

X 射线基本知识

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伦琴(W.C.Rontgen, 1845–1923)

德国物理学家

X射线又叫伦琴射线。

1895年秋，德国乌茨堡大学的物理学家伦琴Roentgen在其实验室研究阴极射线时，偶然发现了一种能穿过固体物质，使荧光质发光和胶片感光的射线，他称之为X射线。

伦琴夫人的手

——世界上第一张X射线透视片



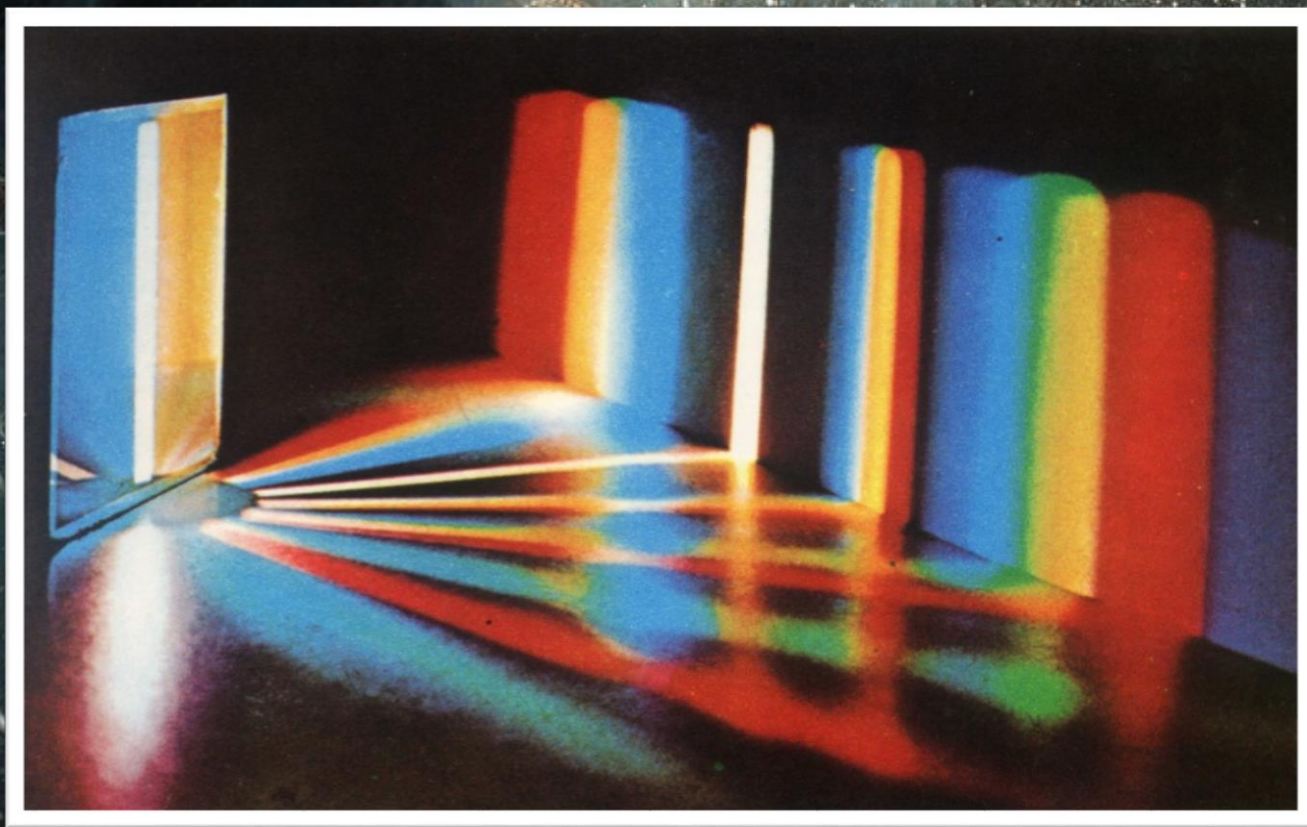
当年伦琴的实验室



获得了诺贝尔奖

X射线的本质



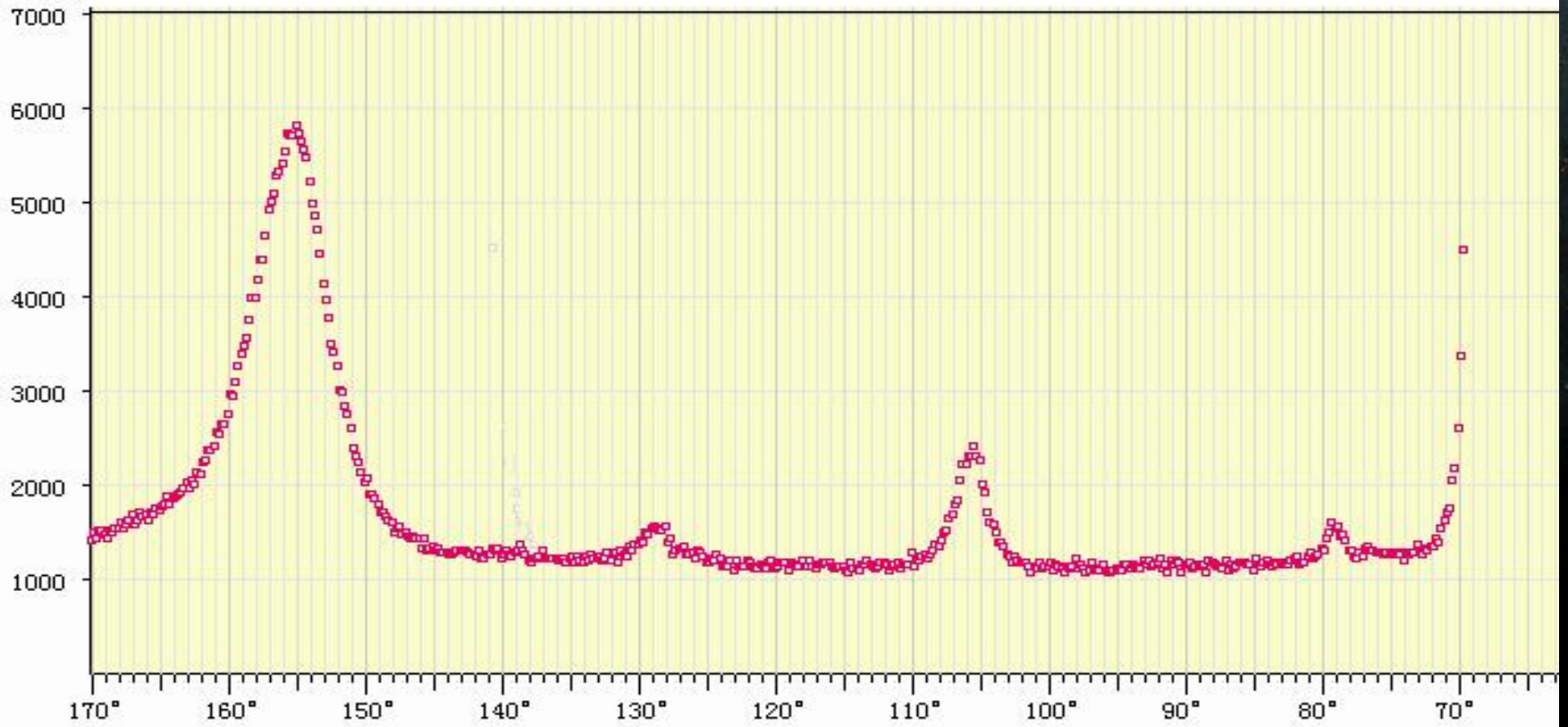


可见光衍射图

X射线在晶体上衍射现象

——X射线电磁波本质的证明

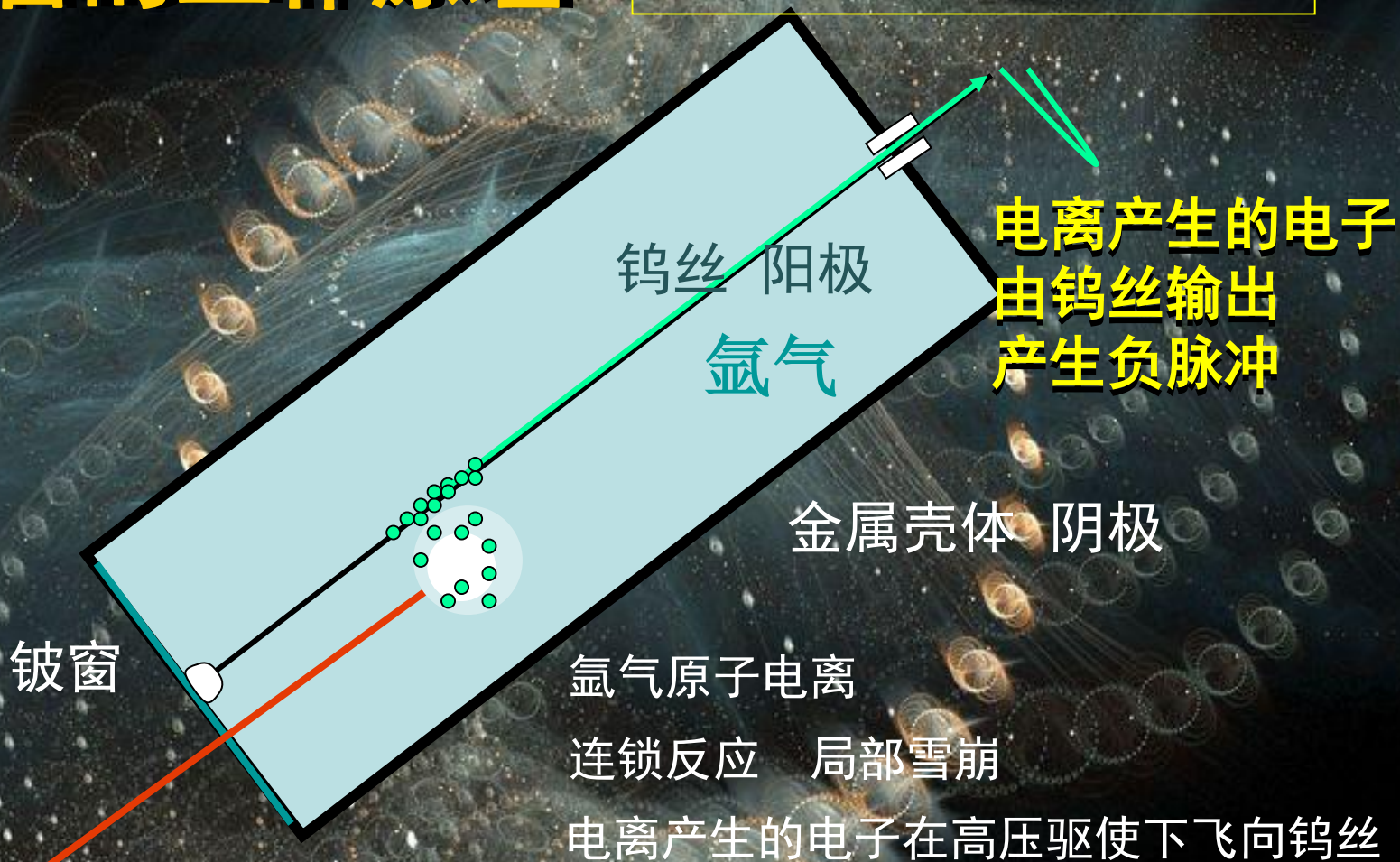
计数



2θ 扫描范围

计数管的工作原理

——X射线粒子性的证明



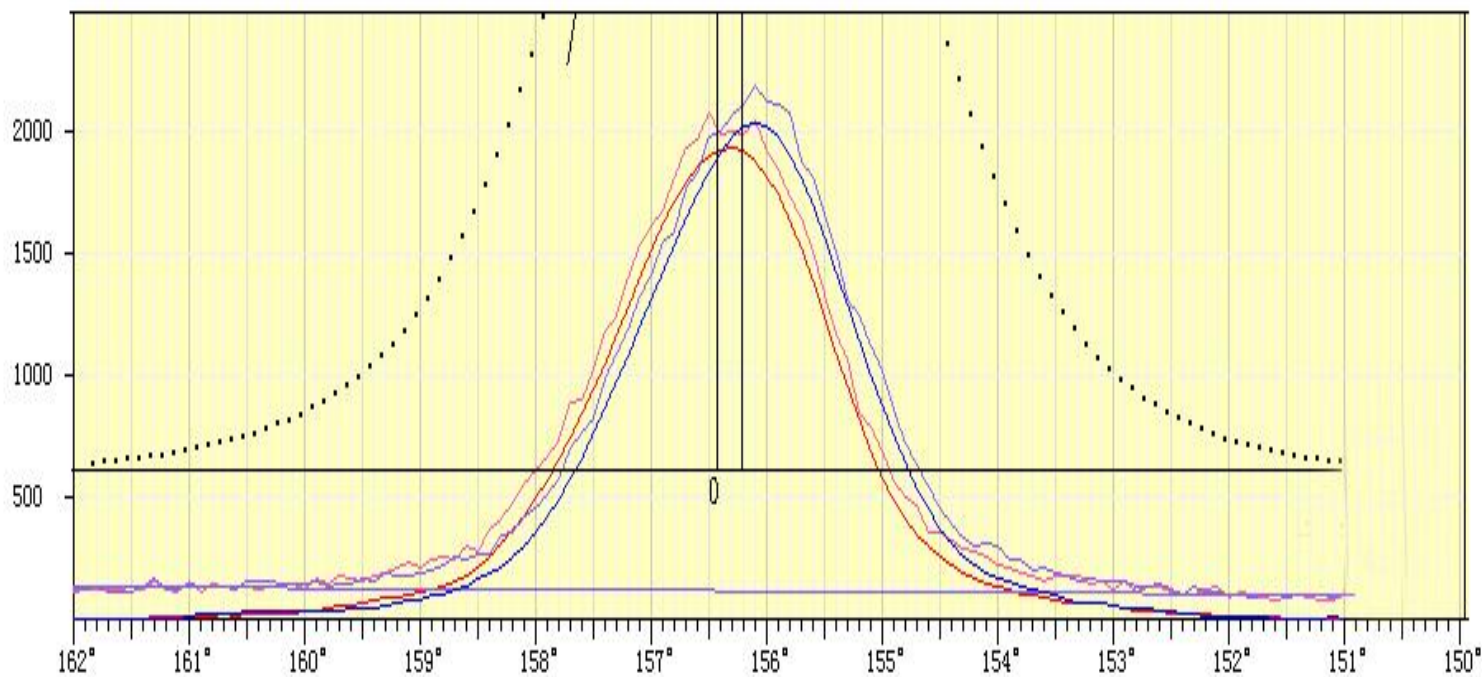
X光子

这样，一个X光子进入计数管，便产生一个脉冲。

计数

——规定时间内进入计数管的X光子数

计数

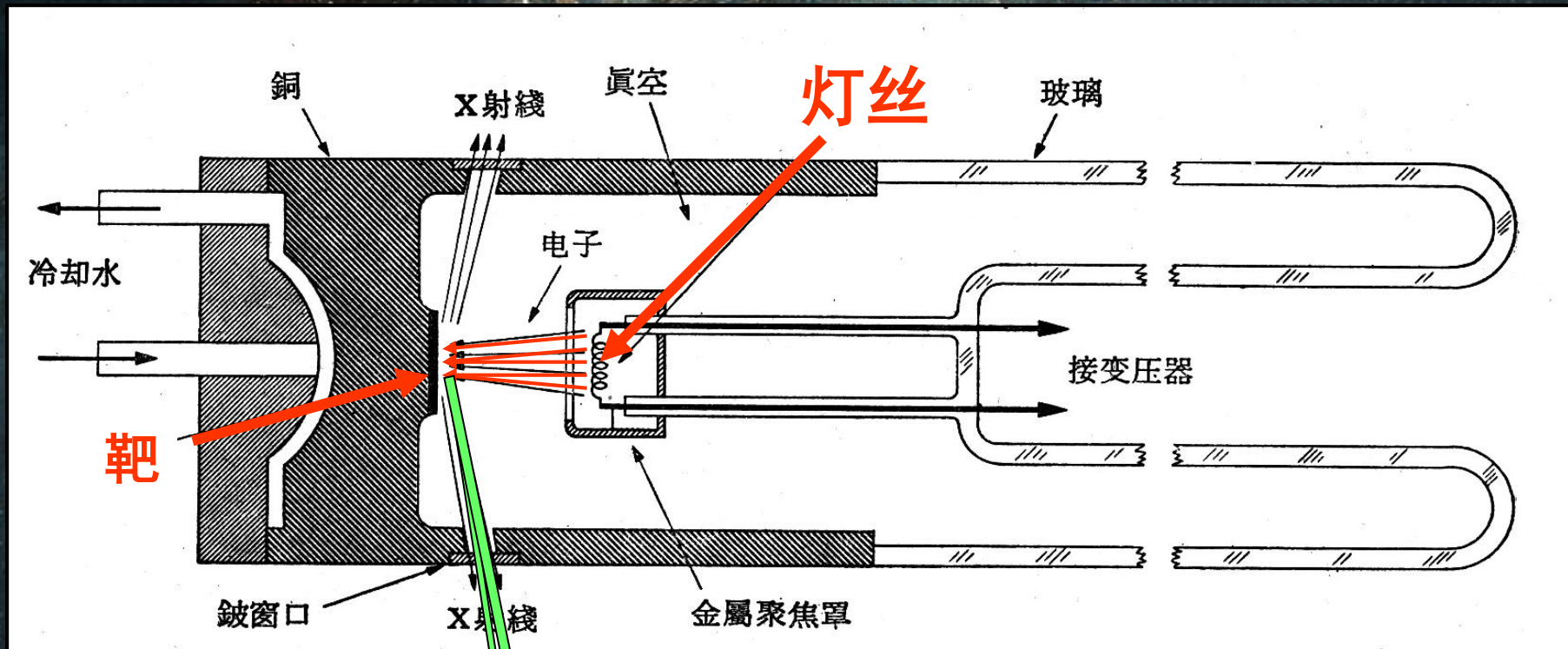


2θ 扫描范围

X射线的产生

The background is a dark, abstract space filled with glowing particles and light trails. There are several prominent, glowing, circular or ring-like structures that appear to be made of small, bright dots or particles. These structures are arranged in a somewhat circular pattern, with some appearing to be in motion or creating a sense of depth. The overall color palette is dark, with shades of blue, green, and yellow/gold, giving it a futuristic or scientific feel.

我们这里讲的是**韧致辐射**，它是在X射线管里产生的。



X射线

X射线管结构示意图

X射线的光谱

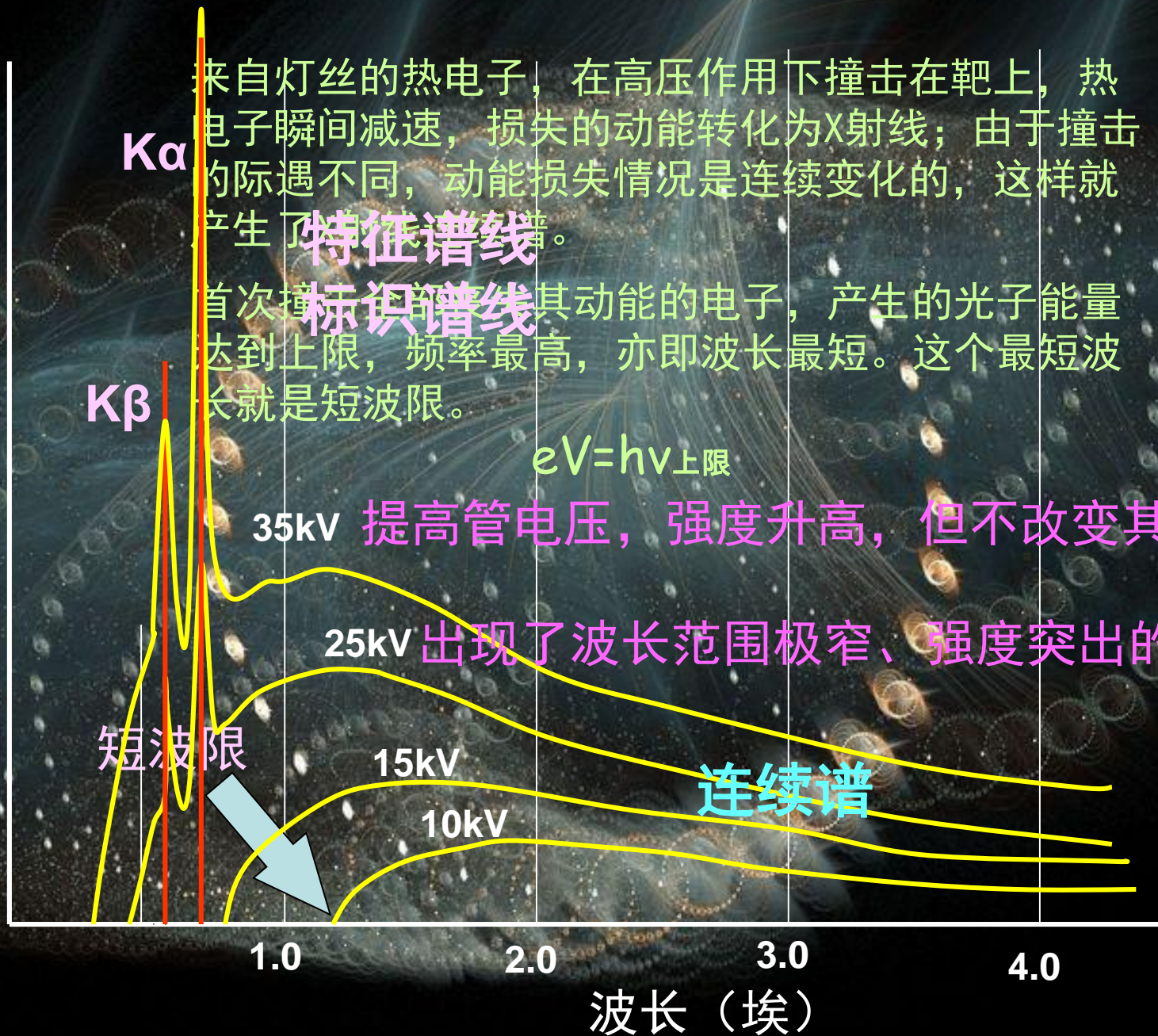
——强度沿波长的分布

X射线

连续谱线

特征谱线（标识谱线）

X射线的强度（相对单位）



来自灯丝的热电子，在高压作用下撞击在靶上，热电子瞬间减速，损失的动能转化为X射线；由于撞击的际遇不同，动能损失情况是连续变化的，这样就产生了连续谱。

特征谱线

首次撞击其动能的电子，产生的光子能量达到上限，频率最高，亦即波长最短。这个最短波长就是短波限。

$$eV = h\nu_{\text{上限}}$$

35kV 提高管电压，强度升高，但不改变其波长

25kV 出现了波长范围极窄、强度突出的谱线

短波限

15kV

10kV

连续谱

1.0

2.0

3.0

4.0

波长（埃）

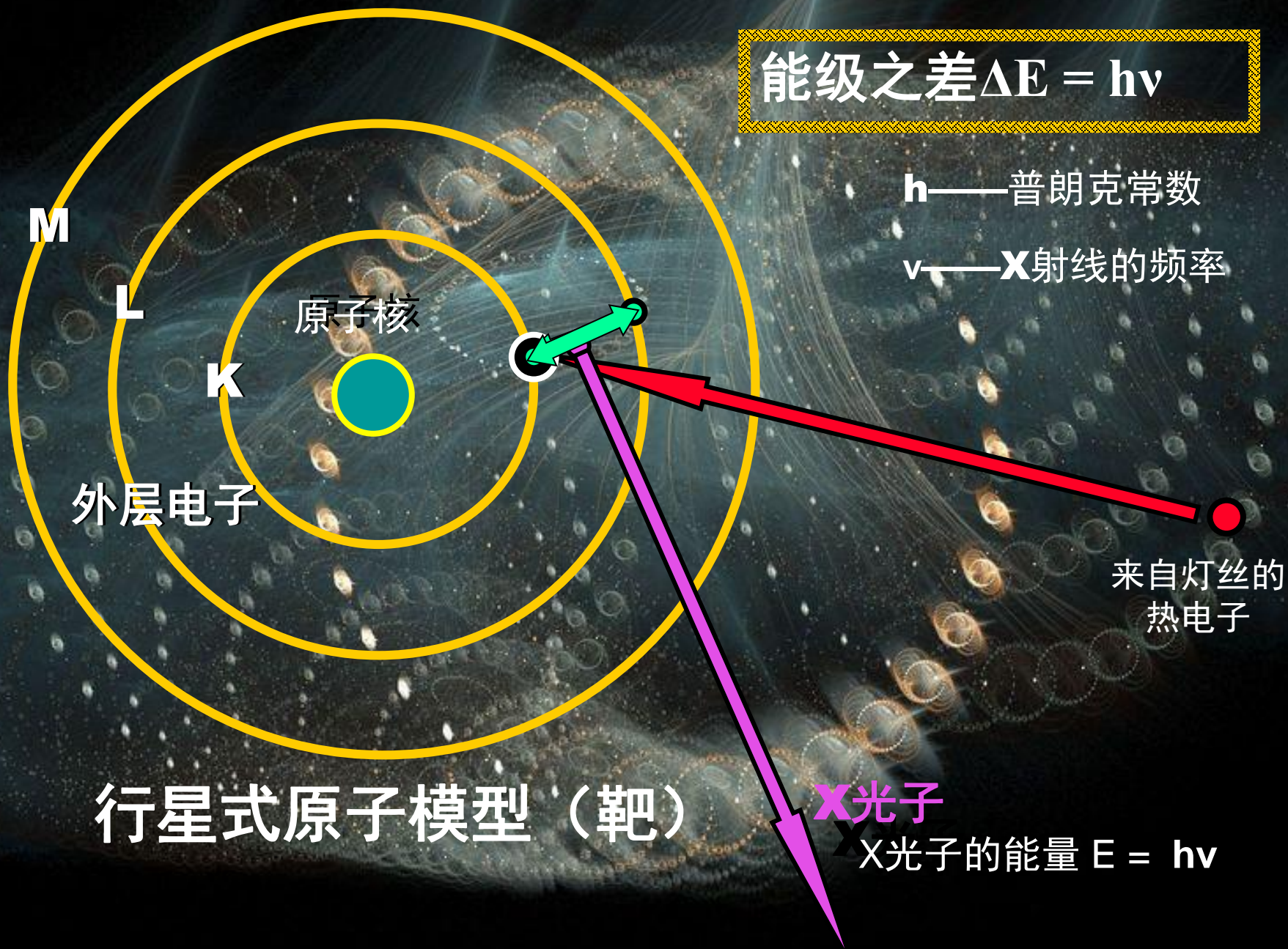
特征X射线的产生

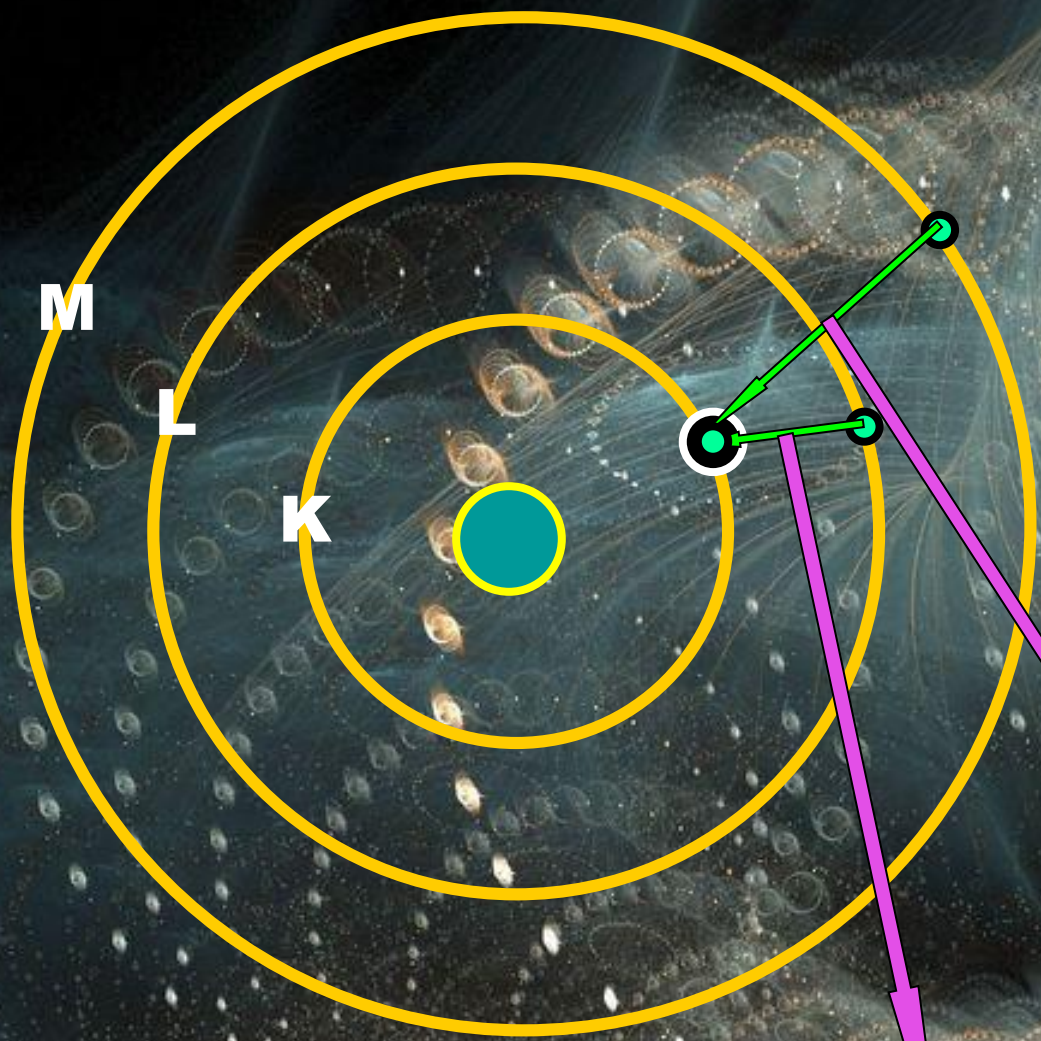
The background of the slide is a dark, abstract space filled with numerous glowing particles and light trails. The particles are primarily small, bright white and yellow dots, some of which are arranged in circular or spiral patterns. The light trails are thin, wispy lines of light, mostly in shades of blue and white, that seem to emanate from or connect the particles, creating a sense of dynamic movement and energy. The overall effect is reminiscent of a microscopic view of a particle interaction or a complex data visualization.

$$\text{能级之差 } \Delta E = h\nu$$

h ——普朗克常数

ν ——X射线的频率





M至K能级之差较大

**K β 辐射频率较高，
波长较短，光子能量较高**

**但是由于M至K产生跃迁的
几率较低，所以K β 辐射
强度较低。**

K β 辐射

K α 辐射

X射线的强度 (相对单位)

$K\alpha$

$K\beta$

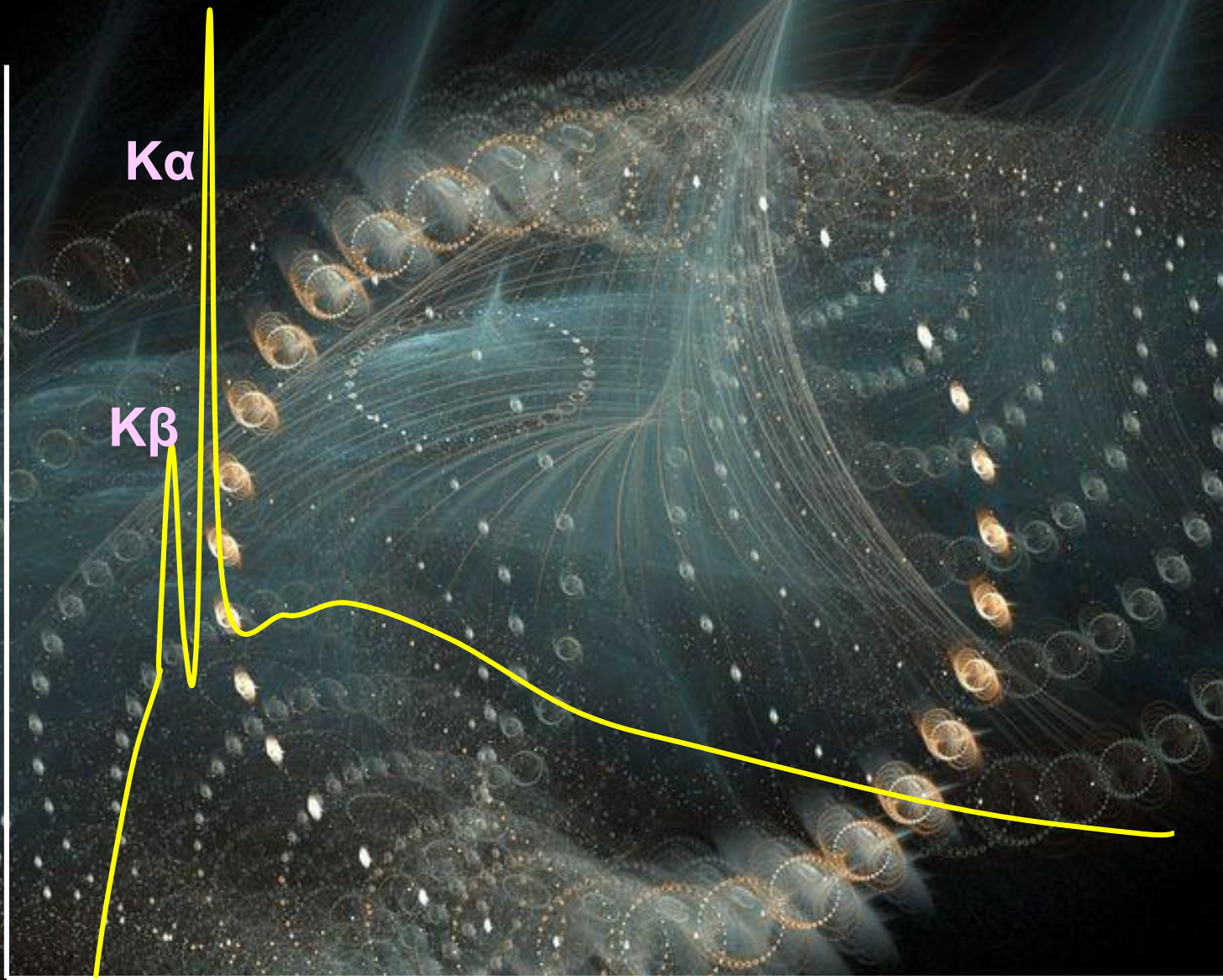
1.0

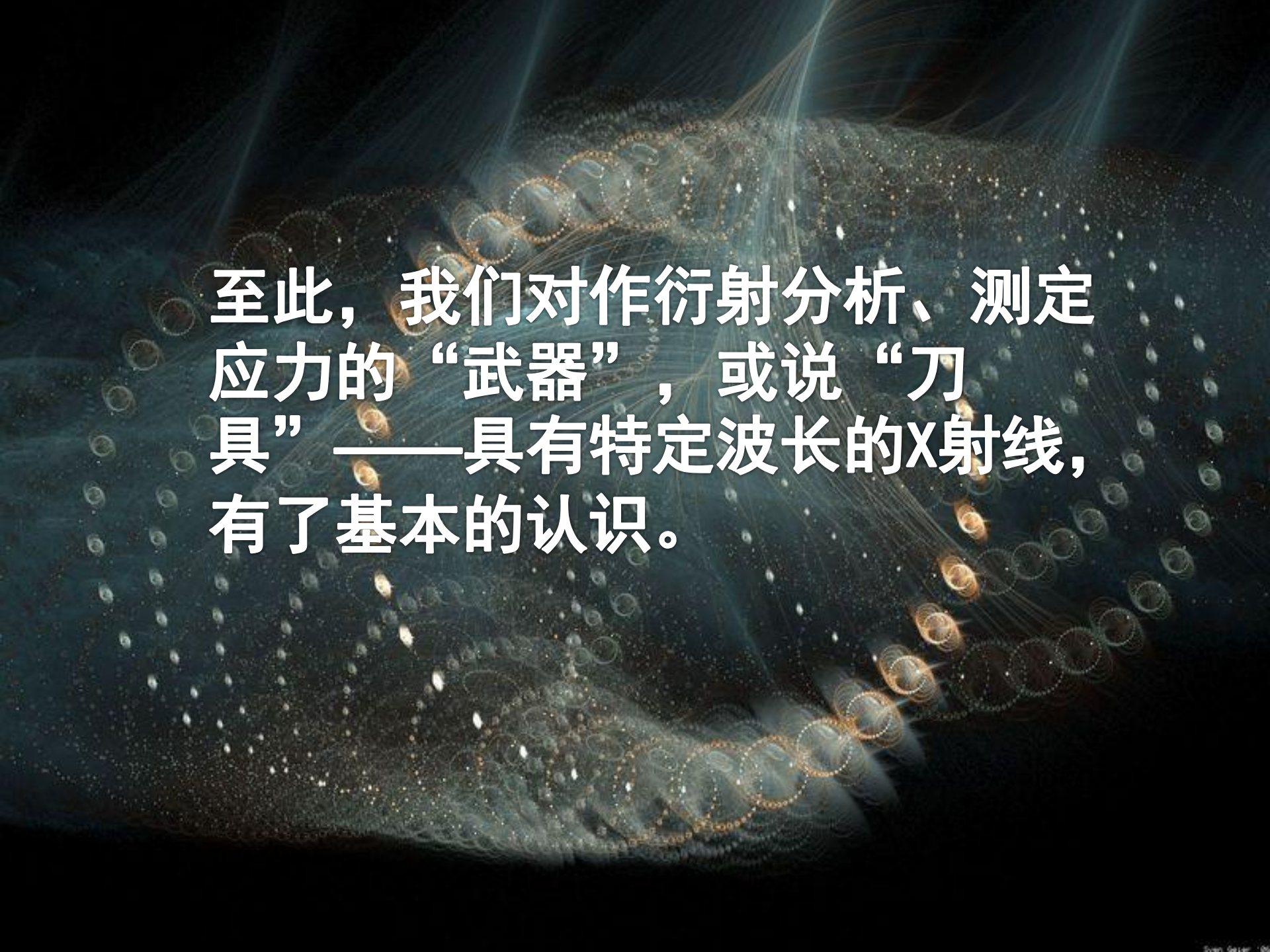
2.0

3.0

4.0

波长 (埃)



The background is a dark, abstract space filled with glowing particles and light trails. There are numerous small, bright white and yellow dots scattered throughout. Larger, more prominent features include glowing orange and yellow circular patterns that resemble orbits or paths of particles. Faint, wispy light trails in shades of blue and white are visible, suggesting movement or energy. The overall effect is that of a complex, dynamic system, possibly representing a scientific or technological theme.

至此，我们对作衍射分析、测定应力的“武器”，或说“刀具”——具有特定波长的X射线，有了基本的认识。