Introduzione

Metodi Computazionali per la Fisica

Corso di Laurea in Fisica

Università degli Studi di Roma “La Sapienza”

Introduzione al Corso (1)

- Corso rivolto principalmente a studenti di fisica delle alte energie
- Strumenti informatici essenziali nell'elaborazione dei dati
- Ogni parte del corso potrebbe essere argomento di un corso dedicato

Introduzione al Corso (2)

- Formato:
  - 2 Lezioni la settimana (~ 10 settimane)
    in due giornate, Lunedi 11-13 (Rasetti)
    e Giovedi 11-13 (Rasetti)
  - Non si programma (anche se si studia un linguaggio di programmazione nuovo)
- Argomenti:
  - Trigger & DAQ
  - Metodi MC
  - Linguaggi di scripting (PERL)
  - Database

Introduzione al Corso (3)

- Pagina Web del corso
  - http://www.roma1.infn.it/people/barone/metinf/
- Materiali
  - sulla pagina web: slides, articoli, materiale vario
- Esami
  - prova scritta con esercizi numerici, temi, domande a scelta multipla

Introduzione al Corso (5)

- Mio indirizzo e-mail:
  - luciano.barone@roma1.infn.it
- Ricevimento mercoledi 14-15 o previa mail
- Date esami: vedi pagina web

Dalla teoria...

10. ELECTROWEAK MODEL AND CONSTRAINTS ON NEW PHYSICS

Revised August 1999 by J. Erler and P. Langacker (Univ. of Pennsylvania).

10.1. Introduction

The standard electroweak model is based on the gauge group [1] SU(2) × U(1), with gauge bosons W_μ^i, $i = 1, 2, 3$, and B_μ for the SU(2) and U(1) factors, respectively, and the corresponding gauge coupling constants g and g'. The left-handed fermion fields $\psi_i = \begin{pmatrix} \nu_i \\ \ell_i^- \end{pmatrix}$ and $\begin{pmatrix} u_i \\ d_i' \end{pmatrix}$ of the i^{th} fermion family transform as doublets under SU(2), where $d_i' \equiv \sum_j V_{ij}\, d_j$, and V is the Cabibbo-Kobayashi-Maskawa mixing matrix. (Constraints on V are discussed in the section on the Cabibbo-Kobayashi-Maskawa mixing matrix.) The right-handed fields are SU(2) singlets. In the minimal model there are three fermion families and a single complex Higgs doublet $\phi \equiv \begin{pmatrix} \phi^+ \\ \phi^0 \end{pmatrix}$

Particle Data Group, Barnett et al

Phenomenology

A good theory contains very few numbers

But it can predict a large number of reactions

Getting those predictions from the theory is called "phenomenology"

10.4. *W* and *Z* decays

The partial decay width for gauge bosons to decay into massless fermions $f_1\bar{f}_2$ is

$$\Gamma(W^+ \to e^+\nu_e) = \frac{G_F M_W^3}{6\sqrt{2}\pi} \approx 226.5 \pm 0.3 \text{ MeV} \quad , \qquad (10.41a)$$

$$\Gamma(W^+ \to u_i\bar{d}_j) = \frac{CG_F M_W^3}{6\sqrt{2}\pi} |V_{ij}|^2 \approx (707 \pm 1)|V_{ij}|^2 \text{ MeV} \quad , \quad (10.41b)$$

$$\Gamma(Z \to \psi_i\bar{\psi}_i) = \frac{CG_F M_Z^3}{6\sqrt{2}\pi} \left[g_V^{i2} + g_A^{i2}\right] \qquad (10.41c)$$

$$\approx \begin{cases} 300.3 \pm 0.2 \text{ MeV } (u\bar{u}), & 167.24 \pm 0.08 \text{ MeV } (\nu\bar{\nu}), \\ 383.1 \pm 0.2 \text{ MeV } (d\bar{d}), & 84.01 \pm 0.05 \text{ MeV } (e^+e^-), \\ 375.9 \mp 0.1 \text{ MeV } (b\bar{b}). \end{cases}$$

From Particle Data Book

...all'esperimento

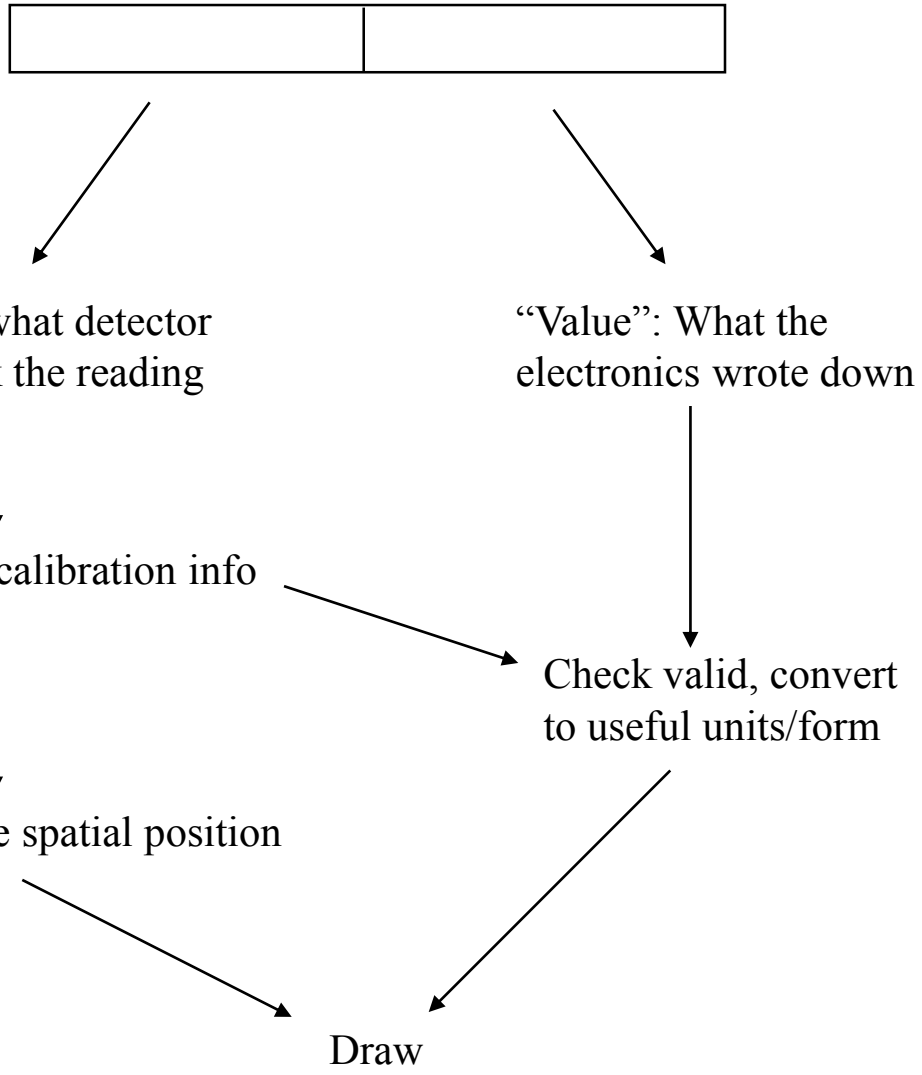
- 0x01e84c10: 0x01e8 0x8848 0x01e8 0x83d8 0x6c73 0x6f72 0x7400 0x0000
- 0x01e84c20: 0x0000 0x0019 0x0000 0x0000 0x01e8 0x4d08 0x01e8 0x5b7c
- 0x01e84c30: 0x01e8 0x87e8 0x01e8 0x8458 0x7061 0x636b 0x6167 0x6500
- 0x01e84c40: 0x0000 0x0019 0x0000 0x0000 0x0000 0x0000 0x01e8 0x5b7c
- 0x01e84c50: 0x01e8 0x8788 0x01e8 0x8498 0x7072 0x6f63 0x0000 0x0000
- 0x01e84c60: 0x0000 0x0019 0x0000 0x0000 0x0000 0x0000 0x01e8 0x5b7c
- 0x01e84c70: 0x01e8 0x8824 0x01e8 0x84d8 0x7265 0x6765 0x7870 0x0000
- 0x01e84c80: 0x0000 0x0019 0x0000 0x0000 0x0000 0x0000 0x01e8 0x5b7c
- 0x01e84c90: 0x01e8 0x8838 0x01e8 0x8518 0x7265 0x6773 0x7562 0x0000
- 0x01e84ca0: 0x0000 0x0019 0x0000 0x0000 0x0000 0x0000 0x01e8 0x5b7c
- 0x01e84cb0: 0x01e8 0x8818 0x01e8 0x8558 0x7265 0x6e61 0x6d65 0x0000
- 0x01e84cc0: 0x0000 0x0019 0x0000 0x0000 0x0000 0x0000 0x01e8 0x5b7c
- 0x01e84cd0: 0x01e8 0x8798 0x01e8 0x8598 0x7265 0x7475 0x726e 0x0000
- 0x01e84ce0: 0x0000 0x0019 0x0000 0x0000 0x0000 0x0000 0x01e8 0x5b7c
- 0x01e84cf0: 0x01e8 0x87ec 0x01e8 0x85d8 0x7363 0x616e 0x0000 0x0000
- 0x01e84d00: 0x0000 0x0019 0x0000 0x0000 0x0000 0x0000 0x01e8 0x5b7c
- 0x01e84d10: 0x01e8 0x87e8 0x01e8 0x8618 0x7365 0x7400 0x0000 0x0000
- 0x01e84d20: 0x0000 0x0019 0x0000 0x0000 0x0000 0x0000 0x01e8 0x5b7c
- 0x01e84d30: 0x01e8 0x87a8 0x01e8 0x8658 0x7370 0x6c69 0x7400 0x0000
- 0x01e84d40: 0x0000 0x0019 0x0000 0x0000 0x0000 0x0000 0x01e8 0x5b7c
- 0x01e84d50: 0x01e8 0x8854 0x01e8 0x8698 0x7374 0x7269 0x6e67 0x0000
- 0x01e84d60: 0x0000 0x0019 0x0000 0x0000 0x0000 0x0000 0x01e8 0x5b7c
- 0x01e84d70: 0x01e8 0x875c 0x01e8 0x86d8 0x7375 0x6273 0x7400 0x0000
- 0x01e84d80: 0x0000 0x0019 0x0000 0x0000 0x0000 0x0000 0x01e8 0x5b7c
- 0x01e84d90: 0x01e8 0x87c0 0x01e8 0x8718 0x7377 0x6974 0x6368 0x0000

Data taking

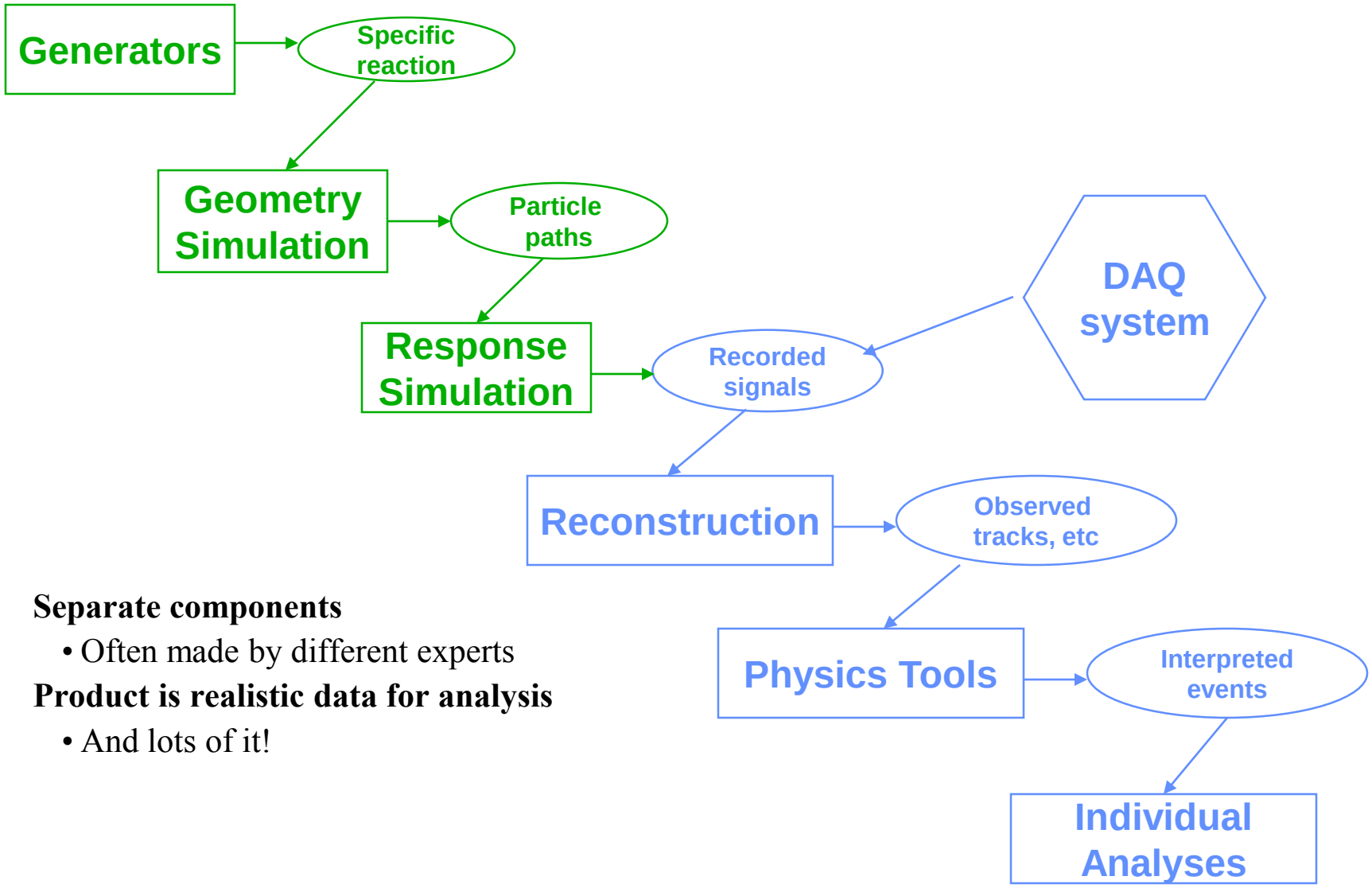
- Evento: interazione tra proiettile e bersaglio che produce N particelle
  - leggi di conservazione
  - particelle instabili
  - prodotti di decadimento
- Detector: un apparato complesso composto in genere da sottorivelatori dedicati che acquisiscono dati in forma analogica e/o digitale

What does the data mean?

Digitization:



Traditional flow of data - real and simulated



Separate components

- Often made by different experts

Product is realistic data for analysis

- And lots of it!