Week 11: Gauge theory of swimming in dense media

	Discussion of outline	Discussion of talk	Your talk
Important dates	before 22.12.2015	before 8.1.2016	15.1.2016

Your seminar talk should roughly cover the following keywords and concepts:

- Non-invariance of path integral measure
- Abelian and non-abelian anomalies
- Relation to indices and topology
- Wess-Zumino consistency conditions

Important aspects that should be emphasized:

-

Remarks:

- It is your task to turn the material related to your topic into a coherent story. This requires a detailed examination and understanding of the subject. Merely giving definitions without motivation and without pointing out the bigger picture is not sufficient.
- You will realize that time is rather limited and that you will need to focus on essentials.
- Personally, I am using 6-7 handwritten A4 pages for a 90 minutes lecture. It is recommended to aim at no more than 4-5 pages for your own presentation (and do not try to gain extra space by writing extra small).
- Please emphasize the physical ideas, not the mathematical formalism. Also avoid detailed calculations (except where they add to the conceptual understanding).
- In the two preparatory meetings you will be able to get feedback and assistance by your supervisor before you give your presentation, both on content and style. In order to maximize the benefit of these meetings it is important that you are well prepared.
- The formulas above are only given for guidance. Please make sure to correct them where necessary and to fill in all the correct signs, prefactors etc.
- It can be assumed (implicitly) that we work on flat Euclidean or Minkowski space, i.e. there is no need to introduce general manifolds.
- We are mainly interested in the non-abelian case but for pedagogical reasons it might be useful to specialize to the abelian case (electromagnetism) occasionally.

References:

- [1] [2] [3] [4]
- Geometry of self-propulsion at low Reynolds number Link
- [5, 6]
- Wikipedia (to get a quick overview)
  - Maxwell's equations in curved spacetime

References

[1] J. E. Avron, O. Gat and O. Kenneth, *Optimal Swimming at Low Reynolds Numbers*, Physical Review Letters **93** (Oct., 2004) 186001 [`math-ph/0404044`].

[2] A. Najafi and R. Golestanian, *Simple swimmer at low Reynolds number: Three linked spheres*, Phys. Rev. **E69** (June, 2004) 062901 [`cond-mat/0402070`].

[3] H. A. Stone and A. D. T. Samuel, *Propulsion of Microorganisms by Surface Distortions*, Physical Review Letters **77** (Nov., 1996) 4102–4104.

[4] L. E. Becker, S. A. Koehler and H. A. Stone, *On self-propulsion of micro-machines at low Reynolds number: Purcell's three-link swimmer*, Journal of Fluid Mechanics **490** (Sept., 2003) 15–35.

[5] A. Shapere and F. Wilczek, *Self-propulsion at low Reynolds number*, Physical Review Letters **58** (May, 1987) 2051–2054.

[6] A. Shapere and F. Wilczek, *Gauge kinematics of deformable bodies*, American Journal of Physics **57** (June, 1989) 514–518.