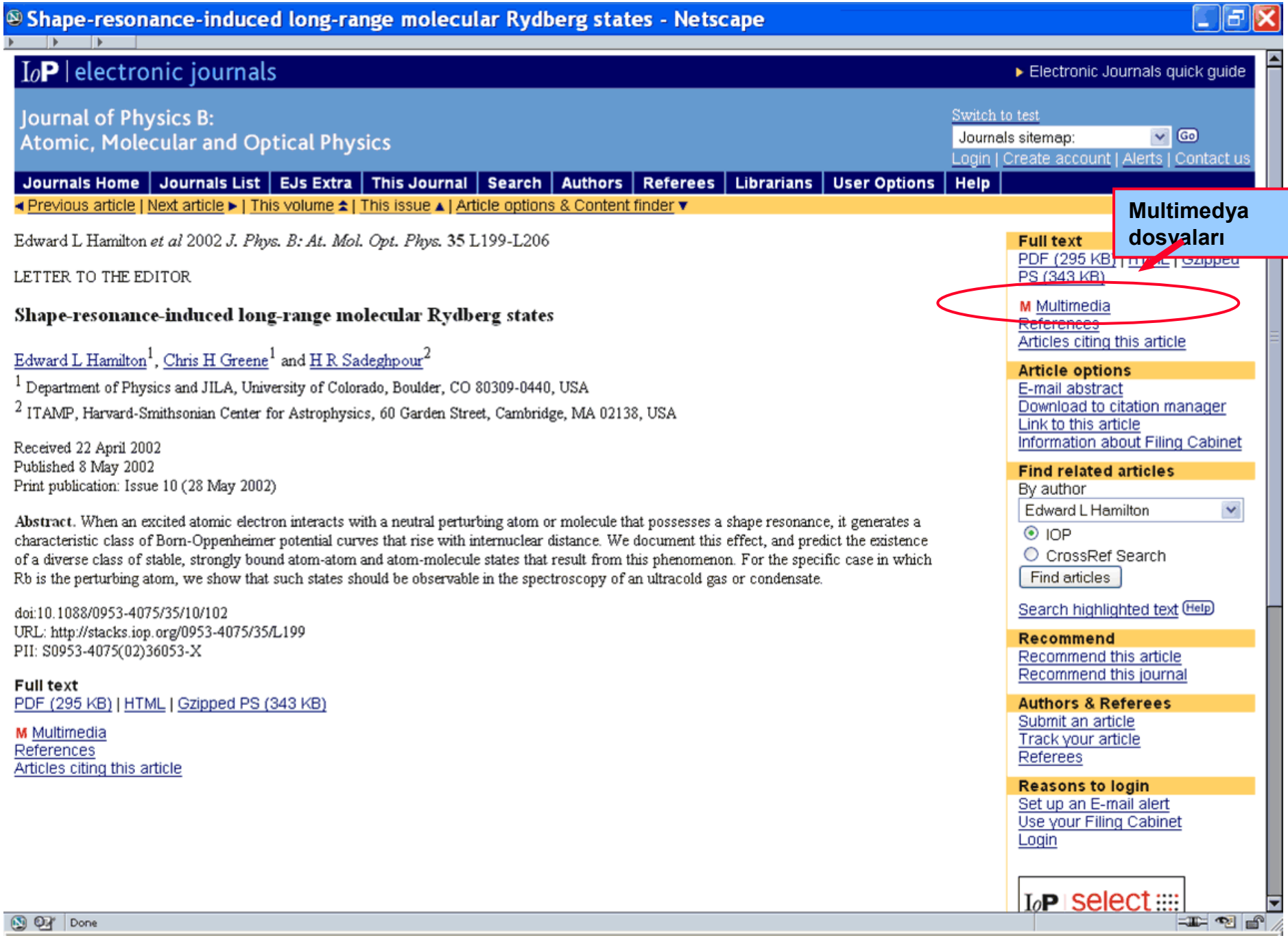
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[1] Department of Physics and JILA, University of Colorado, Boulder, CO 80309-0440, USA
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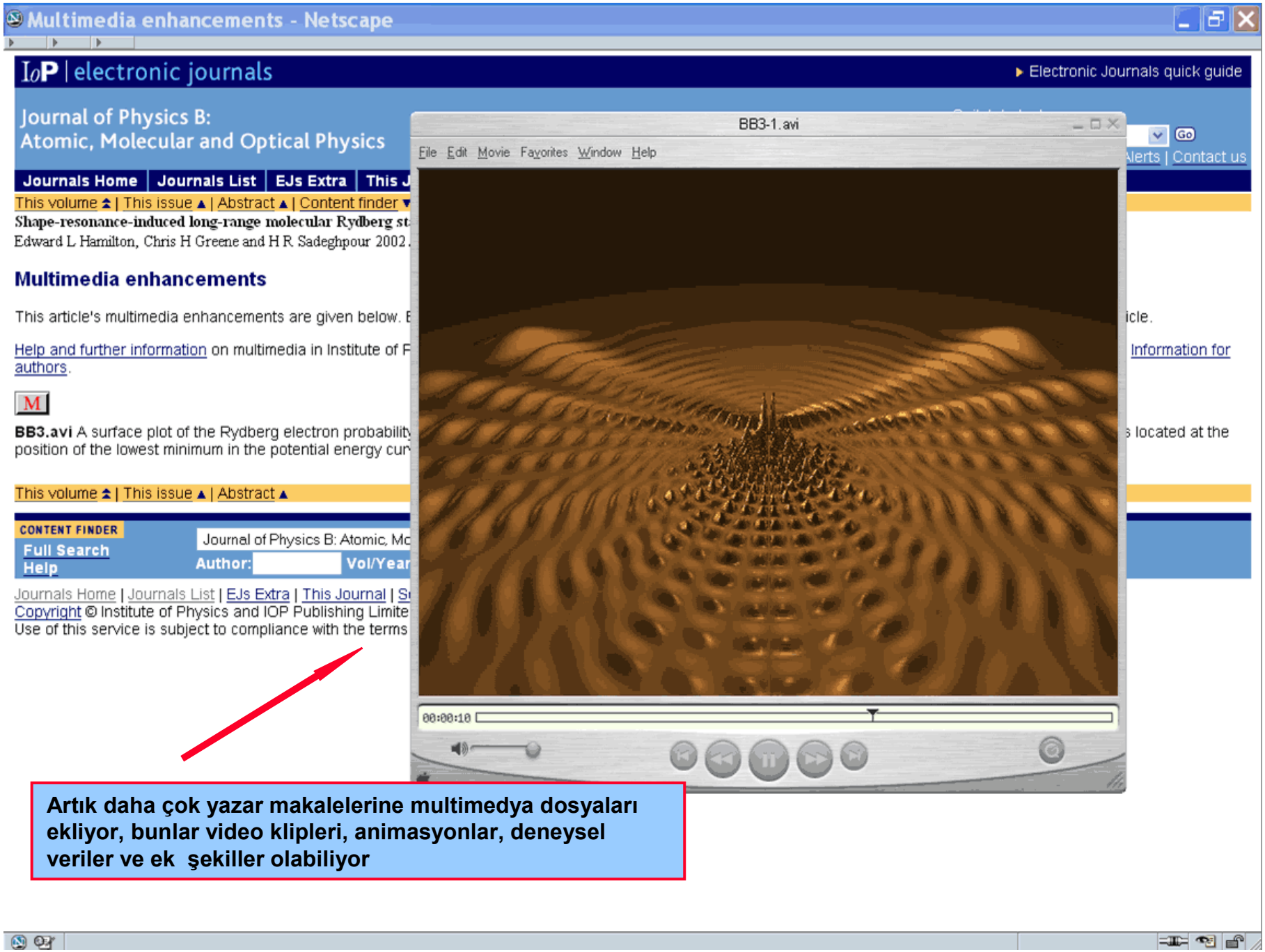


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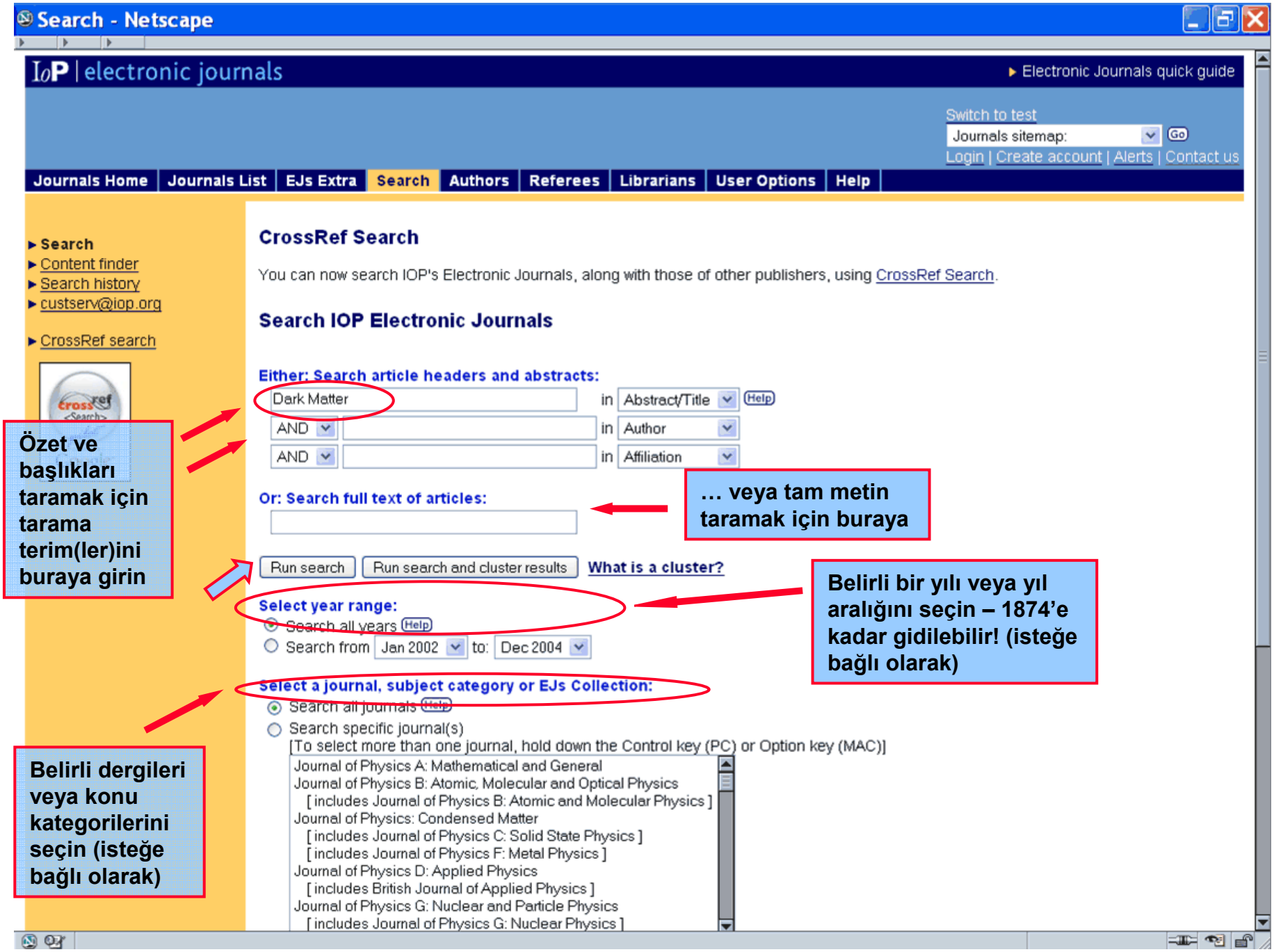
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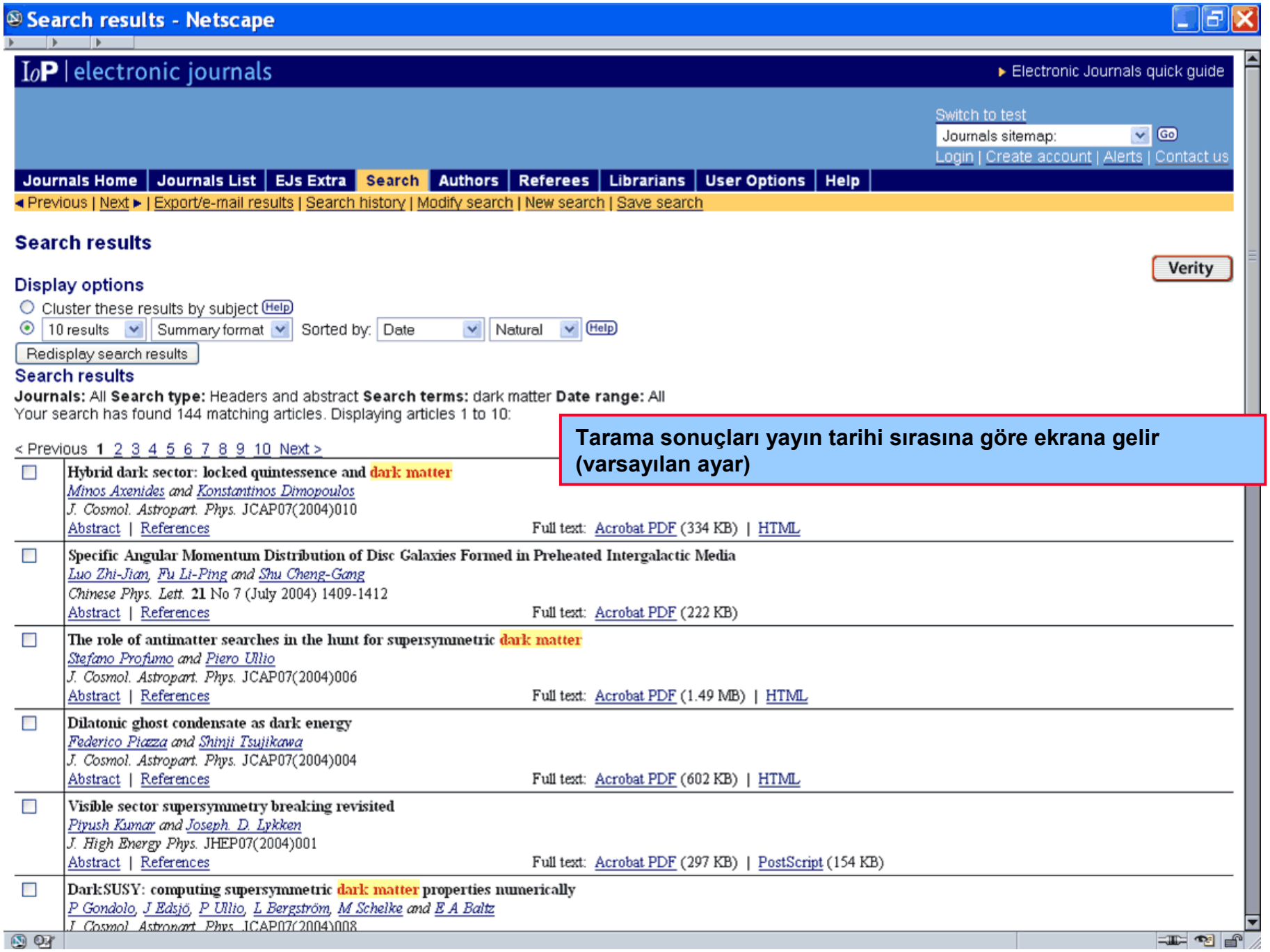


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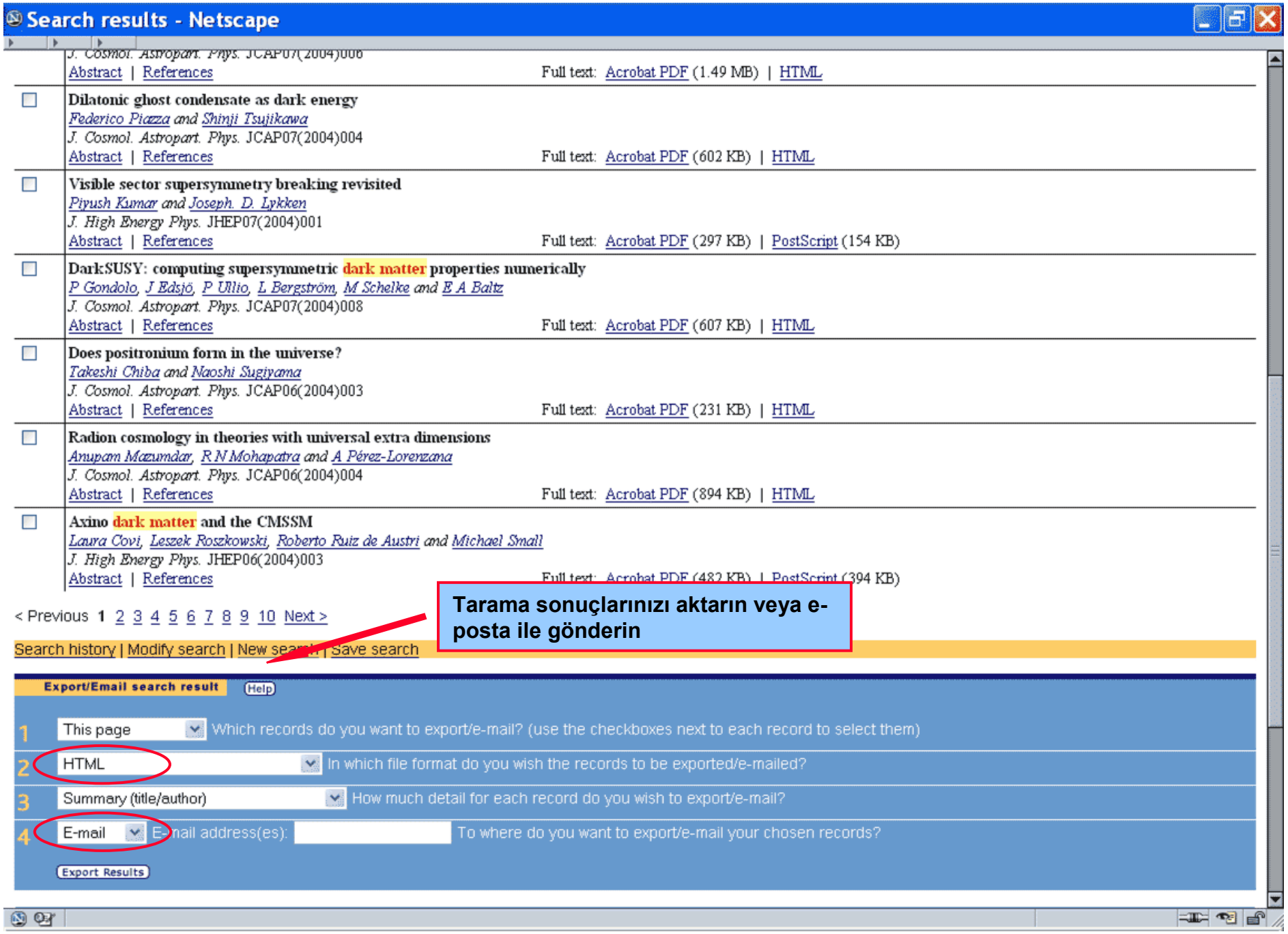

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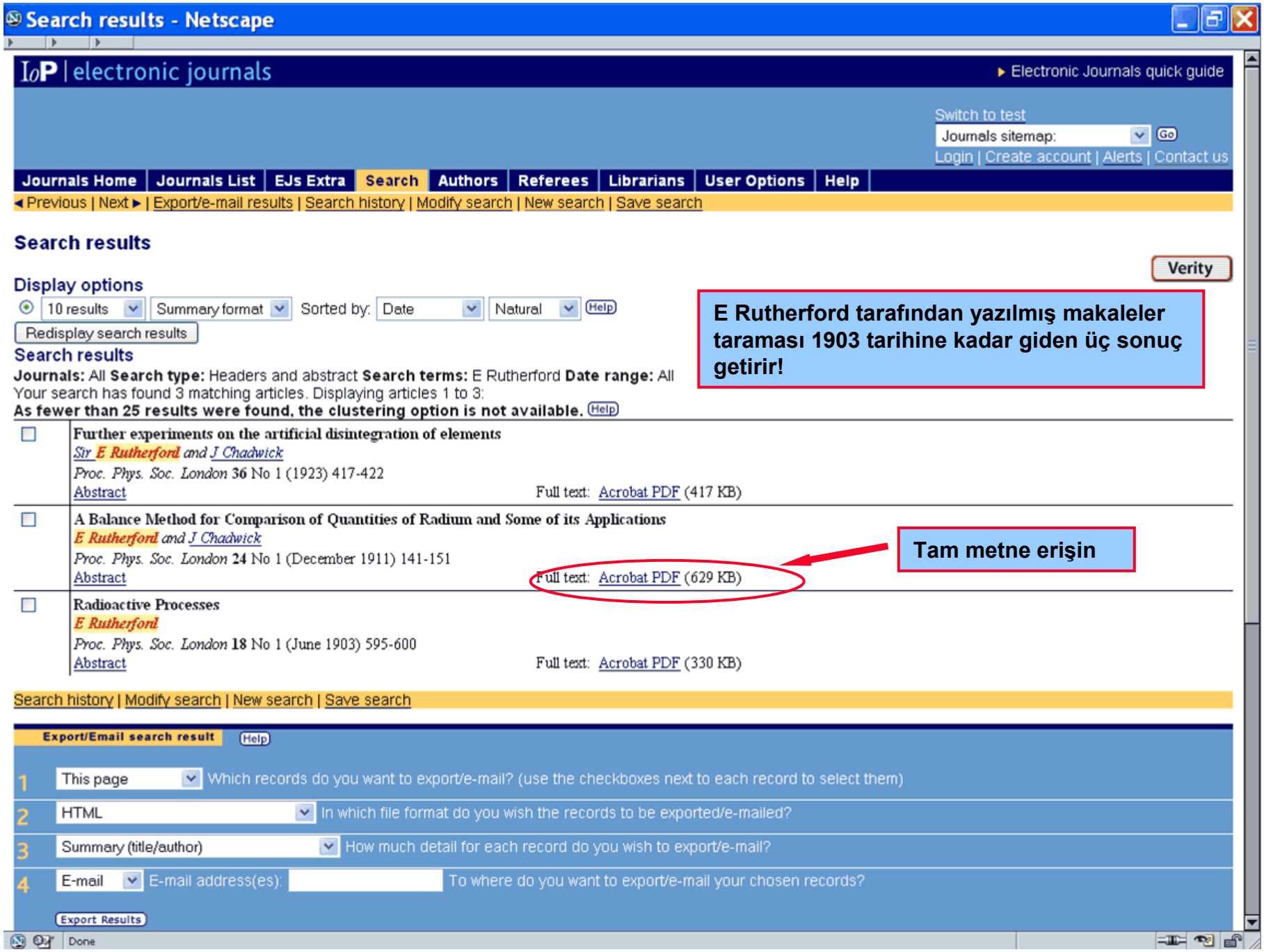


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By Sir E. Rutherford, *F.R.S.*, Cavendish Professor of Experimental Physics, and Dr. J. Chadwick, Fellow of Gonville and Caius College, Cambridge.

*Received July* 19, 1924.

Abstract.

In previous Papers the authors have shown that protons can be ejected from the nuclei of B, N, F, Na, Al and P by bombardment with α-particles, but no certain conclusions could be drawn in cases where the ejected particles had ranges less than 30 cm. in air. In the present experiments these particles were observed at right angles to the path of the incident α-particles, and the limit of the trustworthy range was thus reduced to 7 cm., or less in some cases. Disintegration was found in the case of the light elements Ne, Mg, Si, S, Cl, A and K, but not in the case of H, He, Li, C and O. The results with Be were doubtful. The following heavier elements failed to show the effect: Ni, Cu, Zn, Se, Kr, Mo, Pd, Ag, Sn, Xe, Au, U. Elements from Ca to Fe have not at present given conclusive results.

The comparative ranges of the ejected particles suggest that the nuclei of the even-numbered light elements are stable while those of the odd-numbered light elements are comparatively unstable. An estimate of the field of force within the atom is deduced from these ranges.

## § I.

In previous Papers* we have shown that hydrogen nuclei are ejected from the elements boron, nitrogen, fluorine, sodium, aluminium and phosphorus by bombardment with α-particles. In these experiments the material subjected to the bombardment was placed immediately in front of the source of α-particles and observations of the ejected particles were made on a zinc sulphide screen placed in a direct line a few centimetres away using radium C as a source of α-rays. The ranges

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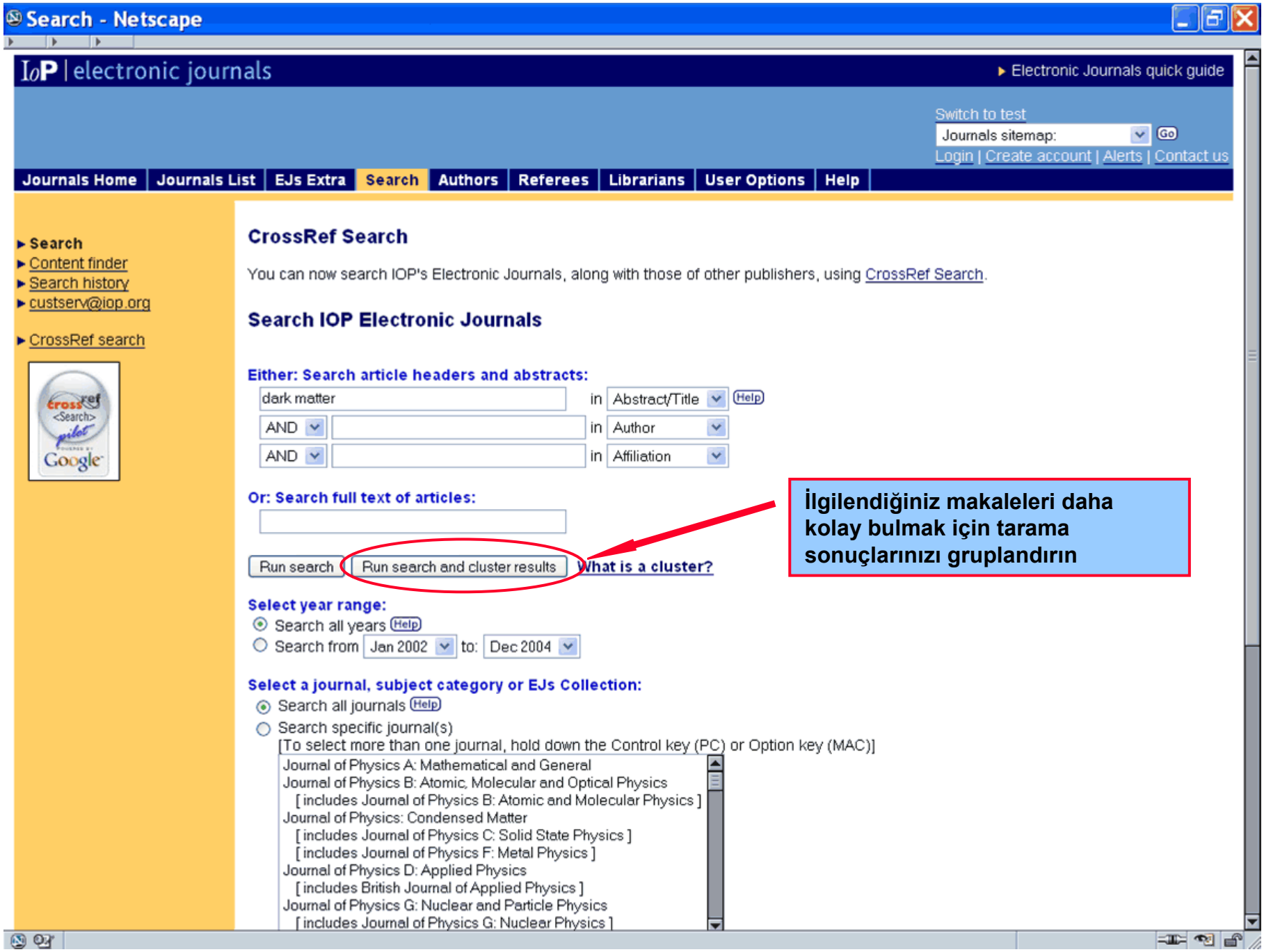


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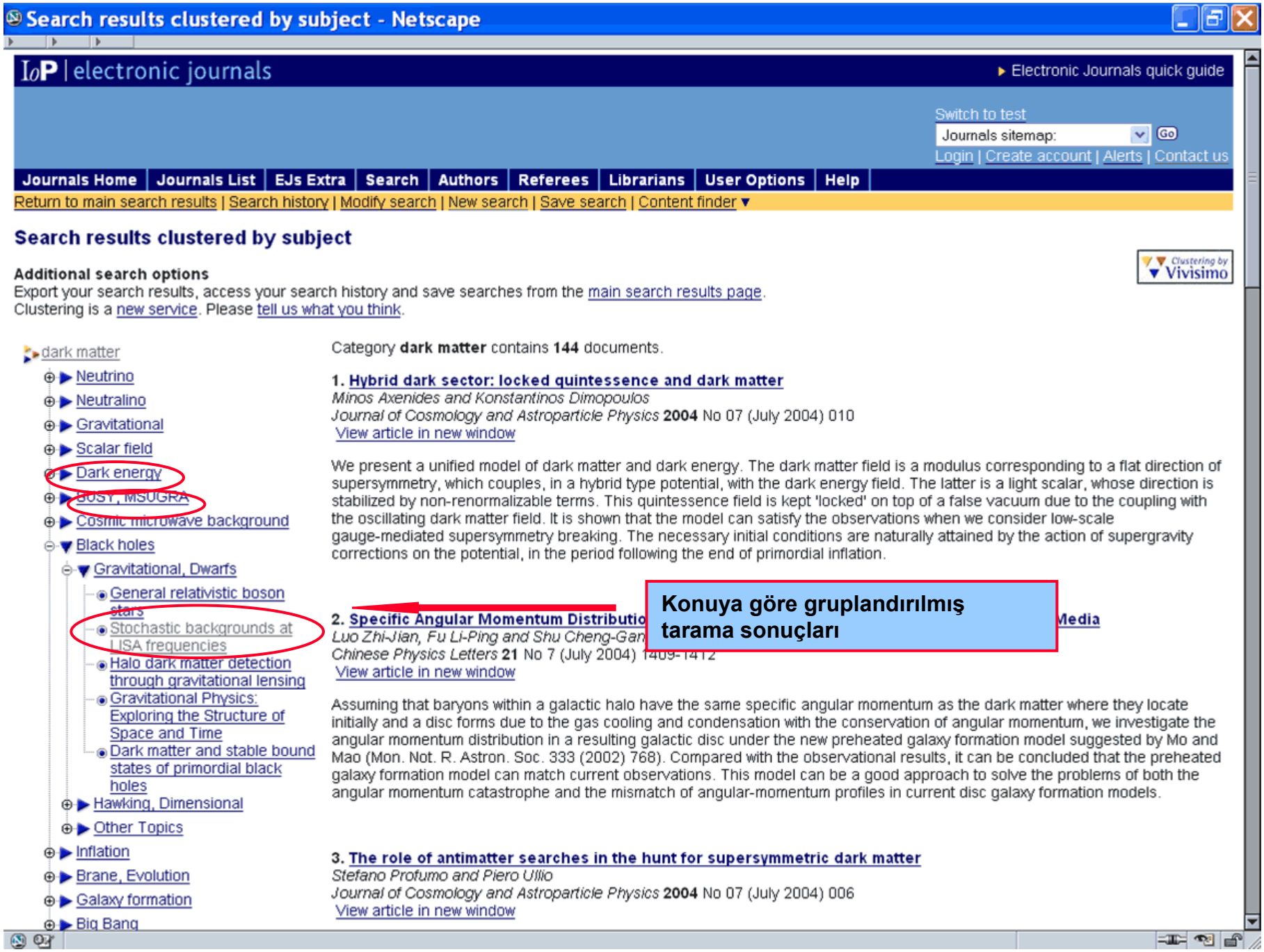

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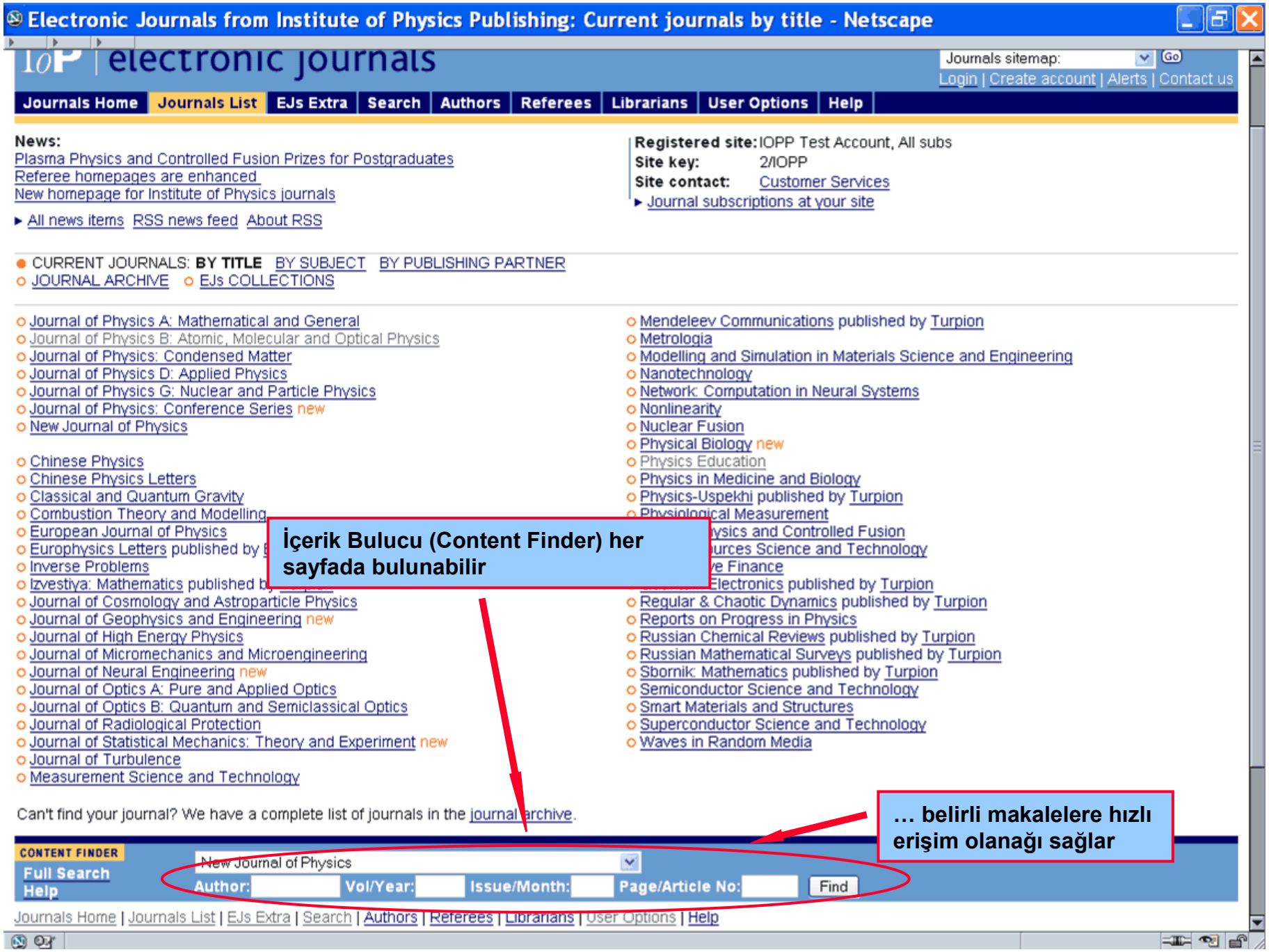

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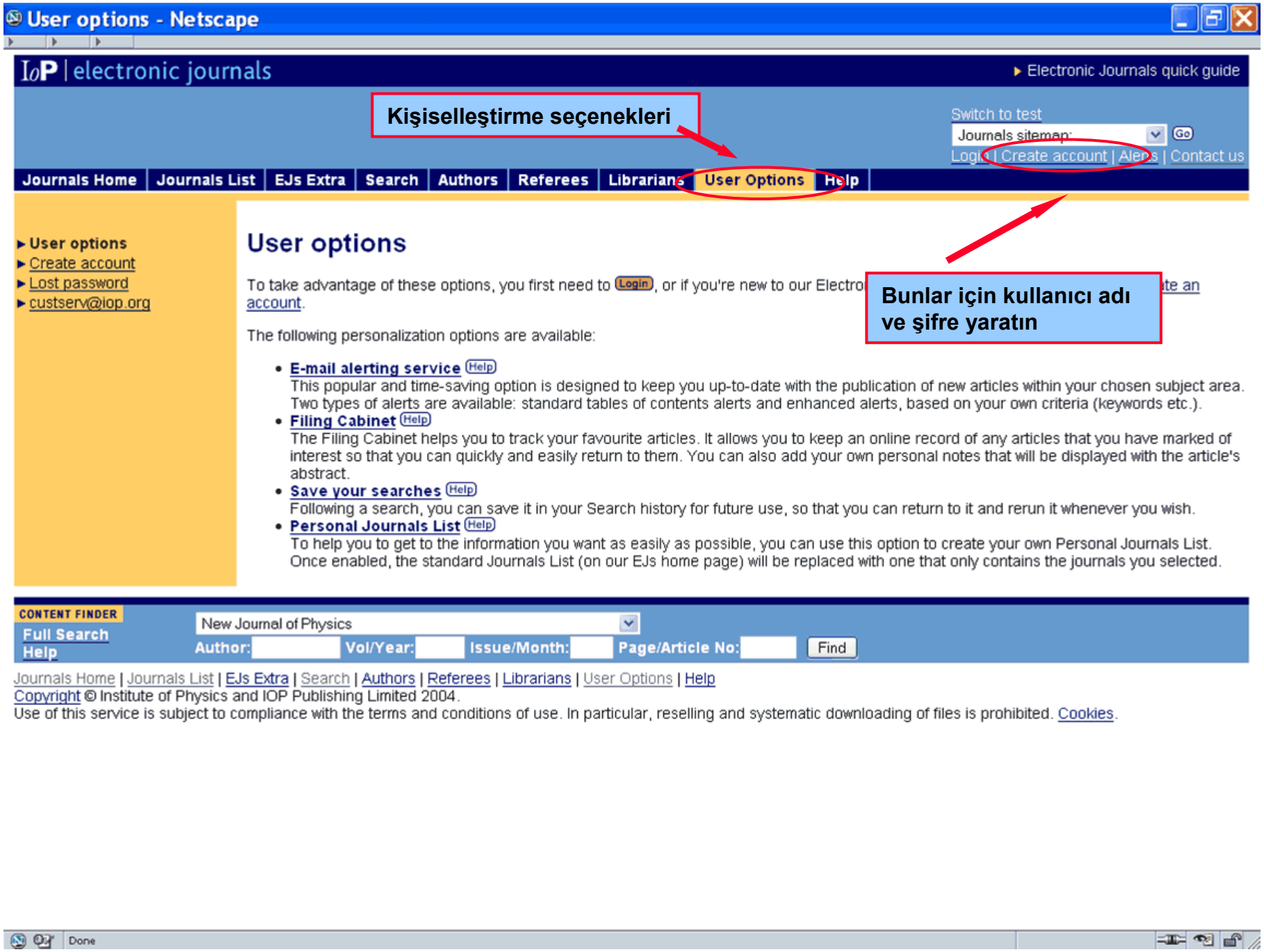

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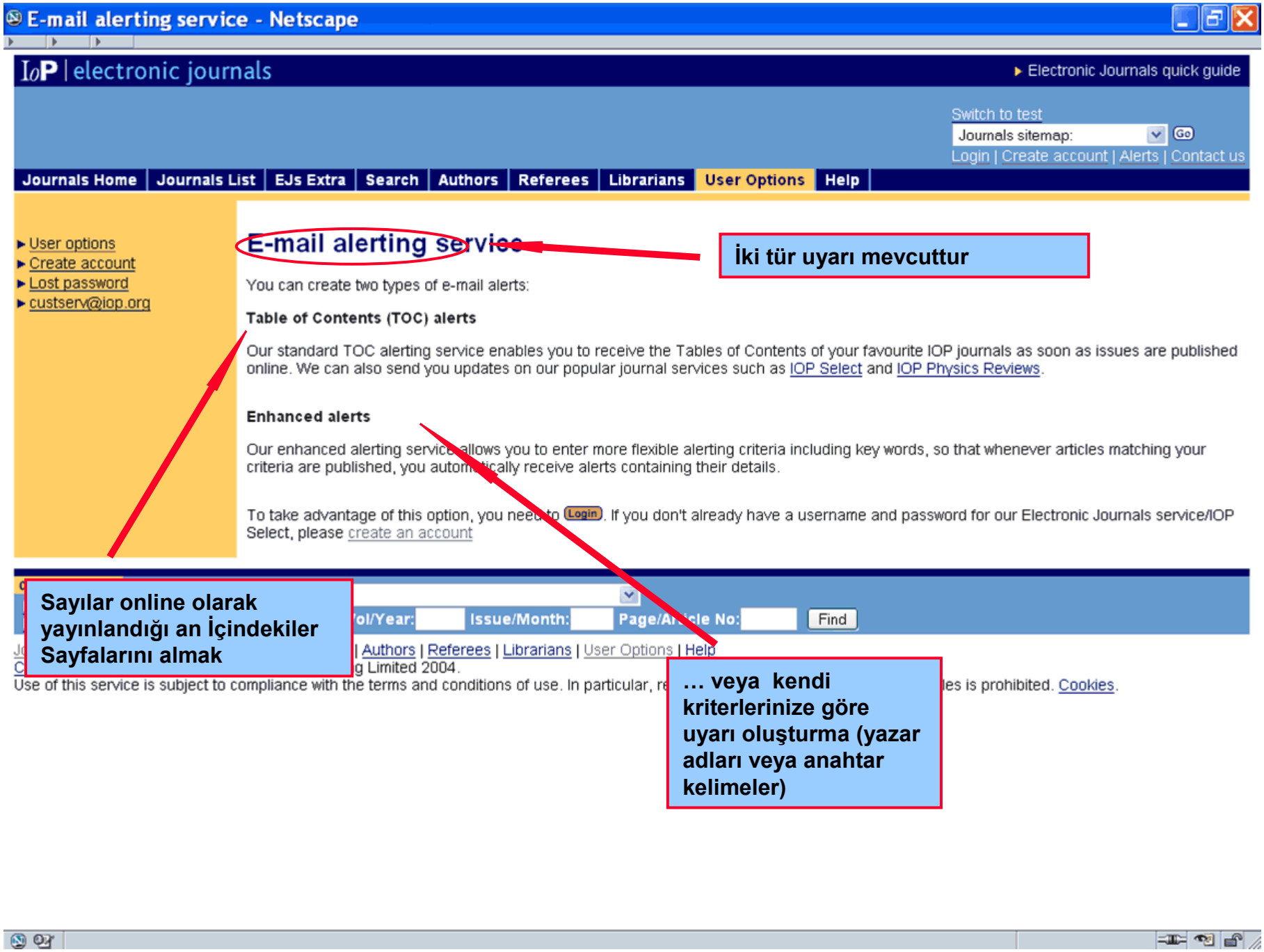
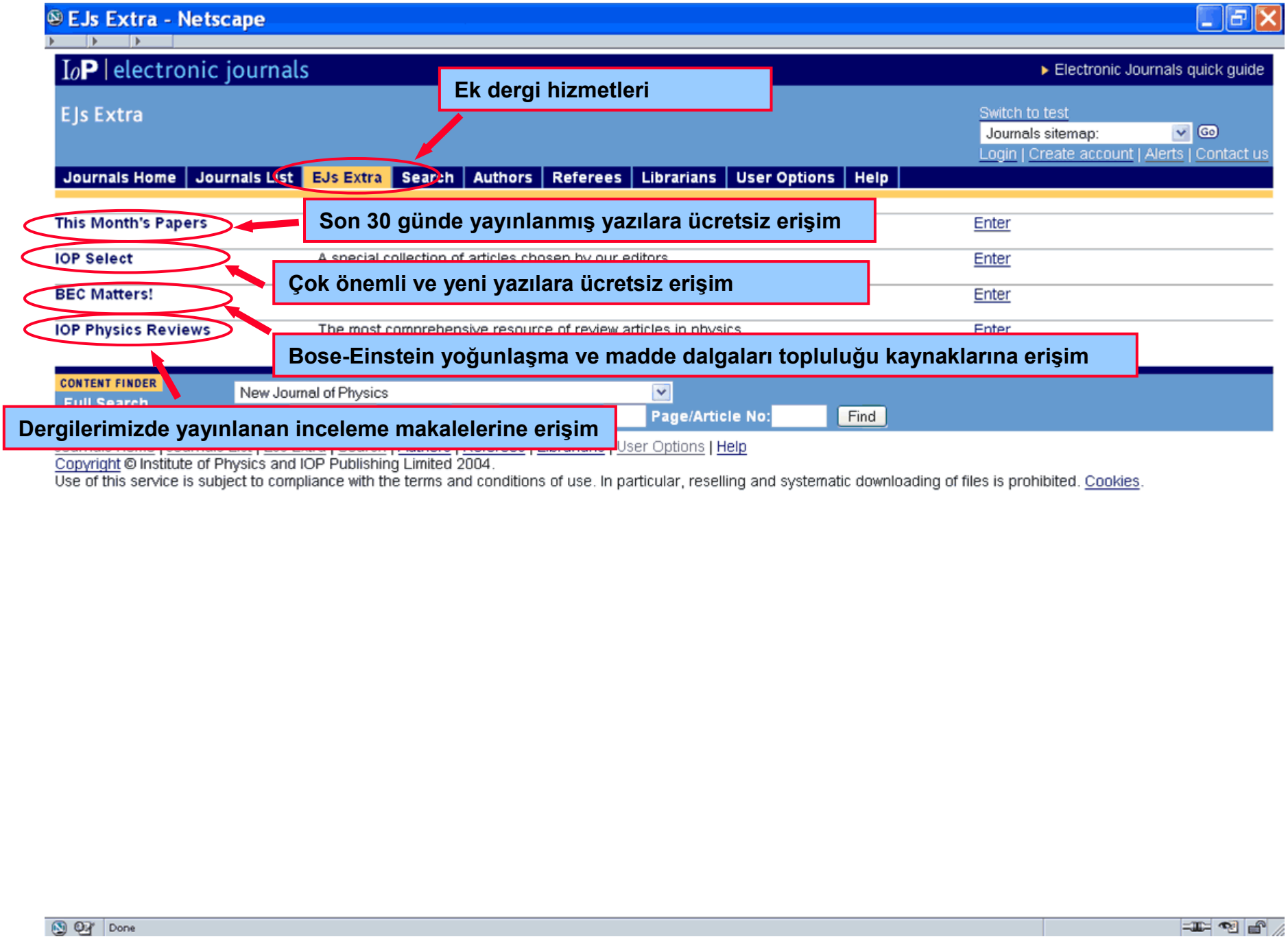


# Elektronik Dergiler (Ejs) Ekstra






Ek dergi hizmetleri

Son 30 günde yayınlanmış yazılara ücretsiz erişim

Çok önemli ve yeni yazılara ücretsiz erişim

Bose-Einstein yoğunlaşma ve madde dalgaları topluluğu kaynaklarına erişim

Dergilerimizde yayınlanan inceleme makalelerine erişim

# Diğer bilgiler