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| NSTX-U Equilibrium Diagnostic Measurement Capabilities – January 2015  (black – available for experiments, blue – under active development) | | | | | | |
| Physics Measurement | Typical range and coverage | Spatial; Temporal Resolution | Typical Precision | Available Diagnostic Techniques | Comment | Contact |
| Coil currents | 0-130 kA | follow pulse shape. | 1.0% | Rogowski coil on buswork; Hall effect transducers at power supplies | For EFIT/LRDFIT equilibrium reconstruction | S. Gerhardt – PPPL |
| Plasma current, Ip, | 0-2 MA | 2-5 kHz sampling rate | 1.0% | 2 Rogowski coils around plasma outside vacuum vessel | For EFIT/LRDFIT reconstruction | S. Gerhardt – PPPL |
| Equilibrium Poloidal Field and Flux |  | Variable spatial resolution  2-5 kHz sampling rate | 1-3% | 2D and 3D solenoids (Mirnov coils) inside vv, flux loops inside and outside vv | For EFIT/LRDFIT reconstruction | S. P. Gerhardt-PPPL |
| Plasma Equilibrium Reconstruction |  | 10 mm absolute  1 ms |  | Solutions of the Grad-Shafranov Equation Constrained by Measurements | Between shot analysis with the EFIT code; post-experiment analysis with EFIT and LRDFIT | S. Sabbagh – CU, J. Menard-PPPL |
| Plasma kinetic energy | > 10 kJ | 1 ms | 1 kJ | Diamagnetic loop | EFIT/LRDFIT constraint, uses TF coil | S. Gerhardt - PPPL |
| B field pitch (for determination of q(R) using LRDFIT or EFIT) |  | 3 cm core, 2 cm edge, 10 ms (target 5 ms) | ≥ 0.2° | Motional Stark effect based on collisionally-induced- fluorescence (MSE/CIF) | 18 channels, presently applies correction for toroidal rotation, requires heating beam source A. | H. Yuh, F. Levinton – Nova Photonics |
|  | target - 3 cm core, 2 cm edge, 10 ms | target ≥ 0.2° | Motional Stark effect based on laser-induced-fluorescence (MSE/LIF) using DNB | 10 channels, Requires compact, radial DNB | Y. Sechrest, F. Levinton – Nova Photonics |
|  | TBD (probably ~2 MHz) |  | 1 mm radial polarimeter | Provides line integral constraint, in conjunction with electron density profile input | S. Kubota - UCLA |
| Compact array of microwave receiving antennas. Two antennas can be configured to launch microwaves for imaging reflectometry. | Measures plasma emission up to 40 GHz with sub-millisecond time resolution. |  | Synthetic Aperture Microwave Imaging (SAMI) | Measures EBW emission as a function of poloidal and toroidal angle, allowing high radial resolution measurements of edge magnetic field pitch. Also can be configured for imaging relectometry to measure edge plasma flows. | G. Taylor – PPPL  R. Vann – University of York, UK |
| B field magnitude, P(R) |  | 5 cm core, 2 cm edge, 10 ms | >5 Gauss | Motional Stark effect based on laser-induced-fluorescence (MSE/LIF) using DNB | 10 channels, Requires compact, radial DNB | Y. Sechrest, F. Levinton – Nova Photonics |

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| NSTX-U MHD Instability Diagnostic Measurement Capabilities – January 2015  (black – available for experiments, blue – under active development) | | | | | | |
| Physics Measurement | Typical range and coverage | Spatial; Temporal Resolution | Typical Precision | Available Diagnostic Techniques | Comment | Contact |
| Low (m,n) MHD modes, sawteeth, locked modes, and disruption precursors | B/B = 10-4 – 10-1,  (0,0)<(m,n) < (5,10) | 2 MHz |  | Mirnov coils outside plasma, known as the “high-n” array | 12 toroidal | E. Fredrickson, S. P. Gerhardt - PPPL |
|  | n=1,2&3 RWM Detection |  | Toroidal arrays of BP and BR sensors inside the vessel. | Used for both n=1 RWM feedback and Dynamic Error Field Correction, and offline analysis | C. Myers-PPPL |
|  | 5 cm; < 300kHz bw |  | Filtered poloidal SXR arrays | 2 arrays (32 ch); discrete AXUV diode arrays | K. Tritz, J. M. Burgos – JHU |
|  | 1 cm, < 10 kHz | 5% (rel) | Tangential multi-color SXR arrays | 5 color/ 20 spatial channels, AXUV diode arrays | K. Tritz, J. M. Burgos – JHU |
| >2x1011 cm-2 | 4MHz | 2x1011 cm-2 | Tangential interferometry, polarimetry (FIReTIP) | FIR laser with retroreflector in 1 tangential chord at RTAN=0.64 m | C. Domier – UC Davis, Y. Ren - PPPL |
| Cut-off  1.1-7.0 x1013cm-3 | 2.5 MHz BW  r ~ 1cm |  | Quadrature reflectometer  (MHD density fluctuation) | 30-75 GHz, 16 channels | S. Kubota - UCLA |
|  | 250 kHz |  | Neutron scintillator array | Plastic scintillators with PM tubes 1- ZnS; 3 BC400 | D. Darrow - PPPL |
| High frequency instabilities (MHD, fast ion modes) | B/B ≥ 10-3 to 10-7,  n = 0 – 30 | 5 MHz | Toroidal and poloidal | Mirnov coils outside plasma, known as the “high-f” array | 3-BT in toroidal array, and 8-BP in Toroidal array, 4-BP in poloidal array | E. Fredrickson – PPPL |
|  | 5 cm; < 300kHz BW |  | Filtered poloidal SXR arrays | 2 horizontal arrays (32 ch); discrete AXUV diode arrays | K. Tritz, J. M. Burgos – JHU |
| 1.1-7.0 x1013cm-3 | 2.5 MHz BW |  | Quadrature reflectometer | 30-75 GHz, 16 channels | S. Kubota - UCLA |
| >2x1011 cm-2 | 500 kHz | 2x1011 cm-2 | Tangential interferometry, polarimetry (FIReTIP) | FIR laser with retroreflector in 1 tangential chord | C. Domier – UC Davis, Y. Ren - PPPL |
| Magnetic field pitch angle fluctuations |  | 3 cm core, 2 cm edge, 5 ms | >0.2° | Motional Stark effect based on collisionally-induced- fluorescence (MSE/CIF) | 18 channels implemented, presently applies correction for toroidal rotation, requires heating beam source A. | Y. Sechrest, F. Levinton – Nova Photonics |
| Disruption Halo Currents | 0-1000 A | ~10x~20cm tiles, 0.1 msec resolution |  | Shunt Tile Arrays | 10 tiles in outboard divertor and 18 on center column | S.P. Gerhardt, PPPL |

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| NSTX-U Electron Diagnostic Measurement Capabilities – January 2015  (black – available for experiments, blue – under active development) | | | | | | |
| Physics Measurement | Typical range and coverage | Spatial; Temporal Resolution | Typical Precision | Available Diagnostic Techniques | Comment | Contact |
| Electron density line integral | >2x1011 cm-2 | 4 MHz | 2x1011 cm-2 | Tangential interferometry, polarimetry (FIReTIP) | FIR laser with retro-reflector in 1 tangential chord with Rtan=0.64 m | C. Domier – UC Davis, Y. Ren - PPPL |
| Electron density profile | 5x1011 - 5x1014 cm-3 | 3.0 cm core,  0.9 cm edge, 2 30 Hz lasers | >3% | Thomson scattering | 60 Hz Nd:YAG, laser nearly radial on horizontal midplane, 42 of 48 channels implemented | B. LeBlanc, A. Diallo, M. Coury – PPPL |
| 0.02-1.6x1013 cm-3 | 1 kHz |  | Reflectometry (SOL) | 6 - 36 Ghz swept system, 1 kHz sweep rate | C. Lau - ORNL |
| Real time density for density feedback control | >2x1011 cm-2 | 5kHz | 2x1011 cm-2 | Tangential interferometry, polarimetry (FIReTIP) | FIR laser with retro-reflector in 1 tangential chord with Rtan=0.64 m | C. Domier – UC Davis, Y. Ren - PPPL |
| Electron temperature profile | 0.003 – 5 keV | 3.0 cm core,  0.9 cm edge, 2 30 Hz lasers | >3% | Thomson Scattering | 2 - 30 Hz Nd:YAG lasers nearly radial on horizontal midplane, 42 of 48 possible spatial channels implemented | B. LeBlanc, A. Diallo, M. Coury – PPPL |
| 0.1-5 keV | 1 cm, < 10 kHz | 5% (rel) | Edge (r/a: 0.6-1.1) tangential multi-color SXR arrays | 5 color/ 20 spatial channels, AXUV diode arrays | K. Tritz, J. M. Burgos– JHU |
| 0.1-5 keV | 3 cm, < 10 kHz | 5% (rel) | Core (r/a: 0-1.1) tangential multi-color SXR arrays | 5 color/ 20 spatial channels, AXUV diode arrays | K. Tritz, J. M. Burgos– JHU |

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| NSTX-U Ion Diagnostics Measurement Capabilities – January 2015  (black – available for experiments, blue – under active development) | | | | | | |
| Physics Measurement | Typical range and coverage | Spatial; Temporal Resolution | Typical Precision | Available Diagnostic Techniques | Comment | Contact |
| Ion temperature profile | 0.02 – 5.0 keV | 3.0 cm core,  0.5 cm edge, 10 ms | ≥ 2% | Toroidal CHERS | 51 channels system using C VI with heating beam, dedicated background view | R. Bell, M.Podestà – PPPL |
|  | 3.0 cm edge only, 10 ms | ≥ 2% | Edge Doppler spectroscopy | 7 channels from tangential view and 6 channels from vertical view of outer midplane edge. Uses intrinsic C III and He II. | R. Bell, M.Podestà – PPPL |
| Plasma rotation profile | -100 km/s to +300 km/s | 3.0 cm core,  0.5 cm edge, 10 ms | ≥ 2% | Toroidal CHERS | See above | R. Bell, M.Podestà – PPPL |
|  | ~ 3.0 cm edge only, 10 ms | ≥ 2% | Edge Doppler spectroscopy | See above | R. Bell, M.Podestà – PPPL |
|  | 1.6 cm core,  0.6 cm edge, 10 ms |  | Poloidal CHERS | Up and down views of heating beam and dedicated background views, 75 active channels using C VI with heating beam. | R. Bell, M.Podestà – PPPL |
| -100 km/s to +300 km/s | 4 radial channels; up to 5kHz sampling rate |  | Real-time toroidal CHERS | 4 channels measuring C VI, active and passive (background) views, fast acquisition and analysis for real-time velocity data | M.Podestà, R. Bell – PPPL |
| ExB flow Core plasma | 5MHz BW  r ~ 1cm |  | Quadrature Doppler Backscattering (DBS) | 1 Channel, 96 GHz (2015)  4 Channels (2016) | S. Kubota - UCLA |
|  | Measures plasma emission up to 40 GHz with sub-millisecond time resolution. |  | Synthetic Aperture Microwave Imaging (SAMI) | Compact array of microwave receiving antennas. Two antennas can be configured to launch microwaves for imaging reflectometry.  Measures EBW emission as a function of poloidal and toroidal angle, allowing high radial resolution measurements of edge magnetic field pitch. Also can be configured for imaging relectometry to measure edge plasma flows. | G. Taylor – PPPL  R. Vann – University of York, UK |
| Profile of the radial Electric field |  | 5 cm core, 2 cm edge, 10 ms |  | MSE/CIF and MSE/LIF | See above; requires heating source A and DNB | F. Levinton, H. Yuh, Y. Sechrest - Nova Photonics |
|  | 3.0 cm core,  0.5 cm edge, 10 ms |  | Toroidal and poloidal CHERS | See above; requires heating beam | R. Bell, M.Podestà – PPPL |
|  | 3.0 cm, 10 ms |  | Edge Doppler spectroscopy | May need helium | R. Bell, M.Podestà – PPPL |
| Radiation profile |  | 2-3 cm, 0.2 ms |  | Toroidal bolometer array | Tangential view, 40 channels (AXUV diode arrays) | L. Delgado-Aparicio - PPPL |
| Lower divertor area | 1-2 cm, 10-20 kHz |  | Divertor radiometer (bolometer) array, can be used with Ly-alpha filter | Vertical view, 20 channel AXUV diode array | V. Soukhanovskii - LLNL |
| Zeff |  | line integral | 10% abs. | Visible continuum sensor | Single filterscope chord, RTAN~60 cm | C. Skinner - PPPL |
|  | 3.0 cm core,  0.5 cm edge, 10 ms | ≥ 5% in (Zeff-1) | Toroidal CHERS | See above, assumes C only impurity | R. Bell, M.Podestà – PPPL |
| Impurity concentrations | C+5 conc. | 3.0 cm core,  1.0 cm edge, 10 ms | 20% abs. | Toroidal CHERS | See above | R. Bell, M.Podestà – PPPL |
| H/D ratio, survey, impurity studies | Integral; 10 ms | 5% (rel) | Ultraviolet-visible survey spectrometer VIPS-2 | **3 (10)** sightlines coupled via fiber to 0.5 M Czerny-Turner; 350-1100 nm, CCD detector. | V. Soukhanovskii - LLNL |
| Z≥3 ions (Li, B, C, O, Cu, Ne, Ar, Fe, Kr, Mo) | 5 cm; 5 ms for impurities | 15% abs | Filtered poloidal soft x-ray arrays | 2 horizontal arrays (32 ch); discrete AXUV diode arrays | K. Tritz, J. M. Burgos– JHU |
| 1 cm, < 10 kHz | 5% (rel) | Tangential multi-color SXR arrays | 5 color/ 20 spatial channels, AXUV diode arrays | K. Tritz, J. M. Burgos – JHU |
| r/a~0.08, 10 ms | 15% abs | TGI spectrometer | 12 chord transmission grating imaging spectrometer; 10Å – 300Å CCD camera | K. Tritz, J. M. Burgos – JHU |
| Integral; 12 ms | 5% (rel) | EUV spectrometer (XEUS) | Flat field grazing incidence spectrometer covering 5-60 Å | P. Beiersdorfer-LLNL |
| Integral; 12 ms | 5% (rel) | EUV spectrometer (LoWEUS) | Flat field grazing incidence spectrometer covering 220-400 Å | P. Beiersdorfer-LLNL |
|  | Integral; 12 ms | 5% (rel) | EUV spectrometer (MonaLisa) | Flat field grazing incidence spectrometer covering 60-220 Å | P. Beiersdorfer-LLNL |

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| NSTX-U Turbulence Diagnostic Measurement Capabilities – January 2015  (black – available for experiments, blue – under active development) | | | | | | |
| Physics Measurement | Typical range and coverage | Spatial; Temporal Resolution | Typical Precision | Available Diagnostic Techniques | Comment | Contact |
| Turbulence | kI <1 | ΔR ~2 cm; r/a~0.4 to SOL | Δn/n >0.1% | Beam Emission Spectroscopy | 2 arrays viewing heating beams with 2-D (radial and poloidal) array of 48 detector channels | D. Smith, G. McKee - UW |
| kI ~ 0.5-10  Density turbulence | 5MHz BW  r ~ 1cm |  | Quadrature Doppler Backscattering (DBS) | 1 Channel, 96 GHz (2015)  4 Channels (2016) | S. Kubota - UCLA |
| Cut-off  1-7 x1013cm-3  kI <1 | 2.5 MHz BW  r ~ 1cm |  | Quadrature reflectometer | 30-75 GHz, 16 channels | S. Kubota - UCLA |
| Te < 200 eV | ~ 1 cm for r/a> 0.8, <400 kHz | 12 bit | gas puff imaging (GPI) | Supported by gas puff manifold. (Phantom 710 camera) | S. Zweben – PPPL |

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| NSTX-U Boundary Diagnostics Measurement Capabilities – January 2015  (black – available for experiments, blue – under active development) | | | | | | |
| Physics Measurement | Typical range and coverage | Spatial; Temporal Resolution | Typical Precision | Available Diagnostic Techniques | Comment | Contact |
| Edge recycling and impurity influx |  | 2 kHz | 5% (rel) | EIES (filterscopes) | 5 upper divertor, 5 lower divertor, 5 midplane inner wall. Filters include D-alpha, CII, CIII, He I, HeII, LiI, LiII, BII, OII | V. Soukhanovskii – LLNL |
|  | 36 kHz | 5% (rel) | Filtered 1D CCD arrays | 3 lower divertor, 2 inner wall,  2 upper divertor. Filters include D-alpha, D-beta, D-gamma, CII, CIII, CIV, LiI, LiII, HeI, HeII | V. Soukhanovskii – LLNL |
|  | 1 kHz or lower | 5% (rel) | Divertor Imaging Spectrometer - DIMS | 19 sightlines coupled via fiber to 0.61m Czerny-Turner; 350-1100 nm, CCD detector.  Divertor ion temperature measurements (via Doppler broadening) under development. | V. Soukhanovskii - LLNL |
|  | 2 kHz or lower | 5% (rel) | Divertor vacuum ultraviolet spectrometer SPRED | 1 sightline; two gratings: 102-310 Å and 165-1650 Å , CCD detector.  Real-time divertor feedback control signal under development. | V. Soukhanovskii - LLNL |
|  | 1 kHz or lower | 5% (rel) | Divertor Control Spectrometer - DICS | 26 sightlines coupled via fiber to 0.3m Czerny-Turner-Schmitt; 300-1100 nm, CCD detector.  Real-time divertor feedback control signal under development. | V. Soukhanovskii - LLNL |
|  | 0.1 kHz | 5% (rel) | Near-infrared spectrometer - NIRS | 1 sightline via fiber, 3 NIR-optimized gratings, 0.5 m Czerny-Turner, InGaAs LN-cooled detector, 800-2400 nm. Presently at DIII-D. | V. Soukhanovskii - LLNL |
|  | 500 kHz or lower | 12 bit | Divertor Control Camera | Horizontal divertor view with Phantom V1211. Real-time divertor feedback control signal under development. | V. Soukhanovskii, F. Scotti - LLNL |
|  | Up to 100 kHz  at 256x208 resolution | 12 bit, 14 bit | Downward facing wide angle divertor fast cameras | View of lower divertor from Bay E-top (Phantom 710) and Bay J-top (Phantom 7.3). | F. Scotti – LLNL |
|  | Up to 8 kHz at 256x256 resolution | 12 bit | Upward facing wide angle divertor fast camera | View of upper divertor from Bay H-bottom (Miro 4). | F. Scotti – LLNL |
|  | 30 Hz, VGA resolution | 8 bit | Two-color radiation-hardened intensified CIDTEC camera | View of lower divertor from Bay I-top | F. Scotti – LLNL |
|  | 30 Hz, VGA resolution | 8 bit | Radiation-hardened intensified CIDTEC camera | Midplane view | F. Scotti – LLNL |
|  | 6 ms, 128x128 | 12 bit | Edge Neutral Density Diagnostic (ENDD) | Tangential view of outer midplane edge – Bay G  CII filter | F. Scotti – LLNL |
|  | 190 kHz at 32x32 | 14 bit | Lower divertor tangential camera | Tangential image of lower divertor from Bay F (Phantom 7.3) | R. Maqueda – X Science |
| 350-900 nm  range  0.08nm/pixel  dispersion | 5ms |  | Imaging Spectrometer at bay G bottom viewing upper Divertor (R=0.3-0.9m) and at bay J middle viewing central stack (Z=0-1.5m) | Monitor upper divertor and center stack with 16 sightlines separately (not simultaneously for both views) 16 sightlines via fiber to IsoPlane SCT 320 spectrometers and 512\*512 detector CCD, monitor ratios of spectrally close C and Li lines | K.F. Gan-UTK,  T.K. Gray-ORNL |
| Dust monitoring |  | Few seconds | 1 mg/cm2 | Electrostatic grid detector | Biased fine pitch PC grid, pulse counting electronics, Bay C bottom | C. Skinner - PPPL |
| First wall deposition |  | 2 sec continuous | several  Angstroms | Quartz microbalances | Four QMBs (Bay E top, Bay F bottom, Bay I midplane, Bay B midplane), 3 shuttered, Inficon XTM/2 | C. Skinner - PPPL |
| Surface chemical state and composition | <1 micron | Outboard lower divertor. Single location intershot |  | Materials Analysis Particle Probe (MAPP) utilizes multiple surface-science measurement techniques to characterize a sample material exposed to NSTX conditions | Thermal Desorption Spectroscopy (TDS), X-ray Photoelectron Spectroscopy (XPS), Low energy Ion Secondary Scattering (LEISS), and Direct Recoil Spectroscopy (DRS) | J. P. Allain – U. Illinois Urbana-Champaign |
| Target Langmuir probes | 1 – 40 eV  1017 – 1020 m-3 | ~1mm electrode heads poloidally distributed along center stack and outboard divertors |  | Classical interpretation yields ne, Te, V. Non-local interpretation yields additional Vp and EEDF | Proud probes distributed poloidally throughout machine. Up-down symmetric on outboard divertor target, inboard divertor targets and center stack column. Operated as swept probes and in Isat mode. | M. Jaworski - PPPL |
| Gas pressure at several locations |  |  |  | Penning gauges | 1 in lower divertor, 1 in upper divertor, 1 in lower divertor with spectroscopy, 1 in inner lower divertor (organ pipe) | R. Raman – U. Washington, V. Soukhanovskii - LLNL |
|  |  |  | Micro-ion gauges | Bays E and C-midplane, Bay L-pumping duct, Bay C-top | R. Raman – U. Wash |
| Gas composition in vacuum vessel | typ A = 1-50/100, ∆A=1 | Approx. 1 min./1 sec. mass sweep | 10-11 /10-9 torr typical sens. | 2 Residual gas analyzers (continuous monitoring/after discharge measurements) | In Bay L pumping duct, differentially pumped system | W. Blanchard - PPPL |
| Plasma TV (discharge monitoring) | Fisheye-view of vessel interior, complementing views from bays B and I | ~1cm spatial resolution |  | Qualitative discharge and operations monitoring via in-vessel imaging. | Plasma TV (Miro 2) | M. Jaworski, S. Zweben |
|  |  |  |  | RF antenna view (Phantom 4.1) | R. Perkins |
| First wall temperature | 50-800°C | 1.6 kHz  12° FOV  5 mm/pixel | 5% typical | Fast, dual-band infrared camera at Bay G bot viewing upper divertor (R = 0.2 – 1.0 m). Calibrated to 4-6 μm (MWIR) / 7-10 μm (LWIR) intensity | SBFP ImagIR HgCdTe camera (128x128 pixels) | T.K. Gray, J.-W. Ahn - ORNL |
| 50-800°C | 1.6 kHz  12° FOV  5 mm/pixel | 5% typical | Fast, dual-band infrared camera at Bay H top viewing lower divertor (R = 0.2 – 1.0 m). Calibrated to 4-6 μm (MWIR) / 7-10 μm (LWIR) intensity | SBFP ImagIR HgCdTe camera (128x128 pixels) | T.K. Gray, J.-W. Ahn - ORNL |
| 20-800°C | 30 Hz  40° FOV  4 mm/pixel  >180° view of strike points | 5% typical | Wide-angle, two-color infrared camera | FLIR Tau 640 μbolometer camera (640x480 pixels). Re-entrant view of lower divertor from Bay H top (R=0.2 to 1.2 m). Calibrated to 8-10 μm (LWIR) / 10.5-13 μm (LWIR) intensity ratio. | J-W. Ahn - ORNL |
| 20-1200°C | 30 Hz  18° FOV  2 mm/pixel | 5°C abs  <1°C rel | Standard frame rate, single-band infrared camera | FLIR Tau 640 8-13 μm LWIR μbolometer camera (640x480 pixels). View from Bay B midplane of RF antenna straps at Bay D, E, and F. | R. Perkins – PPPL, T.K. Gray - ORNL |
| 0-2300°C | 1 kHz  2 locations, 2 mm isolation | 3% typical | Fast ‘eroding’ thermocouples | 2 high speed, Type C eroding thermocouples at PFC surface. Located in the row 1 tile in the upper and lower inboard, horizontal divertor | T.K. Gray - ORNL |
| Vacuum Vessel Illumination |  |  |  | 3 in-vessel tungsten filaments, ~ 25x5 mm helical | Provide lighting of the first-wall surfaces, Bays G and K near midplane, Bay K/L above midplane | W. Blanchard - PPPL |
| RF driven surface waves |  |  |  | High-frequency Langmuir probe | Located between antenna segments, | R. Perkins – PPPL,  C. Lau - ORNL |

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| NSTX-U Energetic Particle Measurement Capabilities – January 2015  (black – available for experiments, blue – under active development) | | | | | | |
| Physics Measurement | Typical range and coverage | Spatial; Temporal Resolution | Typical Precision | Available Diagnostic Techniques | Comment | Contact |
| Fusion source profile |  |  |  | Si diode detectors | 6-8 channels planned | W. Boeglin – Florida Int’l U |
| Neutron flux monitors |  | 1 ms | 5% rel.  20% abs. | Fission chambers | 4 U235 detectors with x26 sensitivity ratio | D. Darrow - PPPL |
|  | 4 μs | <5% rel. | Scintillator detectors | Plastic scintillators with PM tubes 1- ZnS; 3 BC400 | D. Darrow - PPPL |
| Runaway electrons |  | 10 ms | 30% | Hard X-ray detector | At start-up and thermal quench | L. Delgado-Aparicio- PPPL |
| Fast Lost Ions |  |  |  | FLIP | Radial array of Faraday cups | D. Darrow - PPPL |
|  | 50 kHz | 2°  3 cm | SFLIP | Scintillator probe with energy and pitch angle resolution | D. Darrow - PPPL |
| Fast ion dynamics and Fast ion distribution | n < 5x1013 cm-3 | 10ms, 5cm, 10keV |  | s-FIDA - Spectrometer/CCD (energy resolved signal) | Vertical views from Bay A/B. Tangential views from Bay L/F. Based on active charge-exchange spectroscopy: requires NB injection; MPTS and CHERS data needed for analysis | D. Liu, G.Z. Hao, W.W. Heidbrink – UCI |
| 20μs, R=100, 120,140cm |  | f-FIDA - Band-Pass Filter/PMT (energy-integrated signal) | D. Liu, G.Z. Hao, W.W. Heidbrink – UCI |
|  | 10μs in current mode, 5cm, three energy bands [>25, >45, >65] keV |  | Solid state NPA system  (t-SSNPA: subsystem at Bay I for active tangential views,  r-SSNPA: subsystem at Bay L midplane for active radial views  p-SSNPA: subsystem at Bay B for background passive signals) | 15 tangential views with Rmaj  between 90-130 cm; 15 radial views with Rmaj  between 120-145 cm; 15 passive views; Si- diode arrays in current mode, 500kHz sample rate, ~100kHz bandwidth ; requires NB injection; MPTS and CHERS data needed for analysis | D. Liu, G.Z. Hao, W.W. Heidbrink – UCI |

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| NSTX-U Systems Capable of Supporting Active Diagnostics – January 2015  (black – available for experiments, blue – under active development) | | | | |
| System | Purpose of system | Characteristics | Used in diagnostic: | Contact |
| Heating Neutral Beam | Provide neutral population to produce beam emission for various diagnostics | D, 90 - 100 keV, ~50cm V x 20cm H, ~ 150mA/cm2 neutrals entering plasma | CHERS, MSE, MSE/LIF, BES (D) | T. Stevenson - PPPL |
| Diagnostic Neutral Beam | Provide excited neutral atoms for intensity and polarimetry measurement | H, 40 keV, 1 - 2 cm dia., 30 mA neutrals entering plasma | MSE/LIF | Y. Sechrest, F. Levinton – Nova Photonics |
| Supersonic Gas Injector | Provides low divergence, high pressure gas jet | Laval nozzle, on midplane probe | Thermal atomic beam spectroscopy | V. Soukhanovskii - LLNL |
| Laser Blow-Off Impurity Injector | Provides low divergence source (pulse) of atomic impurities for transport studies | Midplane location, multi-pulse, multi-slide, 1 J laser outside NTC | Impurity spectroscopy | P. Beiersdorfer, V. Soukhanovskii - LLNL |
| Gas Puff Manifold | Provides neutral atoms to highlight edge density turbulence | Linear manifold ⊥ to edge B field, multiple 1 mm dia holes, D, He or Ar. | gas puff imaging | S. Zweben - PPPL |
| TAE antenna | Excite stable Alfvén waves to measure linear damping | 5-turn radial loop antenna, ≤ 1 kW | Fast Mirnov Coil | E. Fredrickson - PPPL |