郝智涵：

题目一：咕咚瓶的节奏

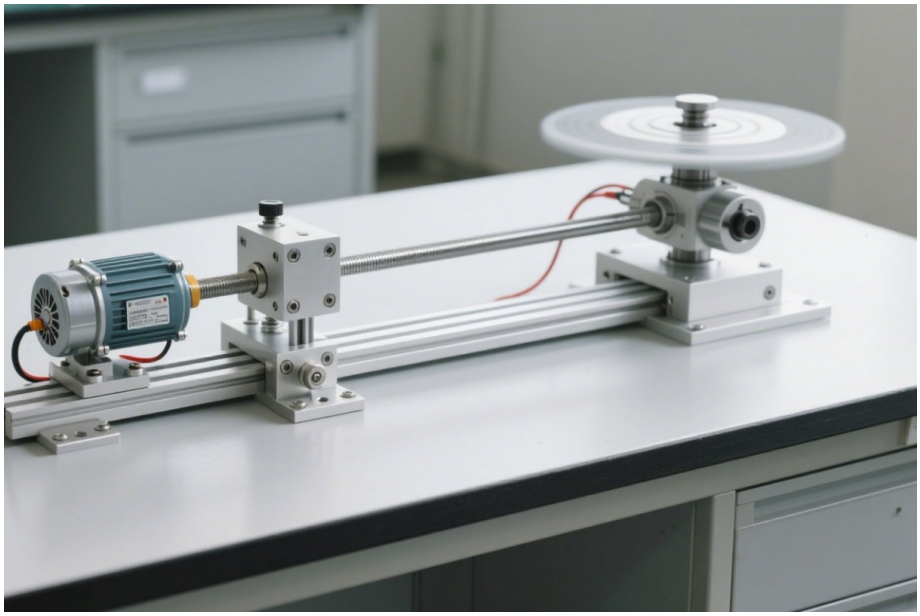
当一个装满液体的啤酒瓶被倒置并允许液体流出时，会观察到周期性的“咕咚”声。该声音的间隔和频率与瓶体结构（如瓶颈尺寸、瓶身几何形状）、液体的物理性质以及液柱压力等因素有关。请研究这一现象的产生机制，并探究声音频率与相关参数之间的定量关系。

Intermittent Fluid-induced Acoustic Emission in an Inverted Bottle
When a liquid-filled beer bottle is inverted and drained, a periodic "gurgling" sound is produced. The intervals and frequency of this sound are related to the bottle's structure (e.g., neck dimensions, body geometry), the physical properties of the liquid, and the hydrostatic pressure. Investigate the mechanism behind this phenomenon and establish quantitative relationships between the acoustic frequency and relevant parameters.

题目二：摇摆与旋转的魔术

在一个往复运动机构上铰接一个刚性杆，当机构以特定形式往复运动时，该杆可产生绕轴心的周期性旋转。研究实现这种运动转换的条件，包括机构运动形式、杆件几何参数及动力学约束，并分析运动的稳定性与能量传递效率。

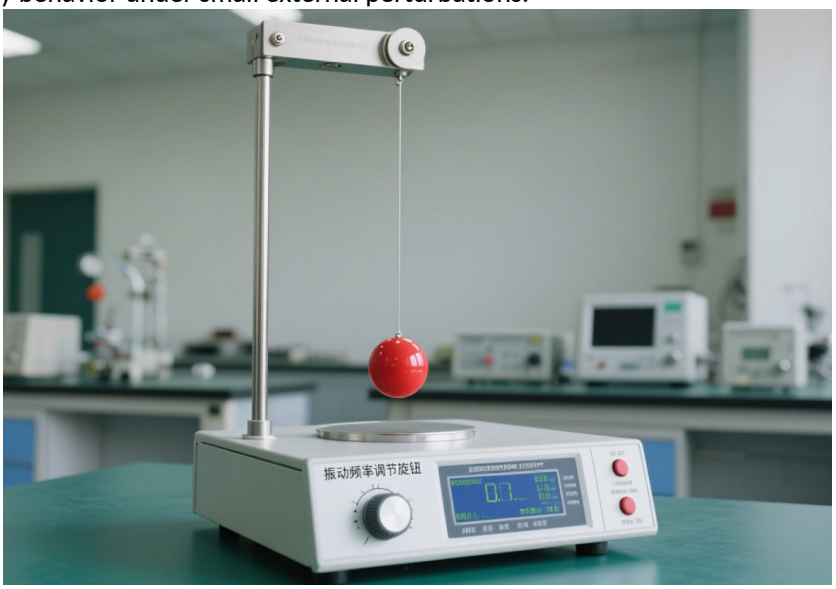
Reciprocating-to-Rotational Motion Conversion in a Linked Rigid Body System
A rigid rod is hinged to a reciprocating mechanism. Under certain reciprocating motions, the rod exhibits periodic rotation about a pivot. Investigate the conditions required for this motion conversion, including the kinematic profile of the mechanism, geometric parameters of the rod, and dynamic constraints. Analyze the stability of the motion and energy transfer efficiency.



题目三：倒立摆的平衡艺术

卡里查摆系统由竖直方向上的往复机构与铰接于其上的刚性杆构成。在特定往复运动条件下，杆可稳定于竖直上端点位置。研究该稳定状态的产生机制，确定临界参数范围，并探讨系统在受到微小外力扰动下的稳定性及恢复行为。

Inverted Stabilization and Perturbation Response in a Kapitza Pendulum System
A Kapitza pendulum consists of a rigid rod attached to a vertically oscillating pivot. Under specific driving conditions, the rod can stabilize in the inverted vertical position. Investigate the mechanism of this stabilization, determine the critical parameter ranges, and analyze the system's stability and recovery behavior under small external perturbations.



宫宇成：

“水滴音阶”

从一定高度处滴落水滴，水滴撞击水面后会发出“滴水声”。探究滴水声的特性如何取决于相关物理量。

When water drops fall from a certain height and hit the water surface, a "dripping sound" is produced. Investigate how the characteristics of the dripping sound depend on relevant physical quantities.

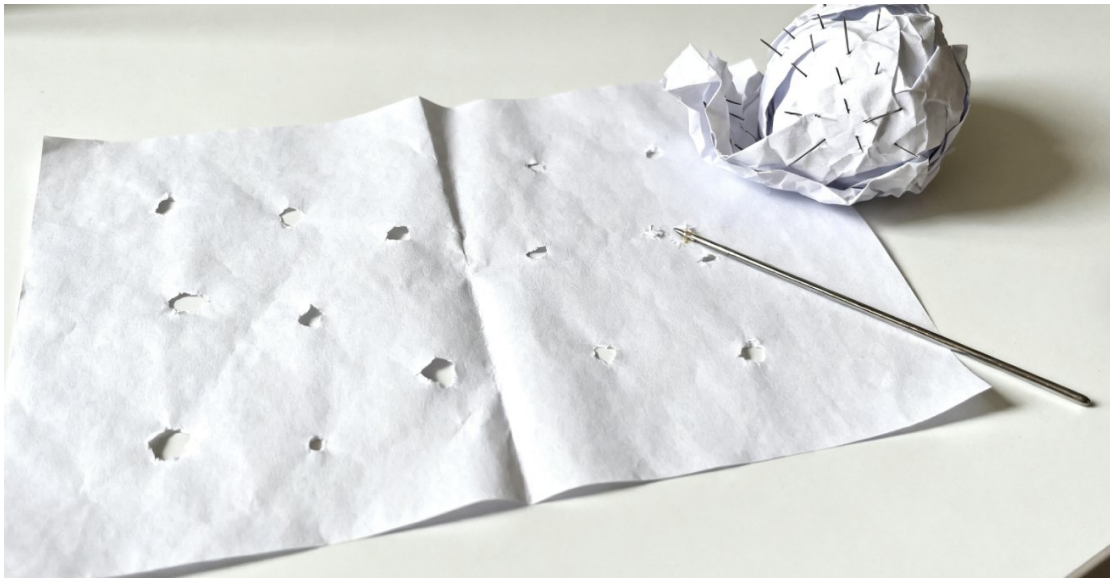
杜浩睿：

自制滑翔机

设计并制作一个无动力滑翔机（不限于纸质，可使用泡沫等轻质材料）。在给定的一组初始条件--固定的发射高度、发射角度和初速度下，对滑翔机进行发射。设计并优化滑翔机的气动模型，以实现最远的飞行距离。飞行距离被定义为飞机在地面的投影距离，该距离需沿初速度在地面上的投影方向计算。

Design and build a non-powered glider (not limited to paper; lightweight materials such as foam are allowed). Launch the glider under a given set of initial conditions—fixed launch height, launch angle, and initial velocity. Design and optimize the glider's aerodynamic model to achieve the farthest flight distance. The flight distance is defined as the projection of the flight path onto the ground, measured along the projection direction of the initial velocity onto the ground.

蔡云汉：



Piercing space

A sheet of thin paper is crumpled into a ball and pierced with a long needle. When unfolded, the sheet will have a certain number of holes. What factors affect the observed number and positions of holes?

穿透空间

将一张薄纸揉成纸团，用长针刺穿。展开后，纸张上会出现若干孔洞。哪些因素会影响观察到的孔洞数量和位置？

车俊逸：

蜗牛球

未装满水的瓶子和装满水的瓶子从斜坡上滚下，速度却大不相同。通过改变内部成分（如加蜂蜜或钢珠等），可以设计出一种像《名侦探柯南》中一样的从斜坡上滚落速度最慢的"蜗牛球"或"蜗牛柱"。

A bottle not full of water and a bottle full of water roll down a slope at significantly different speeds. By changing the internal components (such as adding honey or steel balls), you can design a "snail ball" or "snail column" that rolls down the slope at the slowest speed—just like the one in Detective Conan.

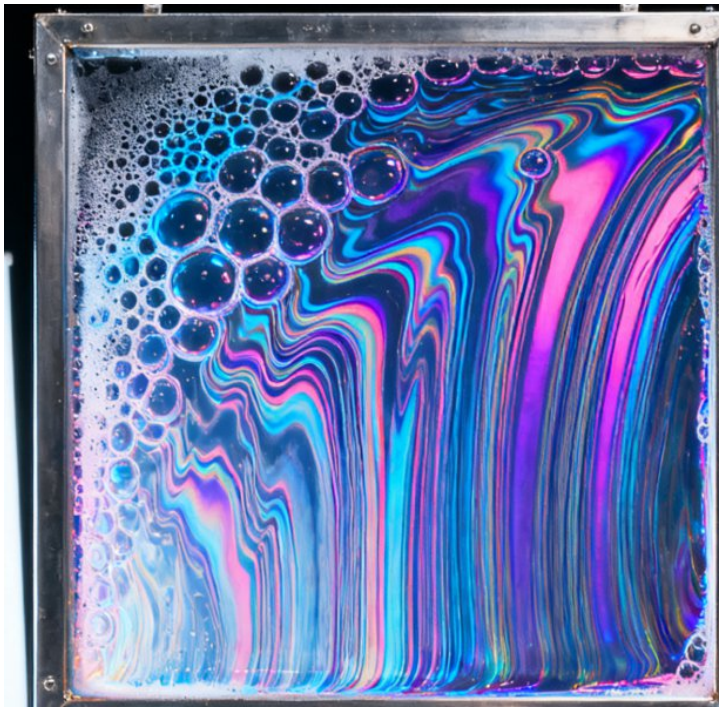
丁皓：

无法装满的容器

当水流从水龙头落入一个口径较小的容器时，观察到一个反直觉的现象：即使持续注水，容器也可能无法被装满。研究表明，这与水流夹带的空气以及容器内的气压动态平衡有关。请系统研究此现象，探究容器口径、水流速度、落水高度等参数如何影响容器内的最终水位，并建立临界条件模型。

The Unfillable Container

A counterintuitive phenomenon is observed when a stream of water from a tap falls into a container with a small opening: the container may not fill up completely, regardless of the duration of water flow. Research suggests this is related to air entrainment by the water stream and the dynamic pressure balance within the container. Systematically investigate this phenomenon, explore how parameters such as container orifice size, flow rate, and fall height affect the final water level, and establish a model for the critical conditions.



热幕上的彩绘

在一块竖直悬挂的肥皂膜旁放置一个稳定的热源，可以观察到膜上自发形成复杂且不断演变的彩色对流图案。这些图案源于热诱导的马兰戈尼对流和薄膜干涉效应的耦合。研究该系统的形成机制，分析热源温度、距离以及肥皂膜溶液性质等参数对图案动态、稳定性和颜色的影响。

The Painted Thermal Curtain

When a stable heat source is placed beside a vertically suspended soap film, complex and evolving colorful convection patterns spontaneously form on the film. These patterns arise from the coupling of thermally induced Marangoni convection and thin-film interference effects. Investigate the formation mechanisms of this system and analyze how parameters such as heat source temperature, distance, and soap solution properties influence the pattern dynamics, stability, and coloration.

谢子霄：

声印（Sonic Membranes）

将一张可调张力的弹性薄膜（例如乳胶膜或薄塑料膜）固定在圆环或方形框架上，用可变频声源垂直激励膜面。研究稳态振动图样（驻波与固有模态）如何随激励频率、膜张力与激励强度变化，定量测量幅值分布、频谱与模式稳定性，重点考察从线性模态到非线性响应（频率混合、模式跳变与空间局部化振动）的转变机理，并分析边界条件与空气耦合对模式选择和能量分配的影响。

Fix a tension-adjustable elastic film (e.g. latex or thin plastic) on a circular or rectangular frame and excite it normal to the surface with a variable-frequency acoustic source. Investigate how the steady-state vibration patterns (standing waves and modal shapes) depend on drive frequency, film tension and excitation amplitude; quantitatively measure amplitude distributions, spectra and pattern stability. In particular, study the transition from linear modal response to nonlinear behaviour (frequency mixing, mode switching and spatial localization), and analyse the role of boundary conditions and air–film coupling in pattern selection and energy partitioning.

润坡蠕动（Sticky Slopes） — Creep and Failure of Wet Granular Slopes

研究湿润颗粒堆在坡面上的稳定角、缓慢蠕动与崩塌模式。系统测定临界倾角与蠕动速率随粒径、液体含量（毛细桥量）、润湿性与外加微振动的依赖关系，构建从毛细粘结/接触力到宏观失稳的半定量模型，并检验是否存在从延展性蠕动到脆性突发失稳的转变条件。

Investigate the angle of repose, slow creep and failure modes of wet granular slopes. Systematically determine how the critical angle and creep rate depend on particle size, liquid content (capillary bridges), wettability and external micro-vibrations; construct a semi-quantitative model linking capillary cohesion/contact forces to macroscopic instability and test for transitions from ductile creep to brittle collapse.

自发车道（Spontaneous Lanes） — Lane Formation in Counter-Directed Flows

研究两股反向流在狭窄通道中自发形成分离车道的条件。通过可控实验（如小车/受控颗粒阵列）与简单微观相互作用规则（避让、视距、反应延迟），量化形成阈值、车道数与稳定性，尝试从微观规则导出或验证宏观连续化描述以解释分层机制与参数边界。

Investigate the conditions under which two opposing streams form segregated lanes in a narrow corridor. Using controlled experiments (e.g. small vehicles/controlled particle arrays) and simple microscopic interaction rules (avoidance, sight distance, reaction delay), quantify formation thresholds, lane number and stability, and attempt to derive or validate a macroscopic continuum description explaining the segregation mechanism and parameter boundaries.

（通俗解释：两群向相反方向行走的人在狭窄通道中常会自然形成分开的“车道”以减少碰撞。相似现象也出现在粒子输运。如何从微观规则预测宏观分层/车道形成？）