2015年国际物理学家锦标赛（IPT）中国代表队选拔赛通知

国际物理学家锦标赛（International Physicists' Tournament ，简称IPT）于2009年由乌克兰发起，旨在培养学生分析和解决物理问题的能力。比赛以英文为工作语言，每个题目都是一个独立的科研小课题，要求以学术报告形式展示研究结果，通过正、评论等多种角色进行讨论、交流与竞技，是个十分优秀的大学生国际交流平台。 IPT2015于2015年4月，在波兰华沙大学举办。南开大学将作为中国参赛队准备赴波兰参加本次比赛，特发此通知选拔招募队员。

**IPT与每年中国大学生学术竞赛（CUPT）的题目和规则不相同.**

详细情况见维基百科： <https://en.wikipedia.org/wiki/International_Physicists%27_Tournament>

IPT2015竞赛组织方网址: http://ipt.strikingly.com/

参赛队由六名学生及2名领队兼裁判组成。**参赛学生为本科生或者硕士培养计划的研究生。**要求参加选拔的学生具备物理知识扎实，实验能力强，英语表达好，对IPT其中的一道题目提出自己的见解和实验方案以及初步实验结果。

二、 报名方式

符合报名条件的学生请填写报名表，打印后手写签名，同时将IPT2015的一道题目准备情况介绍（PPT格式）发送至邮箱:lisaliu@nankai.edu.cn。材料提交的时间为10月15日8:00\_18:00。报名表可交至综合实验楼A202，联系人：刘丽飒，联系电话23494830

三、 选拔流程

根据报名和材料提交情况，由南开大学物理学院以及物理思辨社统一组织筛选。学院将在10月底前组织老师对通过材料初选的报名者进行面试工作。

四、 竞赛费用

选拔前的报名人员的实验费用由个人支付，如有大额支出可向刘丽飒老师申请器材支持。最终确定参赛队员的备赛前、备赛中以及参赛的费用均由物理学院承担。

五、 报名表：

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 信息 | 姓 名 |  | 性 别 |  | 年 级 |  | 专 业 |  |
| **E-mail** |  | 手机号 |  |
| 报名者知识背景、创新经历、特长、兴趣、取得成果： |
| 签名： 填表日期：  |

附：IPT2015题目与参考中文译文

IPT 2015 Problems

**1. Thermal clock**

Construct the most precise clock that uses a periodic change of temperature of one of its components as a timer. It should use a continuous heat supply and the working substance may be air or water in any form. The device should not have any moving parts (such as pistons or gears).

**2. Vortex cannon**

Vortex cannons can be easily constructed to create smoke/air rings:

<http://www.youtube.com/watch?v=4b2SV3ASUxY> .
What factors influence the range of the rings? How can this range be maximized?

**3. Wet rocks**

It’s well known that many materials (asphalt, cloth, etc.) change their color on wetting. Describe the processes that lead to such a spectrum change for reflected (or transmitted) light. What properties of the material/liquid influence the process and how?

**4. Tuning fork connection**

Develop a setup for data transmission that uses tuning forks as the transmitter and receiver. The tuning forks should be 440 Hz and may include a resonator and small features to change the frequency. How does the maximum data transmission rate depend on the distance between the forks?

**5. Ping-Pong-Panda**

Sometimes Ping-Pong players “chop” the ball in such a way that it changes direction after hitting the table. Estimate the maximum angle of deviation from the ball’s initial direction (i.e. a plane formed by the normal vector of the table and the velocity of the ball before bouncing) and determine what parameters it depends on. How will the answer change for a super ball?

<http://youtu.be/ppT6wbep7AM>

**6. “Superconductivity”**

There exists a phenomenon where neodymium magnets levitate a round graphite plate at room temperature. Explain the effect. Propose a setup with minimal mass that will stably levitate a 1 g graphite plate. [http://youtu.be/K9lpykPcdS0](http://youtu.be/K9lpykPcdS0#_blank)

**7. Entropiemeter**

Propose a setup to directly measure the entropy (or its linear function with coefficients that do not depend on system state) of a system containing a small volume of a) gas (air), b) liquid (water), c) a solid body with a lattice (iron). The setup should work in conditions not extreme for humans.

**8. Jalousies**

A strong air flow passing though jalousies make them oscillate and produce a specific sound (it’s most often seen in horizontal models). Describe this phenomenon and explain the dependence of the oscillation characteristics on the setup parameters. Obtain the threshold (conditions) at which the oscillations start.

**9. Reactive balloon**

An untied balloon, if released, flies along a complicated spiral trajectory. Why does the balloon spin? What does the spiral period depend upon?

**10. “Vegetable cell”**

Some fruits and vegetables can be used as natural souce of electricity. Is it possible to use this property to determine the vegetable ‘readiness’ when being cooked (boiled/fried)?

**11. Lifter**

Construct the most powerful Lifter possible with the surface area below 0.1 m2.<http://jnaudin.free.fr/lifters/howto.htm>

**12. The angry salt**

When sea salt is heated in frying pan it begins hissing and jumping. Explain this phenomenon. Find the relationship between the distribution of salt grains and the jumping height.

**13. Trampoline dad**

When two people bounce on a trampoline it is possible for them to time their bounces such that most of the energy is transferred to only one person. Determine what influences the maximum bounce height of a person under these circumstances.

**14. Earth charge**

Measure the electric charge of the Earth. Explain your experimental procedure in detail, prove its correctness and estimate its error. Ideal solution - measure the charge using several different approaches, calculate it and show that results coincide. Does your measured charge depend on time? If yes - how?

**15. Curly ribbon**

Why do ribbons curl after being scored with a blade? What is the typical size of the curl? How do the ribbons parameters influence the effect?

**16. Prince Rupert’s drop**

Prince Rupert’s drops are objects obtained by dropping hot glass into water. They can be destroyed by breaking off a piece of the thin tail. The destruction process moves from the tail to the opposite side with some speed.

Calculate this speed and investigate how the speed depends on the environmental conditions during the drop formation and the properties of the glass. **Be careful carrying out the experiments for this problem!**

**17. Beer battle**

If you tap a beer bottle with the bottom of another one, the beer will spill out like a geyser. Explain this phenomenon and estimate the amount of liquid that can be removed from the bottle via this method. What are the important parameters for this effect to occur?

Many thanks to all the people who contributed to the problem list and helped with the problem selection!

In case of any questions do not hesitate to contact Vladimir Vanovskiy, the IPT Secretary
ipt.ibox@gmail.com

1. 热钟

试用一个持续热源建一个尽可能精确的时钟，这个时钟一个区域的温度是在周期性变化的。其中的工作物质可以用空气或者任何形式的水。装置不能有任何机械运动的部分（比如活塞或齿轮）。

2. 烟圈炮
烟圈炮很好做，它可以制造出烟/空气环。
http://www.youtube.com/watch?v=4b2SV3ASUxY .影响环作用范围的因素是什么？怎样让作用范围最大？

3. 湿石头

众所周知，许多材料（沥青，布料，等等）会在潮湿的时候改变颜色。描述发生这种反射光（或者可能是透射光）光谱改变的过程。材料或者液体的什么性质影响了这个过程，是怎样影响的？

4. 音叉联系
将音叉作为发送器和接收器设计一个数据传输装置。音叉频率为440Hz，可以含有共振器和用以改变频率的小部件。解释数据的最大传送速率与音叉间距离的依赖关系？

5. 乒乓 panda

有时候乒乓选手会用“削球”的方式来改变击中球台后球的方向。预测球的最大偏转角（以桌子为平面作法向量时，碰撞前的球速度方向为初始方向），并确定这个角度取决于哪些参数。对于一个超级球答案又是什么？

6.“超导”
室温下，一个石墨圆盘会悬浮在钕磁铁上。解释这个效应。构建一个使1g石墨盘悬浮的质量最小的装置。

7. 测熵计

构建可直接测量一个系统熵（或者它的线性函数，其中系数与系统状态无关）的装置。要求这个系统包含着小体积的a）气体（空气），b）液体（水），c）与晶相固体（铁）。所设计的装置需工作在人体能承受的环境下。

8. 百叶窗
当强气流通过百叶窗时，百叶窗振荡并会发出特别的声音（这在横模中十分常见）。描述这个现象，解释振荡特征与装置参数的依赖关系。得出发生振荡的阈值（条件）。

9. 被释放的气球
如果释放一个没有打结的气球，它将按一个复杂的螺旋轨道飞行。为什么气球会旋转？螺旋的周期取决于什么？

10. “蔬菜电池”
一些水果和蔬菜可以用作自然电流源。当我们在烹饪（煮/炒）这些蔬菜时，有可能用这个效应去测定蔬菜是否做好了吗？

11. 飘升机

构造表面积低于0.1平方米的最强大的飘升机。

12. 爆盐
当海盐在平底锅里加热时会一边发出嘶嘶的声音一边跳起。解释这个现象。研究盐粒分布情况与跳跃高度的关系。

13. 蹦床老爸
当两个人在一个蹦床上跳跃时，他们可以通过安排各自的跳跃时间来将大部分能量转移到一个人身上。确定这种情况下影响一个人最大弹跳高度的因素有哪些。

14. 地球电量

测定地球的电量。详述你的实验步骤，证明结果的正确性并估计误差。理想的解答：用不同的方法来测量电量，计算并证明这些结果一致。你测量的结果会因为测量时间的不同而发生变化吗？如果是的话，是怎么变化的？

15. 卷曲的丝带
为什是么用刀片展开一个丝带后它会弯曲？典型的卷曲尺寸是多大？丝带的参数如何影响这个效应？

16. 鲁伯特王子之泪

鲁伯特王子之泪是指通过将热玻璃滴入水中得到的物体。当截断该物体细细尾部的一部分，破坏作用将一定速度传导到另一端。计算这个速度，研究这一速度与获取泪滴时周围环境和玻璃性质的关系。**此题实验时注意安全。**

17. 啤酒对战

如果你用一个啤酒瓶的底部敲打另一个啤酒瓶，啤酒可能会像喷泉一样飞溅出来。解释该现象并估计用这个方法从瓶中喷出的液体量。影响该现象发生的重要参数是什么？