Nonlinear Experiments done with the First CPA laser

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PHYSICAL REVIEW LETTERS

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Generation of Vacuum-Ultraviolet and Soft—X-Ray Radiation Using High-Order Nonlinear Optical Polarizabilities*

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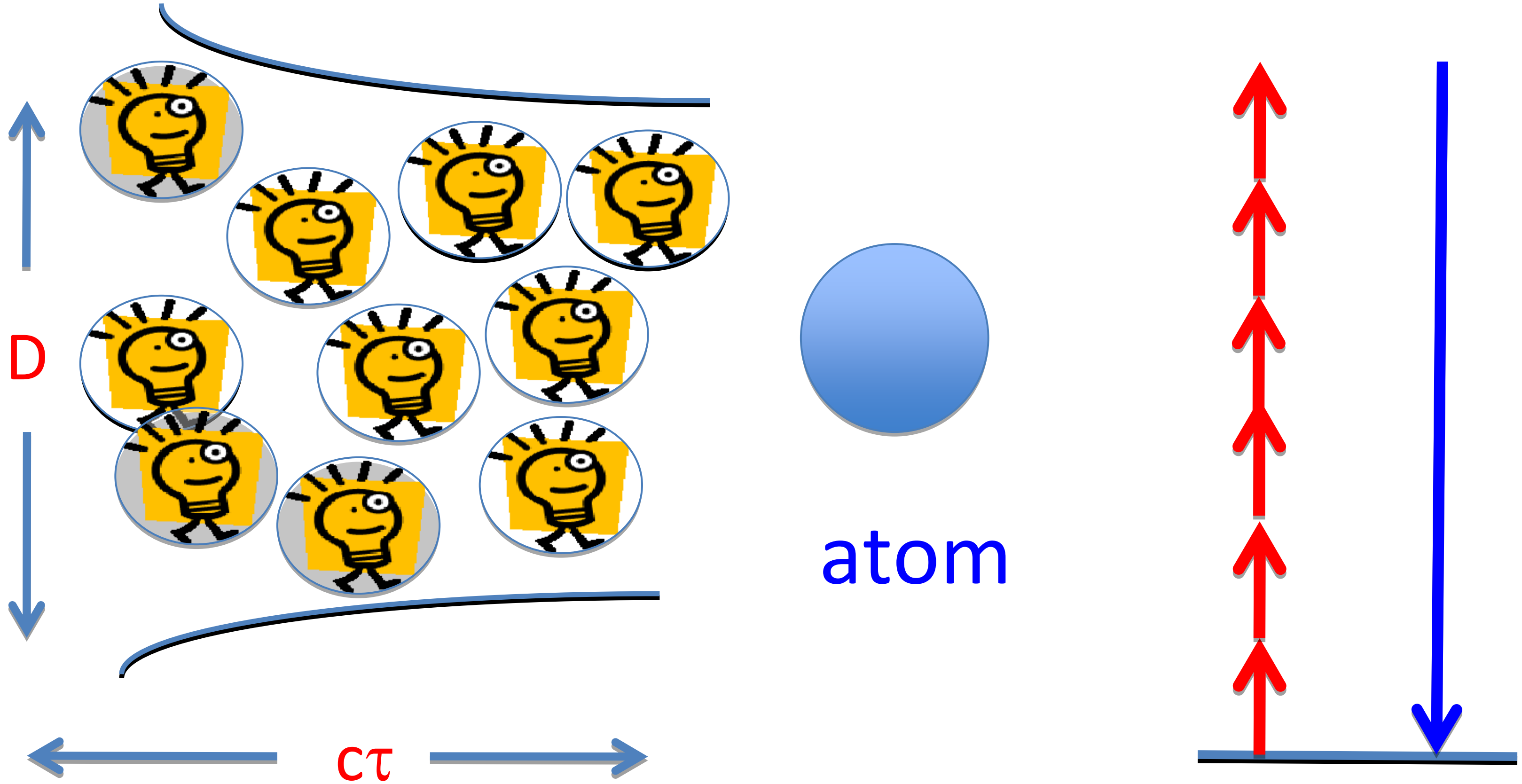
(Received 30 May 1973)

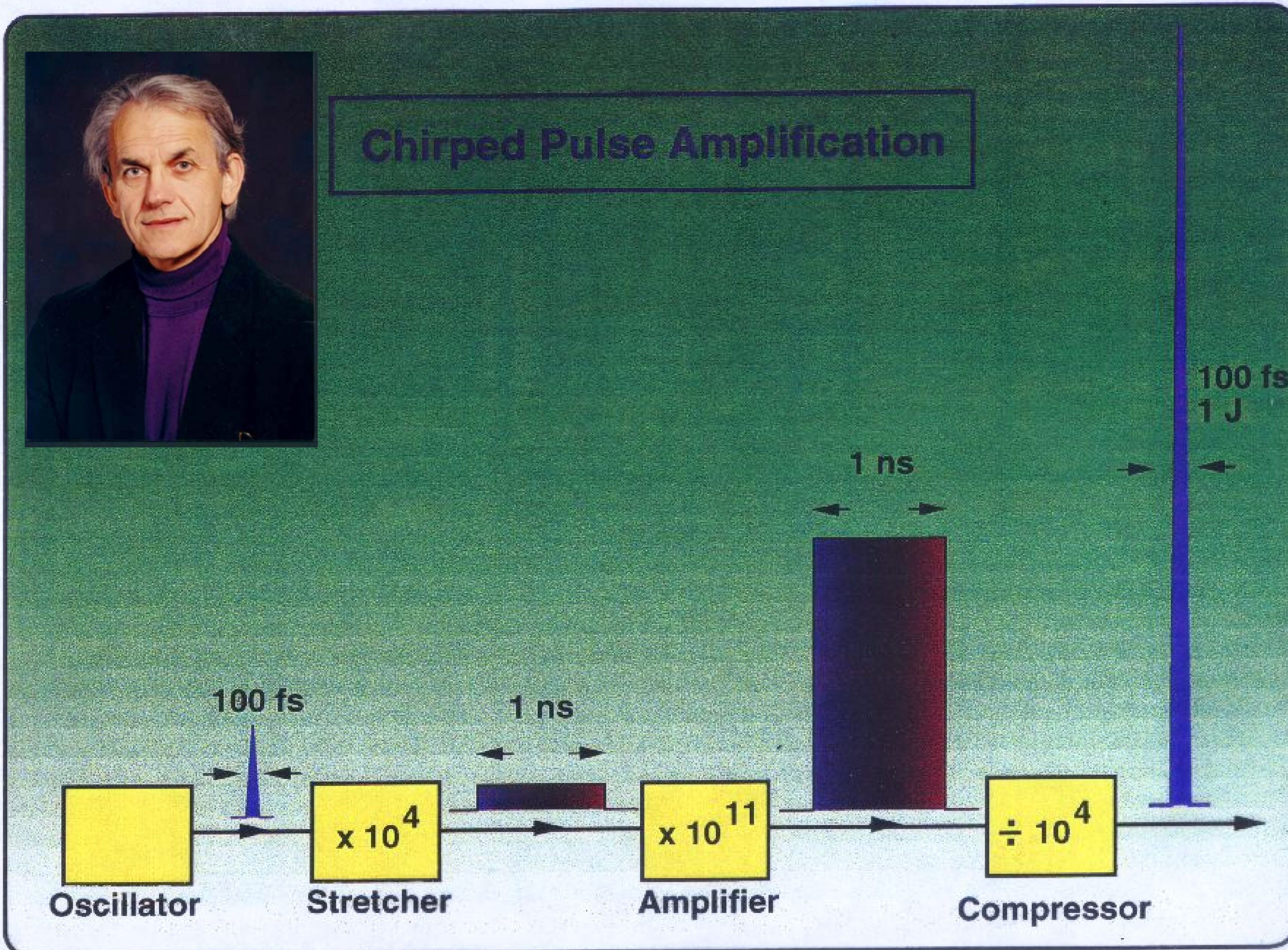
TABLE I. Conversion efficiency and limiting power density for some higher-order nonlinear processes.

Process	Species and path	Limiting P/A ($\mathrm{W/cm^2}$)	Conversion efficiency (%)
$3\times 5320\,\mathrm{\AA}\rightarrow 1773\,\mathrm{\AA}$	Xe[a], $5p$-$6s$-$5p$-$6s$-$6p$-$8d$-c	1.94×10^{12}	0.084
$5\times 5320\,\mathrm{\AA}\rightarrow 1064\,\mathrm{\AA}$	As above	As above	0.051
$5\times 1182\,\mathrm{\AA}\rightarrow 236\,\mathrm{\AA}$	Li^{+}[b], $1s$-$2p$-$1s$-$2p$-$3s$-$2p$-$3s$-$4p$-c	1.68×10^{15}	0.002
$7\times 1182\,\mathrm{\AA}\rightarrow 169\,\mathrm{\AA}$	As above	As above	0.004
$15\times 2660\,\mathrm{\AA}\rightarrow 177\,\mathrm{\AA}$	Li^{+}[c], $(1s\text{-}2p)^7$-$(2p\text{-}3s)^7$-$3p$-$4d$-c	3.47×10^{15}	4×10^{-7}

[a] $5p=5p^6[^1S]0$; $6s=6s[1\frac{1}{2}]^01$; $6p=6p[2\frac{1}{2}]2$; $8d=8d[2\frac{1}{2}]^03$; c = continuum.
[b] $1s=1s^2[^1S]0$; $2p=2p[^1P^0]1$; $3s=3s[^1S]0$; $4p=4p[^1P^0]1$; c = continuum.
[c] $3p=3p[^1P^0]1$, others as in b.

High Intensity laser for nonlinear optics




Chirped Pulse Amplification
100 fs
1 J
1 ns
100 fs
1 ns
x 10^4
x 10^11
÷ 10^4
Oscillator
Stretcher
Amplifier
Compressor

Schematic of First CPA

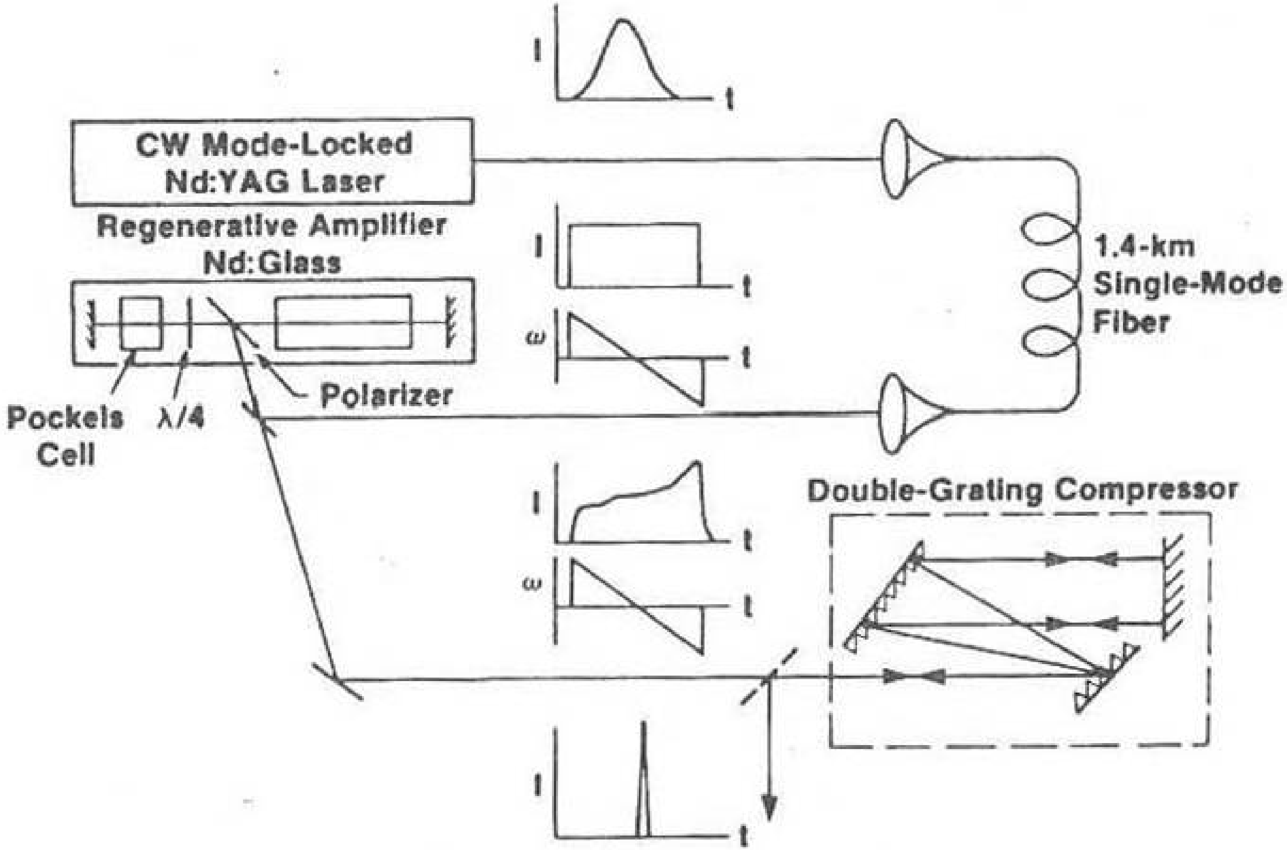
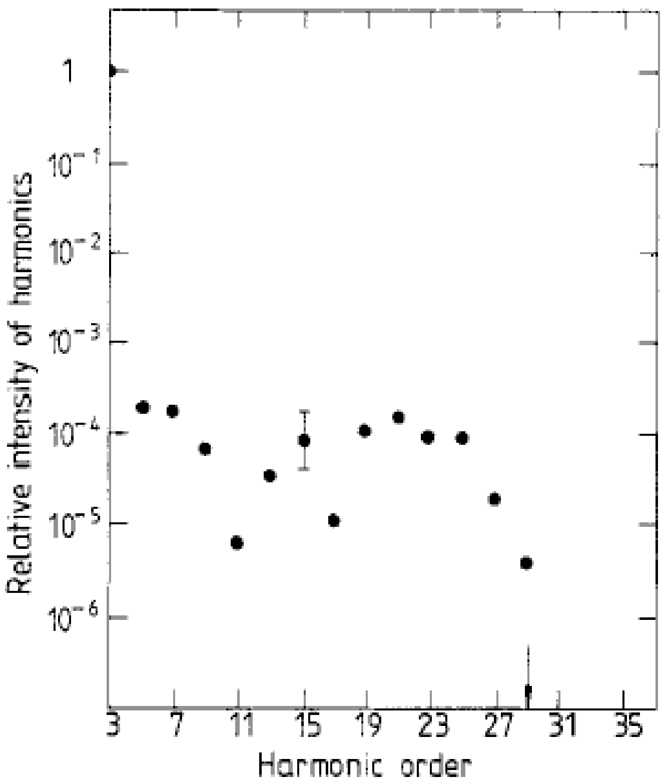


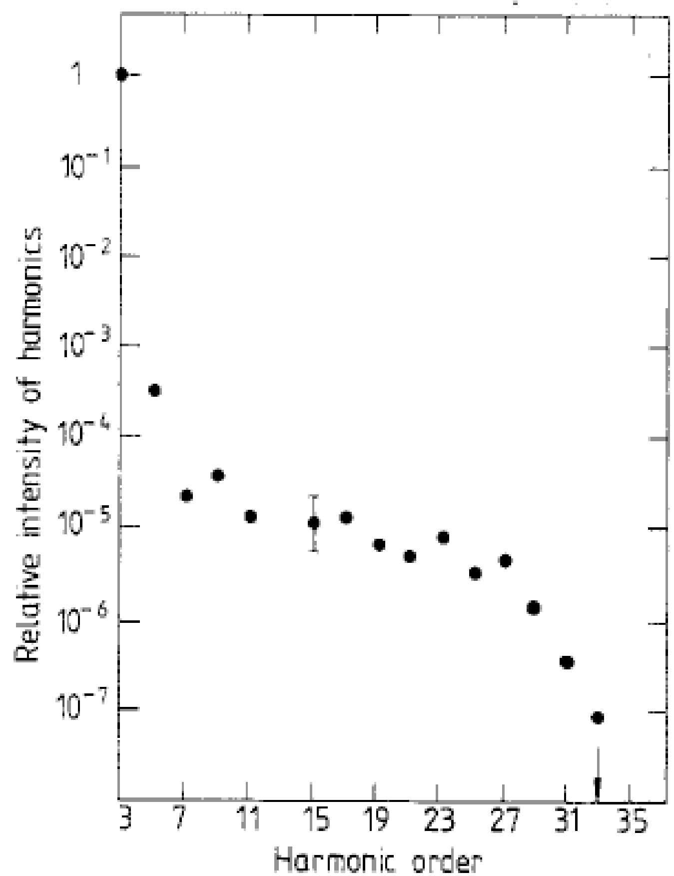
Figure 2 - 6. Experimental configuration of mJ CPA system

J. Phys. B: At. Mol. Opt. Phys. **21** (1988) L31-L35. Printed in the UK

Multiple-harmonic conversion of 1064 nm radiation in rare gases

M Ferray, A L'Huillier, X F Li, L A Lompré, G Mainfray and C Manus
Service de Physique des Atomes et des Surfaces, 91191 Gif sur Yvette, Cédex, France





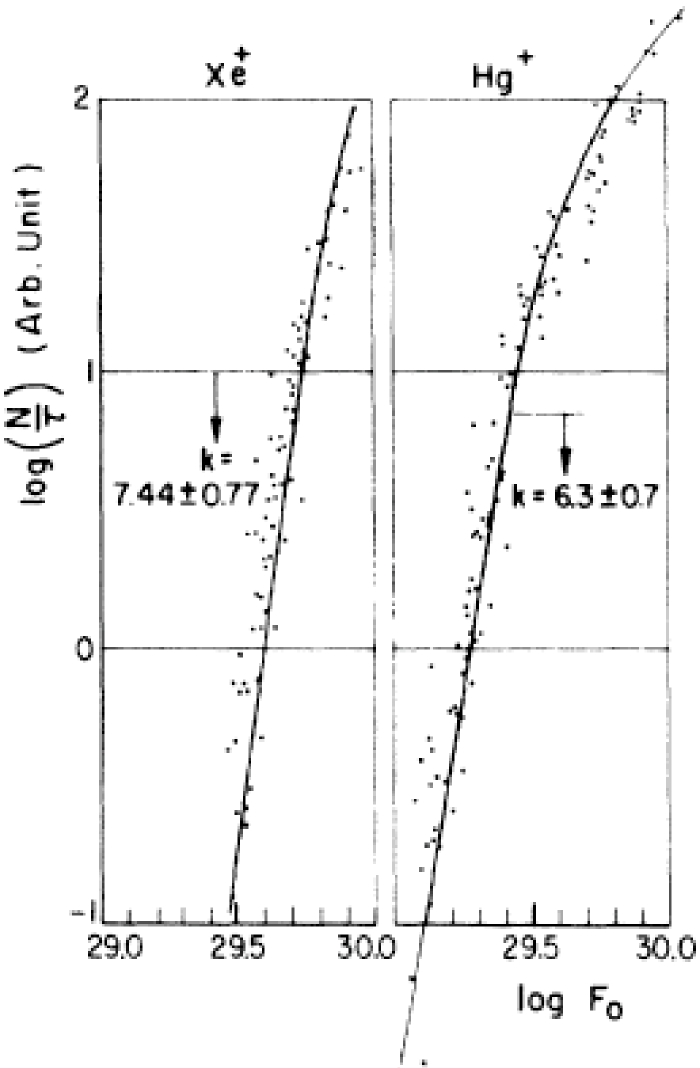
See Leang Chin came for a sabbatical

David Meyerhofer **Steve Augst**

PHYSICAL REVIEW VOLUME 188, NUMBER 1 5 DECEMBER 1969

Multiphoton Ionization of Hg and Xe†

S. L. Chin,* N. R. Isenor, and M. Young
Department of Physics, University of Waterloo, Waterloo, Ontario, Canada

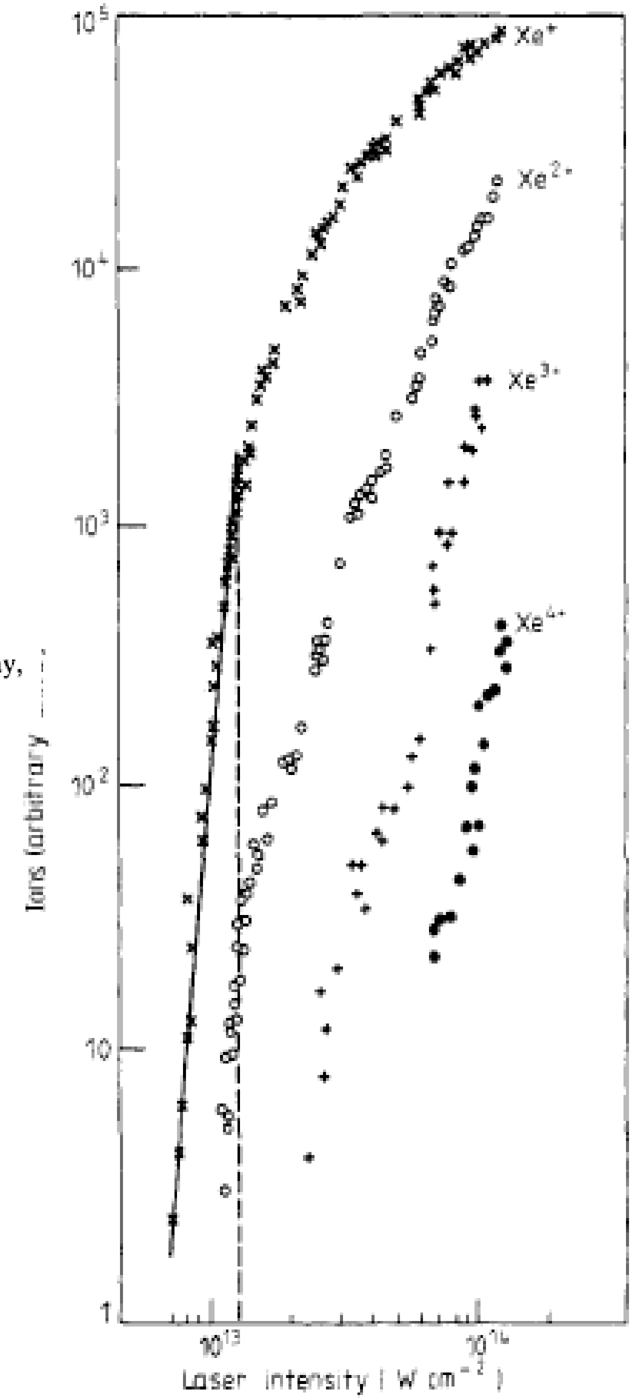


J. Phys. B: At. Mol. Phys. **16** (1983) 1363–1381.

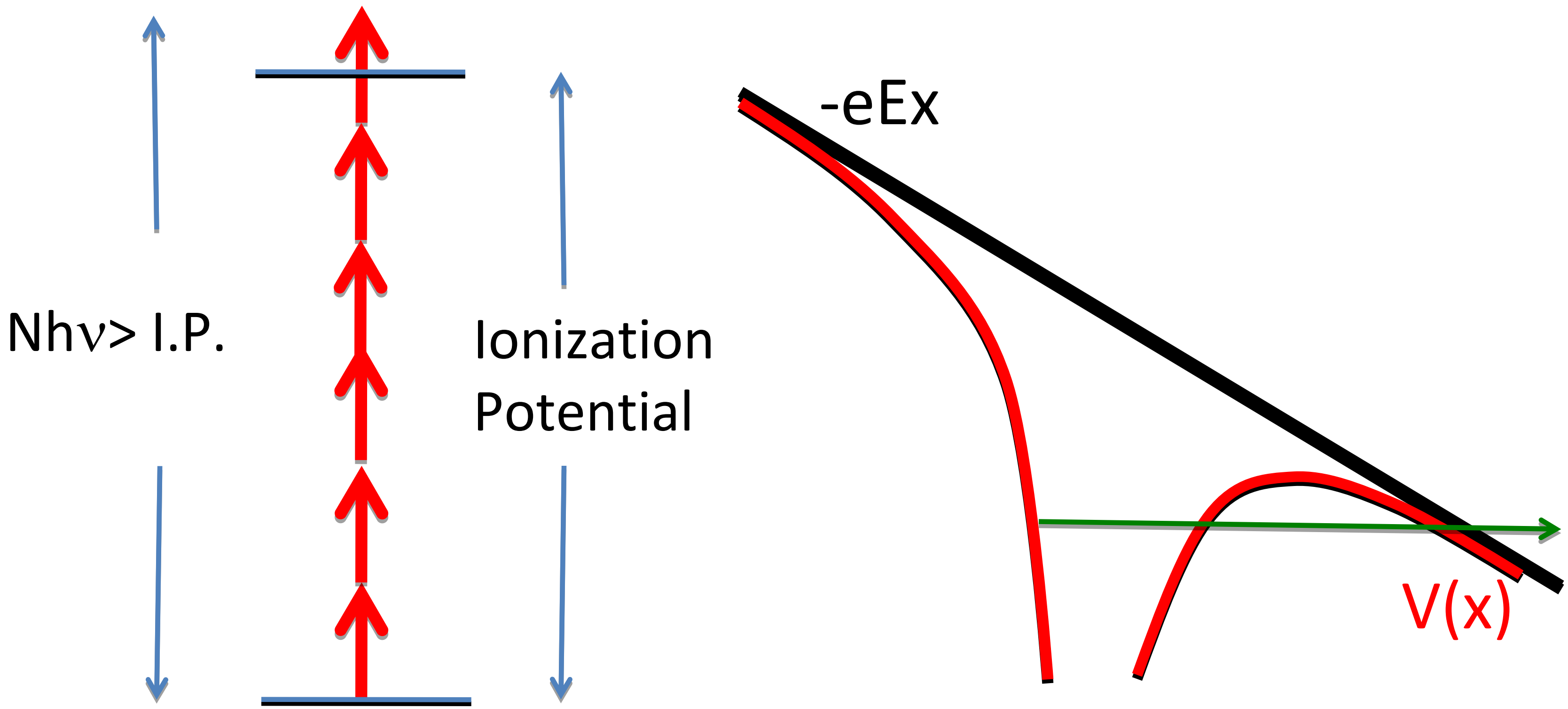
Multiply charged ions induced by multiphoton absorption processes in rare-gas atoms at 1.064 μm

A L'Huillier, L A Lompré, G Mainfray and C Manus

Service de Physique des Atomes et des Surfaces, Centre d'Etudes Nucléaires de Saclay, 91191 Gif-sur-Yvette Cedex, France

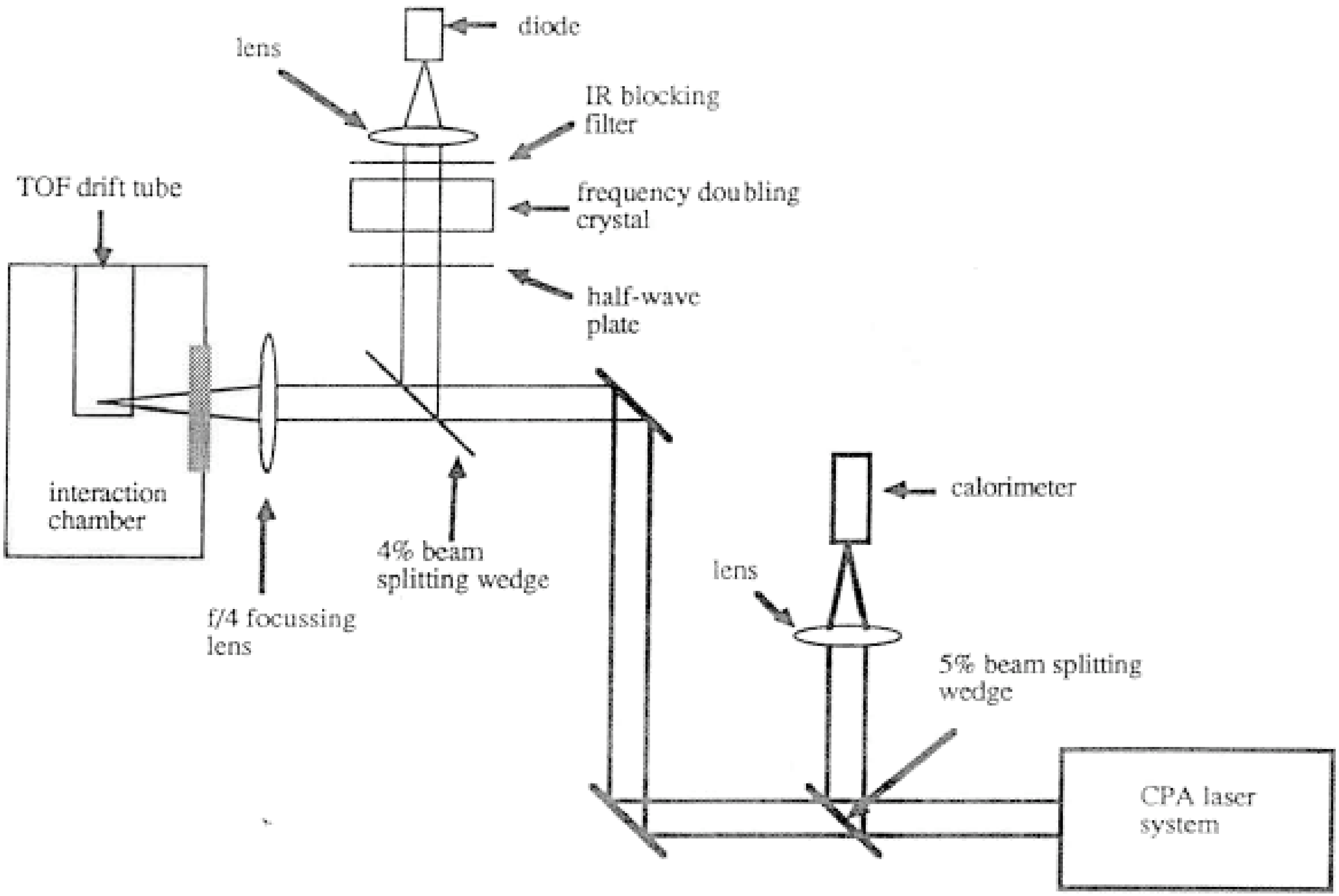


Multi-photon versus Tunnel Ionization



Keldysh parameter, γ

Experimental Set-up



Tunnel Ionization using CPA

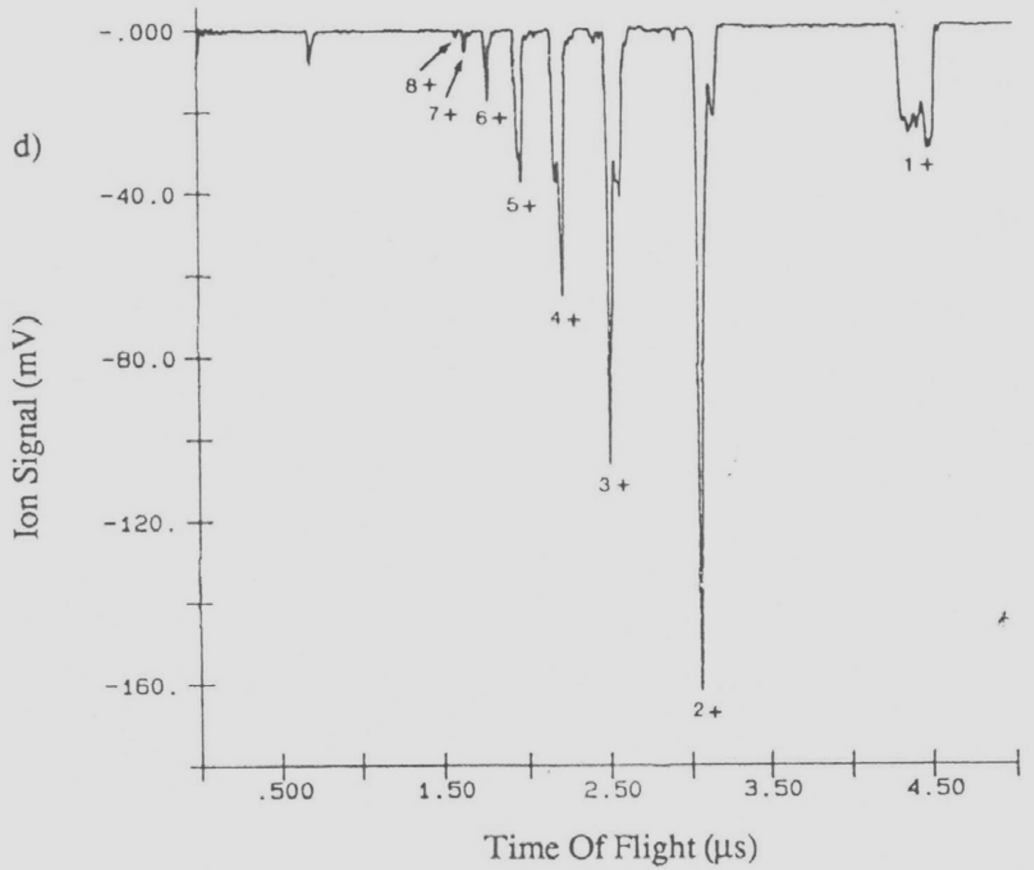
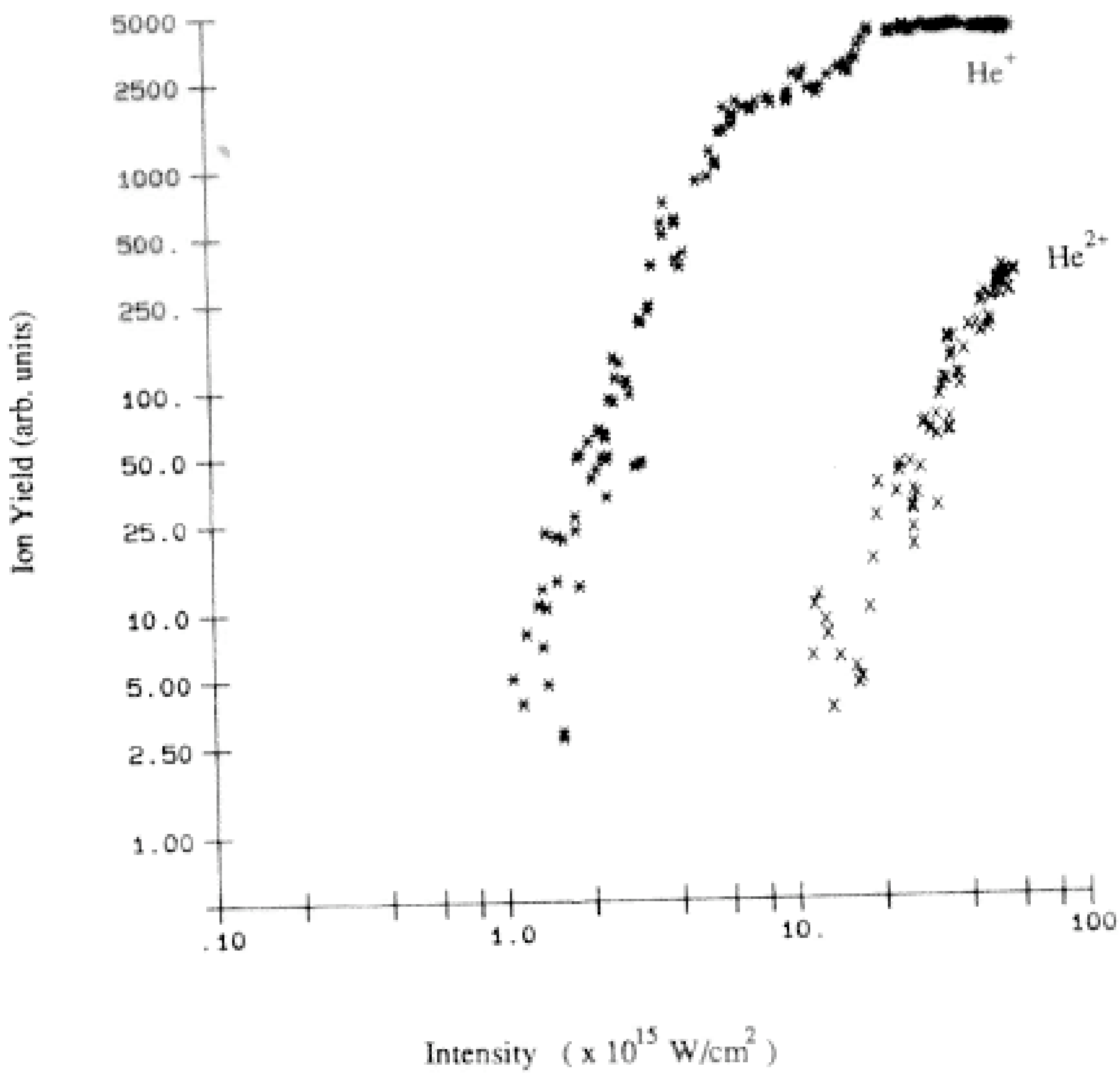
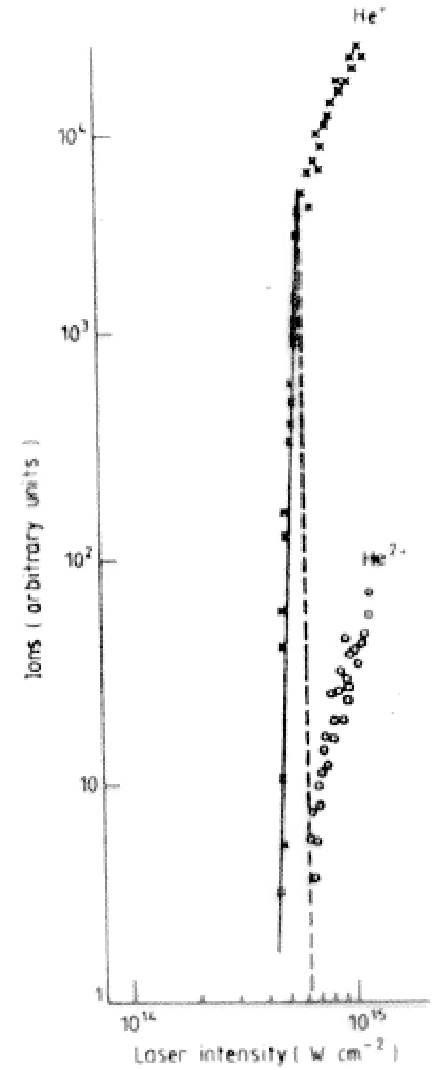


Figure 3 - 8. TOF spectra of (c) Neon and (d) Argon

Helium Ion Yield as a function of 1.05μm Intensity



CPA results



Saclay results

J. Opt. Soc. Am. B/Vol. 8, No. 4/April 1991

Laser ionization of noble gases by Coulomb-barrier suppression

S. Augst, D. D. Meyerhofer, D. Strickland,* and S. L. Chin†

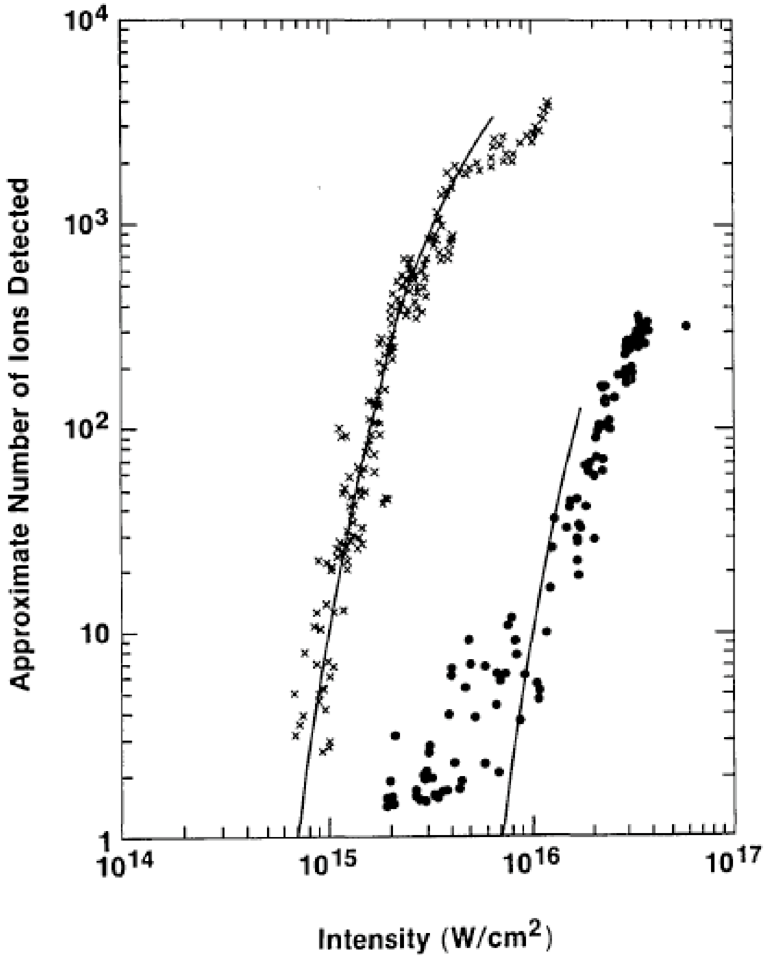


Fig. 11. Comparison of helium ion production and that predicted by KFR theory. The theoretical curves have no shift in intensity.

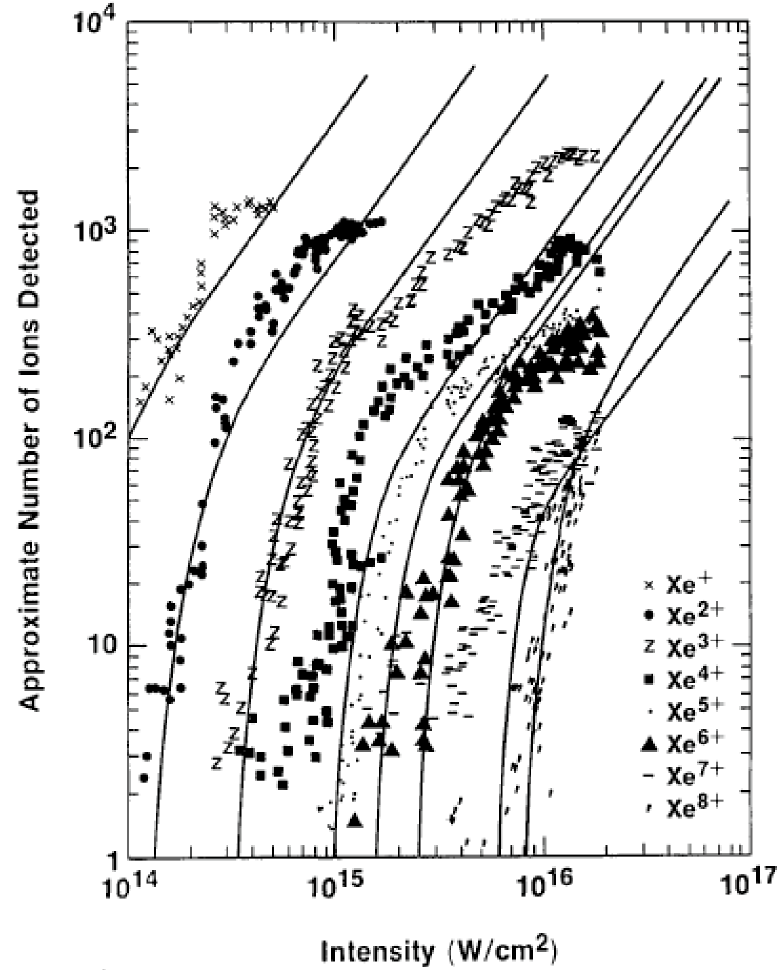


Fig. 8. Comparison of xenon ion production and that predicted by ADK theory. The theoretical curves have no shift in intensity.

Tunneling Ionization of Noble Gases in a High-Intensity Laser Field

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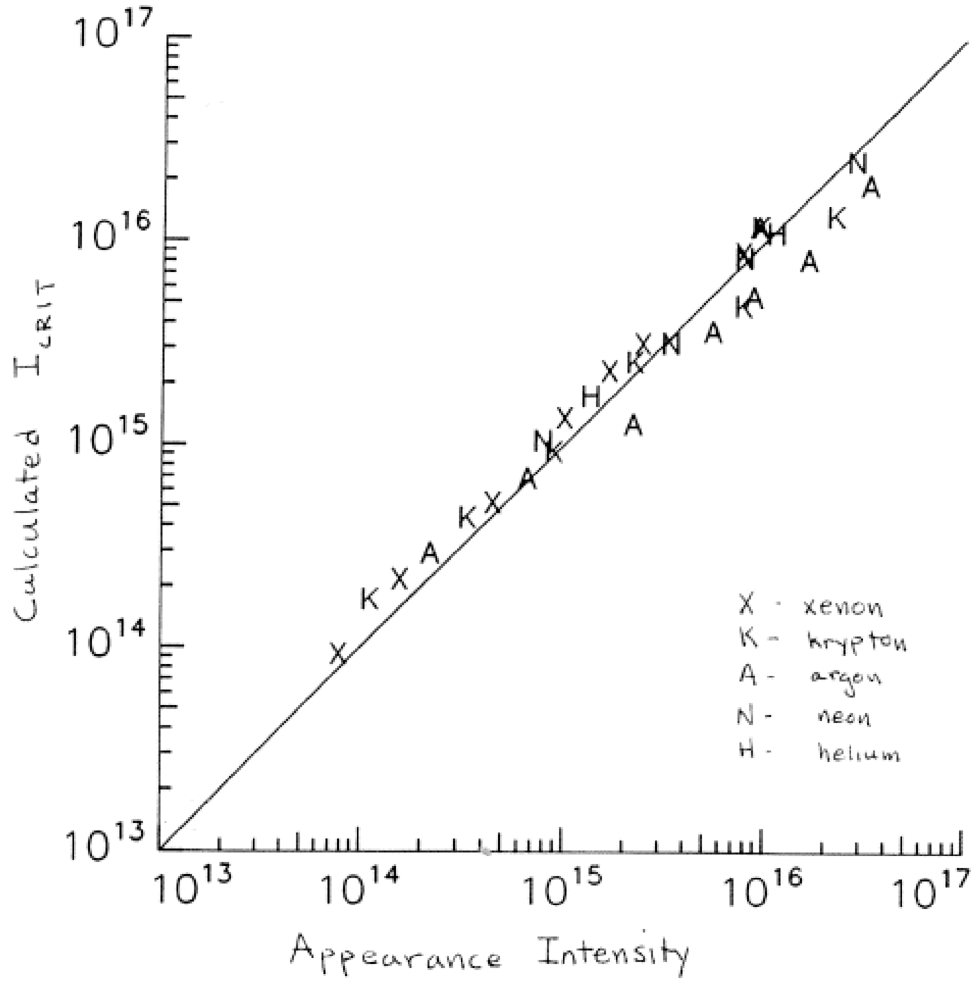
(Received 26 June 1989)

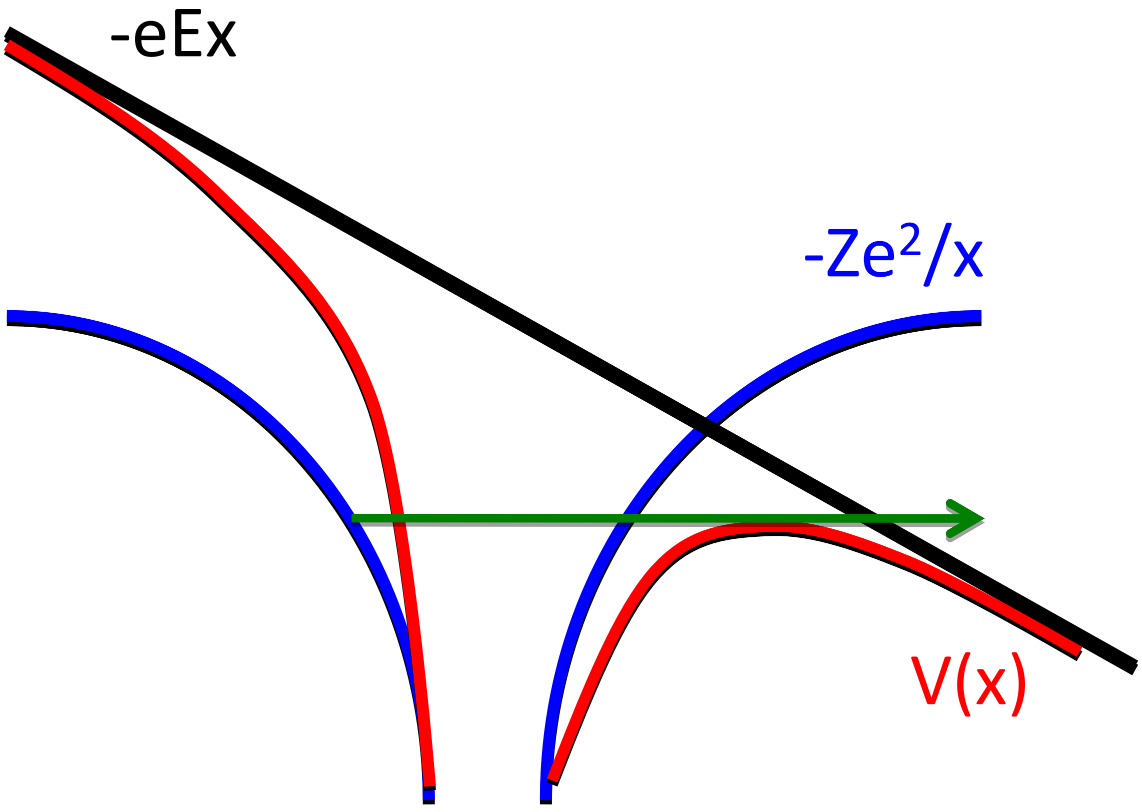


Barrier Suppression Ionization

$V(x) = -Ze^2/x - eEx$

$V_{max}(x_{barrier}) = E_{electron}$

$I_{crit} = cE^4_{ion}/128\pi e^6 Z^2$



Conclusions

- Barrier Suppression Ionization is a good approximation if well in the tunneling regime
- Appearance Intensity can then be used for laser intensity calibration

Acknowledgements

See Leang Chin

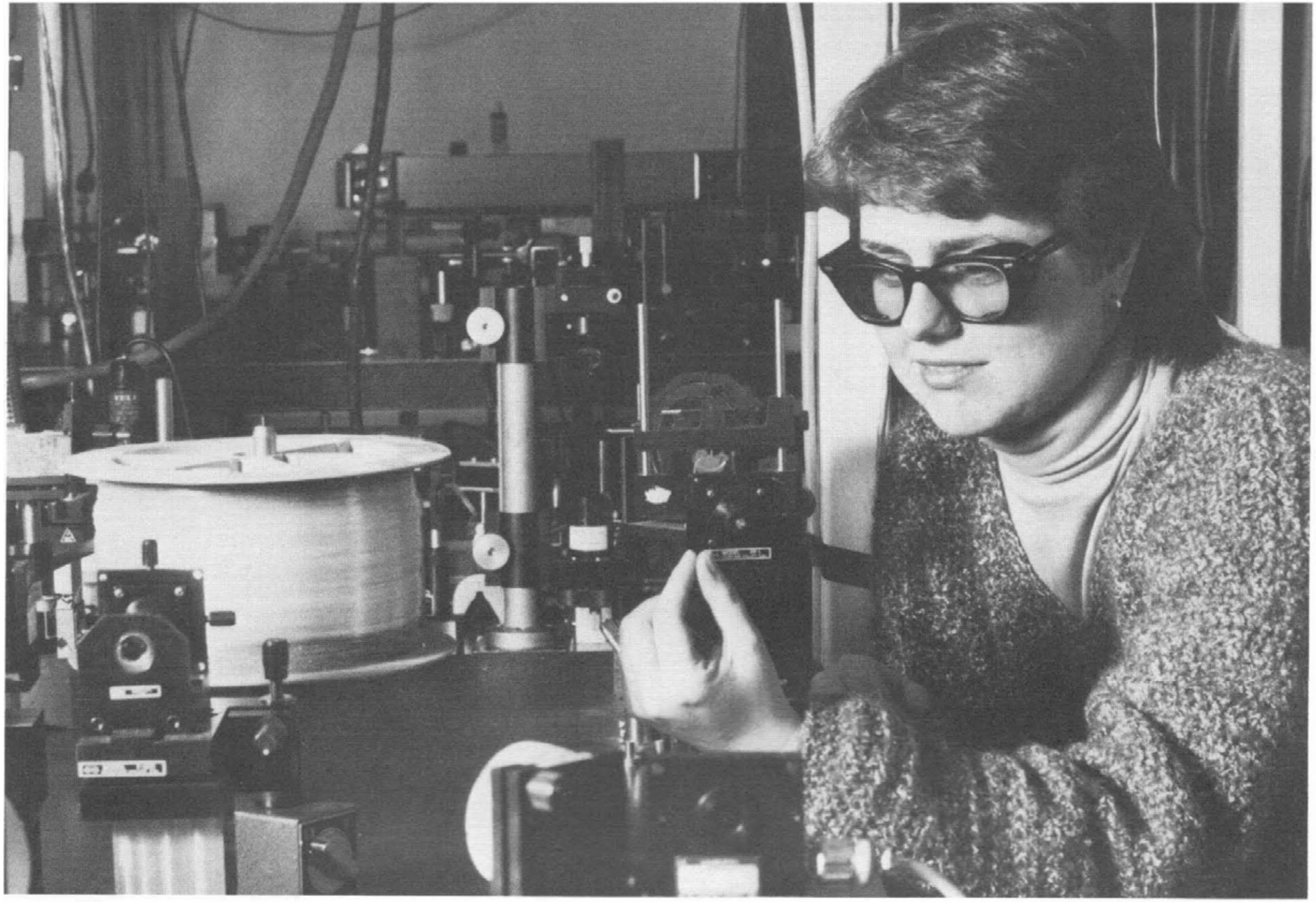
David Meyerhofer

Joe Eberly

Gerard Mourou

Steve Augst


ROCHESTER
BIG & TALL
FREE
TAKE ONE!



Donna Strickland, a graduate student in optics and a member of the Picosecond Research Group, is shown aligning an optical fiber. The fiber is used to frequency chirp and stretch an optical pulse that can later be amplified and compressed in order to achieve high-peak-power pulses.