

DeMaria A J, Glenn W H, Jr., Brienza M J & Mack M E.
Picosecond laser pulses. *Proc. IEEE* 57:2-25, 1969.
[United Aircraft Research Labs., East Hartford, CT]

The paper summarized the work performed at the United Aircraft Research Laboratories, now renamed United Technologies Research Center (UTRC), on the generation, amplification, single pulse selection, pulse compression, measurement, and applications of passively Q-switched and mode-locked laser pulses having pulse widths of 10^{-11} to 10^{-13} sec during the 1966-1968 time period. [The SCJ[®] indicates that this paper has been cited in over 150 publications since 1969.]

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"In 1964, I became aware of the research results of Hargrove et al.¹ which demonstrated the emission of a periodic optical pulse train from a He-Ne laser when utilizing an intracavity acousto-optical modulator driven synchronously at the beat frequency of the laser's axial Fabry-Perot modes. Pulse widths equal to the inverse of the line width of the laser medium were obtained with this active mode-locking technique.

"Realizing that the large bandwidth possessed by the Nd:glass laser could yield optical pulse widths down into the subpicosecond region with peak powers of gigawatts, I set myself the task at United Aircraft Research Labs, now called United Technologies Research Center (UTRC), of mode locking the Nd:glass laser. I believed that with such experiments, I could generate the shortest event ever generated by mankind with sufficient energy per pulse to enable the performance of experiments previously not possible in such fields as transient response of atomic and molecular systems, high-speed photography, plasma generation, spectroscopy, nonlinear optics, etc. My initial experiments utilized acousto-optical modulators and formed the basis for my PhD thesis at the University of Connecticut in 1965. In late-1965, Hans Heynau, of UTRC's Instrumentation Section, discussed with me his problems with eliminating 'spikes' appearing on the output pulses of his passively Q-switched Nd:glass laser. Having read the article by C. Chapin Cutler²

on a microwave regenerative pulse oscillator, which encompassed a traveling wave tube amplifier having its output fed back to its input through a nonlinear circuit whose function was to provide less attenuation for high-level signals than for low-level signals, I realized that an optical saturable absorber could play the same pulse sharpening effect role in the optical region. David Stetser and I set out to optimize the self-mode locking of Nd:glass Q-switched lasers with saturable absorbers. This effort culminated in two *Applied Physics Letters*^{3,4} publications in 1966 which clearly illustrated how Cutler's microwave research results² could be used to describe the operation of a saturable absorber, self-mode locked laser, as well as pointing out the exciting promise of generating coherent subpicosecond pulses. Consequently, widespread research interest was generated in the technique.

"At the time, I headed the Quantum Physics Group at UTRC. From late-1966 until early-1970, nearly the entire research effort of the staff, which consisted of W.H. Glenn, E.B. Traacy, M.J. Brienza, and M.E. Mack, was redirected toward the generation, measurement, and utilization of picosecond laser pulses.

"I believe the paper has been highly cited because it reviewed, for the first time in one concise paper, all of the group's research results which were mostly published in separate letter journals' articles prior to that time. The subsequent application of the techniques described in the paper to CW dye lasers by other researchers has now made available to chemistry, biology, and physics researchers a commercial system emitting well-behaved and reliable tunable laser pulses having pulse widths into the hundreds of femtosecond range and with pulse compression into the tens of femtosecond range. Activity in the field is still growing. Numerous international meetings have been and are continuing to be devoted to the generation, measurement, and utilization of ultrashort laser pulses.⁵

"Based on the role I played in focusing research attention on the subject, I was honored with the IEEE Morris N. Liebmann Award in 1980."

1. Hargrove L E, Fork R L & Pollock M A. Locking of He-Ne laser modes induced by synchronous intracavity modulation. *Appl. Phys. Lett.* 5:4-5, 1964.
2. Cutler C C. The regenerative pulse generator. *Proc. IRE* 43:140-8, 1955.
3. DeMaria A J, Stetser D A & Heynau H. Self-mode locking of lasers with saturable absorbers. *Appl. Phys. Lett.* 8:174-6, 1966.
4. Stetser D A & DeMaria A J. Optical spectra of ultrashort optical pulses generated by mode-locked glass:Nd lasers. *Appl. Phys. Lett.* 9:118-20, 1966.
5. Eshenthal K B, Hochstrasser R M, Kaiser W & Laubereau A, eds. *Picosecond phenomena. III. Proceedings of the Third International Conference on Picosecond Phenomena*. Berlin: Springer-Verlag, 1982. 401 p.