「英語での物理の授業」に向けての試み

Teaching Physics in English

(A Report on Our Experiences in the Physics Class)

平成26年8月理科実験研修会にて

磯部　欣一　　Isobe Kinichi

ジェフリー　ムーマ　Jeffry Moomaugh　(ALT)

宮城県仙台第一高等学校

１　はじめに

Introduction

２　本校の教育課程と指導対象生徒

Curriculum and Students

３　教材・教具

Teaching Materials and Instruments

４　授業方法・内容

Teaching Methods and Contents

５　授業の様子

Classroom Environment

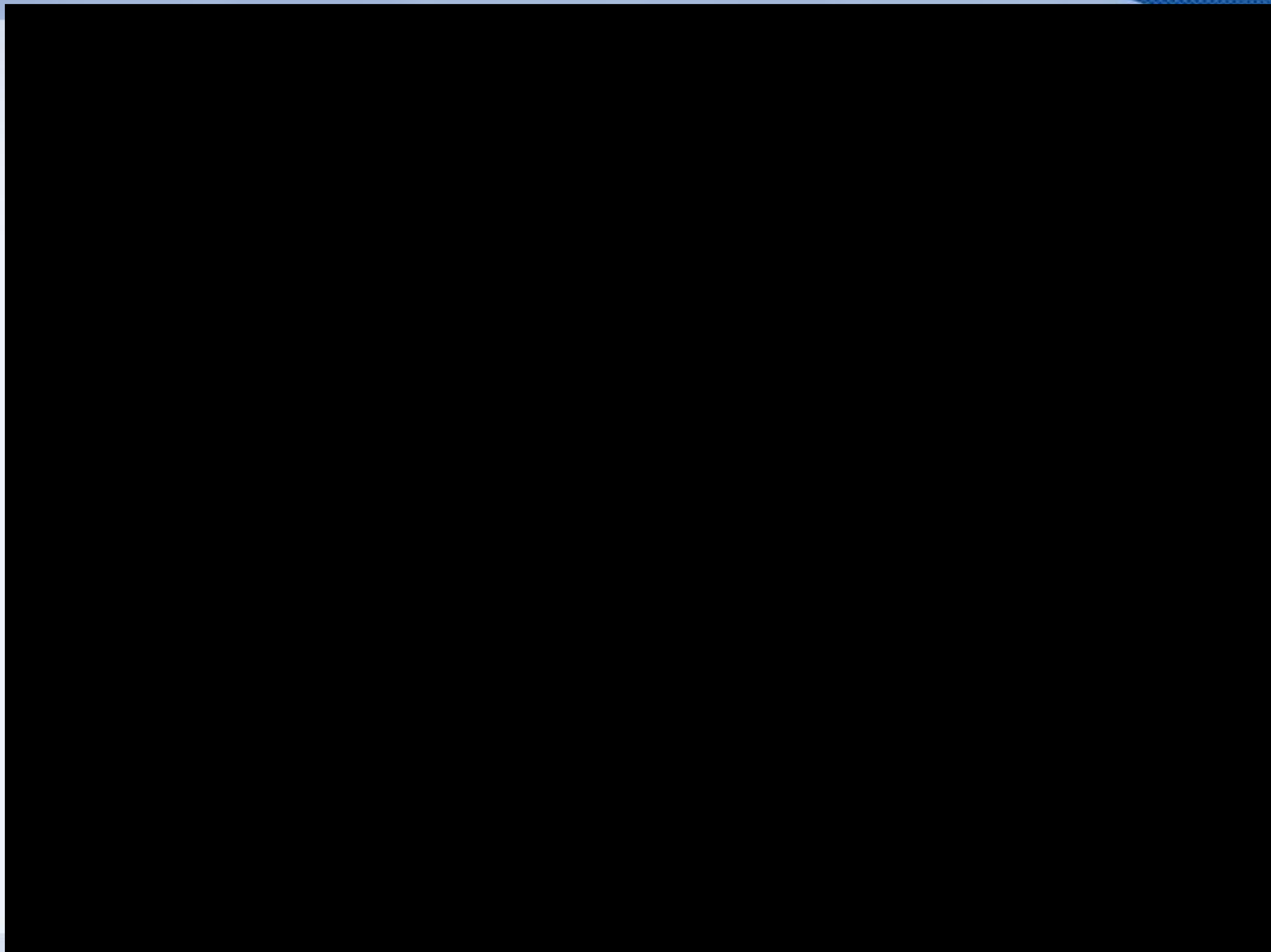
６　現状と課題

Present Conditions and Problems

★　英国ケンブリッジ大学海外研修報告(写真)

１　はじめに　(Introduction)

- **国際大会での生徒の英語による発表 (iCAN’11)**
  Students’ Presentation in English



１　はじめに　(Introduction)

- **「SSH(Science)」＋「SGH(Global)」**
- **科学リテラシーかつ国際的素養を身に付けたグローバルリーダーの育成**
  Globally Competent Leader with Scientific Literacy

英語で物理を･･･「科学英語」＋「実践英語」
Physics in English ･･･English for Science and Practical English

学び方の指導，きっかけづくり
Teach How to Learn, Give a Clue to Learn

２　本校の教育課程と指導対象生徒

（物理関係）Curriculum and Students

1年次
物理分野①単位
(SS理科総合4単位)

2年次理系
④単位
(SS物理Ⅰ)

3年次理系
④単位
(SS物理Ⅱ)

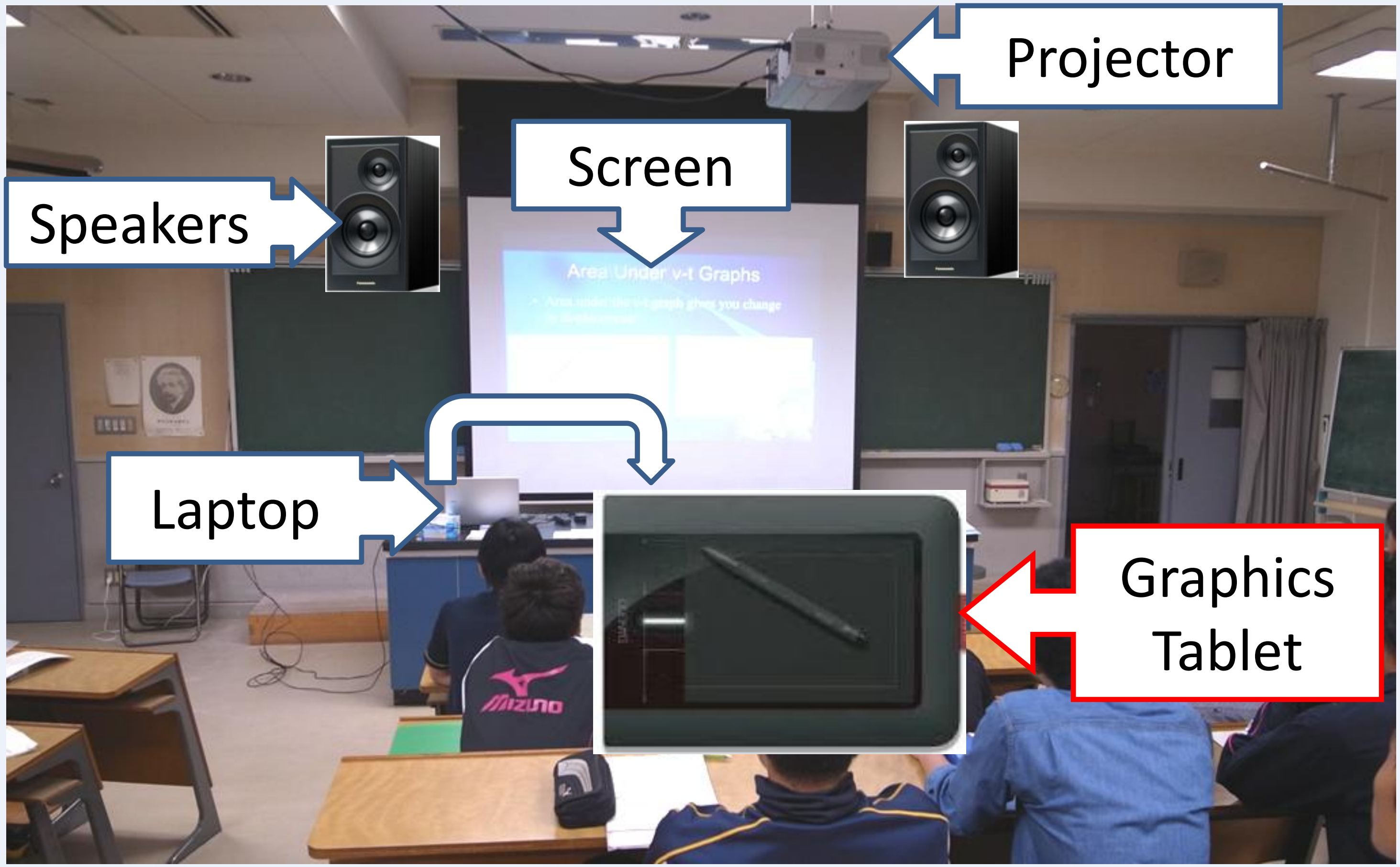
教科	科目	1年	2年 文系	2年 理系		3年 文系	3年 理系	
理科	SS理科総合	4						
	SS物理Ⅰ			④				
	SS物理Ⅱ						④	
	SS化学Ⅰ			3				
	SS化学Ⅱ						4	
	SS生物Ⅰ			④	4			0・
	SS生物Ⅱ						④	
	SS地学Ⅰ							
	SS地学Ⅱ							
	理科総合発展							
	化学研究							
	生物研究							
	地学研究							

『SS物理Ⅰ』④単位中
日本語3単位，英語1単位
４クラス161名(男124，女37)

すべて，SSHの研究開発に
係る学校設定科目

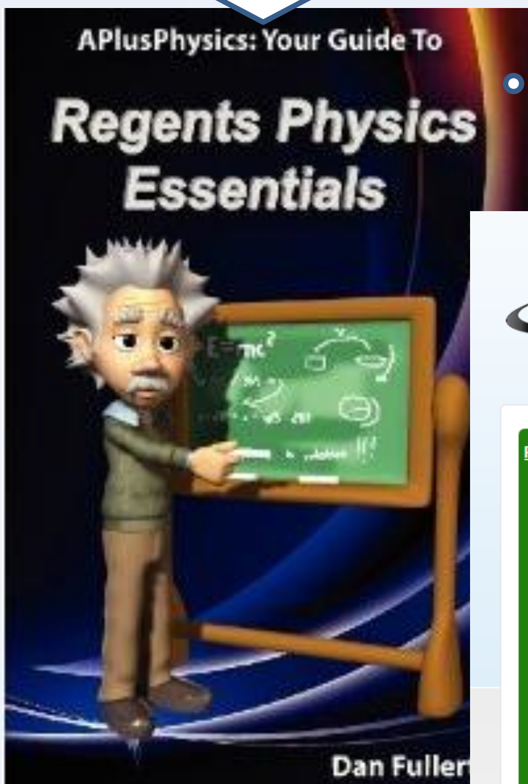
３　教材･教具 (Teaching Materials and Instruments)

PHYSICS LECTURE ROOM



３　教材・教具 (Teaching Materials and Instruments)

Textbook：
“Regents Physics Essentials”



For high school students in New York

APlusPhysics.com

テキスト
ビデオ
練習問題＋用紙
指導例
(すべてダウンロード可)

4　授業方法・内容 (Teaching Methods and Contents)

(1)　通常授業

テキスト: "Regents Physics Essentials"

(2)　ゲーム（物理用語の復習）

Flash Card, CROSSWORD PUZZLE, BINGO GAME

(3)　特別授業（June 11-12, 2014）

QuarkNet Workshop:
International Linear Collider (国際リニアコライダー)
Cosmic Rays(宇宙線)
についてのワークショップ

(4)　生徒(グループ)によるプレゼン

"Short Physics Presentation"

4　授業方法･内容 (Teaching Methods and Contents)

通常授業の内容　Contents：

（すべて日本語での既習内容）

Chapter 1: Introduction
- What is Physics?

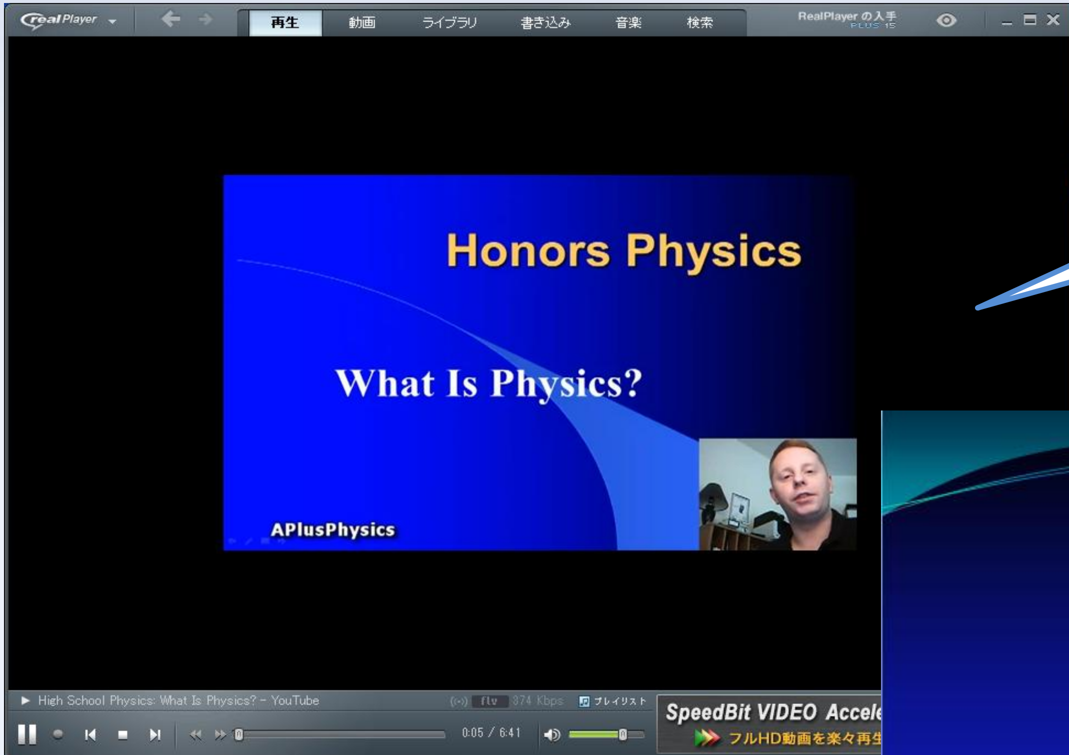
Chapter 2: Math Review
- Metric System
- Significant Figures
- Scientific Notation
- Scalars and Vectors

Chapter 3: Kinematics
- Defining Motion
- Graphing Motion
- Kinematic Equations
- Free Fall
- Projectile Motion

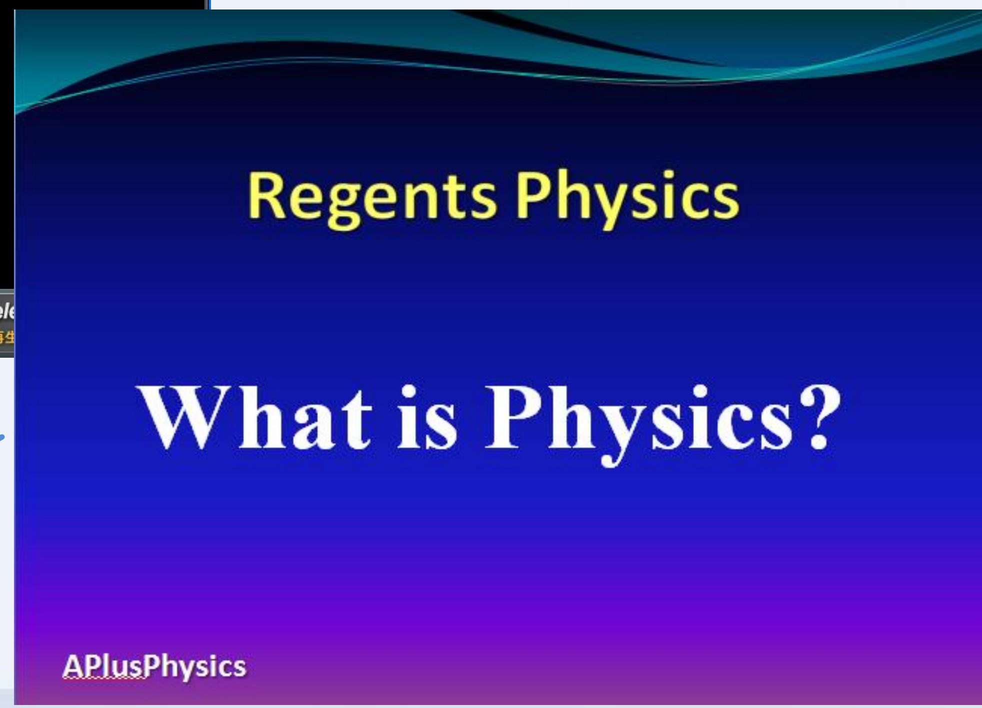
Chapter 4: Dynamics
- Newton's 1st Law of Motion
- Free Body Diagrams
- Newton's 2nd Law of Motion
- Newton's 3rd Law of Motion
- Friction
- Ramps and Inclines

Chapter 5: Work, Energy & Power
- Energy & Power
- Work
- Power
- Types of Energy
- Springs
- Conservation of Energy

4 授業方法･内容 (Teaching Methods and Contents)



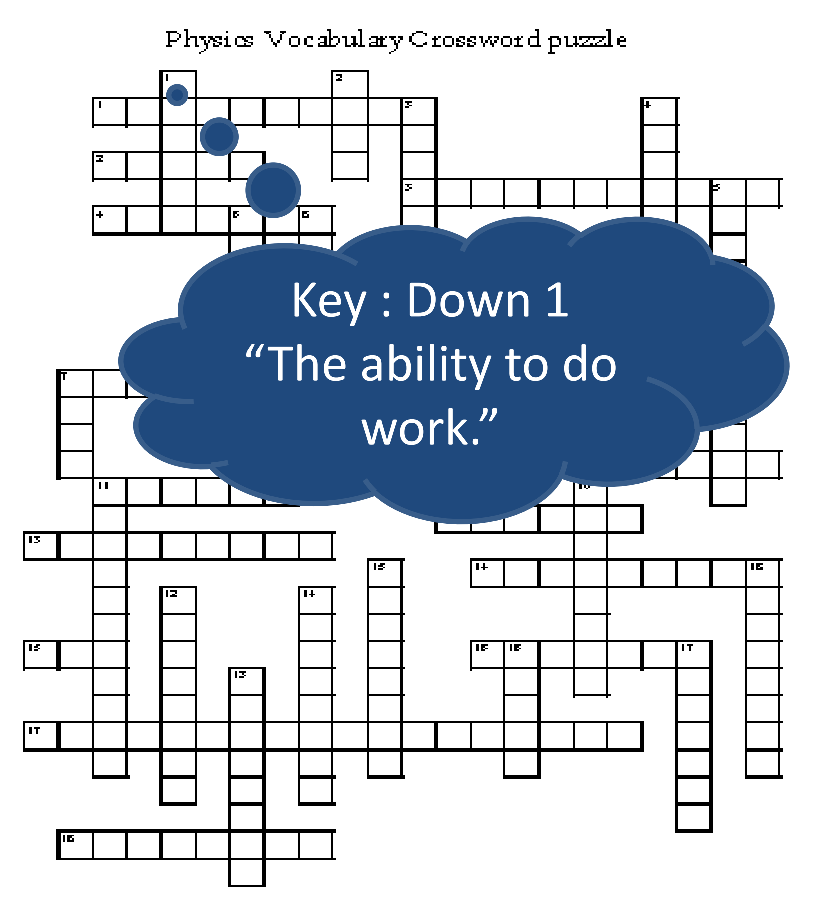
Video from
“APlusPhysics.com”



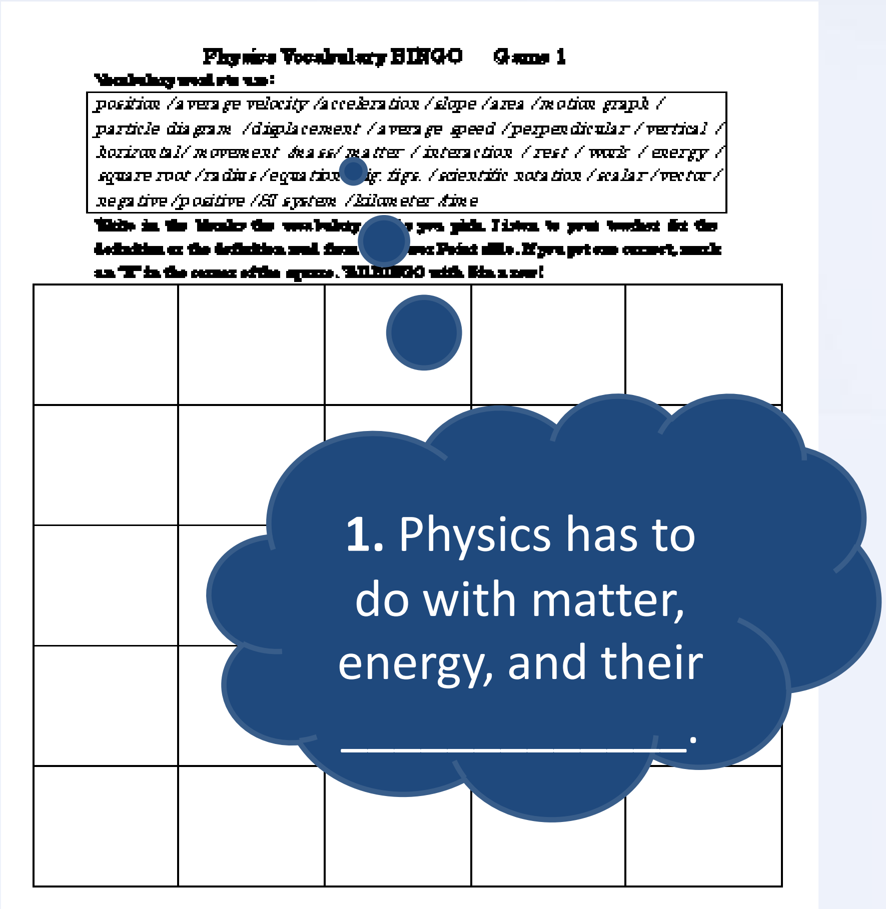
PPT based on the Video

4　授業方法･内容 (Teaching Methods and Contents)

CROSSWORD PUZZLE
(Physics Vocabulary)



BINGO GAME
(Physics Vocabulary)



５　授業の様子① (Classroom Environment)

５　授業の様子②　(Classroom Environment)

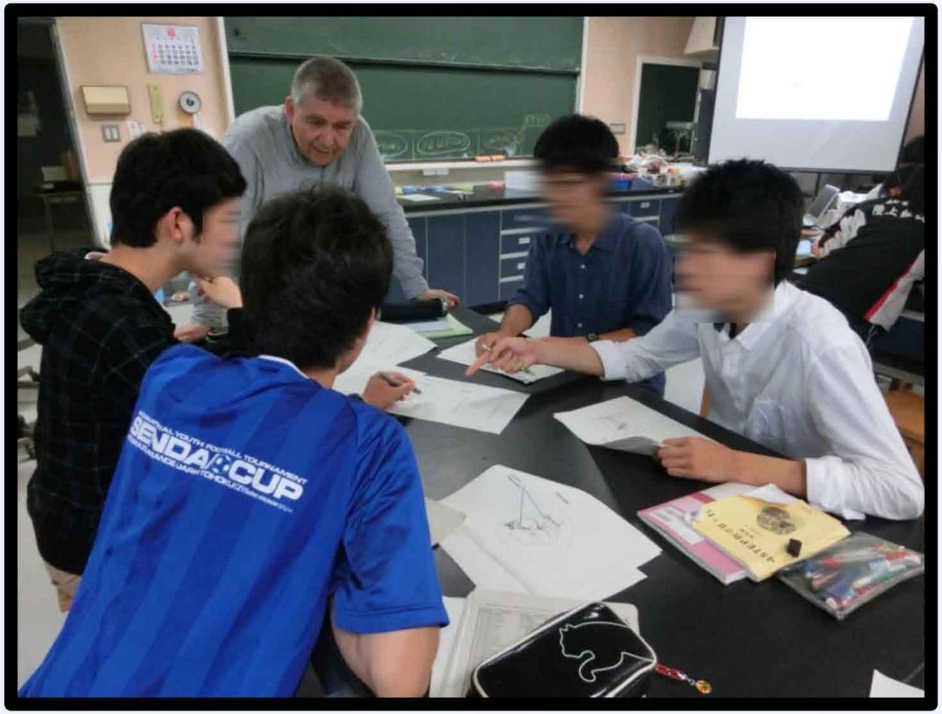
５ 授業の様子③ (Classroom Environment)

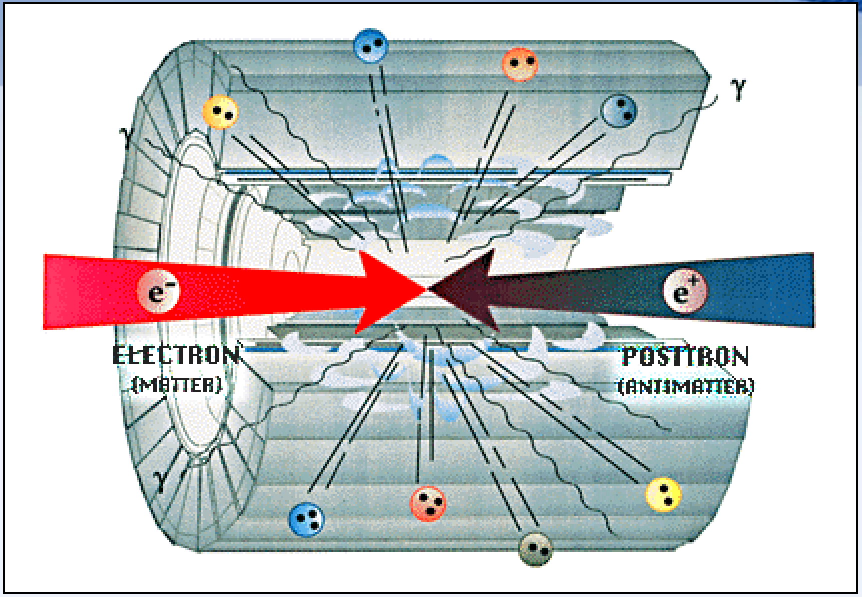
５ 授業の様子④ (Classroom Environment)

特別授業

QuarkNet-ILC Workshop：

International Linear Collider (国際リニアコライダー)
についてのワークショップ June 11-12, 2014



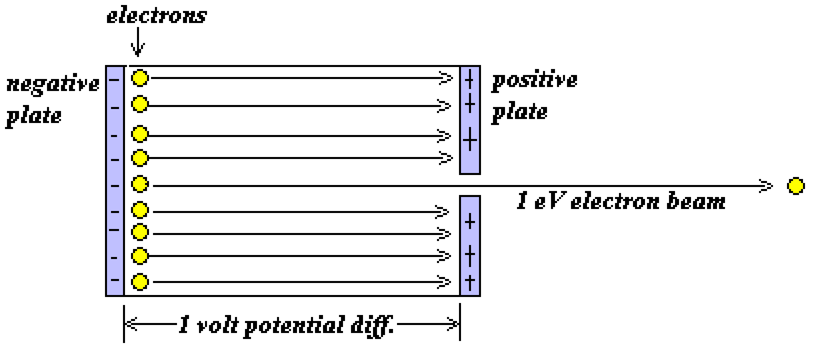


Accelerating to the ILC

Student view of the International Linear Collider

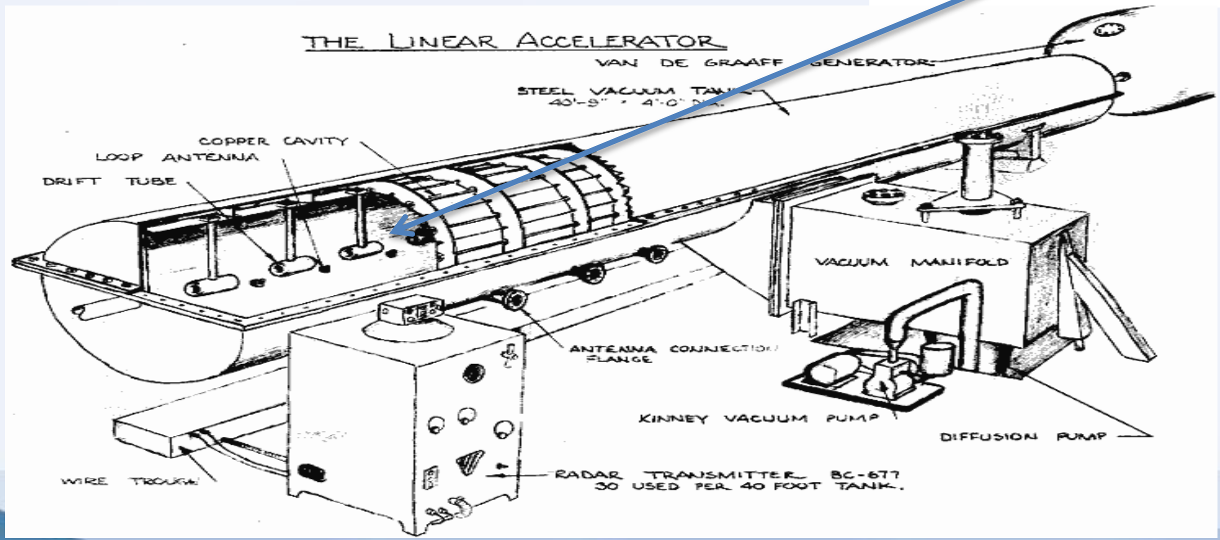
Accelerating electrons

- We know this technology
- Electrons attracted to positive, repelled by negative
- Using repeated stages and high voltage, we can give electrons a lot of energy



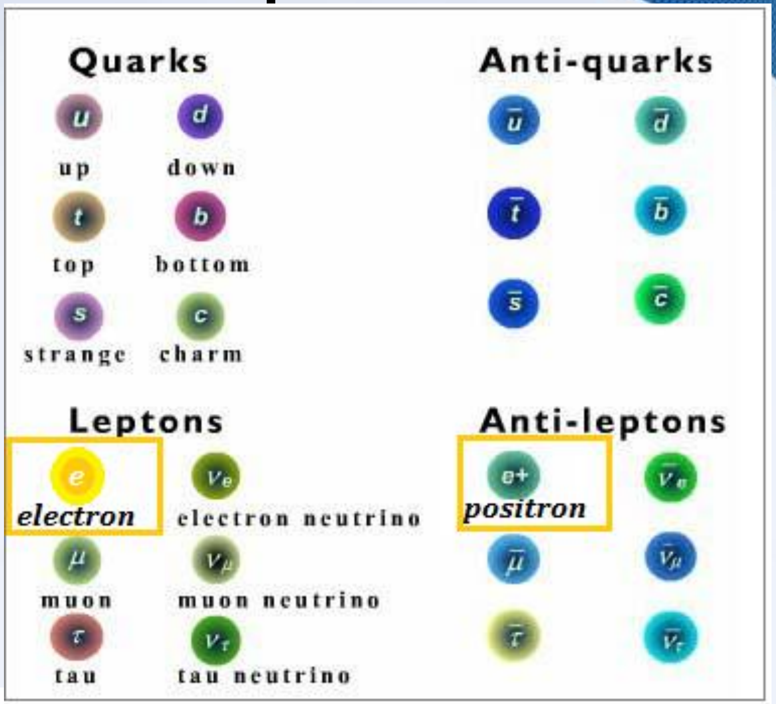
The "Evatron"

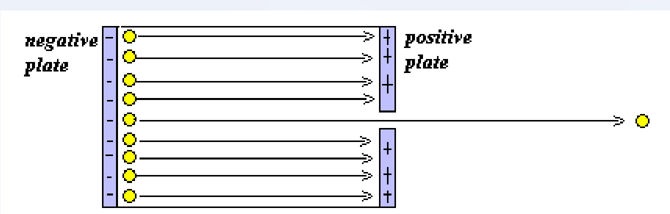
Electrons accelerated across a 1 volt (1 J/C) potential difference each gain 1.6e-19 J, or 1 electron-volt (eV) of kinetic energy.

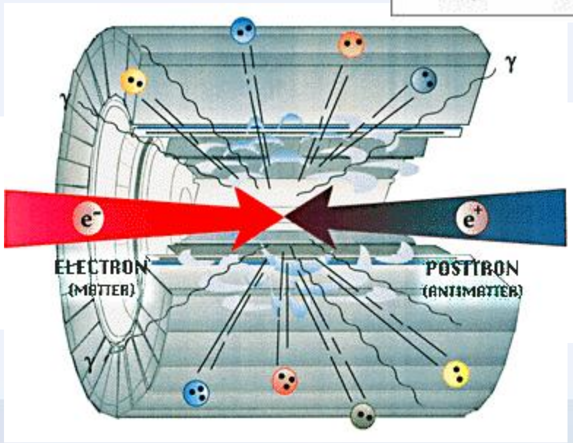


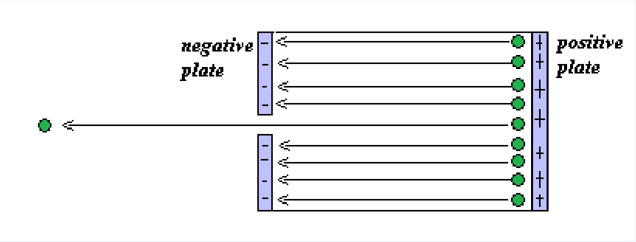
Accelerating electrons and positrons

- Every matter particle has an antimatter partner
- Positrons are antimatter electrons
- We can collide them at high energy
- We build detectors to measure the results of these collisions: new particles!



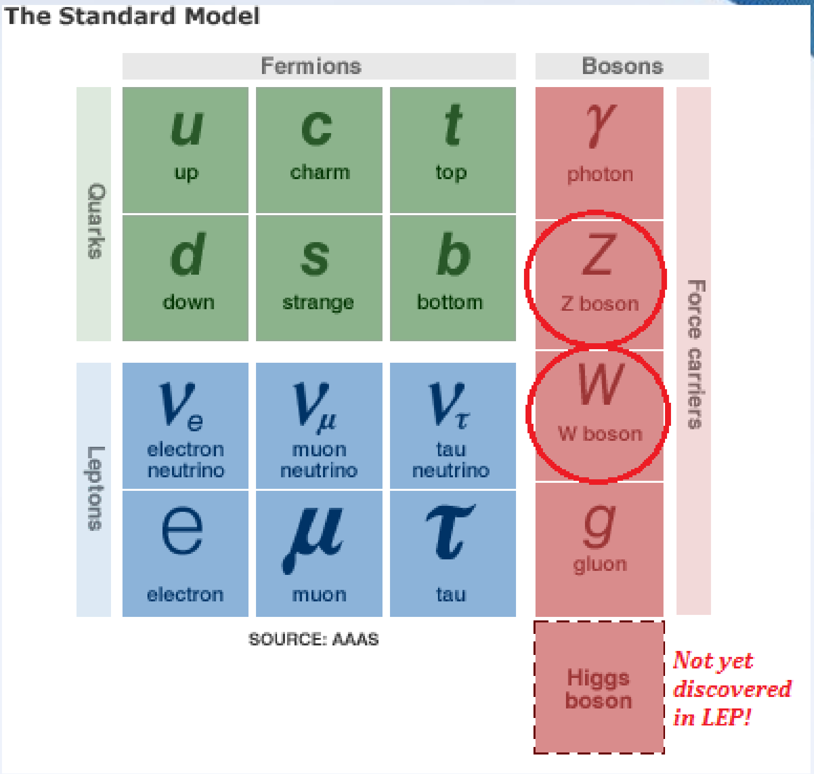


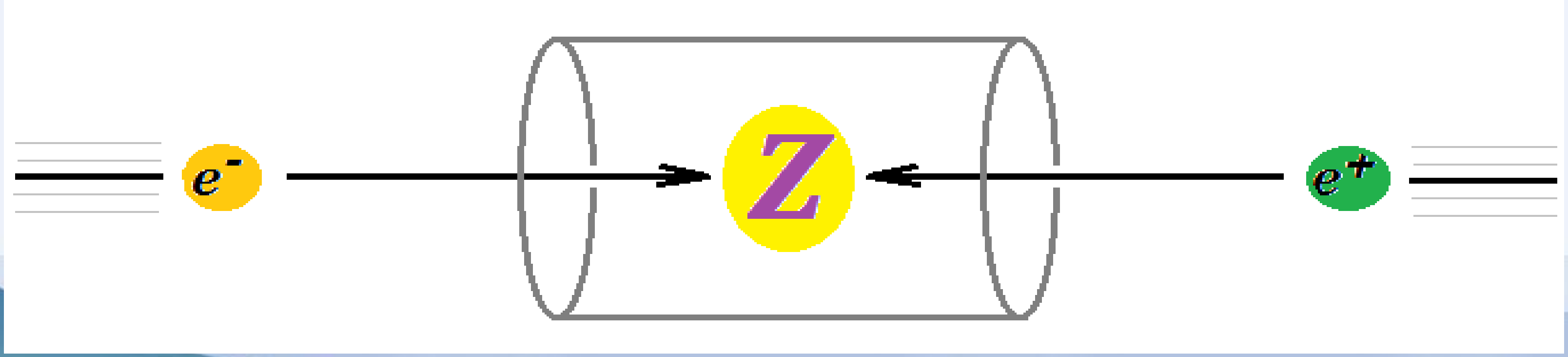




The Large Electron-Positron collider

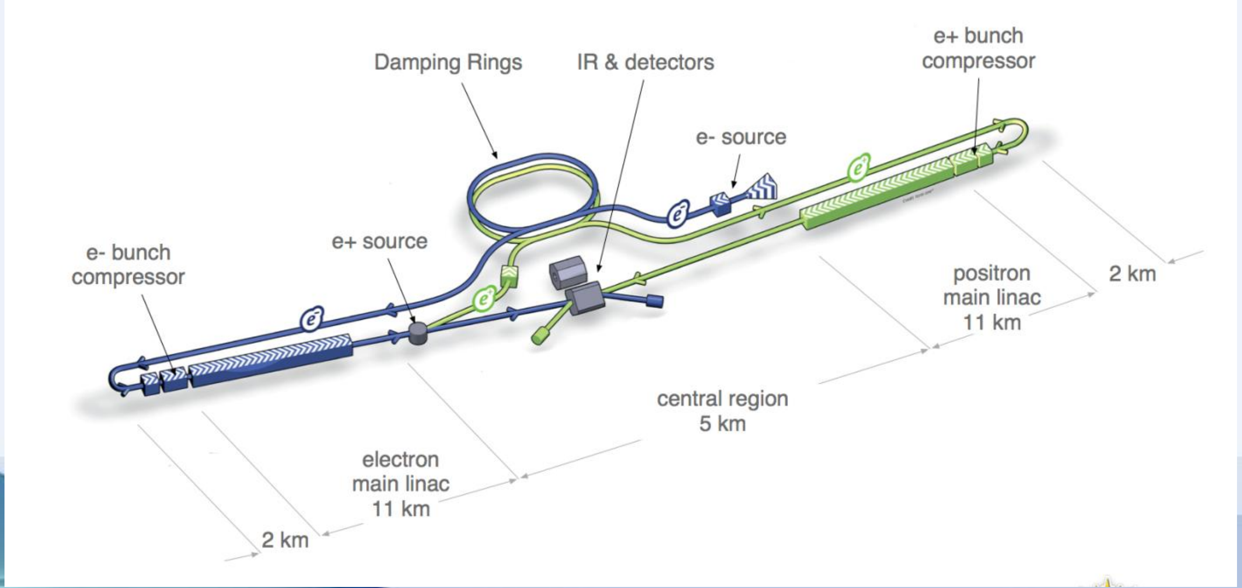
- CERN, 1989-1998 (near Geneva)
- 100 m underground circular tunnel (now used by Large Hadron Collider, LHC)
- Precise measurements of Z and W bosons
  - produced by electron-positron collisions
  - Energy of collisions makes particles





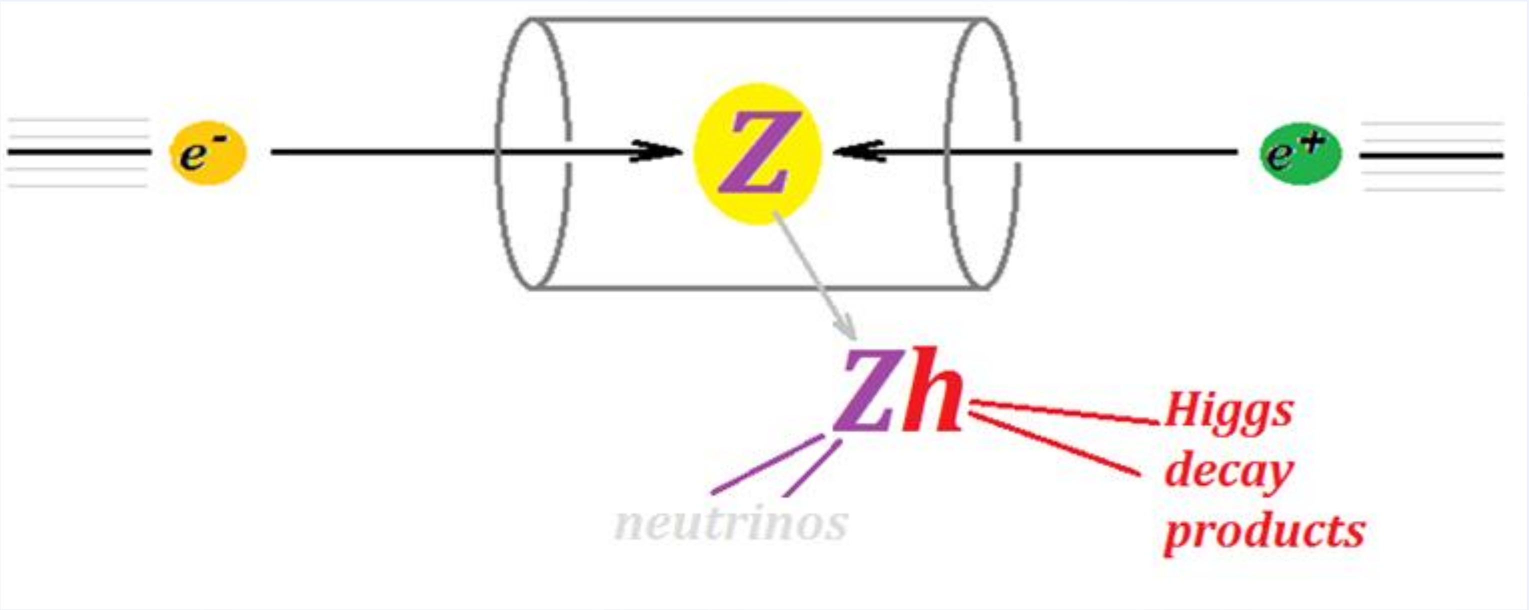
Next step: International Linear Collider

- LEP made precise measurements of the Z boson
- After LEP, the very important Higgs boson was discovered in the Large Hadron Collider (LHC) in 2012
- The International Linear Collider (ILC)
  - will be another electron-positron collider
  - can make precision measurements of the Higgs
  - is planned for Tohoku.



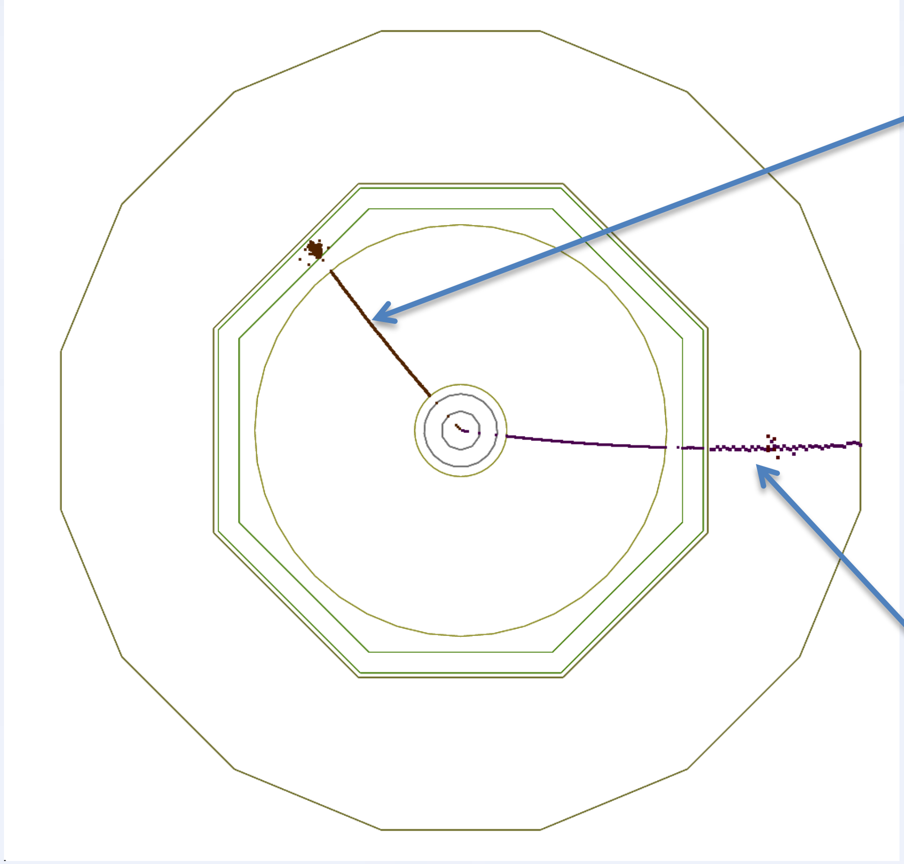
We can study the Higgs!

- The electron-positron collision makes a high-energy Z boson
- The Z boson radiates a Higgs boson
- Both decay – but sometimes Z decays to neutrinos, which we cannot detect
- Higgs decays can be seen and we can study them



Event ID# Example-1

Front view:



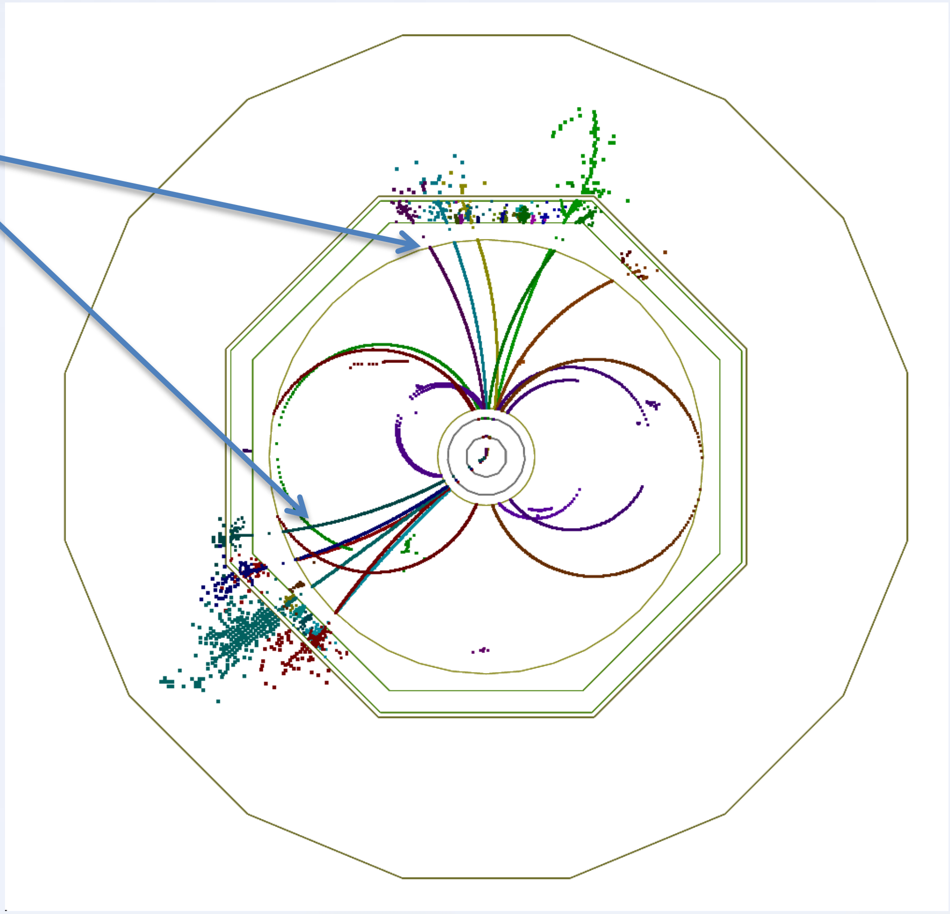
lepton (electron) from Higgs decay

lepton (muon) from Higgs decay

Event ID# Example-2

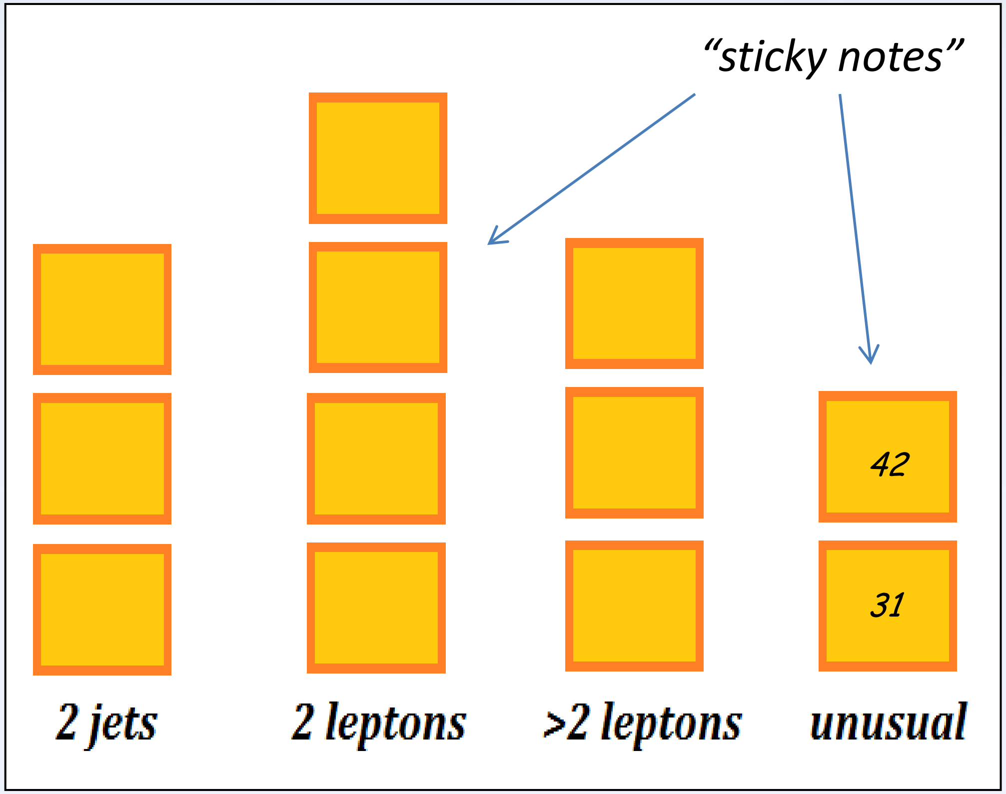
<u>Front view</u>:

jets from Higgs decay



We will make a chart on the wall

- 2 jets
- 2 leptons
- > 2 leptons
- unusual
  - write event ID#



This is how ILC physicists will study Higgs boson decays (but they will use computers).

５　授業の様子⑤ (Classroom Environment)

特別授業

QuarkNet e-Lab Workshop：Cosmic Ray(宇宙線)
についてのワークショップ　June 11-12, 2014 (放課後)

５ 授業の様子⑥ (Classroom Environment)

生徒(グループ)によるプレゼン

“Short Physics Presentation”

６　現状と課題 (Present Conditions and Problems)

能力，関心，意欲に大きな格差

Large Differences in Abilities, Interests and Will

遊び気分

Partly for Enjoyment

- **他教科（外国語科，情報科，数学科，「学術研究」等）との協力** Cooperation with Other Teachers
- **各種国際交流事業の活用** International Exchange

☆ 生徒の価値観（受験勉強中心）の変革

Change/Shift Students’ Mindset