

Supplementary Table S1. Summary of biomarkers in Parkinson’s disease, dementia with Lewy bodies, and atypical parkinsonism. Biomarkers are grouped by domain, modality, disease stage, clinical or research use, and maturity level. Color codes indicate clinical readiness: clinically established (green); emerging with/withour ongoing validation (orange); experimental, limited to research (red).

Domain / Target	Modality	Disease Stage	Clinical and/or Research Use	Maturity Level
IMAGING NEUROTRANSMITTER DYSFUNCTION				
DOPAMINE				
Dopamine (presynaptic)	DAT-SPECT / [¹⁸ F]DOPA PET	Prodromal, Early	Diagnosis. Trial enrichment	● Clinical
Dopamine (postsynaptic)	D2 PET	Advanced	Post-synatpic dopamine function	● Research
Neuromelanin in SN	NM-MRI	Prodromal, Early	Supportive early marker	● Emerging (Ongoing validation)
Nigral Iron Deposition	QSM / SWI (MRI)	Prodromal, Early	Early detection. Diagnosis	● Clinical
NORDADRENALINE				
Noradrenaline (NAT)	[¹¹ C]MeNER PET	Prodromal, Early	Non-motor phenotyping	● Emerging
Noradrenaline (LC)	LC NM-MRI	Prodromal, Early	Non-motor phenotyping	● Emerging (Ongoing validation)
ACETYLCHOLINE				
Cholinergic System (NBM, PPN)	[¹¹ C]-Donepezil, [¹⁸ F]FEOBV PET	Early - Advanced	Cognition, gait dysfunction	● Emerging
Cholinergic System (NBM)	Volumetric MRI	Early - Advanced	Predicting cognitive decline	● Emerging
SEROTONIN				
Serotonin (Raphe, SERT)	[¹²³ I]FP-CIT, [¹¹ C]WAY-100635 PET	Variable	Tremor, psychiatric symptoms	● Emerging
IMAGING BRAIN PATHOLOGY				
α-Synuclein Aggregates	α-syn PET ([¹⁸ F]C05-05, SPAL-T-06)	Early. Research	Diagnosis, patient stratification	● Research

Domain / Target	Modality	Disease Stage	Clinical and/or Research Use	Maturity Level
Tau (4R)	PET (PI-2620, PM-PBB3)	Atypical PKS	Differential diagnosis	● Emerging
β-Amyloid	PET ([¹¹ C]PiB, [¹⁸ F]Florbetaben)	DLB, PDD	Diagnosis. Prognosis. Co-pathology	● Clinical
Neuroinflammation	TSPO ([¹¹ C]PK11195, [¹⁸ F]DPA-714)	Variable	Pathophysiological research	● Research
NETWORK AND OTHER IMAGING MARKERS				
Glucose Hypometabolism	FDG-PET	All stages	Differential diagnosis, staging.	● Clinical
Structural MRI (Morphometry)	MRI	All stages	Diagnosis of PSP, MSA, CBS	● Clinical
Free Water Imaging	Diffusion MRI	Early	Gait, cognition prediction	● Emerging
DBS Planning	Structural MRI	Advanced	Personalized therapy planning (DBS)	● Clinical
Functional Connectivity	fMRI, DTI, Connectomics	Advanced	Personalized therapy planning (DBS, MRgFUS)	● Emerging
IN VIVO PATHOLOGY AND NEUROPHYSIOLOGICAL MARKERS				
Seed Amplification Assay (SAA)	CSF (± skin biopsy, olfactory mucosa, blood)	Prodromal, Early	Biological confirmation of synuclein pathology. Application in trials	● Emerging (ongoing validation)
Skin Biopsy (p-α-syn detection)	Immunofluorescence	Early - Advanced	Synucleinopathy diagnosis	● Emerging (ongoing validation)
Local Field Potentials (LFPs)	Intraoperative Electrophysiology	Advanced	Adaptive DBS programming	● Clinical

Supplementary Table S2. Faculty contributions

Faculty	Expertise	Course lecture topic	Manuscript contribution
Roberto Cilia	Movement disorders; clinical translation; molecular imaging.	Course Direction; Chair	Overall coordination; drafting the first manuscript draft including cross-sectional integration
Dario Arnaldi	Prodromal synucleinopathies; sleep medicine; iRBD risk stratification	Prodromal stages of Synucleinopathies: Sleep and Glymphatic dysfunction	Section 4. <i>4.1. From Prodromal to Overt Clinical stages</i>
Bénédicte Ballanger	Noradrenergic system; PET/MRI biomarkers; non-motor symptoms	Noradrenergic Dysfunction: Molecular and MRI Biomarkers	Section 1 <i>1.2. Noradrenergic Dysfunction</i>
Roberto Ceravolo	Dopaminergic molecular imaging; SPECT/PET biomarkers	Dopaminergic Dysfunction: Molecular Biomarkers	Section 1 <i>1.1. Dopaminergic Dysfunction - Molecular Imaging</i>
Rosa De Micco	Network neuroscience; connectomics; progression modeling	Staging Parkinson's Disease: A Network Perspective	Section 4 <i>4.3. Network-driven conceptualization of PD</i>
Angelo Del Sole	Amyloid imaging; mixed pathologies; nuclear medicine	Imaging Amyloid and copathology; Chair (molecular imaging session)	Section 2 <i>2.3. Imaging Amyloid and Copathology</i>
Roberto Eleopra	Movement disorders; clinical phenotyping; advanced therapies	Chair (session discussion)	Editorial contribution; clinical integration across sections
Hironobu Endo	α -synuclein imaging; PET tracer development	Imaging Alpha-synuclein pathology	Section 2 <i>2.1. Imaging α-Synuclein Pathology</i>
Alfonso Fasano	Surgical therapies; DBS and lesioning; advanced PD management	Management of Parkinson's disease: surgical approaches	Section 4 <i>4.6. Management of PD: pharmacological and surgical approaches - Surgical approaches</i>
Merle C. Hoenig	Motor/cognitive reserve; resilience/compensation; neuroimaging correlates	The concept of Motor and Cognitive reserve vs. compensation in Neurodegenerative disorders	Section 4 <i>4.2. The Concept of Motor and Cognitive Resilience vs. Compensation in</i>

			<i>Neurodegenerative Disorders: Two Sides of the Same Coin?</i>
Jacob Horsager	Cholinergic dysfunction; PD subtypes; brain- first/body-first model	Cholinergic Dysfunction: Molecular Biomarkers	Section 1 <i>1.3. Cholinergic Dysfunction — Molecular Imaging</i> Section 3 <i>3.5. Brain-First vs. Body-First: A Model to Reconcile Clinical, Imaging, and Pathological Heterogeneity.</i>
Stéphane Lehericy	MRI biomarkers; neuromelanin/iron- sensitive MRI; nigrostriatal imaging	Dopaminergic Dysfunction: MRI Biomarkers	Section 1 <i>1.1. Dopaminergic Dysfunction - Magnetic Resonance Imaging</i>
Valentina Leta	Pharmacological therapy; infusion strategies; levodopa pharmacokinetics	Management of Parkinson's disease: oral and infusion pharmacological approaches	Section 4 <i>4.6. Management of PD: pharmacological and surgical approaches - Oral and infusion pharmacological approaches</i>
Fabio Moda	Seed amplification assays; translational biomarkers	Alpha-Synuclein Seed Amplification Assay: Present and Future	Section 3 <i>3.2. aSyn Seed Amplification Assays: Present and Future</i>
Maria Nolano	Skin biopsy; peripheral neuropathology; autonomic involvement	Update on the role Skin Biopsy in the diagnosis of Parkinsonism	Section 3 <i>3.3. The Role Skin Biopsy in the Diagnosis of Parkinsonism</i>
Tiago F. Outeiro	α -synuclein biology; therapeutic pipelines; disease mechanisms	Alpha-Synuclein: New discoveries and potential therapeutic applications	Section 3 <i>3.1. aSyn Biology: From Aggregates to Therapeutic Strategies</i>
Laura Parkkinen	Neuropathology; co- pathologies in PD and parkinsonism	The Role of Copathology in Parkinson's disease: the Neuropathologist's Perspective; Chair (pathology-focused session)	Section 3 <i>3.4. The Role of Co-pathologies in PD: The Neuropathologist's Perspective</i>
Nicola Pavese	Serotonergic imaging; neuropsychiatric and motor complications	Serotonergic Dysfunction: Molecular Biomarkers	Section 1 <i>1.4. Serotonergic Dysfunction</i>

Andrea Quattrone	MRI in atypical parkinsonism; differential diagnosis; trial endpoints	Imaging Biomarkers in Atypical Parkinsonian Disorders	Section 4 <i>4.5. MRI Biomarkers in Atypical Parkinsonian Disorders</i>
Nicola J. Ray	Cholinergic networks; MRI biomarkers; cognition/gait correlates	Cholinergic Dysfunction: MRI Biomarkers	Section 1 <i>1.3. Cholinergic Dysfunction – Magnetic Resonance Imaging</i>
Martin M. Reich	DBS connectomics; neuroimaging-guided targeting/programming	Updates on Neuroimaging approaches in Deep Brain Stimulation	Section 4 <i>4.6. Management of PD: pharmacological and surgical approaches - Neuroimaging approaches in DBS</i>
Irena Rektorova	Cognitive impairment imaging; MRI markers in Lewy body diseases	Imaging Cognitive Impairment; Chair (molecular imaging session)	Section 4 <i>4.4. MRI for tracking Cognitive Impairment in Lewy Body Diseases</i>
Antonio P. Strafella	SPECT & PET molecular imaging; TSPO PET;	Imaging Neuroinflammation; Chair (molecular imaging session)	Section 2 <i>2.4. Imaging Neuroinflammation</i>
Fabrizio Tagliavini	Neuropathology; neurodegenerative disease mechanisms	Chair (pathology-focused session)	Editorial contribution; pathology integration across sections
Alessandro Tessitore	Functional connectivity; PD networks; imaging signatures	Chair (imaging sessions)	Editorial contribution; MRI imaging and functional connectivity
Thilo van Eimeren	Tau imaging; multimodal neuroimaging; course direction	Imaging Tau pathology Course Direction; Chair	Section 2 <i>2.2. Imaging Tau Pathology</i>

Abbreviations: DBS, deep brain stimulation; iRBD, isolated/idiopathic REM sleep behavior disorder; MRI, magnetic resonance imaging; PET, positron emission tomography; SPECT, single photon emission computed tomography; TSPO, 18-kDa translocator protein.