Macromolecules and macromolecular complexes

- This Mini-Review lists the published papers that report the use of OptiPrep™ for the density gradient purification and analysis principally of DNA, RNA and proteins, and their complexes. All sections and subsections are listed alphabetically.
- Note also the following OptiPrep™ Application Sheets that provide detailed protocols for the purification and analysis of certain macromolecules and macromolecular complexes:
- Application Sheet M06: Plasmid DNA purification
- Application Sheet M09: Protein complex formation, cytoskeleton, microtubules, myosin II, prion proteins
- Application Sheet M11: Protein size analysis in pre-formed gradients
- Application Sheet M13: Nucleic acids and nucleic acid-protein complexes
- Application Sheet M14: Protein size analysis in self-generated gradients

These may be accessed from the OptiPrep™ Applications flash drive or from the following website: www.axis-shield-density-gradient-media.com, click on "Methodology" then "Macromolecules" to open up the "Macromolecules and Macromolecular Complex Index". Other OptiPrep™ Application Sheets on the preparation of self-generated gradients and harvesting of gradients may also be accessed from the top of the Index.

List of research topics
The papers are listed (alphabetically by first author) under the following six broad topic headings:

1. **DNA**
2. **Mitochondrial DNA/RNA**
3. **Proteins, protein oligomerization and protein complex formation**
4. **Ribonucleoproteins and RNA**
5. **Vesicles (laboratory synthesized)**
6. **Therapeutic use of polymers/surfactants**

Each topic may be further divided into more specific research areas

1. DNA
1.1 Binding to polymer particles
Singh, M., Ugozzoli, M., Briones, M., Kazzaz, J., Soenawan, E. and O'Hagan, D. T. (2003) *The effect of CTAB concentration in cationic PLG microparticles on DNA adsorption and in vivo performance* Pharmaceut, Res., **20**, 247-251

1.2 Centrosomes
Zhao, Z., Oh, S., Li, D., Ni, D., Pirooz, S.D., Lee, J-H., Yang, S., Lee, J-Y., Ghozalli, I., Costanzo, V., Stark, J.M. and Liang, C. (2012) *A dual role for UVRAG in maintaining chromosomal stability independent of autophagy* Dev. Cell **22**, 1001–1016

1.3 Chromatin
Magalska, A., Schellhaus, A.K., Moreno-Andrés, D., Zanini, F., Schooley, A., Sachdev, R., Schwarz, H., Madlung, J. and Antonin, W. (2014) *RuvB-like ATPases function in chromatin decondensation at the end of mitosis* Developmental Cell. **31**, 305–318

1.4 Detection by PCR
Periyannan Rajeswaria, P.K., Soderberg, L.M., Yacoub, A., Leijon, M., Andersson Svahna, H. and Joensson, H.N. (2017) *Multiple pathogen biomarker detection using an encoded bead array in droplet PCR* J. Microbiol. Meth., **139**, 22-28

1.5 DNA Encapsulation
Perrault, S.D. and Shih, W.M., (2014) *Virus-inspired membrane encapsulation of DNA nanostructures to achieve in vivo stability* ACS Nano. **8**, 5132–5140
Perrault, S.D. and Shih, W.M. (2017) *Lipid membrane encapsulation of a 3D DNA nano octahedron* in 3D

DNA nanostructure: Methods and Protocols, Methods in Molecular Biology, **1500** (ed. Ke, Y. and Wang, P.) Springer Science+Business Media New York 2017, pp 165-184

1.6 DNA replication

García-Gómez, S., Reyes, A., Martínez-Jiménez, M.I., Chocrón, E.S., Mourón, S., Terrados, G., Powell, C., Salido, E., Méndez, J., Holt, I.J. and Blanco, L. (2013) *PrimPol, an archaic primase/ polymerase operating in human cells* Mol. Cell, 52, 541-553

1.7 Plasmid DNA purification

Rickwood, D. and Patel, N. (1996) *Isolation of plasmid DNA* Mol. Biol. Cell, **7**, 162a

2. Mitochondrial DNA/RNA

2.1 DNA

Gerhold, J.M., Cansiz-Arda, S., Lõhmus, M., Engberg, O., Reyes, A., van Rennes, H., Sanz, A., Holt, I.J., Cooper, H.M. and Spelbrink, J.N. (2015) *Human mitochondrial DNA-protein complexes attach to a cholesterol-rich membrane structure* Sci. Rep., **5**: 15292

Rajala, N., Gerhold, J.M., Martinsson, P., Klymov, A. and Spelbrink, J.N. (2014) *Replication factors transiently associate with mtDNA at the mitochondrial inner membrane to facilitate replication* Nucleic Acids Res., **42**, 952-967

Reyes, A., He, J., Mao, C.C., Bailey, L.J., Di Re, M., Sembongi, H., Kazak, L., Dzionek, K., Holmes, J.B., Cluett, T.J., Harbour, M.E., Fearnley, I.M., Crouch, R.J., Conti, M.A., Adelstein, R.S., Walker, J.E. and Holt, I.J. (2011) *Actin and myosin contribute to mammalian mitochondrial DNA maintenance* Nucleic Acids Res., **39**, 5098-5108

2.2 Mitochondrial isolation for nucleic acid studies

Lee, K-W. and Bogenhagen, D.F. (2016) *Scalable isolation of mammalian mitochondria for nucleic acid and nucleoid analysis* In Mitochondrial DNA: Methods and Protocols, **1351** (ed. McKenzie, M.), Springer Science+Business Media, LLC, pp 67-79

2.3 Mitochondrial ribosome assembly

Lee, K-W., Okot-Kotber, C., LaComb, J.F. and Bogenhagen, D.F. (2013) *Mitochondrial ribosomal RNA (rRNA) methyltransferase family members are positioned to modify nascent rRNA in foci near the mitochondrial DNA nucleoid* J. Biol. Chem., **288**, 31386–31399

Rosa, I.D., Durigon, R., Pearce, S.F., Rorbach, J., Hirst, E.M.A., Vidoni, S., Reyes, A., Brea-Calvo, G., Minczuk, M., Woellhaf, M.W., Herrmann, J.M., Huynen, M.A., Holt, I.J. and Spinazzola, A. (2014) *MPV17L2 is required for ribosome assembly in mitochondria* Nucleic Acids Res., **42**, 8500–8515

2.4 Nucleoids

Bogenhagen, D.F., Martin, D.W. and Koller, A. (2014) *Initial steps in RNA processing and ribosome assembly occur at mitochondrial DNA nucleoids* Cell Metab., **19**, 618–629

Di Re, M., Sembongi, H., He, J., Reyes, A., Yasukawa, T., Martinsson, P., Bailey, L.J., Goffart, S., Boyd-Kirkup, J.D., Wong, T.S., Fersht, A.R., Spelbrink, J.N. and Holt, I.J. (2009) *The accessory subunit of mitochondrial DNA polymerase c determines the DNA content of mitochondrial nucleoids in human cultured cells* Nucleic Acids Res., **37**, 5701–5713

He, J., Mao, C-C., Reyes, A., Sembongi, H., Di Re, M., Granycome, C., Clippingdale, A.B., Fearnley, I.M., Harbour, M., Robinson, A.J., Reichelt, S., Spelbrink, J.N., Wlaker, J.E. and Holt, I.J. (2007) *The AAA$^+$ protein ATAD3 has displacement loop binding properties and is involved in mitochondrial nucleoid organization* J. Cell Biol., **176**, 141-146

He, J., Cooper, H.M., Reyes, A., Di Re, M., Sembongi, H., Litwin, T.R., Gao, J., Neuman, K.C., Fearnley, I.M., Spinazzola, A., Walker, J.E. and Holt, I.J. (2012) *Mitochondrial nucleoid interacting proteins support mitochondrial protein synthesis* Nucleic Acids Res., **40**, 6109–6121

He, J., Cooper, H.M., Reyes, A., Di Re, M., Kazak, L., Wood, S.R., Mao, C.C., Fearnley, I.M., Walker, J.E. and Holt, I.J. (2012) *Human C4orf14 interacts with the mitochondrial nucleoid and is involved in the biogenesis of the small mitochondrial ribosomal subunit* Nucleic Acids Res., **40**, 6097–6108

2.5 Reverse transcriptase

Sharma, N.K., Reyes, A., Green, P., Caron, M.J., Bonini, M.G., Gordon, D.M., Holt, I.J. Hertzog Santos, J. (2012) *Human telomerase acts as a hTR-independent reverse transcriptase in mitochondria* Nucleic Acids Res. **40**, 712-725

2.6 RNA/DNA hybrids

Kazak, L., Reyes, A., He, J., Wood, S.R., Brea-Calvo, G., Holen, T.T. and Holt, I.J. (2013) *A cryptic targeting signal creates a mitochondrial FEN1 isoform with tailed R-loop binding poperties* PLoS One, **8**: e62340

2.7 Translation initiation

Kazak, L., Reyes, A., Duncan, A.L., Rorbach, J., Wood, S.R., Brea-Calvo, G., Gammage, P.A., Robinson, A.J., Minczuk, AM. and Holt, I.J. (2013) *Alternative translation initiation augments the human mitochondrial proteome* Nucleic Acids Res., **41**, 2354–2369

3 Proteins, protein oligomerization and protein complex formation

3.1 Actin-cofilin rods

Ishikawa-Ankerhold, H.C., Daszkiewicz, W., Schleicher, M. and Müller-Taubenberger, A. (2017) *Actin-interacting protein 1 contributes to intranuclear rod assembly in Dictyostelium discoideum* Sci. Rep., **7**: 40310

Minamide, L.S., Maiti, S., Boyle, J.A., Davis, R.C,, Coppinger, J.A., Bao, Y., Huang, T.Y., Yates, J., Bokoch, G.M. and Bamburg, J.R. (2010) *Isolation and characterization of cytoplasmic cofilin-actin rods* J. Biol. Chem., **285**, 5450-5460

3.2 β-Amyloid peptide

3.2.1 Aggregation

Brener, O., Dunkelmann, T., Gremer, L., van Groen, T., Mirecka, E.A., Kadish, I., Willuweit, A., Kutzsche, J., Jürgens, D. et al (2015) *QIAD assay for quantitating a compound's efficacy in elimination of toxic Aβ oligomers* Sci. Rep., **5**: 13222

Frenzel, D., Glück, J.M., Brener, O., Oesterhelt, F., Nagel-Steger, L, and Willbold, D, (2014) *Immobilization of homogeneous monomeric, oligomeric and fibrillar Aβ species for reliable SPR measurements* PLoS One, **9**: e89490

Funke, S.A., van Groen, T., Kadish, I., Bartnik, D., Nagel-Steger, L., Brener, O., Sehl, T., Batra-Safferling, R., Moriscot, C., Schoehn, G., Horn, A.H.C., Müller-Schiffmann, A., Korth, C., Sticht, H. and Willbold, D. (2010) *Oral treatment with the D-enantiomeric peptide D3 improves the pathology and behavior of Alzheimer's disease transgenic mice* ACS Chem. Neurosci., **1**, 639–648

Funke, S.A., Liu, H., Sehl, T., Bartnik, D., Brener, O., Nagel-Steger, L., Wiesehan, K. and Willbold, D. (2012) *Identification and characterization of an Aβ oligomer precipitating peptide that may be useful to explore gene therapeutic approaches to Alzheimer disease* Rejuvenation Res., **15**, 144-147

Klein, A.N., Ziehm, T., Tusche, M., Buitenhuis, J., Bartnik, D., Boeddrich, A., Wiglenda T., Wanker, E., Funke, S.A. et al (2016) *Optimization of the All-D Peptide D3 for Aβ Oligomer Elimination* PloS One, **11**, e015035

Levy, M., Porat, Y., Macharach, E., Shalev, D.E. and Gazit, E. (2008) *Phenolsulfophthalein but not phenolphthalein inhibits amyloid fibril formation: implications for the modulation of amyloid self-assembly* Biochemistry, **47**, 5896-5904

Lockhart, A., Ye, L., Judd, D.B., Merritt, A.T., Lowe, P.N., Morgenstern, J.L., Hong, G., Gee, A.D. and Brown, J. (2005) *Evidence for the presence of three distinct binding sites for the thioflavin T class of Alzheimer's disease PET imaging agents on β-amyloid peptide fibrils* J. Biol. Chem., **280**, 7677-7684

Rudolph, S., Klein, A.N., Tusche, M., Schlosser, C., Elfgen, A., Brener, O., Teunissen, C., Gremer, L., Funke, S.A,, Kutzsche, J. and Willbold, D. (2016) *Competitive mirror image phage display derived peptide modulates amyloid beta aggregation and toxicity* PLoS One, **11**: e0147470

Rzepeck, P., Nagel-Steger, L., Feuerstein, S., Linne, U., Molt, O., Zadmard, R., Aschermann, K., Wehner, M., Schrader, T. and Riesner, D. (2004) *Prevention of Alzheimer's disease-associated Aβ aggregation by rationally designed nonpeptidic β-sheet ligands* J. Biol. Chem., **279**, 47497-47505

Sehlin, D., Englund, H., Simu, B., Karlsson, M., Ingelsson, M., Nikolajeff, F., Lannfelt, L. and Pettersson, F.E. (2012) *Large aggregates are the major soluble Aβ species in AD brain fractionated with density gradient ultracentrifugation* PLoS One, **7**: e32014

Stöhr, J., Watts, J.C., Mensinger, Z.L., Oehler, A., Grillo, S.K., DeArmond, S.J., Prusiner, S.B. and Giles, K. (2012) *Purified and synthetic Alzheimer's amyloid beta (Aβ) prions* Proc. Natl. Acad. Sci. USA, **109**, 11025-11030

Thomaier, M., Gremer, L., Dammers, C., Fabig, J., Neudecker, P. and Willbold, D. (2016) *High-affinity binding of monomeric but not oligomeric amyloid-β to ganglioside GM1 containing nanodiscs* Biochemistry 2016, **55**, 6662−6672

Ward, R.V., Jennings, K. H., Jepras, R., Neville, W., Owen, D. E., Hawkins, J., Christie, G., Dabis, J. B., George, A., Karran, E. H. and Howlett, D. R. (2000) *Fractionation and characterization of oligomeric, protofibrillar and fibrillar forms of β-amyloid peptide* Biochem. J., **348**, 137-144

Ziehm, T., Brener, O., van Groen, T., Kadish, I., Frenzel, D., Tusche, M., Kutzsche, J., Reiß, K., Gremer, L., Nagel-Steger, L. and Willbold, D. (2016) *Increase of positive net charge and conformational rigidity enhances the efficacy of D-enantiomeric peptides designed to eliminate cytotoxic Aβ species* ACS Chem. Neurosci., **7**, 1088-1096

3.2.2 LDL binding

Yeh, F.L., Wang, Y., Tom, I., Gonzalez, L.C. and Sheng, M. (2016) *TREM2 binds to apolipoproteins, including APOE and CLU/APOJ, and thereby facilitates uptake of amyloid-Beta by microglia* Neuron **91**, 328–340

3.2.3 Metal nanoparticle binding

Streich, C., Akkari, L., Decker, C., Bormann, J., Rehbock, C., Muller-Schiffmann, A., Niemeyer, F.C., Nagel-Steger, L. et al (2016) *Characterizing the effect of multivalent conjugates composed of Aβ-specific ligands and metal nanoparticles on neurotoxic fibrillar aggregation* ACS Nano, **10**, 7582-7597

3.3 Apolipoproteins

Fukuhara, T., Wada, M., Nakamura, S., Ono, C., Shiokawa, M. et al (2014) *Amphipathic α-helices in apolipoproteins are crucial to the formation of infectious hepatitis C virus particles* PLoS Pathog., **10**, e1004534

Oliveira, C., Fournier, C., Descamps, V., Morel, V., Scipione, C.A., Romagnuolo, R., Koschinsky, M.L., Boullier, A., Marcelo, P. et al (2017) *Apolipoprotein(a) inhibits hepatitis C virus entry through interaction with infectious particles* Hepatology, **65**, 1851-1864

3.4 Chaperonin purification

Large, A.T., Kovacs, E. and Lund, P.A. (2002) *Properties of the chaperonin complexes from the halophilic archaeon Haloferax volcanii* FEBS Lett., **532**, 309-312

3.5 Circadian clock PERIOD complex

Padmanabhan, K., Robles, M.S., Westerling, T. and Weitz, C.J. (2012) *Feedback regulation of transcriptional termination by the mammalian circadian clock PERIOD complex* Science, **337**, 599-602

3.6 Collagen-bound von Willebrand factor, affinity for factor VIII

Bendetowicz, A.V., Wise, R.J. and Gilbert, G.E. (2000) *Collagen-bound von Willebrand factor has reduced affinity for factor VIII* J. Biol. Chem., **274**, 12300-12307

3.7 Cry protein crystal binding

Nair, M.S., Lee, M.M., Bonnegarde-Bernard, A., Wallace, J.A., Dean, D.H., Ostrowski, M.C., Burry, R.W., Boyaka, P.N. and Chan, M.K. (2015) *Cry protein crystals: a novel platform for protein delivery* PLoS One, **10**: e0127669

3.8 Cytoskeleton: see also "Myosin II, non-muscle, cellular contractile system"

Betschinger, J., Eisenhaber, F. and Knoblich, J.A. (2005) *Phosphorylation-induced autoinhibition regulates the cytoskeletal protein lethal (2) giant larvae* Curr. Biol., **15**, 276-282

Chen, Q., Peto, C.A., Shelton, G.D., Mizisin, A., Sawchenko, P.E. and Schubert, D. (2009) *Loss of modifier of cell adhesion reveals a pathway leading to axonal degeneration* J. Neurosci., **29**, 118-130

Lin, W-H., Nelson, S.E., Hollingsworth, R.J. and Chung, C.Y. (2010) *Functional roles of VASP phosphorylation in the regulation of chemotaxis and osmotic stress response* Cytoskeleton, **67**, 259–271

3.9 *Drosophila* lipophorin-protein interactions

Brankatschk, M. and Eaton, S. (2010) *Lipoprotein particles cross the blood–brain barrier in Drosophila* J. Neurosci., **30**, 10441–10447

Eugster, C., Panáková, D., Mahmoud, A. and Eaton, S. (2007) *Lipoprotein-heparan sulfate interactions in the Hh pathway* Devel. Cell, **13**, 57-71

Palm, W., Swierczynska, M.M., Kumari, V., Ehrhart-Bornstein, M., Bornstein, S.R. and Eaton, S. (2013) *Secretion and signaling activities of lipoprotein-associated hedgehog and non-sterol-modified hedgehog in flies and mammals* PLoS Biol., **11**: e1001505

3.10 Factor VIII binding

Gilbert, G.E., Novakovic, V.A., Shi, J., Rasmussen, J. and Pipe, S.W. (2015) *Platelet binding sites for factor VIII in relation to fibrin and phosphatidylserine* Blood, **126**, 1237-1244

3.11 *Francisella tularensis* secretion sheath

Clemens, D.L., Ge, P., Lee, B-Y., Horwitz, M.A. and Zhou, Z.H. (2015) *Atomic structure of T6SS reveals interlaced array essential to function* Cell, **160**, 940–951

Hedgehog proteins see “3.9 *Drosophila* lipophorin-protein interactions”

3.12 Hep B surface antigen

Czarnota, A., Tyborowska, J., Peszyńska-Sularz, G., Gromadzka, B., Bieńkowska-Szewczyk, K. and Grzyb, K. (2016) *Immunogenicity of Leishmania-derived hepatitis B small surface antigen particles exposing highly conserved E2 epitope of hepatitis C virus* Microb. Cell Fact, **15**: 62

3.13 Hensin

Vijayakumar, S., Peng, H. and Schwartz, G.J. (2013) *Galectin-3 mediates oligomerization of secreted hensin using its carbohydrate-recognition domain*.Am. J. Physiol. Renal Physiol., **305**, F90–F99

3.14 Kinesin-related motor protein

Rashid, D.J., Bononi, J., Tripet, B.P., Hodges, R.S. and Pierce, D.W. (2005) *Monomeric and dimeric states exhibited by the kinesin-related motor protein KIF1A* J. Pept. Res., **65**, 538-549

3.15 Microtubules

MacCormick, M., Moderscheim, T., van der Salm, L.W M., Moore, A., Pryor, S.C., McCaffrey, G. and Grimes, M.L. (2005) *Distinct signaling particles containing ERK/MEK and B-Raf in PC12 cells* Biochem. J., **387**, 155-164

3.16 Molecular weight determination

Basi, N.S. and Rebois, V. (1997) *Rate zonal sedimentation of proteins in one hour or less* Anal. Biochem., **251**, 103-109

Kesimer, M., Makhov, A.M., Griffith, J.D., Verdugo, P. and Sheehan, J.K. (2010) *Unpacking a gel-forming mucin: a view of MUC5B organization after granular release* Am. J. Physiol. Lung Cell Mol. Physiol., **298**, L15–L22

3.17 Mucin

Kesimer, M., Makhov, A.M., Griffith, J.D., Verdugo, P. and Sheehan, J.K. (2010) *Unpacking a gel-forming mucin: a view of MUC5B organization after granular release* Am. J. Physiol. Lung Cell Mol. Physiol., **298**, L15–L22

3.18 Myocilin interactions

Wentz-Hunter, K., Ueda, J. and Yue, B.Y.J.T. (2002) *Protein interactions with myocilin* Invest. Ophthalmol. Vis. Sci., **43**, 176-182

3.19 Myosin II, non-muscle, cellular contractile system

Shutova, M., Yang, C., Vasiliev, J.M. and Svitkina, T. (2012) *Functions of nonmuscle myosin II in assembly of the cellular contractile system* PLoS One, **7**: e40814

3.20 Paromyxovirus $F_{cysteine}$ protein oligomerization

Brindley, M.A., Plattet, P. and Plemper, R.K. (2014) *Efficient replication of a paramyxovirus independent of full zippering of the fusion protein six-helix bundle domain* Proc. Natl. Acad. Sci., USA, **111**, E3795–E3804

3.21 Prion proteins

Aguilar-Calvo, P., Xiao, X., Bett, C., Eraña, H., Soldau, K., Castilla, J., Nilsson, K.P.R., Surewicz, W.K. and Sigurdson, C.J. (2017) *Post-translational modifications in PrP expand the conformational diversity of prions in vivo* Sci. Rep., **7**: 43295

Bett, C., Lawrence, J., Kurt, T.D., Orru, C., Aguilar-Calvo, P., Kincaid, A.E., Surewicz, W.K., Caughey, B., Wu, C.and Sigurdson, C.J. (2017) *Enhanced neuroinvasion by smaller, soluble prions* Acta Neuropath. Comm., **5**: 32

Coleman, B.M., Harrison, C.F., Guo, B., Masters, C.L., Barnham, K.J., Lawson, V.A. and Hill, A.F. (2014) *Pathogenic mutations within the hydrophobic domain of the prion protein lead to the formation of protease-sensitive prion species with increased lethality* J. Virol., **88**, 2690-2703

Herrmann, U.S., Schütz, A.K., Shirani, H., Huang, D., Saban, D., Nuvolone, M., Li, B., Ballmer, B., Åslund, A.K.O. et al (2015) *Structure-based drug design identifies polythiophenes as antiprion compounds Sci. Transl.*

Med., **7**, 299ra123
Laferrière, F., Tixador, P., Moudjou., M., Chapuis, J., Sibille, P., Herzog, L., Reine, F., Jaumain, E., Laude, H., Rezaei, H. and Béringue, V. (2013) *Quaternary structure of pathological prion protein as a determining factor of strain-specific prion replication dynamics* PLoS Pathog., **9**: e1003702
Leske, H., Hornemann, S., Herrmann, U.S., Zhu, C., Dametto, P., Li, B., Laferriere, F., Polymenidou, M., Pelczar, P. et al (2017) *Protease resistance of infectious prions is suppressed by removal of a single atom in the cellular prion protein* PLoS One, **12**: e0170503
Sigurdson, C.J., Joshi-Barr, S., Bett, C., Winson, O., Manco, G., Schwarz, P., Rülicke, T., Nilsson, P.R., Margalith, I., Raeber, A., Peretz, D., Hornemann, S., Wüthrich, K. and Aguzzi, A. (2011) *Spongiform encephalopathy in transgenic mice expressing a point mutation in the β2–α2 lop of the prion protein* J. Neurosci., **31**, 13840 –13847
Sim, V.L. and Caughey, B. (2009) *Ultrastructures and strain comparison of under-glycosylated scrapie prion fibrils* Neurobiol. Aging, **30**, 2031–2042
Terry, C., Wenborn, A., Gros, N., Sells, J., Joiner, S., Hosszu, L.L.P., Tattum, M.H., Panico, S., Clare, D.K., Collinge et al (2016) *Ex vivo mammalian prions are formed of paired double helical prion protein fibrils* Open Biol., 6: 160035
Tixador, P., Herzog, L., Reine, F., Jaumain, E., Chapuis, J., Le Dur, A., Laude, H. and Béringue. V. (2010) *The physical relationship between infectivity and prion protein aggregates is strain-dependent* PLoS Pathogens, **6**: e1000859
Wenborn, A., Terry, C., Gros, N., Joiner, S., D'Castro, L., Panico, S., Sells, J., Cronier, S., Linehan, J.M., Brandner, S., Saibil, H.R., Collinge, J. and Wadsworth, J.D.F. (2015) *A novel and rapid method for obtaining high titre intact prion strains from mammalian brain* Sci. Rep. **5**: 10062

3.22 Serine/threonine kinase complex analysis

Diedrich, B., Rigbolt, K.T.J., Röring, M., Herr, R., Kaeser-Pebernard, S., Gretzmeier,C., Murphy, R.F., Brummer, T. and Dengjel, J. (2017) *Discrete cytosolic macromolecular BRAF complexes exhibit distinct activities and composition* EMBO J., **36**, 647-663

3.23 SNARE proteins

Xu, W., Nathwani, B., Lin, C., Wang, J., Karatekin, E., Pincet, F., Shih, W. and Rothman, J.E. (2016) *A programmable DNA origami platform to organize SNAREs for membrane fusion* J. Am. Chem. Soc. **138**, 4439−4447

3.17 α-Synuclein

Lee, H-J. and Lee, S-J. (2002) *Characterization of cytoplasmic α-synuclein aggregates* J. Biol. Chem., **277**, 48976-48983

3.18 Tau filaments

Khlistunova, I., Biernat, J., Wang, Y., Pickhardt, M., von Bergen, M., Gazova, Z., Mandelkow, E. and Mandelkow, E-M. (2006) *Inducible expression of Tau repeat domain in cell models of tauopathy* J. Biol. Chem., **281**, 1205-1214
Li, T. and Paudel, H.K. (2016) *14-3-3ζ Mediates tau aggregation in human neuroblastoma M17 cells* PLoS One, **11**: e0160635
Mocanu, M-M., Nissen, A., Eckermann, K., Khlistunova, I., Biernat, J., Drexler, D., Petrova, O., Schönin, K., Bujard, H., Mandelkow, E., Zhou, L., Rune, G. and Mandelkow, E-M. (2008) *The potential for β-structure in the repeat domain of Tau protein determines aggregation, synaptic decay, neuronal loss and coassembly with endogenous Tau in inducible mouse models of Tauopathy* J. Neurosci., **16**, 737-748

4 Ribonucleoproteins and RNA

4.1 Micro-RNA

Detzer, A., Engel, C., Wünsche, W. and Sczakiel, G. (2011) *Cell stress is related to re-localization of Argonaute 2 and to decreased RNA interference in human cells* Nucleic Acids Res., **39**, 2727–2741

4.2 Ribosomes (40S, 60S, 80S) and polysomes

Apcher, S., Komarova, A., Daskalogianni, C., Yin, Y., Malbert-Colas, L. and Fåhraeus, R. (2009) *mRNA translation regulation by the Gly-Ala repeat of Epstein-Barr virus nuclear antigen 1* J. Virol., **83**, 1289-1298

4.3 RNA helicase

Padmanabhan, K., Robles, M.S., Westerling, T. and Weitz, C.J. (2012) *Feedback regulation of transcriptional termination by the mammalian circadian clock PERIOD complex* Science, **337**, 599-602

RNAi see “4.1 Micro-RNA”

4.4 RNA granules

Fritzsche, R., Karra, D., Bennett, K.L., Ang, F-y., Heraud-Farlow, J.E., Tolino, M., Doyle, M., Bauer, K.E., Thomas, S., Planyavsky, M., et al (2013) *Interactome of two diverse RNA granules links mRNA localization to translational repression in neurons* Cell Rep., **5**, 1749–1762

RNA polymerase; see “4.3 RNA helicase”

4.5 RNP analysis

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4.8 Virus RNA

4.8.1 Hepatitis B nucleocapsid

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6. Therapeutic use of polymers/surfactants

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