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OPTICS OF SOLIDS (SURFACE RELATED) AND EFFECT OF
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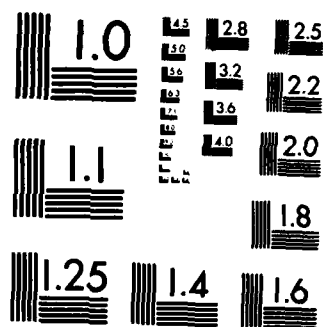
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TITLE

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AUTHOR (S)

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18. SUPPLEMENTARY NOTES The view, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Optics; Excitons; Resonance Scattering; Goos-Hanchen Effect; Giant Lateral Displacement; Non-linear Optical Susceptibility; Surface Roughness Effect on Scattering; Dynamical X-Ray and Incommensurate Transitions; Scattering from Superconductors; Scattering from Phasons.		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Major results of these contracts included: 1) New predictions of giant enhanced Goos-Hanchen shift at resonance in semiconductors; 2) New predictions of spectral and temporal behavior of optical responses; 3) New 4-wave mixing in resonant exciton semiconductors;		

p.t.o.

FINAL REPORT

(Army Research Office)

During the course of the grants # DAAG29-79-G-0040 and # DAAG29-83-K-0019 we carried out research in a number of areas.

Some major findings of our work are: (Reference to list of publications in square brackets [])

1. The giant enhancement of lateral beam displacement (Goos-Hanchen Effect) on a surface was predicted. This effect can be a highly sensitive tool to probe surface roughness and other irregularities.
[27]
2. We analyzed the spectral and temporal behavior of optical pulses in resonant (exciton) media. The characteristics of these pulses can be used for communication purposes.
[16,17,22]
3. We discovered a new four-wave mixing effect in resonant (exciton) semiconductors. This highly selective angular tuning method can be used to determine the material optical constants of semiconductors and the detailed structure of the travelling optical physical modes.
[21]
4. We investigated the energy transport velocity and the signal velocity and the group velocity of optical pulses in semiconductor media and we found anomalies.
[14]
5. We analyzed optical surface propagation in an optically active media and found novel dispersion characteristics for volume and surface waves.
[12,13,18]
6. We analyzed light scattering from elementary excitations in incommensurate crystals and found new selection rules.
[28]
7. We investigated microscopic quantum theory of surface enhanced Raman scattering and we developed a surface plasmon mechanism.
[9,10,20]
8. We collaborated on theoretical analysis of optical spectra of polyacetylene and we developed a theory related to optical response of solitons.
[29,30]

9. We analyzed hopping conductivity mechanism and electron localization in disordered media.
[19,23]
10. We investigated problems in Gaussian beam propagation, optical resonance and transients in dispersive media.
[1,2,3]
11. We have initiated investigation of large amplitude random effects on optical response of metallic surfaces, and small particles. This work is now beginning.
[Proposal submitted to U.S. Army Research Office]



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List of Publications (under ARO sponsorship)

1. "Theory of Electromagnetic Transients in Spatially Dispersive Media and a New Approach to Precursor Theory", J.L. Birman, M.J. Frankel, D.N. Pattanayak in Coherence and Quantum Optics IV (1978) ed. L. Mandel, E. Wolf (Plenum Press, NY)
2. "An Integral Equation Approach to the Theory of Optical Resonance D.N. Pattanayak in Coherence and Quantum Optics IV (1978 ed. L. Mandel, E. Wolf (Plenum Press, NY).
3. "Gaussian Beam Propagation beyond the Paraxial Approximation" G.P. Agrawal and D.N. Pattanayak, J. Opt. Soc. Am. 69, 575 (1979).
4. "Electrical Quadrupole Sum Rules in Solids" C.H. Wu, G. Mahler, J.L. Birman, Phys. Rev. B18, 4221 (1978).
5. "A Surface Wave Dispersion Relation for non-Local Media, D.N. Pattanayak, J.L. Birman, Sol. St. Comm. 28, 927 (1978).
6. "Recent Developments in Non-Local Optics" J.L. Birman, Proceedings of - USA-Japan Binational Symposium on Light Scattering So. St. Comm. 32, 25 (1979).
7. "Non-Local Optics" D.N. Pattanayak, J.L. Birman in Light Scattering in Solids, ed. J.L. Birman, H.Z. Cummins, K.K. Rebane (Plenum Press, NY 1979) p. 131-143.
8. "Lattice Dynamics - Phonon Symmetry and Selection Rules" in Handbook on Semiconductors, ed. W. Paul (North-Holland Press, 1980) 102 page invited review article.
9. "Molecule Adsorbed on Plane Metal Surface: Coupled System Eigenstates" T.K. Lee, J.L. Birman, Phys. Rev. B22, 5953 (1980).
10. "Quantum Theory of Enhanced Raman Scattering by Molecules on Metals: Surface Plasmon Mechanism for Plane Metal Surface" T.K. Lee, J.L. Birman, Phys. Rev. B22, 5961 (1980).
11. "Quantum Theory of Enhanced Raman Scattering by Molecules on Metals: Surface Plasmon Mechanism" T.K. Lee, J.L. Birman. Invited contribution to Journal of Raman Spectroscopy, 10, 140 ((1981)
12. "Wave Propagation in Optically Active and Magnetoelectric Media of Arbitrary Geometry", D. Pattanayak, J.L. Birman, Phys. Rev. B24, 4271 (1981).
13. "Phenomenological Electrodynamics of Bounded Gyrotropic Media Near a Dipole Transition Frequency", D.N. Pattanayak, A. Puri, J.L. Birman, Phys. Rev. B24, 4279 (1981)

14. "Energy-Transport, Group and Signal Velocities near Resonance in Spatially Dispersive Media", A. Puri, J.L. Birman, Phys. Rev. Lett. 47, 173 (1981).
15. "Extinction Theorem Boundary Conditions and Dispersion Equations in Bounded Gyrotropic Media", A. Puri, J.L. Birman, Optics Comm. 37, 81 (1981).
16. "Resonance-Enhanced Transient Reflectivity via Exciton Polaritons" D.N. Pattanayak, G.P. Agrawal, J.L. Birman, Phys. Rev. Lett. 46, 174 (1981)
17. "Transient Optical Reflectivity from Bounded Non-Local Media" G.P. Agrawal, J.L. Birman, D.N. Pattanayak, A. Puri, Phys. Rev. B25, 2715 (1982).
18. "Surface Waves in Bounded Gyrotropic Media", A. Puri, D.N. Pattanayak, J.L. Birman, JOSA, 72, 938 (1982).
19. "Electron Localization in Spatially Disordered Systems", A. Puri, T. Odagaki, Phys. Rev. B24, 5541 (1981).
20. "Coupled Excitation Model and Quantum Test of Image Field Effect" T.K. Lee, J.L. Birman:Invited contribution for "Surface Enhanced Raman Scattering, ed. R.K. Chang and T. Furtak (Plenum Press, NY 1981) p.51-67.
21. "Four Wave Mixing Spectroscopy and Additional Boundary Conditions: A Proposal" T. Takagahara, J.L. Birman, Sol. St. Comm. 44, 465 (1982).
22. "Pulse Propagation in Spatially Dispersive Media", A. Puri, J.L. Birman, Phys. Rev. A27, 1044 (1983).
23. "Hopping Conduction in the d-Dimensional Lattice Bond-Percolation Problem", T. Odagaki, M. Lax, A. Puri, Phys. Rev. B28, 2755 (1983).
24. "Light Scattering in an Anisotropic Charge Density Wave Superconductor" X.L. Lei, C.S. Ting, J.L. Birman (Accepted by Phys. Rev. B)
25. "Dynamical X-ray Diffraction Effects at the Incommensurate Transition" R. Berenson, J.L. Birman Phys. Rev. B28, 5724 (1983).
26. "Microscopic Calculation of the Wave-Vector Dependence of the Third Order Nonlinearity Due to Excitonic Polaritons in CuCl" T. Takagahara, J.L. Birman, Phys. Rev. B28, 6161 (1983).
27. "Resonance Effects on Total Internal Reflection and Lateral (Goos-Hanchen) Beam Displacement at the Interface Between Non-Local Dielectric" A. Puri, D.N. Pattanayak, J.L. Birman, Phys. Rev. B28, 5877 (1983).

28. "Microscopic Theory of Light Scattering from Phasons and Amplitudons" R. Berenson and J.L. Birman (submitted to Phys. Rev. B)
29. "Optical Properties and Photo Excitation of a Novel Liquid Form of Soluble Polyacetylene", R. Tubino, A. Dorsinville, W. Lam, R.R. Alfano, J.L. Birman, A. Bolognesi, S. Destri, M. Catellani and W. Porzio, Phys. Rev. B, Rapid Comm. (in press, Aug. 1984).
30. "Infra-Red Photoinduced Absorption Studies in Soluble Trans-Polyacetylene" R. Dorsinville, R. Tubino, S. Krumchansky, R. R. Alfano, J.L. Birman, S. Bolognesi, S. Destri, M. Catellani and W. Porzio, Sol. St. Comm. (submitted).

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