



Products: Diagnostics

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For: General release

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1 Diagnostic offerings

Woodruff Scientific Inc offers a complete range of plasma diagnostics. Each diagnostic will be built to order, meeting customer specifications and requirements. For all diagnostics, all we need is a concept outline, and we will provide engineering design for review and then manage the purchase and fabrication before shipping. For some of our past diagnostic efforts, please see our News page on the website. Our primary reference for all diagnostic offerings remains Hutchinson [1], and some of the papers we have published cover some of the diagnostics (e.g. Mclean [2]).

Diagnostic	Orienting references
Magnetics	
Magnetic field coils	[3][4][5]
Linear coil arrays	[6]
Rogowski coils	[7][8]
Flux loops	[9] [10]
Mirnov coils	[11][12]
Polarimeters	[13] [14]
Plasma Particle Flux	
Langmuir probes	[15][16]
Gridded ion energy analyzers	[17] [18] [19]
Density	
HeNe Interferometer	[20]
CO2 Interferometers	[21] [22] [23]
Radiation	
Soft X-ray diode imaging	[24] [25]
Bolometer	[26] [27]
VUV Spectrometer	[28] [29]
Visible Spectrometer	[30]
Ion Doppler Spectrometer	[31][32]
Thomson Scattering	[33] [34] [35]
Neutral particle analyzers	[36] [37]
Scintillator detectors	[38]

2 Ordering

To place an order, request literature, or obtain product and services information, please call us at (206) 905-9477, send an email to sales@woodruffscientific.com, or visit us on the web at www.woodruffscientific.com; **PAYMENT TERMS:** Standard payment terms are net 30 days from date of invoice (prior credit approval required). Non approved accounts will require COD terms. WSI accepts VISA and Mastercard.; **DISCOUNTS:** Quantity discounts may be available to qualified customers.; **SHIPPING CHARGES:** All domestic shipments are via UPS/surface, prepaid, and added to invoice, unless quoted otherwise.; **RETURN POLICY:** Authorization for the return of goods must be obtained from Woodruff Scientific Incorporated prior to return of products for refund. All return shipping charges must be prepaid by customer.; **PRICES & SPECIFICATIONS:** Prices and specifications are subject to change at any time and without prior notice.

References

- [1] I. H. Hutchinson, "Principles of plasma diagnostics," *Cambridge*, 2002.
- [2] H. McLean, A. Ahmed, D. Buchenauer, D. Den Hartog, C. Domier, D. Hill, C. Holcomb, E. Hooper, E. Morse, M. Nagata, Y. Roh, B. Stallard, R. D. Wood, S. Woodruff, G. Wurden, Z. Wang, and

- G. Wurden, "Plasma diagnostics for the sustained spheromak physics experiment," *Review of Scientific Instruments*, vol. 72, no. 1, pp. 556–561, 2001.
- [3] S. Howard, R. D. Horton, D. Hwang, R. Evans, and S. Brockington, "Calibration of magnetic probes in the vicinity of a conducting well," *Review of Scientific Instruments*, vol. 79, no. 2, pp. 023 503–023 503–10, 2008.
- [4] P. V. Savrukhn and E. A. Shestakov, "Movable magnetic probe system in the t-10 tokamak," *Review of Scientific Instruments*, vol. 83, no. 1, pp. 013 505–013 505–5, 2012.
- [5] E. J. Strait, "Frequency response of metal-clad inductive magnetic field probes," *Review of Scientific Instruments*, vol. 67, no. 7, pp. 2538–2540, 1996.
- [6] C. Romero-Talamas, P. Bellan, and S. Hsu, "Multielement magnetic probe using commercial chip inductors," *Review of Scientific Instruments*, vol. 75, no. 8, pp. 2664–2667, 2004.
- [7] I. Metwally, "Coaxial-cable wound rogowski coils for measuring large-magnitude short-duration current pulses," *Instrumentation and Measurement, IEEE Transactions on*, vol. 62, no. 1, pp. 119–128, 2013.
- [8] B. McCormack, R. Kaita, H. Kugel, and R. Hatcher, "Rogowski loop designs for nstx," in *Fusion Engineering, 1999. 18th Symposium on*, 1999, pp. 306–309.
- [9] G. Labik, T. Brown, D. Johnson, N. Pomphrey, B. Stratton, M. Viola, M. Zarnstorff, M. Duco, J. Edwards, M. Cole, and E. Lazarus, "National compact stellarator experiment vacuum vessel external flux loops design and installation," in *Fusion Engineering, 2007. SOFE 2007. 2007 IEEE 22nd Symposium on*, 2007, pp. 1–3.
- [10] A. Elahi and M. Ghoranneviss, "A modified flux loop for the determination of plasma position in ir-t1 tokamak," *Plasma Science, IEEE Transactions on*, vol. 38, no. 11, pp. 3163–3167, 2010.
- [11] M. Hole, L. C. Appel, and R. Martin, "A high resolution mirnov array for the mega ampere spherical tokamak," *Review of Scientific Instruments*, vol. 80, no. 12, pp. 123 507–123 507–10, 2009.
- [12] E. Fredrickson, R. Colchin, K. McGuire, W. Morris, and N. Sauthoff, "Tftr mirnov loop system," *Review of Scientific Instruments*, vol. 57, no. 8, pp. 2084–2086, 1986.
- [13] D. Brower, Y. Jiang, W. X. Ding, S. D. Terry, N. E. Lanier, J. Anderson, C. Forest, and D. Holly, "Multichannel far-infrared polarimeter-interferometer system on the mst reversed field pinch," *Review of Scientific Instruments*, vol. 72, no. 1, pp. 1077–1080, 2001.
- [14] C. T. Holcomb, T. Jarboe, A. Mattick, D. Hill, H. Mclean, R. D. Wood, V. Cellamare, R. Bulmer, and E. Hooper, "Nonperturbing field profile measurements of a sustained spheromak," *Review of Scientific Instruments*, vol. 72, no. 1, pp. 1054–1058, 2001.
- [15] D. Buchenauer, W. L. Hsu, J. Smith, and D. Hill, "Langmuir probe array for the diii-d divertor," *Review of Scientific Instruments*, vol. 61, no. 10, pp. 2873–2875, 1990.
- [16] D. A. Taussig, J. G. Watkins, and R. Boivin, "Improved langmuir probe array for diii-d," in *Fusion Engineering, 2007. SOFE 2007. 2007 IEEE 22nd Symposium on*, 2007, pp. 1–4.
- [17] V. Sokolov and A. Sen, "Ion energy analyzer for measurement of ion turbulent transport," *Review of Scientific Instruments*, vol. 83, no. 10, pp. 103 503–103 503–4, 2012.
- [18] R. Stenzel, R. Williams, R. Agüero, K. Kitazaki, A. Ling, T. McDonald, and J. Spitzer, "Novel directional ion energy analyzer," *Review of Scientific Instruments*, vol. 53, no. 7, pp. 1027–1031, 1982.
- [19] M. J. McCarrick, R. Ellis, M. Koepke, and R. Majeski, "Perpendicular ion energy analyzer for hot-ion plasmas," *Review of Scientific Instruments*, vol. 56, no. 7, pp. 1463–1464, 1985.
- [20] D. Kumar and P. M. Bellan, "Heterodyne interferometer with unequal path lengths," *Review of Scientific Instruments*, vol. 77, no. 8, pp. 083 503–083 503–6, 2006.

- [21] W. Yongqian, Z. Yudong, and W. Fan, "Design of far-infrared interferometer at 10.6 μm ," in *Photonics and Optoelectronics, 2009. SOPO 2009. Symposium on*, 2009, pp. 1–4.
- [22] Y. Kawano, A. Nagashima, T. Hatae, and S. Gunji, "Dual co2 laser interferometer with a wavelength combination of 10.6 and 9.27 μm for electron density measurement on large tokamaks," *Review of Scientific Instruments*, vol. 67, no. 4, pp. 1520–1528, 1996.
- [23] T. N. Carlstrom, D. R. Ahlgren, and J. Crosbie, "Real time, vibration compensated co2 interferometer operation on the diii-d tokamak," *Review of Scientific Instruments*, vol. 59, no. 7, pp. 1063–1066, 1988.
- [24] Y. P. Zhang, Y. Liu, J. W. Yang, X. Y. Song, M. Liao, X. Li, G. Yuan, Q. Yang, X. Duan, and C. H. Pan, "A new soft x-ray pulse height analysis array in the hl-2a tokamak," *Review of Scientific Instruments*, vol. 80, no. 12, pp. 126 104–126 104–3, 2009.
- [25] P. Beiersdorfer, M. Bitter, M. May, and L. Roquemore, "High-resolution soft x-ray spectrometer for the nstx tokamak," *Review of Scientific Instruments*, vol. 74, no. 3, pp. 1974–1976, 2003.
- [26] B. Joye, P. Marmillod, and S. Nowak, "Multichannel bolometer for radiation measurements on the tea tokamak," *Review of Scientific Instruments*, vol. 57, no. 10, pp. 2449–2454, 1986.
- [27] A. Murari, K. F. Mast, L. D'Ambra, P. T. Lang, L. Marrelli, P. Martin, and A. Romagnolo, "Multichord calibrated bolometer array for the rfx experiment," *Review of Scientific Instruments*, vol. 66, no. 1, pp. 665–667, 1995.
- [28] R. Barnsley, I. Coffey, R. Lucock, and M. F. Stamp, "Jet beamline with integrated x-ray, vuv, and visible spectrometers, for burning plasma experiments," *Review of Scientific Instruments*, vol. 74, no. 3, pp. 1969–1973, 2003.
- [29] I. H. Coffey and R. Barnsley, "First tritium operation of iter-prototype vuv spectroscopy on jet," *Review of Scientific Instruments*, vol. 75, no. 10, pp. 3737–3739, 2004.
- [30] A. Graf, S. Howard, R. Horton, D. Hwang, M. May, P. Beiersdorfer, and J. Terry, "Visible spectrometer at the compact toroid injection experiment and the alcator c-mod tokamak for doppler width and shift measurements," *Review of Scientific Instruments*, vol. 77, no. 10, pp. 10F125–10F125–3, 2006.
- [31] J. D. King, H. McLean, R. D. Wood, C. Romero-Talamas, J. Moller, and E. Morse, "An ion doppler spectrometer instrument for ion temperature and flow measurements on sspx," *Review of Scientific Instruments*, vol. 79, no. 10, pp. 10F535–10F535–4, 2008.
- [32] D. J. Den Hartog and R. Fonck, "A fast spectroscopic diagnostic for the measurement of plasma impurity ion dynamics," *Review of Scientific Instruments*, vol. 65, no. 10, pp. 3238–3242, 1994.
- [33] T. N. Carlstrom, G. L. Campbell, J. DeBoo, R. Evanko, J. Evans, C. M. Greenfield, J. Haskovec, C. L. Hsieh, E. McKee, R. T. Snider, R. Stockdale, P. Trost, and M. Thomas, "Design and operation of the multipulse thomson scattering diagnostic on diii-d (invited)," *Review of Scientific Instruments*, vol. 63, no. 10, pp. 4901–4906, 1992.
- [34] K. Narihara, I. Yamada, H. Hayashi, and K. Yamauchi, "Design and performance of the thomson scattering diagnostic on lhd," *Review of Scientific Instruments*, vol. 72, no. 1, pp. 1122–1125, 2001.
- [35] H. McLean, J. Moller, and D. Hill, "Use of fast scopes to enable thomson scattering measurement in presence of fluctuating plasma light," *Review of Scientific Instruments*, vol. 75, no. 10, pp. 3887–3890, 2004.
- [36] R. Boivin, M. Koltonyuk, C. P. Munson, and R. Mayo, "Time-of-flight neutral particle analyzer for alcator c-mod," *Review of Scientific Instruments*, vol. 68, no. 1, pp. 982–985, 1997.
- [37] E. Mezonlin, S. Roberson, C. Raynor, R. Appartaim, I. Johnson, J.A., V. Afanasyev, S. S. Kozlovsky, J. M. Moller, D. Hill, E. Hooper, H. S. McLean, and R. D. Wood, "Neutral particle analyzer measurements on the sspx spheromak," *Review of Scientific Instruments*, vol. 78, no. 5, pp. 053 504–053 504–7, 2007.

- [38] D. Darrow, H. Herrmann, D. Johnson, R. Marsala, R. W. Palladino, S. Zweben, and M. Tuszewski, “Measurement of loss of dt fusion products using scintillator detectors in tftr (invited),” *Review of Scientific Instruments*, vol. 66, no. 1, pp. 476–482, 1995.