**Problems for the 29th IYPT 2016**

1．Invent yourself

Truly random numbers are a very valuable and rare resource. Design, produce, and test a mechanical device for producing random numbers. Analyse to what extent the randomness produced is safe against ering tamp

真实随机数是一种很有价值而且稀有资源。请设计、制造并测试一个可以产生随机数的机械设备并分析随机性抵御恶意攻击的能力。

2．Lagging Pendulum

A pendulum consists of a strong thread and a bob. When the pivot of the pendulum starts moving along a horizontal circumference, the bob starts tracing a circle which can have a smaller radius, under certain conditions. Investigate the motion and stable trajectories of the bob.

滞后的摆

一根坚韧的线和重物可构成一个摆。当摆的,悬挂点在水平面上作圆周运动的时候,在某些情况下重物也可开始做圆周运动，并且半径更小。研究该运动以及重物的稳定轨迹。

3．Acoustic Lens

Fresnel lenses with concentric rings are widely used in optical applications, however a similar principle can be used to focus acoustic waves. Design and produce an acoustic lens and investigate its properties, such as amplification, as a function of relevant parameters.

声学透镜

菲涅耳透镜在光学中很常用，而利用相同的原理可以汇聚声波。请设计并制造一个声学菲涅耳透镜并研究其性质（例如放大率）作为相关参量的函数。

4．Super Ball

Throw a highly elastic ball into the space between two plates. The ball starts bouncing and under some circumstances can even be projected back to you. Investigate the motion of the ball and parameters influencing the motion, including the orientation of the plates.

超级球

向两个平板间的空隙扔一个弹性很好的球。球开始弹，在某些情况下甚至可以弹回到你手上。研究球的轨迹以及影响运动包括平板方向在内的参量。

5．Ultrahydrophobic Water

Set a dish filled with soapy water onto a loudspeaker or other vibrator. When it oscillates, it is possible to hold small droplets on its surface for a long time. Explain and investigate the phenomenon.

不易打湿东西的水

把一个装满肥皂水的盘子放在扬声器或者震动台上，当它震动的时候，它有可能会把一小滴液滴留在上面很长时间，解释并研究这一现象。

6．Electric Honeycomb

Set a vertically oriented steel needle over a horizontal metallic plate. Place some oil onto the plate. If you apply constant high voltage between the needle and the plate, a cell structure appears on the surface of the liquid. Explain and investigate this phenomenon.

电制蜂巢

将一个垂直的金属针放在一个水平的金属盘子上方，在盘子上放一些油，假如你对金属针和盘子施加恒定的高电压，可以产生格状蜂巢结构。请解释并研究这一现象。

7．Hot Water Fountain

Partially fill a Mohr pipette with hot water. Cover the top of the pipette with your thumb. Turn the tip upwards and observe the fountain exiting the tip. Investigate the parameters describing the height of the fountain, and optimize them to get the maximum height.

热水喷泉

用热水部分装填一个莫尔吸量管。用你的大拇指盖住其上端并倒置，可观察到从尖部喷出的水喷泉。请研究决定水喷泉高度的参量，并改变它们以获得喷泉最大的高度。

8．Magnetic Train

Button magnets are attached to both ends of a small cylindrical battery. When placed in a copper coil such that the magnets contact the coil, this "train" starts to move. Explain the phenomenon and investigate how relevant parameters affect the train's speed and power.

磁力小火车

两个扁圆柱形磁铁与一个柱状的电池两端相接，当这个体系放在铜线圈内部且与铜接触的时候，它会开始运动。解释这个现象并且研究相关参量怎么影响火车的速度和功率。

9．Water Waves

Generate a water wave with a vertically oscillating horizontal cylinder. When varying the excitation frequency and/or amplitude, the water seems to drift away from or towards the cylinder. Investigate the phenomenon.

水波

用一个竖直振动的水平圆柱来产生水波，当改变激励频率和振幅的时候水波会看起来流向或背离圆柱。请研究这个现象。

10．Light Rings

Let a liquid jet fall onto a surface. If the contact point is illuminated by a laser beam, rings of light around the jet can be observed (see Figure). Investigate the light rings and determine how they depend on relevant parameters of the whole system.

光环

让一个液体喷向一个平面，当接触点被激光照明的时候，可观测到环绕水柱的光环。研究这个光环和相关参量对整个系统的影响。

11．Rolling on a Disc

If you put a light rolling object (e.g. a ring, a disc, or a sphere) on a horizontal rotating disc, it may start moving without being expelled from the disc. Explain how different types of motion depend on the relevant parameters.

在一个光盘(Disc)上旋转

假如你把一个轻的旋转着的物体放在一个水平旋转的盘子上，它可以不离开盘子地开始运动。解释相关参量如何影响各种不同形式的运动。

12．Van der Pauw Method

It is known that conductivity of a material can be measured independently of the sample shape, as long as the sample has one border (no holes). To what extent can such a method be applied? Investigate and explain such measurements if the sample has holes.

范德堡方法

大家都知道材料的导电率可以独立于样品形状地被测量，只要样品没有孔。这种方法的应用条件是什么?研究并解释这种方法应用于有孔物体的行为。

13．Paper Vice

Take two similar paperback books and interleave a few pages at a time. Push the books together. Hold the two books by their spines and try to pull them apart. Investigate the parameters that set the limits of being able to separate the books.

纸钳子

拿两本类似的平装书然后互相交叉几页，将两本书推在一起。揪住两本书的书脊并尝试将它们分开。研究相关参量对分开书临界拉力大小的影响。

14．Sensitive Flame

A combustible gas (e.g. propane) streams vertically out of a fine nozzle and then through a fine metallic mesh at a distance of about 5 cm. The gas is lit and produces a flame above the mesh. Under some circumstances, this flame reacts very sensitively to sound. Investigate the phenomenon and the relevant parameters.

敏感的火焰

一种可燃性气体（如丙烷）从一个气嘴里垂直的流出然后穿过一个很好的金属网格（二者距离约为5cm左右）。可燃气体被点燃并在金属网格上方形成一个火焰。在某些情况下，这火焰会对声音极其灵敏。研究这个现象和相关参量的影响。

15．Contactless Calliper

Invent and construct an optical device that uses a laser pointer and allows contactless determination of thickness, refractive index, and other properties of a glass sheet.

非接触千分尺

请利用一个激光笔发明并制造一个做的光学仪器，使其可以不接触地测量一个玻璃片的厚度、折射率以及其他属性。

16．Frisbee Vortices

When a vertical plate is partially submerged in water and pulled in a direction normal to the plate, a pair of vortices is created in the surface of the water. Under certain conditions, these vortices travel along the surface for a long distance. Investigate the parameters influencing the motion and stability of these vortices.

飞盘漩涡

当一个垂直的盘子部分沉在水中并作垂直于盘面的移动时，一对水涡会在水面上出现。在一定情况下，这些水涡可以在水面上运动很长一段距离。研究相关参量对水涡运动和稳定性的影响。

17．Crazy Suitcase

When one pulls along a two wheeled suitcase, it can under certain circumstances wobble so strongly from side to side that it can turn over. Investigate this phenomenon. Can one suppress or intensify the effect by varied packing of the luggage?

疯狂的手提箱

当一个人拉着一个两轮的旅行箱的时候，在某些时候旅行箱会很剧烈地左右摆最终倾覆。研究这个现象。一个人可否通过不同的装箱方法来抵制或激化这种现象吗？