Paper Evaluation and Summary

Name: Lukas Nies
Paper: Schlamminger et al. (Test of Equivalence Principle using Rotation Torsion Balance, 2008)

- What is the main finding of this paper and why is it important?
  Schlamminger et al. measure an upper limit for the violation of the equivalence principle of $(0.6 \pm 3.1) \times 10^{-15} m/s^2$ on ranges between $1m$ and ∞ using a rotating torsion balance and therefore improve the constraints by an order of magnitude.

- Describe at a high level the basic technique used. Try a series of "steps" here if necessary, if there is a sequence to be followed (like a recipe).

  1. The constant turntable rotation is set to 0.835 mHz.
  2. The angular position of the balance, the temperature and the tilt sensors are recorded every 2.76 seconds.
  3. Adjust length of the two legs of the apparatus by thermal expansion using Peltier elements to avoid tilt.
  4. Change orientation of pendulum daily by 180°.
  5. Change orientation of pendulum biweekly by 90° and use opposite mirrors for data taking.

- Choose an interesting technical aspect of the experiment and describe its relation and importance to the measurement.
  The whole pendulum is similar to the gravitational balance which Schlamminger built earlier in the 2000s. It utilizes a turntable to rotate the pendulum and measures the sinusoidal variation of the twist angle of the fiber induced by different accelerations towards various gravitational sources, eg. the hill side at CENPA, the earth or the galactic center.

- Pick one systematic uncertainty issue that you find interesting and describe its importance and the author's method of addressing it.
  It is interesting how sensitive the pendulum is to small tilts. In order to avoid large tilts Peltier elements control the temperature of two legs of the apparatus. The corrections of the tilt are tiny therefore the thermal expansion and contraction of the legs is sufficient to control the pendulum. Still, uncertainties remain which have to be taken into consideration.

- Where did you get lost? Was there anything you did not understand?:
  How exactly does the experiment depend on the baryon number of the test masses?