shorter period ULF waves, 193
subsolarmagnetopause structure,
89–91, 89f, 90f
at terrestrial magnetopause, 73–82
in ultra-low-frequency waves, 187–95
Dayside auroral emissions
binned by IMF and SWP, 146, 148,
148f, 149, 149f
binned by KP index, 146, 147f
hemispheric differences, 143–53
IMF for, 150–1, 151f
prenoon-postnoon asymmetries,
152–3
synoptic distributions of, 145–6, 145f,
147f, 148–9, 148f, 149f
two-peak structure in dayside
oval, 150
Dayside magnetopause, 74
Dayside magnetosheath, 51
Dayside reconnection, 96
DEF. See Differential energy fluxes
Defense Meteorological Satellite
Program (DMSP), 41, 42, 182,
247, 289–90
electron precipitation data from,
276, 278f
lobe cells in, 291f
precipitating energy flux
measurements, 297–8, 297f
SSJ4/5 particle detector on, 256
deHoffmann-Teller frame velocity, 76
DFBs. See Dipolarizing flux bundles
Differential energy fluxes (DEF), 328
Diffuse electron aurora, 258f, 276,
298, 299
substorms and, 256, 257f, 258
Diffusion, 29, 74
Dione, 328
Dipolarization fronts, 233, 235–6
Dipolarized flux tubes, 235
Dipolarizing field lines, 179
Dipolarizing flux bundles (DFBs), 179,
180, 181, 233, 235, 236f
localization of, 237
role in global pressure redistribution,
236–7
Discontinuity classification,
magnetopause, 76–7
Dispersionless injections
separating by species, 175
spatial distributions, 177f, 178f
Dispersionless signatures, 172
D-month, 134
DMSP. See Defense Meteorological
Satellite Program
DMSP-F12, 290, 291f
DMSP-F13, 290, 291f
Doornbos, Eelco, 125
Double-spiraled boundary, 172, 173f
Double Star, 36
mid-distant tail studies with, 237
DPR. See Dark Polar Regions
Drag Temperature Model (DTM), 130
Drift mirror waves, 191
Drift velocity orientation, 87
DSX, 182
DTM. See Drag Temperature Model
Duncey Cycle, 109, 112, 113, 119, 312
Dynamical binning, 202
Dynamic pressure changes
asymmetry in, 24–6
lag differences, 22–4, 22f, 23f
lagged correlation in, 20–1, 20f
propagation model of, 16–18
propagation speeds, 21–2, 24
Dynamic pressure forcing, 15, 16
Dynamics Explorer 2 satellite,
112, 132
Dynamo layer, 125
Earth. See also Near-Earth plasma
sheet
Alfvén wings at, 8–9
magnetotail plasma sheet, 95
sub-Alfvénic solar wind conditions at,
5–6, 7f, 8
Earthward ion flow speed, 95–6, 102
Earthward motion, of spiral injection
Earthward ion flow speed, 95–6, 102
Earthward ion flow speed, 95–6, 102
Earthward motion, of spiral injection
boundary, 172
Earthward plasma sheet transport, 95
speeds of, 96
tail twisting and, 97
Earthward-propagating transient electric
fields, 172
Eastward polarization (RH), 161, 162f
ECH waves. See Electron cyclotron
harmonic waves
EDI. See Electron drift instrument;
Electron Drift Instrument
EFW. See Electric field and wave
instrument
EIE. See Electrostatic ion cyclotron
E-layer dynamo region, 126
Electric drift instrument (EDI), 245
Electric field and wave instrument
(EFW), 245
Electric fields
acceleration potential structures and,
298, 299f
asymmetry in, 299
corotation, 333
global distribution of, 300
ionospheric convection patterns and,
126–30, 127f, 128f
at Saturn, 333
Electrojets, 109, 256
Electromagnetic ion cyclotron (EMIC),
189, 193, 256, 274
Electron aurora
broadband, 258, 259f, 260, 260f,
267–8
diffuse, 256, 257f, 258, 258f, 276,
298, 299
monoenergetic, 261, 262f, 267–8
substorms and asymmetry in, 266–7
power increase in nightside,
264–5, 264f
Electron cyclotron harmonic waves
(ECH waves), 258
Electron Drift Instrument (EDI),
127, 128
Electron flux burst, 178, 179f
Electron heating, in auroral region,
276–7
Electron injections, premidnight
preponderance of dispersionless,
171–82
Electron precipitation, 256, 276, 278f
substorm cycle duration and,
265–6, 266f
Electron pressure, equatorial, 215
Electron spectrometer (ELS), 324, 328
ElectroStatic Analyser (ESA), 51
Electrostatic ion cyclotron (EIC), 274
Ellipticity parameter, polarization
and, 162
ELS. See Electron spectrometer
EMIC. See Electromagnetic ion
cyclotron
E-months, 134
ENA. See Energetic neutral atom
imager
ENA low-altitude emissions, 217
ENAs. See Energetic neutral atoms
Enceladus, 323, 324
Energetic electrons, 328–30, 329f
Energetic ions, 330–1, 330f
Energetic neutral atom imager (ENA),
213, 215f, 247
equatorial electron pressure study
with, 215
hydrogen and oxygen
measurements, 215
LADE detection, 217
ring current dynamics study with,
214–15
Energetic neutral atoms (ENAs),
210, 324
hydrogen, 215, 216f, 331, 332f
oxygen, 215–16, 216f, 331, 332f
Saturn, 331–2, 332f
Energetic oxygen ions, 249
Energetic Particle Detector (EPD), 310
Energetic particles
dayside intensity of, 249
enhancement, 225
injections
geosynchronous observations, 172–5
inner magnetosphere through midtail observations, 175–8
introduction, 171–2
relationship with other phenomena, 178–80
in near-Earth plasma sheet, 247
Energetic Particles and Ion Composition (EPIC), 247
Energetic protons, 248–9, 330, 330f
Energy budget, upper atmosphere, 133
Energy-latitude dispersion, 45f
Energy-latitude profile, 277
Equatorial magnetosphere, 67f
Equatorial electron pressure study, 215
Equatorial currents
FAC modeling and, 205–6, 208
modeling, 200–1, 203f
Equatorial magnetosphere, 67f
ERG, 182
ESA. See ElectroStatic Analyser
European Space Agency (ESA), 127
EUV heating, 133
Energy-latitude dispersion, 45f
Enhanced flux boundary, 173, 174f
EPD. See Energetic Particle Detector
EPIC. See Energetic Particles and Ion Composition
Equatorial currents
FAC modeling and, 205–6, 208
modeling, 200–1, 203f
Equatorial electron pressure study, 215
Equatorial magnetosphere, 67f
ERG, 182
ESA. See ElectroStatic Analyser
European Space Agency (ESA), 127
EUV heating, 133
Energy-latitude dispersion, 45f
Exoplanets, Alfvén wings at, 4
Explorer 10 spacecraft, terrestrial
magnetopause observation, 73
Explorer 12 spacecraft, terrestrial
magnetopause observation, 73
FACs. See Field-aligned currents
Far Ultraviolet Imagery (FUV), 111, 286
Far ultraviolet spectrograph (FUV), 324, 325
Fast flow events, 98, 99f, 233
azimuthal, 103, 104
IMF and, 99–100, 100f, 101f, 102f
B component, 101, 103, 104
ionosphere and, 100
localization of, 237
magnetic electron aurora and, 261
rapid untwisting hypothesis and, 99–100
FAST satellite, 260, 297
FBs. See Flow bursts
FGM. See FluxGate Magnetometer
Field-aligned acceleration processes, 132
Field-aligned currents (FACs), 41, 125,
126, 203f, 276
Birkeland currents and, 201–2
distributions, 204, 205f, 206f, 207f,
208f, 209f
equatorial current resolution and modeling, 205–6, 208
global distribution of, 300
at Jupiter, 314, 315, 316
modeling, 199–200, 204–5, 209f
in TS07D model, 204, 209f
Field-aligned vorticity, 342f
Field line resonances (FLRs), 158, 160,
162, 163, 188f
in Pc4-5 ranges, 188–90
Finite Larmor radius (FLR), 35, 340–1
Flank magnetopause
characteristics, 77–80, 77t
current density, 78–9, 79f, 80, 82
observations, 74–7, 80, 81t, 92
sheet thickness histogram, 78f
as tangential discontinuity, 80
Flank magnetosheath, magnetic field, 54
F-layer dynamo, 126
Flow bursts (FBs), 233–5
FR. See Finite Larmor radius
FLRs. See Field line resonances
FluxGate Magnetometer (FGM), 51,
98, 324
Flux-pileup, 180, 181
Flux ropes, 237, 239
Flux tubes, 114
Jupiter and, 309–11, 310f, 313
Fly-wheel effect, 130
Force balance, 15
Foreshock region, equatorial plane, 159f
Force balance, 15
Foreshock region, equatorial plane, 159f
Finite Larmor radius (FLR), 35, 340–1
F-layer dynamo, 126
Flow bursts (FBs), 233–5
FLR. See Finite Larmor radius
FLRs. See Field line resonances
FluxGate Magnetometer (FGM), 51,
98, 324
Flux-pileup, 180, 181
Flux ropes, 237, 239
Flux tubes, 114
Jupiter and, 309–11, 310f, 313
Fly-wheel effect, 130
Force balance, 15
Foreshock region, equatorial plane, 159f
FUV. See Far Ultraviolet Imagery; Far ultraviolet spectrograph
FUV-WIC instrument, 286
Galileo spacecraft, 310–11, 310f, 313–15
Gas-dynamic models, 49
Geocentric Interplanetary Medium (GIPM), 52
Geocentric solar magnetic coordinate system (GSM), 96, 98, 99,
234, 285, 286
Geocorona, 217–18
Geomagnetic field
solar wind and IMF interaction with,
125
thermal plasma diffusion along, 132
upper atmosphere and, 126
Geomagnetic fluctuations
general aspects, 158
low-frequency range
polarization pattern, 163–4, 164f
wave characteristics and LT occurrence, 162–3
waves at discrete frequencies,
164–6
middle frequency
range of, 158–62
wave characteristics and LT occurrence, 158–60
polarization pattern, 160–2, 161f, 162f
Geomagnetic indices, 68
Geomagnetic latitude (MLAT), 144, 144f
Geospace Observatory (GO) Canadian riometers, 182
Geotail spacecraft, 19, 36, 74, 182,
223, 247
Alfvén wing data, 3, 6, 9, 10f, 11
KH wave data from, 80
LT occurrence observations, 162, 166
plasma flow studies with, 234–5
Giant Pulsiations, 191f
Gillam All-Sky Imager (ASI), 297
Gillam station, 174
GIPM. See Geocentric Interplanetary Medium
Global auroral oval asymmetries, 295–8
Global conductivity dependences, 300
Global hybrid H3D code, 56
Global HMD simulations, 42–7, 50
auroral electron precipitation simulation, 278f
mantine plasma and, 226–7
Global precipitation patterns, 297–8
Global pressure redistribution, RFT/DFBs role in, 236–7
Global transpolar neutral air circulation, 133
Global Ultraviolet Imagery (GUVI),
295–6, 296f
GO. See Geospace Observatory
Canadian riometers
GOCE. See Gravity field and steady-state Ocean Circulation Explorer
GOES spacecraft, 16, 18, 260
lagged correlation and, 20–1, 21f
magnetospheric response measurement, 19–20
wind dynamic pressure changes,
22–4, 25f
GRACE spacecraft, 130, 137
Gradient drift entry, 29
Gravity field and steady-state Ocean Circulation Explorer (GOCE),
130, 137
GSE coordinate system, 52–3
GSM. See Geocentric solar magnetic coordinate system
GUVI. See Global Ultraviolet Imagery
Gyroradius, for magnetic field, 86, 86t
HAE. See High-altitude emissions
Hall conductance, 277
Hall conductivity, 126
Harang discontinuity, 109, 119, 200, 206
INDEX 353

Harang reversal, 199, 205, 208

Heavy planetary ions, 339

HEEs. See Hot electron enhancements

HEIDI ring current model, 218

Heliophysics/Geospace System Observatory, 182

HENA instrument, 210

HIA. See Hot Ion Analyzer

High-altitude emissions (HAE), 216

High-altitude neutral wind vorticity, 132

High-speed stream (HSS), 216–17

Hisaki spacecraft, 318

Horizontal Wind Model (HWM), 130

Hot electron enhancements (HEEs), 223, 224f, 225

ARTEMIS data on, 228, 228f, 230
dawn-dusk asymmetry, 228–30
density distributions, 228, 229f

Hot Ion Analyzer (HIA), 98

HSS. See High-speed stream

Hubble Space Telescope (HST), 314, 315f

HWM. See Horizontal Wind Model

Hydrogen ENAs, 215, 216f, 331, 332f

IAGA. See International Association of Geomagnetism and Aeronomy

IMAGE. See Imager for Magnetopause-to-Aurora Global Exploration

IMAGE FUV. See Far Ultraviolet Imager

Imager for Magnetopause-to-Aurora Global Exploration (IMAGE), 111, 116f, 210, 213, 285

aurora observations, 286, 287f
FUW-WIC instrument, 286
polar cap data, 286
substorm database, 256
substorm onset time data from, 116, 117f

IMAGE Wideband Imaging Camera (IMAGE WIC), 11, 116f, 286

IMF. See Interplanetary magnetic field

IMP 8, 19

Impulsive penetration, 74

INCA. See Ion-Neutral Camera

Injections
classification of, 172
distribution, 174f

Inner magnetosphere
composition, 215–16
HSS storm simulations, 217

INTERBALL, 50

International Association of Geomagnetism and Aeronomy (IAGA), 157

Interplanetary magnetic field (IMF), 6, 8f, 11, 73, 158
anti-Parker-spiral, 229
auroral region distorted by, 285
Bv component, 95, 97, 109, 137, 138
auroral events and, 285, 287, 289, 292
convection patterns and, 129
equatorial current resolution and, 205–4, 208
fast flow events and, 101, 103, 104
ionospheric convection patterns and, 112–15
nonsubstorm asymmetries and, 74
plasma transport asymmetry and, 246
substorm convection and, 115–16
CEP precipitation and, 278
cold ion deposition and, 245–6, 245f
cusp outflow and, 279
dawn-dusk asymmetry and, 41–2, 47
dayside auroral emissions, 150–1, 151f
dependences, 134–6, 135f, 136f
earthward ion flow speeds and, 95–6
fast flow events and, 99–100, 100f, 101f, 102f, 103
geomagnetic field interaction with, 125
global conductivity dependences and, 300
ionospheric convection pattern control by, 108–9, 108f, 129, 280
ion temperature anisotropy and orientations of, 60
LLBL and, 345
magnetic reconnection and, 54
magnetopause and pitch angles of, 26, 26f
magnetopause reconnection with, 108
magnetosheath asymmetry and, 41, 64
magnetosphere coupling with, 107
mantle plasma and, 226
OMNI data on, 98, 225, 228
Parker Spiral, 30, 50, 52, 60, 64, 189
plasma velocity and, 64
reconfiguration of, 119
TRINIs and, 97, 98, 107, 113, 114, 114f
upper atmosphere and, 126
Inverted-V events, 297
Io, 309
plasma torus, 318
Ion acceleration mechanisms, 244, 274
Ion aurora, 261, 263f, 264
Ion beams, 279, 280f
Ion bulk upflow, 274

Ion conics, 274, 279, 280f

Ion density
dayside, 249
in magnetosheath, 56, 58f, 64–8
in near-Earth plasma sheet, 247, 247f

Ion dispersion, 44f
energy levels and, 45f
modeling, 43, 44, 45–7

Ion distribution, 244

Ion-drug momentum source, 129

Ion drift, 125

subauroral, 109

Ion flow speed, earthward, 95–6

Ion gyrofrequency range, 274

Ion gyro resonance, 341–2, 344f

Ion injections, 180f

preamidnight preponderance of dispersionless, 171–82

Ion-Neutral Camera (INCA), 324, 331

Ionosphere, 10f

Alfvén wings and, 4, 5
asymmetric energization in, 274–9, 275f
azimuthal flow bursts, 97
cold ion transport from, 245–7, 245f, 280–2, 282f
convection streamlines in, 97f
drivers and apparent forces, 132–4
dynamo regions, 126
electrical potential of, 280, 281f
energy inputs, 275, 275f
fast flow events and, 100
flow speeds in, 112f
Joule heating, 194f, 195, 276
magnetic connection, 125
magnetosphere coupling with, 314
nightside plasma flows in, 97f
outflow from, 273, 274, 279–82
plasma convection patterns in, 103
plasma precipitation, 277
Saturn, 325f
thermospheric dynamics, 130, 132
topside, SW speed, 160
wave characteristics and, 158

Ionospheric conductivity, 5, 277
dawn-dusk asymmetries in, 74
gradients and nonuniformities in, 138
magnetic local times and, 299

Ionospheric convection, 276, 279–80

Ionospheric convection patterns, 111f, 117f, 136
asymmetries in, 107
electric fields and, 126–30, 127f, 128f
IMF Bv and
nonsubstorm asymmetries, 113, 113f
substorms, 115–16
IMF control of, 108–9, 108f, 129
magnetotail control of, 109, 111–17, 239
Low-altitude emissions
See LAE.
Lyman-alpha detector
See Kinetic pressure, 74
Lyman-alpha detector (LAD), 213
ISEE-1, 213
ISEE-2, 6, 96
ISEE-3, 6
ISEE spacecraft, terrestrial magnetopause observation, 73
Joule heating, 129, 133, 273–4
of ionosphere, 194f, 195, 276
Jupiter
auroral emissions, 314–18, 315f
crosstails events, 311, 311f
FACs at, 314, 315, 316
magnetic field, 309
configuration of, 312–14, 312f
magnetopause, 313
magnetosphere, 313
currents distribution in, 314
magnetotail, 311
plasma flow around, 309–14
plasma sheet thickness, 311–12, 312f
Kelvin-Helmholtz instability, 34, 35f, 49,
50, 159, 188, 317
ion gyro resonance and, 341–2
ion temperature variations and, 67
LLBL and, 343
magnetosheath-magnetosphere coupling through, 66
at Mercury, 338, 339–43
plasma transport and, 66
plasma variations and, 68
Saturn and, 333
velocity shear layer and, 341
Kelvin-Helmholtz vortices, 342f
Kelvin-Helmholtz (KH) waves, 29, 30,
34, 80, 82, 91, 337
dawn-dusk asymmetries and, 35–6
frequency distribution of, 341f
magnetopause deformations from, 228
at Mercury, 338, 340f
rollover, 77
rollover of nonlinear, 74
KH. See Kelvin-Helmholtz waves
Kinematic analyses, 132
Kinetic-ballooning/interchange mode, 261
Kinetic hybrid simulations, 49
Kinetic pressure, 74
LAD. See Lyman-alpha detector
LAE. See Low-altitude emissions
LANL, 182
Large-scale convection electric field, 126–30
Large-scale kinetic simulations (LSK), 41–7
LBH. See Lyman-Birge-Hopfield band
Left-handed (LH) polarization, 160
LEMMS. See Low-Energy Magnetospheric Measurement System
LEP. See Low Energy Particle instrument
LFM. See Lyon-Fedder-Mobarry MHD model
LFM-MIX model, 285, 287
LH. See Left-handed polarization
Li, S. S., 233
LLBL. See Low-latitude boundary layer
Lobe cells, 289–90, 291f
Local MHD simulations, 50
Long-period ULF waves, asymmetry, 188–92
Lorentz force, 315
Low-altitude emissions (LAE), 217
Low-energy electrons, 328, 329f
Low-Energy Magnetospheric Measurement System (LEMMS), 324, 328
Low Energy Particle instrument (LEP), 247
Low-frequency range geomagnetic fluctuations
polarization pattern, 163–4, 164f
wave characteristics and LT occurrence, 162–3
waves at discrete frequencies, 164, 166
Low-latitude boundary layer (LLBL), 47, 338, 343, 344–5, 345f
L-shells, 315
LSK. See Large-scale kinetic simulations
LT modulation, 160
LT occurrence, geomagnetic fluctuations low frequency, 162–6
middle frequency, 158–60
Lyman-alpha detector (LAD), 213, 214
Lyman-Birge-Hopfield band (LBH), 286, 296, 296f, 301f
Lyon-Fedder-Mobarry MHD model (LFM), 33, 249, 276, 277, 285, 287
IMF data comparison with, 287
model performance, 292
PCW symmetry and, 289
polar cap boundaries, 291f
Mach numbers, 4, 7f
MAG. See Cassini Magnetic Field instrument
Magnetic field, 68. See also
Geomagnetic field;
Interplanetary magnetic field
Alfvén Mach number and asymmetries in, 54, 55f
do Birkeland currents, 201–2
earthward transport, 95
do equatorial currents, 200–1, 203f
ion acceleration by, 274
Jupiter, 309
configuration of, 312–14, 312f
in magnetosheath, 64
strength of, 54, 56
model fitting for, 202
reconfiguration after reconnection, 97
Saturn, 327–8, 327f
twisted tail, 100
Magnetic field rotation, 87
Magnetic gradient, 244
Magnetic latitude (MLAT), 286, 298,
299, 299f, 300f
Magnetic nulls, 313
Magnetic pressure, 9
Magnetic reconnection, 29, 33f, 34f, 95.
See also Tail reconnection
Alfvén speed and, 32
dayside, 96
field reconfiguration after, 97
flux ropes and, 237
IMF and, 54
IMF and magnetopause, 108
IMF-magnetosphere coupling via, 107
ionospheric convection and, 108
localization of, 234, 239
magnetotail, 237, 239
solar wind-magnetosphere coupling, 32–4
Magnetic storms, 126, 247
Magnetized plasma, Kelvin-Helmholtz instability in, 34–5
Magnetohydrodynamics (MHD)
BATS-R-US code, 33, 215, 226–7,
285, 287, 289, 291f
cusp precipitation simulation, 279
finite Larmor radius, 35
global simulations, 10f, 42–7, 49, 50,
226–7
Jupiter plasma flow simulations,
311, 311f
Kelvin-Helmholtz wave modeling, 35
LFM model, 33, 249, 276, 277
local simulations, 50
Lyon-Fedder-Mobarry model, 249
magnetosheath asymmetries and models of, 30
mantle plasma simulations, 226–7
Magnetosheath
See also Central Magnetosheath, Dayside magnetosheath, Flank magnetosheath
ARTEMIS data on, 225, 228, 228f asymmetries in, 30 asymmetry and Parker Spiral, 64 bow shock and field lines of, 229 configuration in Parker Spiral, 52 data from THEMIS spacecraft, 42, 49–53, 88 data sets, 51 dawn-dusk asymmetries in, 4, 50, 54, 56, 59, 64 global interpretation, 66–8 Pc1–2 magnetic field variations in, 60, 62f, 63 density distributions, 228, 229f HEEs in, 225 IMF and asymmetries in, 41, 64 instrumentation of, 51 ion density in, 56, 58f, 64–8 ionospheric energy inputs and, 275f ion temperature anisotropy and mirror mode occurrence, 60, 61f, 66, 68 ion temperature in, 56, 59–60, 59f, 65, 67, 68 ion velocity in, 56, 57f, 64 magnetic field strength in, 54, 55f, 56, 64 mantle plasma in, 225 Mercury asymmetries in, 339 modeling, 17 Pc3–Pe5 fluctuations, 63–4 Pc3 velocity in dayside, 51 plasma parameters, 30 plasma precipitation from, 277 plasma properties, 49–50 plasma velocity in, 64 pressure propagation speeds and, 21–2 solar wind speed and temperatures in, 56 statistical data, 55f statistical data compilation, 51–2 ULF range and field variations in plasma, 64–6 ULF range plasma and field variations in, 64–7 velocity flow Pc3–Pe5 fluctuations, 63–4, 63f Magnetosheath Interplanetary Medium (MIPM), 50 coordinate transformation to, 52–3 data point processing, 53–4 as reference frame, 52 Magnetosphere asymmetries in, 30–2 composition of inner, 215–16 equatorial, 67f HSS-driven storm simulations for inner, 217 IMF coupling with, 107 inner through midtial observations of energetic particle injections, 175–8 ion dispersion in, 43, 44 ionospheric energy inputs and, 275f ionospheric outflow to plasma in, 274 Jovian, 309, 311, 313 currents distribution in, 314 low-frequency range fluctuations, 164–6 Mercury, 337 modeling, challenges, 199 models of inner, 292 particle acceleration by, 46, 46f path differences in, 18 perturbation propagation, 18 plasma circulation in, 125 plasma cloak, 31–2, 33 plasma densities in, 18 plasma parameters, 30–2 plasma populations, 223 plasmaspheric drainage plume, 32, 32f plasma transport in, 31 prenoon sources, 150 propagation model for, 16–18 Saturn, 323, 325f local time asymmetries, 324 scales of, 15 solar wind coupling with, 29 magnetic reconnection, 32–4 solar wind force balance with, 15 solar wind phase front orientation and, 24 sub-Alfvénic conditions and, 8 substorms and configuration of, 268 SW speed, 160 Magnetosphere-ionosphere coupling, 314 Magnetosphere-ionosphere-thermosphere coupling (M-I-T coupling), 125, 126, 133, 138 neutral wind dynamo effect and, 130 Magnetospheric boundary layers (MBLs), 146 Magnetospheric convection, 129 Magnetospheric currents, 199, 207f equatorial, 200–1, 203f Magnetospheric Imaging Instrument (MIMI), 324, 328, 330 Magnetospheric Multiscale Mission (MMS) satellites, 68, 75, 182 Magnetospheric substorms, 110f convection patterns, 111, 111f IMF B and convection in, 115–16 intrinsic asymmetries during, 109, 111–12 Magnetospheric waves, 345–6 Magnetotail, 3, 302 coordinate systems for flows in, 99, 234 ionospheric convection pattern control by, 109, 111–17, 239 Jovian, 311 localization of reconnection, 234 rapid untwisting hypothesis and, 97 substorms and, 256 THEMIS observations of, 234–5, 237 transients, 233 transients in mid-distant, 237–8 twisting of, 96, 97, 97f
Magnetotail plasma sheet, 95, 96
earthward transport in, 102
Magnetotail reconnection, 237, 239
Magnetotomography, stochastic, 26
Mantle plasma, 230
dawn-dusk asymmetry and characteristics, 226, 226f
formation of, 223
global MHD simulation comparisons with, 226–7
in magnetosheath, 225
Mantle precipitation, 47
Map Potential analysis, 110f, 112f
Mariner 10 spacecraft, 337–9, 340f, 338
Medium Energy Particles Instrument (MEPI), 213
Mercury
Alfvén wings and, 4
bow shock and magnetosheath asymmetries, 339
FLR effects, 340–1
heavy planetary ions, 339
ion gyro resonance and, 341–2
KH instability, 338, 339–43
KH waves, 338, 340f
LBL, 343, 344–5
magnetic field, 338
magnetosphere, 337
magnetospheric waves, 345–6
Parker Spiral and, 338, 338f
structural and seasonal asymmetries, 338–9
velocity shear layer, 341
MESSENGER spacecraft, 337–9, 340f, 344, 346
MHD. See Magnetohydrodynamics
Middle frequency range, of geomagnetic fluctuations, 158–62
Midtail
ARTEMIS data on, 225
HEEs in, 225
mantle plasma in, 225
transients in, 237–8
MIMI. See Magnetospheric Imaging Instrument
MIPM. See Magnetosheath Interplanetary Medium
Mirror mode occurrence, 60, 61f, 66, 68
Mirror-mode waves, 191, 192f
M-I-T coupling. See Magnetosphere-ionosphere-thermosphere coupling
MIX model, 292
MLAT. See Geomagnetic latitude; Magnetic latitude
MMS. See Magnetospheric Multiscale mission
Model fitting, 202
Monoenergetic electron aurora, 261,
262f, 267–8
Moons, with ionospheres, 4
Morning/afternoon asymmetry of geomagnetic fluctuations, 157–66
Motion
magnetopause, 76, 76f, 79, 79f
of spiral injection boundary, 172, 173f
MSIS. See Mass Spectrometer and Incoherent Scatter
MVABC. See Constrained minimum variance analysis
NASA Goddard Space Flight Center, 226
National Center for Atmospheric Research (NCAR), 132
Near-Earth neutral line (NENL), 98
Near-Earth plasma sheet asymmetries in, 243
BBFs and FBs in, 234–5
dayside, 249–50
ion sources, 243–4
ion species in, 245
nightside
bulk population, 247–8
cold ion population and transport from ionosphere, 245–7, 245f
energetic particles, 248–9
oxygen and hydrogen ion densities, 247, 247f
open questions, 250
NENL. See Near-Earth neutral line
Neutral hydrogen densities, 218f
Neutral wind dynamo effect, 130
Neutral wind vorticity, 132, 138
IMF dependence, 134–6, 135f, 136f
New Horizons spacecraft, 310
Nightside auroral zone convection, 118
Nightside electron aurora, substorms and power increase in, 264–5, 264f
Nighttime, ULF waves in, 158
NOAA/POES, 182
NOAA Space Weather Prediction Center, 19
Nonsubstorm asymmetries, 112–15, 113f
Northern hemisphere, dayside auroral emissions, 143–53
OGO-5, 235
OGO spacecraft, terrestrial magnetopause observation, 73
Omega bands, 297f
OMNI (HRO) data set, 19, 51, 52, 287
IMF data from, 98, 225, 228
modified minimum variance algorithm, 16
solar wind parameters, 225, 228
wind dynamic pressure changes, 22–4, 25f
1D model, 314
OpenGGCM model, 285, 287, 289, 291f
Orientation
drift velocity, 87
of IMF, 60, 137
ionosphere, of Saturn, 325f
magnetopause, 76, 76f
magnetopause, of Saturn, 325f
solar wind phase front, 17f, 24
Ortho-spiral conditions, 189
Outer Radiation Belt region, 191
Outflow
auroral, 273, 279
cold ion, 245–7, 282f
ionospheric, 273, 274, 279–82
polar cap, 280–2
Oxygen ENAs, 215–16, 216f, 331, 332f
Oxygen ions, 249, 273
outflow of, 279
Parker Spiral, 15, 30, 50, 189
HEEs and, 230
ion temperature anisotropy and, 60
Kelvin-Helmholtz waves and, 35
magnetosphere asymmetry and, 64
magnetosphere configuration in, 52
Mercury, 338, 338f
Particle-driven waves, 190–2
Particle precipitation, 41, 42, 43f, 129.
See also Auroral particle precipitation
asymmetries in, 295
auroral, 255–6
modeling, 43, 46–7
Patchy aurora, 297f
PBI. See Poleward boundary intensifications
PBL. See Plasmapause boundary layer
Pc1–2 magnetic field variations, 50
in magnetosheath dawn-dusk asymmetries, 60, 62f, 63
Pc3–5 fluctuations, ULF-range, 66
Pc3 velocity pulsations, 66, 69
Pc5 micropulsations, 188, 188f
Pc5 waves, 189
compressional, 191
PCB. See Polar cap boundary
PCW. See Polar cap width
Pedersen conductance, 5, 42, 126, 189, 277
Perturbation field, Saturn, 327f, 328
Phase front normal (PFN), 17, 17f, 19, 24
orientation of, 25
time history and, 25–6
Phase front orientation, time history, 25
PiB, 260
Pioneer 11 spacecraft, 323
Plasma, 77. See also Cassini Plasma
Spectrometer; Mantle plasma
antisolar cross polar cap plasma
flow, 129
asymmetric transport of, 246
asymmetry in mantle, 226, 226f
bow shock and, 49
bulk velocity, 234
convection patterns in ionosphere, 103
cusp precipitation, 17, 17f, 19, 24
earthward transport, 95–7
flow studies with Geotail spacecraft, 234–5
IMF and convection in, 41
incompressible, 35
ionosphere, precipitation, 277
Io torus, 318
Jupiter, flow simulations in MHD, 311, 311f
Jupiter flow of, 309–14, 312f
Kelvin‐Helmholtz instability and
transport of, 66, 68
Kelvin‐Helmholtz instability in magnetized, 34–5
magnetized, 34–5
magnetopause, transfer across, 230
magnetopause parameters, 29–32
magnetosheath
parameters, 30
precipitation from, 277
properties of, 49–50
velocity in, 64
magnetosphere, 32f
circulation in, 125
densities in, 18
ionospheric outflow to, 274
parameters in, 30–2
populations in, 223
transport in, 31
magnetotail sheet of, 96
MHD mantle, simulations, 226–7
nighttime flows in Ionosphere, 97
Pc3 variations in flow of, 69
THEMIS spacecraft
flow studies with, 234
magnetosphere plasma
measurements, 31
thermal, diffusion along geomagnetic
field, 132
ULF range and field variations in
magnetosheath, 64–6
velocity in magnetosheath, 64
Plasma cloak, 31–2, 33
Plasma cloud, 172
Plasmapause boundary layer (PBL), 189
Plasmapause crossings, 189
Plasma sheet. See also Earthward
plasma sheet transport;
Magnetotail plasma sheet; Near‐Earth plasma sheet
cold ion outflow on, 245–7, 282f
energetic particles in near-Earth, 247
ion density in near-Earth, 247, 247f
at Jupiter, thickness of, 311–12, 312f
quiet-time, 171
substorms and, 256, 266
THEMIS spacecraft measurement of, 175
Plasma sheet field, 118, 118f
asymmetries in, 243
BBFs and FBs in, 234–5
Plasmaspheric drainage plume, 32, 32f
Plasma wake, 280
Plasma waves, 4–5, 345–6
Plasmoids, 233, 237, 238f, 239, 310
Polar cap, 302
Polar cap boundary (PCB), 286–7, 291f
Polar cap outflow, 280–2
Polar cap width (PCW), 285, 286, 292
correlations, 287–9, 288f
symmetry in, 289
Polarization. See also Dipolarization
fronts
diurnal and latitudinal variation
patterns, 164f
gemagnetic fluctuations patterns,
low-frequency range, 162–4, 164f, 165f
LT variation of, 160–2, 163f
of Pc5 micro pulsations, 188f
POLAR satellite, 213, 285
Alfvénic Poynting flux
measurements, 277f
aurora observations, 286, 287f
electric field measurements, 298, 299f
Polar cap data, 286
UVI instrument, 295, 296, 296f, 301f
UVI storm database, 256
VIS Earth instrument, 286
Polar UVI images, 143–4
Polar wind, 274, 280
Polar Wind Outflow Model (PWOM), 246
Poleward boundary intensifications (PBIs), 301–2
Power spectral densities (PSDs), 189–90
Poynting flux, 255, 275
Alfvénic, 276, 277f
Poynting vector, 194f
Pressure balance, 87, 87f
Pressure valve effect, 130
Propagation model, 16–18
Proton bursts distribution, 179f
PSDs. See Power spectral densities
PWOM. See Polar Wind Outflow Model
Quasiparallel bow shocks, 51, 64
Quasiparallel shock conditions, 189
Quasiperpendicular shock, 64
Quasistatically accelerated electrons, 297f, 298–9
Quiet-time plasma sheet, 171
Radiation belt, 193–5
Ram pressure, 9
Rankine‐Hugoniot conditions, 54
RAPID. See Research with Adaptive
Particle Imaging Detector
Rapid flux transfer (RFT), 233, 235–6
role in global pressure redistribution, 236–7
Rapid untwisting hypothesis, 97, 98
fast flows and, 99–100
RCM-E. See Rice Convection
Model-Equilibrium
RD. See Rotational discontinuity
Reconnection, 74
Relative Ionospheric Opacity Meters
(Riometers), 174, 181
Research with Adaptive Particle Imaging
Detector (RAPID), 248
RFT. See Rapid flux transfer
RH. See Eastward polarization
Rhea, 328, 329, 330, 331
Rice Convection Model-Equilibrium
(RCM-E), 215, 261
Ring current, 210, 218
dynamics of, 214–15
physics of, 193–5
Riometers. See Relative Ionospheric
Opacity Meters
Rotational discontinuity (RD), 85
SAID. See Subauroral ion drifts
SAPS. See Subauroral polarization
streams
Satellites
ACE, 19, 98
Akebono, 274, 279
AMPTE/IRM, 96
Astrid, 213
CHAMP, 129–30, 132, 136
Joule studies with, 276
mass density estimations from, 133–4, 134f, 137
Conjugate Solar, 194f
Satellites (cont’d)
DMSP, 41, 42, 182, 247, 289–90
electron precipitation data from,
lobe cells in, 291f
precipitating energy flux
measurements, 297–8, 297f
SSJ4/5 particle detector on, 256
Dynamics Explorer 2, 112, 132
FAST, 260, 297
geosynchronous orbit abundance, 172
MMS, 68, 75, 182
Alfvénic Poynting flux
measurements, 277f
aurora observations, 286, 287f
electric field measurements,
298, 299f
polar cap data, 286
UVI instrument, 295, 296,
296f, 301f
UVI substorm database, 256
POLAR, 213, 285
Alfvén Pointing flux
measurements, 277f
aurora observations, 286, 287f
electric field measurements,
298, 299f
polar cap data, 286
UVI instrument, 295, 296,
296f, 301f
UVI substorm database, 256
Vis Earth instrument, 286
Swarm constellation, 130, 137, 182
Triad, 200
Saturn
aurora, 325–7, 326f
corotation electric field, 333
ENAs, 331–2, 332f
ergetic electrons, 328–30, 329f
ergetic ions, 330–1, 330f
ergetic protons, 330, 330f
ionosphere, orientation of, 325f
KH instability and, 333
low-energy electrons, 328, 329f
magnetic field, 327–8, 327f
magnetosphere, 323
local time asymmetries, 324
orientation of, 325f
perturbation field, 327f, 328
Saturn-Zaxis-Sun coordinate
system, 324
SCW. See Substorm current wedge
SEA. See Solar elevation angle
Shorter period ULF waves, EMIC
waves, 193
Shorter period ULF waves
asymmetry, 193
SI. See Sudden impulse
Singly ionized sodium, 337, 339
SMC. See Steady magnetospheric
convection
SMR. See SuperMag Ring current
Sodium ions, 337, 339, 345
Solar cycle dependence, of ULF wave
powers, 190
Solar elevation angle (SEA), 152
Solar wind, 74
Alfvén Mach numbers, 7f
auroral emissions and, 298
corotation electric field, 333
dynamic pressure changes, 15, 16
force balance with magnetic field, 15
geomagnetic field interaction
with, 125
low ram pressure, 9
magnetic pressure, 9
magnetosheath temperatures and
speed of, 56
magnetosphere and phase front
orientation of, 17f, 24
mantle plasma and, 226
numerical simulations, 9, 10f, 11
Pc1–2 magnetic field variations and
speed of, 60, 62f, 63
PFN, 17f
pitch angle and lag profile
properties, 21f
polar cap width and, 287–8
precipitating energy flux and, 297f
in propagation model, 16–18
scales of, 15
sub-Alfvénic, 3–6, 7f, 8f
travel times to geosynchronous orbit
from, 26
typical structure, 3
Solar wind–magnetosphere coupling,
29, 223
Kelvin-Helmholtz waves, 34–6
magnetic reconnection, 32–4
Solar wind parameters (SWP), 146, 148,
148f, 149, 149f, 225, 228
Southern hemisphere, dayside auroral
emissions, 143–53
South Pole Station (SPS), 143–53,
144f, 152
Spacecraft. See also Satellites
Cassini, 323, 324, 331
Cluster, 64, 74–7, 75f, 97, 98, 104, 114,
182, 243
cusp outflow data, 279
edi, 127, 128, 245, 280
EFW, 245
flank magnetopause observations,
80, 81t, 92
ion outflow study with, 246
mid-distant tail studies with, 237
RAPID instrument, 248
Explorer 10, terrestrial magnetopause
observation, 73
Explorer 12, terrestrial magnetopause
observation, 73
Galileo, 310–11, 310f, 313–15
goethal, 19, 36, 74, 182, 223, 247
Alfvén wing data, 3, 6, 9, 10f, 11
KH wave data from, 80
LT occurrence observations,
162, 166
plasma flow studies with, 234–5
GOES, 16, 18, 260
lagged correlation and, 20–1, 21f
magnetospheric response
measurement, 19–20
wind dynamic pressure changes,
22–4, 25f
GRACE, 130, 137
Hisaki, 318
ISEE, terrestrial magnetopause
observation, 73
magnetopause and, 74
Mariner 10, 338
MESSENGER, 337–9, 340f,
344, 346
New Horizons, 310
OGO, terrestrial magnetopause
observation, 73
Pioneer 11, 323
TC-1 spacecraft, 74
THEMIS
equatorial current observation,
208, 209f
fast flow data set, 98–9
gemagnetic fluctuation
observations, 160
injection observations, 179, 180
Kelvin-Helmholtz wave
measurements, 34
magnetopause coupling
measurements, 33, 33f
magnetosheath data from, 49–53, 88
magnetosheath density
measurements, 42
magnetosphere plasma
measurements, 31
magnetotail observations,
234–5, 237
mid-distant tail studies with, 237
orbit of, 53
plasma flow studies with, 234
plasma sheet measurements, 175
stochastic magnetotomography
data from, 26
whistler-mode chorus wave
observation, 192f
Ulysses, 311, 315
Voyager, 313, 315, 323, 324
Space Weather Modeling Framework
(SWMF), 215–16, 287
Spatial interpolations, 75
Spiral injection boundary, earthward
motion of, 172, 173f
SPS. See South Pole Station
SSJ4/5 particle detector, 256
Standing Alfvén waves, 3
Standing fast mode shock wave, 49
Static Weimer substorm model, 112
Steady magnetospheric convection (SMC), 119, 235
Stephens, Grant, 199
STEREO, 230
Stochastic magnetotomography, 26
Stretched mesh capability, 56
Sub-Alfvénic solar wind, 3–4, 8f
Substorm‐related phenomena, 179
Substorm injections, 214
Substorm current wedge (SCW), 300
Subsolar magnetopause structure, 73–4
Subauroral polarization streams (SAPS), 109, 111
Subauroral ion drifts (SAID), 109
Sub‐Alfvénic solar wind, 3–4, 8f
Super Dual Auroral Radar Network (SuperDARN), 107, 111, 111f, 194f
SuperMag Ring current (SMR), 210
SuperMAG. See Space Weather Modeling Framework
Swarm satellite constellation, 130, 137, 182
Swirl region, 317
SWMF. See Space Weather Modeling Framework
SWP. See Solar wind parameters
Tail reconnection, 95, 97, 97f
tail reconnection observations, 179, 180
Titan, 330, 331
topside ionosphere, SW speed, 160
Transpolar arcs, 114, 302, 302f
Transpolar cap convection, timescale of, 117
Transpolar neutral air circulation, 133
Transverse accelerated ions (TAI), 279
Traveling compression regions (TCRs), 237
Travel-time magnetoseismology, 26
TRIAD data, 203f, 206
Triad satellite, 200
TRIAD data, 203f, 206
TRIAD data, 203f, 206
TRINNIs. See Tail reconnection during IMF‐northward, non‐substorm intervals
TS07D model, 208
UCLA‐MHD code, 42
UCL‐MHD. See Ultra‐low‐frequency ULF range
ULF. See Ultra‐low‐frequency ULF range
ULF range
magnetosheath variations in, 65–6
Pc3–5 fluctuations, 66
ULF wave powers, 189–90
Ultra‐low‐frequency (ULF) waves, 187
classification, 188f
compressional mirror‐made waves, 191, 192f
compressional waves and field line resonances in Pc4–5 ranger, 188–90
Joule heating of ionosphere, 194f, 195
long‐period, 188–92
in magnetosheath, 67
morning/afternoon asymmetry, 157–66
particle‐driven waves, 190–1
shorter period, 193
Ultraviolet imagery (UVI),
auroral emissions survey using, 143–4

Ultraviolet Imaging Spectrograph (UVIS), 324, 325, 325f
Ultraviolet light (UV light), 274, 286, 315, 316f
auroral oval emissions, 295–6
Ulysses spacecraft, 311, 315
Upper atmosphere
drivers and apparent forces, 132–4
energy budget, 133
fly-wheel effect, 130
geomagnetic field and, 126
heating areas, 133
IMF and, 126
models for, 130
thermospheric dynamics, 130, 132
UVI. See Ultraviolet imagery
UVIS. See Ultraviolet Imaging Spectrograph
UV light. See Ultraviolet light

Van Allen Probes, 68, 180, 182, 208
Van Allen radiation belts, 193, 194f
Vasyliunas cycle, 309, 310f

Velocity
deHoffman-Teller frame, 76
drift, orientation of, 87
magnetopause, 82, 86
magnetosheath ion, 56, 57f, 64
Pc3, 51
Pc3–Pc5 fluctuations, 63–4
Pc3 pulsations, 66, 69
plasma bulk, 234
in magnetosheath, 64
Velocity shear layer, 341

VIS. See Visible Imaging System
VIS Earth instrument, 286
Visible Imaging System (VIS), 116f
Vlasov-Maxwell model, 85, 86
Voyager spacecraft model, 313, 315, 323, 324
VxB-electric field. See Dipolarizing flux bundles

Walén analysis, 77

Wave activity discontinuity
classification, magnetopause, 76–7
Wave characteristics, geomagnetic fluctuations, 158–60, 162–6

Waves at discrete frequencies, low-frequency range, geomagnetic fluctuations, 164–6

Westward Traveling Surge (WTS), 300
Whistler-mode chorus waves, 256, 258, 258f
Whistler-mode waves, 191, 192f
Wind, 19, 300f. See also Solar wind
dynamic pressure changes of GOES spacecraft, 22–4, 25f
dynamic pressure changes of OMNI (HRO) data set, 22–4
high-altitude neutral vorticity, 132
IMF dependence and neutral vorticity, 134–6, 135f, 136f
neutral dynamo effect, 130
neutral vorticity, 132, 134, 138
thermosphere, patterns, 131f, 132

WIND, 234
WTS. See Westward Traveling Surge

X-ray auroral emissions, 317
X-ray heating, 133

Yellow River Station, 143–53, 144f

Zero-energy boundary, 173f