University of Stuttgart (1958-66)

I wanted to know how fast vibrations of simple molecules get into thermal equilibrium in the liquid and solid state. So far gases were studied where equilibrium is established by molecular collisions.

Results
Thermal equilibrium requires a few hundred picoseconds. It is proportional to the density from gas to solid, although there are no collisions. This sentence, written June 10, 2012, is my shortest publication: Now I believe that molecular interactions are with the van der Waal's dipole-dipole force of $1/R^6$ effective only at distances where collisions and a ligand cage may not make much difference for energy transfer. At that time I derived a quantum-mechanical phonon collision theory. Since melting kills long wavelength phonons, only short wavelength (and therefore local) phonons can be effective for energy transfer in a liquid.

Measurement
The coupling to molecular energy storage changes the sound absorption and -velocity analogous to light absorption when passing through matter with optical transitions. Built the only pulsed ultrasonic measuring bridge to date, tunable from 50 to 450 MHz with surface excitation of single crystal quartz rods. The molecular crystals (including pure Br_2) could be grown between the rods at different spacing from 100 to 10.000 wavelengths (about 2 microns at 450 MHz). The comparison path was with a single quartz delay line electronically identical.

Application
Invented and built in 1960 the first lock-in amplifier. It allowed picking up signals buried in 4 orders of magnitude larger noise. Built at the ICI Labs in Welwyn (UK) another apparatus for measuring and understanding the properties of insoluble micro-droplets in liquids.

AT&T Bell Labs (1966-71)

1. Wanted to deflect infrared light beams with spin waves in YIG. Failed. 10 years later it was achieved with four orders of magnitude higher detection sensitivity.

2. Wanted to understand, optimize, and stabilize the Nd:YAG laser for communication, manufacturing, and nuclear fusion (Livermore-connection). Set up a complete laser lab.

Results
When the laser rod is axially moved with 1 cm per second in the cavity all longitudinal modes collapse into a single mode with the entire power and stable frequency. The same is achieved electro-optically without movable parts when the frequency modulation follows the solutions of the Bessel function J_o. Achieved satisfactory frequency and amplitude stabilization. Gaussian Evanescent wave output coupling optimizes radial efficiency. Nearly lossless round-trip modulation yields regular spiking with 3 orders of magnitude compression of output power. Frequency doubling and power transfer to seeding beams. The doping level is limited to 1.5% because Nd^{3+} - excitation is quenched (again $1/R^6$- interaction) for less than 0.6nm distance, and doping creates channels of adjacent ions.

3. Rudi Kompfner (my Executive Director, architect in London before WWII, 300 patents) wanted an optical amplifier with 10 dB gain per optical wavelength (0.7 microns).

Result
Invention of the first pure chemical compound single crystal laser. Required was an inorganic single crystal where Nd is the only metal with over 0.6 nm distance to the next Nd ion. The chemical cage required about 20 non-metals consisting of O, S, N or P. Set up a simple chemical and crystal growth lab and tested acids dissolving Nd oxide and losing water at high temperatures. The third solvent produced NdP_5O_{14} crystals with a distance of 0.63 nm between the Nd ions. Over 10 dB per wavelength gain, insoluble except for red hot polymerized phosphoric acid.

4. Studied Economics at Rutgers University (evening courses). MBA 1971

MPI for Solid State Research in Stuttgart (1972-75)

1. Set up a spectroscopy group for analyzing the entire Rare Earth Pentaphosphate series and identifying their possible laser and amplifier properties. Examining pressure-dependence (with the Ultrahigh Pressure Group) and magnetic field dependence (with the High Field Lab in Grenoble, France.

2. Project reviews for the ministry of Research and Technology (BMFT) in electronics, semiconductors, and optical communication.

Institute of Applied Physics of Hamburg University (1975-86)

1. Set up Czochralski crystal growth, spectroscopy, and laser test labs. Research and staff exchange contracts with the Lebedev Institute of the USSR Academy of Science (1976-86), Lincoln Lab MIT (1977-82), and the Laser Lab of the University of Shandong in Jinan, PR of China (1980-86).
2. Member of the Large Research Project Committees (scientific and financial) of the German Science Foundation (DFG), responsible for all projects in physics (1978-84). Courses in solid state physics for all physics students and basic physics for all engineering students.
3. Founding President of the Technical University of Hamburg-Harburg (1978-86).
4. Founding Chairman of the Hamburg Technology Park HIT e. V. (1981-86)
5. About 50 invited publications on research, engineering, education, and university management (mostly in German).

Siemens AG (1987-96)

Responsible for Corporate R&D (medical diagnosis, energy, communication, industrial automation, semiconductors, software). Chairman Corporate Research Lab in Princeton, N. J., USA. About 50 invited publications on industrial research and development (mostly in German). Book on industrial R&D with Y. Takeda, CTO of Hitachi Ltd. (Ref. 45)

Consultant for governments and universities, since 2010 Guest Professor at the Institute of Neuro- and Biotechnology, University of Lübeck.

Patents

1. US 3,628,173 – Laser Mode Selection and Stabilization Apparatus employing birefringent Etalon. H G Danielmeyer, Bell Telephone Laboratories (BTL) 4-28-69, granted 12-14-71
2. US 3,609,586 – Laser with pulsed Transmission Mode Q-Switching.
H G Danielmeyer BTL
H G Danielmeyer, BTL 6-18-69, granted 9-28-71
3. US 3,633,124 Laser with Feedback Circuit for Controlling Relaxation Oscillation.
H G Danielmeyer, BTL 6-10-70, granted 1-4-72
4. US 3,675,156 – Laser Pump Cavity with conical Geometry.
H G Danielmeyer, BTL 2-25-71, granted 7-4-72
5. US 3,676,799 – Frequency stabilized Laser
H G Danielmeyer, BTL 12-28-70, granted 7-11-72
6. US 3,697,888 – Evanescent Wave coupling Technique for Beam Shaping
H G Danielmeyer, BTL 6-1-71, granted 10-10-72
7. US 3,813,613 – Laser employing metallic Pentaphosphate
H G Danielmeyer and H P Weber, BTL 4-2-73, granted 5-28-74
8. D 23.42.182 – Neodymultraphosphate, Verfahren zu deren Herstellung und Verwendung
H G Danielmeyer, J P Jeser,, W W Krühler, E Schönherr, G Huber,
MPG (GI 195-1) 21.8.73, erteilt 8.6.78
9. D 24.00.911 – Verfahren zur Herstellung von Neodym-Ultraphosphaten,
H G Danielmeyer, J P Jeser, W W Krühler, E Schönherr, G Huber,
MPG (GI 195-2) 9.1.74, erteilt 1.6.78
10. D 24.62.693 – Laseranordnung für hochdotierte optische Verstärkerelemente,
H G Danielmeyer, J P Jeser, W W Krühler, K H Thiemann, G Huber,
MPG (GI-195-3) 25.3.74,
erteilt 31.10.79
11. D 24.14.531 – Verfahren zur Herstellung von Neodxm-Penta-Phosphaten,
H G Danielmeyer, J P Jeser, W W Krühler, E Schönherr, G Huber,
MPG (GI-195-4) 26.3.74, erteilt 9.11.78
12. D 24.17.963 Lichtleiter, H G Danielmeyer, J P Jeser, W W Krühler,
K H Thiemann, G Huber,MPG (GI-195-5) 11.4.74, erteilt 26.11.75
13. D 37.27.546 Lichtverstärker mit ringförmig geführter Strahlung, insbesondere Ringlaser- Diode, H G Danielmeyer, Siemens AG 18.8.87, erteilt 22.6.89