Problems for the 32nd IYPT 2019

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1. Invent Yourself

Build a simple motor whose propulsion is based on corona discharge. Investigate how the rotor's motion depends on relevant parameters and optimize your design for maximum speed at a fixed input voltage.

1. 你来发明

构建一个基于电晕放电来推进的简易马达。探究相关参数是如何影响转子运动的，并优化你的设计，从而获得固定输入电压下的最大速度。

2. Aerosol

When water flows through a small aperture, an aerosol may be formed. Investigate the parameters that determine whether an aerosol is formed rather than a jet for example. What are the properties of the aerosol?

2. 气溶胶

当水流经一个小孔时，可能会形成气溶胶。探究参数怎样能形成气溶胶而不是水柱等。气溶胶的特性是什么？

3. Undertone Sound

Allow a tuning fork or another simple oscillator to vibrate against a sheet of paper with a weak contact between them. The frequency of the resulting sound can have a lower frequency than the tuning fork's fundamental frequency. Investigate this phenomenon.

3. 低音

让一个音叉或一个简易的振子靠着轻微接触的纸振动。产生的声音频率会比音叉的基本频率更低，探究此现象。

4. Funnel and Ball

A light ball (e.g. Ping-Pong ball) can be picked up with a funnel by blowing air through it. Explain the phenomenon and investigate the relevant parameters.

4. 漏斗与球

通过向漏斗中吹气，一个轻质小球（如乒乓球）可以被拾起。解释此现象并探究相关的参数。

5. Filling Up a Bottle

When a vertical water jet enters a bottle, sound may be produced, and, as the bottle is filled up, the properties of the sound may change. Investigate how relevant parameters of the system such as speed and dimensions of the jet, size and shape of the bottle or water temperature affect the sound.

5. 填充瓶子

当垂直的水柱进入瓶子时，可能会产生声音，并且，随着瓶子被填充，声音的特性会改变。探究此系统的相关参数，如水柱的速度与尺寸，瓶子的大小与形状或水温等对声音的影响。

6. Hurricane Balls

Two steel balls that are joined together can be spun at incredibly high frequency by first spinning them by hand and then blowing on them through a tube, e.g. a drinking straw. Explain and investigate this phenomenon.

6. 飓风球

通过起始时用手旋转，并使用一根管子（如吸管）朝其吹气，连在一起的两个钢球能以极高频率旋转。解释并探究这一现象。

7. Loud Voices

A simple cone-shaped or horn-shaped object can be used to optimise the transfer of the human voice to a remote listener. Investigate how the resulting acoustic output depends on relevant parameters such as the shape, size, and material of the cone.

7. 响亮的声音

一个简易的圆锥形或牛角形装置可以优化人声向远处收听者的传递。探究锥形装置的形状、大小、材质等相关因素对其声学输出的影响。

8. Sci-Fi Sound

Tapping a helical spring can make a sound like a “laser shot” in a science-fiction movie. Investigate and explain this phenomenon.

8. 科幻之声

敲击螺旋弹簧可以模拟出类似科幻电影中“激光枪”的声音。探究并解释这一现象。

9. Soy Sauce Optics

Using a laser beam passing through a thin layer (about 200 μm) of soy sauce the thermal lens effect can be observed. Investigate this phenomenon.

9. 酱油光学

以一束激光穿透一层薄的酱油（约 200 μm），可以观察到热透镜效应。探究此现象。

10. Suspended Water Wheel

Carefully place a light object, such as a Styrofoam disk, near the edge of a water jet aiming upwards. Under certain conditions, the object will start to spin while being suspended. Investigate this phenomenon and its stability to external perturbations.

10. 悬浮水轮

在靠近水柱的边缘小心地朝上放置一个轻质物体，如聚苯乙烯泡沫塑料盘，在一定条件下，物体将在悬浮的同时开始旋转。探究这一现象以及它对外部扰动的稳定性。

11. Flat Self-Assembly

Put a number of identical hard regular-shaped particles in a flat layer on top of a vibrating plate. Depending on the number of particles per unit area, they may or may not form an ordered crystal-like structure. Investigate the phenomenon.

11. 自组装平面

在平坦的振动板上放置一些完全相同、形状规则的硬质颗粒，根据单位面积上的颗粒数量，它们可能形成或不能形成有序的晶体状结构。探究此现象。

12. Gyroscope Teslameter

A spinning gyroscope made from a conducting, but non-ferromagnetic material slows down when placed in a magnetic field. Investigate how the deceleration depends on relevant parameters.

12.陀螺仪特斯拉计

当放置在磁场中时，一个由非铁磁性导电材料制成的旋转的陀螺仪会减速。探究相关参数对减速的影响。

13. Moiré Thread Counter

When a pattern of closely spaced non-intersecting lines (with transparent gaps in between) is overlaid on a piece of woven fabric, characteristic moiré fringes may be observed. Design an overlay that allows you to measure the thread count of the fabric. Determine the accuracy for simple fabrics (e.g. linen) and investigate if the method is reliable for more complex fabrics (e.g. denim or Oxford cloth).

13.莫尔织物分析镜

当紧密排列的非相交线条（其间有透明间隙）组成的图案覆盖在一块机织物上时，可以观察到独特的莫尔条纹。设计一种使你能够测量织物经纬密度的覆盖物。确定测量简单织物（例如亚麻布）的精确度，并探究此方法能否适用于更复杂的织物（例如牛仔布或牛津布）。

14. Looping Pendulum

Connect two loads, one heavy and one light, with a string over a horizontal rod and lift up the heavy load by pulling down the light one. Release the light load and it will sweep around the rod, keeping the heavy load from falling to the ground. Investigate this phenomenon.

14.循环摆

将一重一轻两个负载通过水平杆上的一根绳子相连，并下拉轻负载以吊起重负载。释放轻负载，它将围着杆扫动，从而阻止重负载落到地面。探究此现象。

15. Newton’s Cradle

The oscillations of a Newton's cradle will gradually decay until the spheres come to rest. Investigate how the rate of decay of a Newton's cradle depends on relevant parameters such as the number, material, and alignment of the spheres.

15.牛顿摆

牛顿摆的振动会逐渐衰减，直到摆球静止。探究相关参数，例如摆球的数量、材质和排列方式对牛顿摆衰减速率的影响。

16. Sinking Bubbles

When a container of liquid (e.g. water) oscillates vertically, it is possible that bubbles in the liquid move downwards instead of rising. Investigate this phenomenon.

16. 下沉的气泡

当一个盛有液体（例如水）的容器垂直振动时，液体中的气泡可能不会上升，而是向下运动。探究此现象。

17. Popsicle Chain Reaction

Wooden popsicle sticks can be joined together by slightly bending each of them so that they interlock in a so-called “cobra weave” chain. When such a chain has one of its ends released, the sticks rapidly dislodge, and a wave front travels along the chain. Investigate the phenomenon.

17.雪糕棒连锁反应

通过轻微的弯曲，可将木制的雪糕棒连接在一起，以实现在被称作“眼镜蛇式编织”形状的链条中连锁。当这种链条的一端被释放时，木棒迅速脱落，且波阵面沿着链条传播。探究这一现象。

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