

---

---

## REFERENCES

---

---

- Amboss, K., "The current art of millimeter-wave solid state and tube type power sources" *Proc. Conference Military Microwaves*, MM-80, London, pp. 520-546, 1980.
- Andronov, A. A., Flyagin, V. A., Gaponov, A. V., Goldenberg, A. L., Petelin, M. I., Usov, V. G., and Yulpatov, V. K., "The gyrotron: high power source of millimeter and sub millimeter waves," *J. Infrared Phys.*, Vol. 18, No. 5, pp. 385-393, 1978.
- Ashutosh, Jain, P. K., "Design and analysis of metallic photonic band gap cavity for a gyrotron" *J. Microwaves, Optoelectron. Electromagn. Appl.*, Vol. 11, No.2, pp. 242-251, 2012.
- Baird, J. M., "Survey of fast wave tube developments," *Proc. Electron Devices Meeting Technical Digest*, pp. 156-163, 1979.
- Baird, J. M., and Lawson, W., "Magnetron injection gun (MIG) design for gyrotron applications," *Int. J. Electron.*, Vol. 61, pp. 953-967, 1986.
- Barker, R. J., and Schamiloglu, E., "*High-Power Microwave Sources and Technologies*," New York: IEEE Press, 2001.
- Barker, R. J., Booske, J. H., Luhmann, N. C., and Nusinovich, G. S., *Modern Microwave and Millimeter-Wave Power Electronics*, New Jersey: IEEE Press, 2004.
- Basu, B. N., *Electromagnetic Theory and Applications in Beam-Wave Electronics*, Singapore: World Scientific, 1996.
- Benford, J., and Swegel, J., *High Power Microwaves*, Boston: Artech House, 1992.
- Blank, M., Felch, K., James, B. G., Borchard, P., Cahalan, P., Chu, T. S., Jory, H., Danly, B. G., Levush, B., Calame, J. P., Nguyen, T., and Pershing, E., "Development and demonstration of high-average power W-band gyro-amplifiers for radar applications," *IEEE Trans. Plasma Sci.*, Vol. 30, No. 3, pp. 865-875, 2002.
- Bollen, W. M., McCurdy, A. H., Arfin, B., Parker, R. K., Ganguly, A. K., "Design and performance of a three-cavity gyrokystron amplifier," *IEEE Trans. Plasma Sci.*, Vol. 13, No. 6, pp. 417-423, 1985.
- Borie, E., and Gantenbein, G., "Self consistent theory for gyrotrons including effect of voltage depression," *Int. J. Infrared Millimeter Waves*, Vol. 12, No. 2, pp. 65-78, 1991.
- Calame, J. P., Garven, M., Choi, J. J., Nguyen, K., Wood, F., Blank, M., Danly, B. G., and Levush, B., "Experimental studies of bandwidth and power production in a three-cavity, 35 GHz gyrokystron amplifier," *Phys. Plasmas*, Vol. 6, pp. 285-297, 1999.
- Carter, R. G., *Electromagnetic Waves, Microwave Components and Devices*, London: Chapman & Hall, 1990.
- Castle, M., Yovchev, I., Lawson, W., Hogan, B., Granatstein, V. L., and Reiser, M., "Operation of a three cavity second harmonic coaxial gyrokystron" *Proc. Particle Accelerator Conference*, pp. 1046-1048, 1999.

- Chatterjee, R., *Microwave, Millimetre-Wave and Submillimetre-Wave: Vacuum Electron Devices*, New Delhi: Affiliated East-West Press, 1999.
- Choi, J. J., "A high-gain, 28GHz gyrokystron amplifier," *Int. J. Infrared Millimeter Waves*, Vol. 19, No. 12, pp. 1681–1691, 1998.
- Choi, J. J., "Design of a temperature limited single-anode magnetron-injection-gun," *Int. J. Infrared Millimeter Waves*, Vol. 20, No. 2, pp. 239-252, 1999.
- Choi, J. J., McCurdy, A. H., Wood, F. N., Kyser, R. H., Calame, J. P., Nguyen, K. T., Danly, B. G., Antonsen, T. M., Levush, B., and Parker, R. K., "Experimental investigation of a high power, two-cavity, 35 GHz gyrokystron amplifier", *IEEE Trans. Plasma Sci.*, Vol. 24, pp. 416-425, 1998.
- Chu, K. R., "The electron cyclotron maser," *Rev. Mod. Phys.*, Vol. 76, pp. 489-540, 2004.
- Chu, K. R., and Hirshfield, J. L., "Comparative study of the axial and azimuthal bunching mechanisms in electromagnetic cyclotron instabilities" *Phys. Fluids*, Vol. 21, pp. 461-466, 1978.
- Chu, K. R., Granatstein, V. L., Latham, P. E., Lawson, W., and Striffler, C. D., "A 30-MW gyrokystron-amplifier design for high-energy linear accelerators," *IEEE Trans. Plasma Sci.*, Vol. 13, No. 6, pp. 424–434, 1985.
- Chu, K. R., Latham, P. E., and Granatstein, V. L., "Penultimate cavity tuning of the gyrokystron amplifier," *Int. J. Electron.*, Vol. 65, No. 3, pp. 419–428, 1988.
- Collin, R. E., *Foundations for Microwave Engineering*, New York: McGraw-Hill, 1966.
- Curie, N. C., and Brown, C. E., *Principle and Applications of Millimeter-Wave Radars*, Boston: Artech House, 1989.
- Danly, B. G., and Temkin, R. J., "Generalized nonlinear harmonic gyrotron theory," *Phys. Fluids*, Vol. 29, No. 2, pp. 561–567, 1986.
- Di-Wei, L., Xue-Song, Y., Yang, Y., and Sheng-Gang, L., "Self-consistent nonlinear analysis of a frequency-quadrupling terahertz gyrokystron," *Chin. Phys. B*, Vol. 18, No. 12, pp. 5507-5510, 2009.
- Dumbrajs, O., and Koponen, J. P. T., "Generalized gyrotron theory with inclusion of electron velocity and energy spreads," *Phys. Plasmas*, Vol. 6, No. 6, pp. 2618–2621, 1999.
- Dumbrajs, O., Meyer-Spasche, R., and Reinfelds, A., "Analysis of electron trajectories in a gyrotron resonator," *IEEE Trans. Plasma Sci.*, Vol. 26, No. 3, pp. 846–853, 1998.
- Edgcombe, C. J. Ed., *Gyrotron Oscillators: Their Principles and Practice*, London: Taylor & Francis, 1993.
- Feinstein, J., and Felch, K., "Status review of research on millimeter-wave tubes," *IEEE Trans. Electron Dev.*, Vol. 34, pp. 461-467, 1987.
- Felch, K. L., Danly, B. G., Jory, H. R., Kreischer, K. E., Lawson, W., Levush, B., and Temkin, R. J., "Characteristics and applications of fast-wave gyrodevices," *Proc. IEEE*, Vol. 87, pp. 752-781, 1999.
- Fischer, R. P., Manheimer, W. M., Fliflet, A. W., "Theory and simulation of an 85 GHz quasioptical gyrokystron experiment," *Int. J. Infrared Millimeter Waves*, Vol. 18, No. 4, pp. 759-778, 1997.

- Fliflet, A. W., Read, M. E., and Chu, K. R., "A self-consistent field theory for gyrotron oscillators: Application to a low Q gyromonotron," *Int. J. Electron.*, Vol. 53, No. 6, pp. 505–521, 1982.
- Flyagin, V. A., and Nusinovich, G. S., "Gyrotron oscillators," *Proc. IEEE*, Vol. 76, pp. 644–656, 1988.
- Gandhi, O. P., *Microwave Engineering and Applications*, New York: Pergamon Press, 1981.
- Ganguly, A. K., and Chu, K. R., "Analysis of two-cavity gyrokystron," *Int. J. Electron.*, Vol. 51, pp. 503–520, 1981.
- Ganguly, A. K., and Chu, K. R., "Limiting current in gyrotrons," *Int. J. Infrared Millimeter Waves*, Vol. 5, pp. 103–122, 1984.
- Gaponov, A. V., and Granatstein, V. L., *Applications of High Power Microwaves*, Boston: Artech House, 1994.
- Gaponov, A. V., Petelin, M. I., and Yulpatov, V. K., "The induced radiation of excited classical oscillators and its use in high-frequency electronics," *Radiophys. Quantum Electron.*, Vol. 10, No. 9–10, pp. 794–813, 1967.
- Garven, M., Calame, J. P., Nguyen, K. T., Danly, B. G., Levush, B., and Wood F. N., "Experimental studies of a four-cavity, 35 GHz gyrokystron amplifier," *IEEE Trans. Plasma Sci.*, Vol. 28, No. 3, pp. 672–680, 2000.
- Geng, Zhi-Hui, and Liu, Pu-Kun, "Calculation of the electron efficiency for a two-cavity gyrokystron amplifier by using a self-consistent code," *Int. J. Infrared Millimeter Waves*, Vol. 25, pp. 1133–1141, 2004.
- Gilmour, A. S., *Microwave Tubes*, Boston: Artech House, 1986.
- Gold, S. H., and Nusinovich, G. S., "Review of high-power microwave source research," *Rev. Sci. Instrum.*, Vol. 68, pp. 3945–3974, 1997.
- Gold, S. H., Fliflet, A. W., Manheimer, W. M., Kirkpatrick, D. A., Black, W. M., Kinkead, A. K., Hardesty, D. L., and Sucey, M. S., "Millimeter-wave gyrokystron amplifier experiment using a relativistic electron beam," *IEEE Trans. Plasma Sci.*, Vol. 18, No. 6, pp. 1021–1027, 1990.
- Granatstein, V. L., and Lawson, W., "Gyro-amplifiers as candidate RF drivers for TeV linear colliders," *IEEE Trans. Plasma Sci.*, Vol. 24, pp. 648–665, 1996.
- Granatstein, V. L., and Park, S. Y., "Survey of recent gyrotron developments," *IEDM Tech. Dig.*, pp. 263–265, 1983.
- Granatstein, V. L., Levush, B., Danly, B. G., Parker, R. K., "A quarter century of gyrotron research and development," *IEEE Trans. Plasma Sci.*, Vol. 25, pp. 1322–1335, 1997.
- Granatstein, V. L., Nusinovich, G. S., Calame, J., Lawson, W., Singh, A., Guo, H., and Reiser, M., "Prospects for developing microwave amplifiers to drive multi-TeV colliders" *Proc. Particle Accelerator Conference*, pp. 1561–1562, 1995.
- Grantstein, V. L., and Alexeff, I., *High Power Microwave Sources*, Boston: Artech House, 1987.

- Hazelton, D. W., Danly, B. G., and Gubser, D. U., "Cryogen free high temperature superconducting magnets for 94 GHz gyrokystron-powered radar applications," *Naval Engineers Journal*, Vol. 110, No. 1, pp. 117-121, 1998.
- Hirshfield, J. L., and Granatstein, V. L., "Electron cyclotron maser — An historical survey," *IEEE Trans. Microw. Theory Tech.*, Vol. 25, pp. 522-527, 1977.
- Jain, P. K., and Basu, B. N., "A review on some aspects of a gyro-TWT," *J. IETE (India)*, Vol. 40, pp. 3-9, 1994.
- Jianhua, G., Sheng, Y., Xiang, L., and L. Hongfu, "Study on nonlinear theory and code of beam-wave interaction for gyrokystron," *J. Infrared, Millimeter, Terahertz Waves*, Vol. 32, No. 12, pp. 1382–1393, 2011.
- Joo, Y. D., Won, J. H., and Park, G. S., "Study on photonic crystal cavity for harmonic multiplying gyrokystron using axis-encircling electron beam," *Proc. International Vacuum Electronics Conference*, pp. 467-468, 2006.
- Jory, H. R., Friedlander, F., Hegji, S. J., Shively, J. F., and Symons, R. S., "Gyrotrons for high power millimeter wave generation" *Proc. International Electron Devices Meeting*, pp. 234-237, 1977.
- Joye, C. D., Shapiro, M. A., Sirigiri, J. R., and Temkin, R. J., "Design of a 140 GHz, 100 W gyrokystron amplifier," *Proc. IEEE International Vacuum Electronics Conference*, pp. 198–199, 2004.
- Kartikeyan, M. V., Borie, E., and Thumm, M., *Gyrotrons High-Power Microwave and Millimeter Wave Technology*, Germany: Springer, 2004.
- Kasatkin, L. V., Rapoport, G. N., and Taranenko, V. P., "Gyrodevices as power sources of electromagnetic waves in the microwave band," *Radioelectron. Commun. Syst.*, Vol. 51, No. 1, pp. 3-15, 2008.
- Kirshner, M. F., Wilsen, C. B., Hargreaves, T. A., True, R. B., Kowalczyk, R. D., Bartkowski, R. J., and Nguyen, K. T., "Multi-beam klystron for next generation accelerators," *Proc. International Vacuum Electronics Conference*, pp. 110-111, 2003.
- Kou, C. S., Wu, M. H., and Tseng, F., "Nonlinear analysis of a multi-cavity gyro-twystrotron," *Int. J. Infrared Millimeter Waves*, Vol. 18, No.106, pp. 1857-1883, 1997.
- Kreischer, K. E., Danly, B. G., Schutkerer, J. B., and Temkin, R. J., "The design of megawatt gyrotrons," *IEEE Trans. Plasma Sci.*, Vol. 13, pp. 364-373, 1985.
- Latham, P. E., "AC space-charge effects in gyrokystron amplifiers," *IEEE Trans. Plasma Sci.*, Vol. 18, No. 3, pp. 273-285, 1990.
- Lawson, W., "Theoretical evaluation of nonlinear tapers for a high-power gyrotron," *IEEE Trans. Microw. Theory and Tech.*, Vol. 38, No. 11, pp. 1617-1622, 1990,
- Lawson, W., Cheng, J., Calame, J., Castle, M., Hogan, B., Granatstein, V. L., Reiser, M., and Saraph, G. P., "High-power operation of a three-cavity X-band coaxial gyrokystron" *Phys. Rev. Lett.*, Vol. 81, No. 14, pp. 3030-3033, 1998.
- Lei, C., "Design and simulation of 30GHz 4 cavities gyrokystron," *IEEE Int. Vac. Electron. Conf. (IVEC)*, pp. 228–229, Apr. 2009.
- Liao, S. Y., *Microwave Devices and Circuits*, Englewood Cliffs, New Jersey: Prentice Hall, 1985.
- Liao, S. Y., *Microwave Electron Tubes*, New Jersey: Prentice-Hall, 1988.

- Liu, P. K., and Borie, E., "Mode competition and self consistent simulation of a second harmonic gyrotron oscillator," *Int. J. Infrared Millimeter Waves*, Vol. 21, No. 6, pp. 855-882, 2000.
- Luo, Y., Li, H., Xu, Y., and Deng, X., "Analysis and numerical calculations of the beam-wave interaction for gyrokystron amplifiers," *Int. J. Infrared Millimeter Waves*, Vol. 26, No. 5, pp. 691-700, 2005.
- MAGIC *User's Manual*: 2007 version of Magic 3D, ATK Mission Research, Washington.
- McNally, J. D., McDermott, D. B., Wang, Q. S., Hartemann, F. V., and Luhmann, N. C., "High performance, 70 kV third-harmonic smooth-bore gyrokystron amplifier," *IEEE Trans. Plasma Sci.*, Vol. 22, No. 5, pp. 932-938, 1994.
- Nagarkoti, D. S., Sharma, R., Dua, R. L., and Jain, P. K., "Analysis of nonlinear cylindrical waveguide taper using modal matching technique," *Int. J. Microwaves Appl.*, Vol. 1, No. 1, pp. 5-12, 2012.
- Nguyen, K. T., Levush, B., Antonsen, T. M., Botton, M., Blank, M., Calame, J. P., and Danly, B. G., "Modeling of gyrokystrons with MAGY," *IEEE Trans. Plasma Sci.*, vol. 28, no. 3, pp. 867-886, Jun. 2000.
- Nusinovich, G. S., "Cyclotron resonance masers with inhomogeneous external magnetic fields," *Phys. Fluids-B*, Vol. 4, pp. 1989-1997, 1992.
- Nusinovich, G. S., Antonsen, T. M., Guo, H., and Granatstein, V. L., "Theory of clustered-cavity gyrokystron," *Phys. Plasmas*, Vol. 9, No. 9, pp. 4032-4039, 2002.
- Nusinovich, G. S., Antonsen, T. M., Guo, H., and Granatstein, V. L., "Theory of clustered-cavity gyrokystron," *Phys. Plasmas*, Vol. 9, No. 9, pp. 4032-4039, 2002.
- Nusinovich, G. S., Chen, W., and Tripathi, V. K., "Linear theory of a gyrotwyston with stagger-tuned cavities," *IEEE Trans. Plasma Sci.*, vol. 26, No. 3, pp. 468-474, 1998.
- Nusinovich, G. S., Danly, B. G., and Levush, B., "Gain and bandwidth in stagger-tuned gyrokystrons," *Phys. Plasmas*, Vol. 4, No. 2, pp. 469-478, 1997.
- Nusinovich, G. S., *Introduction to the Physics of Gyrotrons*, Baltimore, Maryland: Johns Hopkins Univ. Press, 2004.
- Nusinovich, G. S., Levush, B., and Danly, B. G., "Theory of multibeam stagger-tuned gyrokystrons," *IEEE Trans. Plasma Sci.*, Vol. 26, No. 3, pp. 475-481, 1998.
- Nusinovich, G. S., Levush, B., and Danly, B., "Theory of multi-beam stagger-tuned gyrokystrons," *IEEE Trans. Plasma Sci.*, Vol. 26, pp. 475-481, 1998.
- Nusinovich, G. S., Walter, M. T., Kremer, M., Read, M. E., and Boehme, D., "A submillimeter-wave gyrokystron: theory and design," *IEEE Trans. Plasma Sci.*, Vol. 28, No. 3, pp. 936-944, 2000.
- Parker, R. K., Abrams, R. H., Danly, B. G., and Levush, B., "Vacuum electronics," *IEEE Trans. Microw. Theory Tech.*, Vol. 50, No. 3, pp. 835-845, 2002.
- Sakamoto, K., "Gyrotrons and mm wave technology for ITER," *Proc. International Conference on Terahertz Electronics. IRMMW-THz*, pp. 4-7, 2007.
- Salop, A., and Caplan, M., "Self-consistent field large signal analysis of the gyrokystron," *Int. J. Electron.*, Vol. 61, No. 6, pp. 1005-1024, 1986.

- Saraph, G. P., Granatstein, V. L., and Lawson, W., "Design of a single-stage depressed collector for high power gyrokystrons," *IEEE Trans. Electron Devices*, Vol. 45, No. 4, pp. 986-990, 1998,
- Savilov, A. V., and Nusinovich, G. S., "On the theory of frequency-quadrupling gyrokystrons," *Phys. Plasmas*, Vol. 14, No. 5, pp. 053113(1-13), 2007.
- Scott, A. W., *Understating Microwaves*, John Wiley and Sons, New York, 1993.
- Shou-Xi Xu, Pu-Kun Liu, and Zhi-Hui Geng, "Numerical simulation of a W-band four-cavity gyrokystron amplifier," *Phys. Plasmas*, Vol. 19, No. 3, pp. 033104 (1-5), 2012.
- Singh, U., Bera, A., Kumar, N., Purohit, L. P., and Sinha, A. K., "Three-dimensional simulation of MIG for 42-GHz 200-kW gyrotron," *IEEE Trans. Plasma Sci.*, Vol. 38, pp. 1546-1550, 2010,
- Singh, U., Kumar, N., Singh, T. P., Sinha, A. K., "A review on the applications of high power, high frequency microwave source: gyrotron," *J. Fusion Energy: Springer*, Vol. 30, pp. 257–276, 2011.
- Symons, R. S., and Jory, H. R., "Cyclotron resonance devices," *Adv. Electron Phys.*, Vol. 55, pp. 1-75, 1986.
- Symons, R. S., and Vaughan, R. M., "The linear theory of the clustered-cavity<sup>TM</sup> klystron," *IEEE Trans. Plasma Sci.*, Vol. 22, No. 5, pp. 713–718, 1994.
- Thumm, M., "History, Present and Future of Gyrotrons", *Proc. International Vacuum Electronics Conference*, pp. 87-88, 2002.
- Thumm, M., "MW gyrotron development for fusion plasma applications," *Plasma Phys. Control Fusion*, Vol. 45, pp. A143–A161, 2003.
- Thumm, M., "Novel applications of millimeter and submillimeter wave gyro-devices," *Int. J. Infrared Millimeter Waves*, Vol. 22, No. 3, pp. 377-386, 2001.
- Thumm, M., *State-of-the-Art of High Power Gyro-Devices and Free Electron Masers*, KIT Scientific Reports 7575, 2010.
- Thumm, M., *State-of-the-Art of High Power Gyro-Devices and Free Electron Masers*, update 2009, KIT Scientific Reports 7641, 2012.
- Tran, T. M., Danly, B. G., Kreisler, K. E., Schutkeker, J. B., and Temkin, R. J., "Optimization of gyrokystron efficiency," *Phys. Fluids*, Vol. 29, pp. 1274-1281, 1986.
- Walter, M. T., Nusinovich, G. S., Lawson, W., Granatstein, V. L., Levush, B., and Danly, B. G., "Design of a frequency-doubling, 35-GHz, 1-MW gyrokystron", *IEEE Trans. Plasma Sci.*, Vol. 28, No.3, pp. 688-694, 2000.
- Wang, J., Luo, Y., Xu, Y., and Li, H., "Theoretical and numerical investigation of a four-cavity TE<sub>021</sub>-mode gyrokystron," *Int. J. Infrared Millimeter Waves*, vol. 29, no. 12, pp. 1113–1122, Sep. 2008.
- Winternitz, P., Wolf, K. B., Pogosyan, G. S., and Sissakian, A. N., "Graf's Addition Theorem Obtained from SO(3) Contraction," *Theoretical and Mathematical Phys.*, Vol. 129, No. 2, pp. 1501-1503, 2001.
- Xu, X., Lawson, W., Liu, C., Cheng, J., Hogan, B., Granatstein, V. L., and Reiser, M., "Design of a new concept cavity for high power gyrokystrons," *Proc. IEEE International Conference on Plasma Science*, Vol. 3P27, pp. 198, 1998.

Yong, X., Yong, L., Hongfu, L., Sheng, Y., Caidong, X., and Jianxun, W., “RF windows of low reflectivity and absorption for high average power gyrokystrons,” *Proc. International Conference on Terahertz Electronics*, pp. 698-699, 2007.

Zasytkin, E. V., Gachev, I. G., and Antakov, I. I., “Experimental study of a W-band gyrokystron amplifier operated in the high-order  $TE_{021}$  cavity mode,” *Radiophys. Quantum Electron.*, Vol. 55, No. 5, pp. 309-317, 2012.

Zasytkin, E. V., Moiseev, M. A., Sokolov, E. V., and Yulpatov, V. K., “Effect of penultimate cavity position and tuning on three-cavity gyrokystron amplifier performance,” *Int. J. Electron.*, Vol. 78, No. 2, pp. 423–433, 1995.

Zhou, J., Dagang, L., Chen, L., and Zhenghao, Li, “CHIPIC: A highly efficient code for electromagnetic PIC modeling and simulation,” *Proc. High Power Particle Beams (BEAMS)*, Xi'an, China, pp. 1-5, 2008.