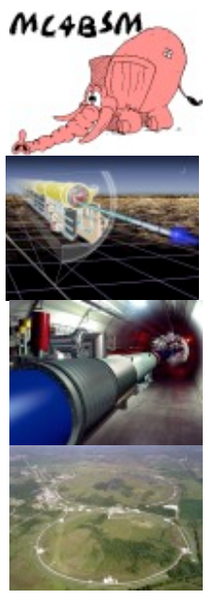
Welcome to MC4BSM!



[theory.fnal.gov/mc4bsm/]

Monte Carlo Tools for Beyond the Standard Model Physics

6th Workshop: MAR 22 - 24 , 2012 (CORNELL)

ORGANIZERS e-mail:
mc4bsm.AT.nbi.dk

RESOURCES:

- BSM tool repository
- Les Houches Accord for BSM Generators
- Video Lectures on Monte Carlo for the LHC
- Summary of MC4BSM-1 Discussion sessions

RELATED WORKSHOPS:

- TOOLS 2010

5th workshop: APR 14-16, 2010 (NBI, COPENHAGEN)

Organizing committee: Poul Henrik Damgaard, Christophe Grojean, Peter Hansen, Jørgen Beck Hansen, Rasmus Mackeprang, Konstantin Matchev, Stephen Mrenna, Maxim Perelstein, Peter Skands.

4th workshop: APRIL 3-4, 2009 (UC DAVIS)

Organizing committee: Hsin-Chia Cheng, Christophe Grojean, Konstantin Matchev, Stephen Mrenna, Maxim Perelstein, Peter Skands.

3rd workshop: MARCH 10-11, 2008 (CERN)

Organizing committee: Georges Azuelos, Christophe Grojean, Jay Hubisz, Borut Kersevan, Joe Lykken, Fabio Maltoni, Konstantin Matchev, Filip Moortgat, Stephen Mrenna, Maxim Perelstein, Peter Skands, James Wells.

2nd workshop: MARCH 21-24, 2007 (PRINCETON)

Organizing committee: Jay Hubisz, Konstantin Matchev, Stephen Mrenna, Maxim Perelstein, Peter Skands.

1st workshop: MARCH 20-21, 2006 (FERMILAB)

Organizing Committee: Marcela Carena, Mu Chun Chen, Bogdan Dobrescu, Chris Hill, Jay Hubisz, Joe Lykken, Konstantin Matchev, Stephen Mrenna, Maxim Perelstein, Jose Santiago, Peter Skands.

"NEW PHYSICS PIPELINE"

Build a Model

Identify Collider Signatures

Compute Signal Cross Sections

Compute Backgrounds and Optimize Cuts

Focus of MC4BSM

MC4BSM Circa 2005

$$\mathcal{L} \rightarrow \frac{d\sigma}{d\Pi}$$

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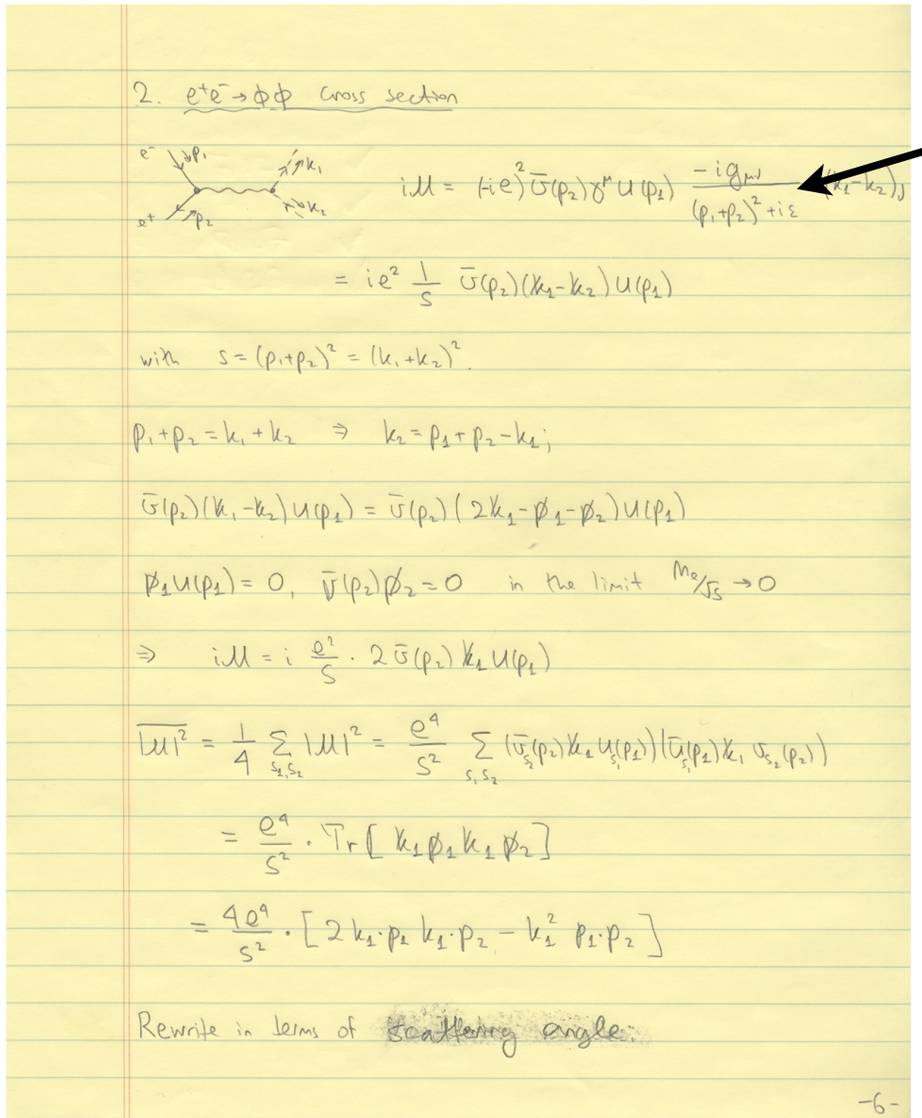

2. $e^+e^- \to \phi\phi$ cross section

$$i\mathcal{M} = (-ie)^2 \bar{v}(p_2)\gamma^\mu u(p_1) \frac{-ig_{\mu\nu}}{(p_1+p_2)^2+i\varepsilon} (k_1-k_2)^\nu$$

$$= ie^2 \frac{1}{s} \bar{v}(p_2)(k_1-k_2)u(p_1)$$

with $s = (p_1+p_2)^2 = (k_1+k_2)^2$

$p_1+p_2 = k_1+k_2 \Rightarrow k_2 = p_1+p_2-k_1$,

$\bar{v}(p_2)(k_1-k_2)u(p_1) = \bar{v}(p_2)(2k_1-p_1-p_2)u(p_1)$

$p_1 u(p_1) = 0$, $\bar{v}(p_2)p_2 = 0$ in the limit $m_e/\sqrt{s} \to 0$

$\Rightarrow \quad i\mathcal{M} = i\frac{e^2}{s} \cdot 2\bar{v}(p_2)k_1 u(p_1)$

$$\overline{|\mathcal{M}|^2} = \frac{1}{4}\sum_{s_1 s_2} |\mathcal{M}|^2 = \frac{e^4}{s^2} \sum_{s_1 s_2} (\bar{v}_{s_2}(p_2)k_1 u_{s_1}(p_1))(\bar{u}_{s_1}(p_1)k_1 v_{s_2}(p_2))$$

$$= \frac{e^4}{s^2} \cdot \mathrm{Tr}[k_1 p_1 k_1 p_2]$$

$$= \frac{4e^4}{s^2} \cdot [2k_1\cdot p_1 \, k_1\cdot p_2 - k_1^2 \, p_1\cdot p_2]$$

Rewrite in terms of scattering angle:

-6-

HANDWRITTEN NOTES!

MC4BSM Circa 2005

$$\frac{d\sigma}{d\Pi} \rightarrow \text{Events}$$

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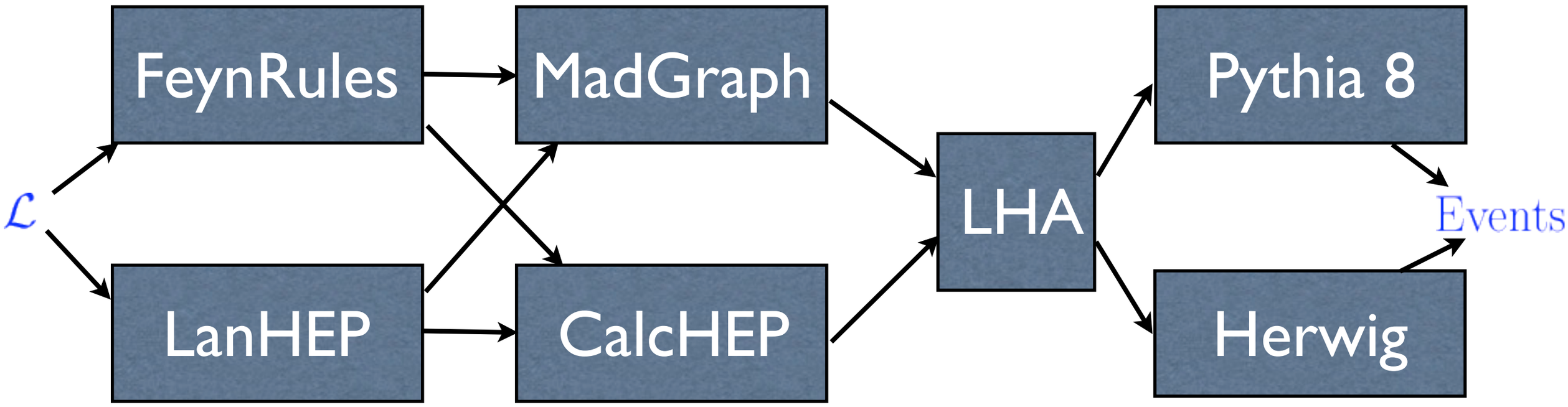
$$\frac{d\sigma}{d\Pi} \rightarrow \text{Events}$$

FORTRAN!!!

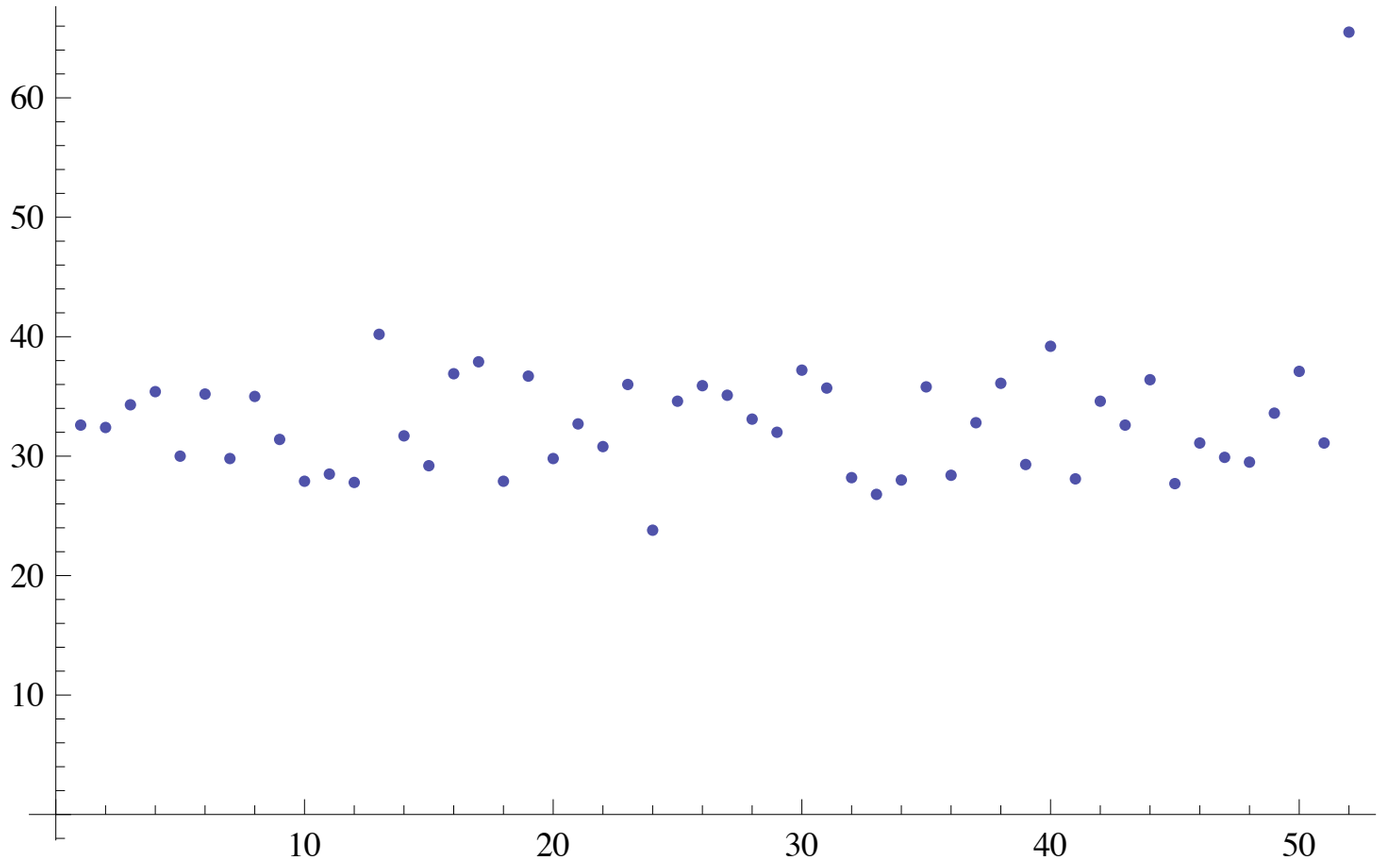
```
      REAL*8 SCALEF,WTMAX
      COMMON/UPPRIV/SCALEF,WTMAX,LNHIN,LNHOUT,MODE
      INTEGER IREAD
      COMMON/UPINFO/IREAD

C...External functions
      EXTERNAL PYALPS,PYP

C...Local variables
      INTEGER NEV,IE
      CHARACTER*5 CGIVE
      CHARACTER*30 CGIVE0

C...Maximum number of events to generate.
      NEV=-1                    ! -1 means all available events

C   initialize HEP logical units
      LNHIN=77

      OPEN (LNHIN, FILE='unweighted_events.dat', ERR=90 )

C...MODE, process mode; agrees with IDWTUP code (+-1,+-2,+-3,+-4).
C   IF MODE=0 (default), MODE is set automatically
C   depending on the kind of MadEvent event file:
C   MODE=3 for unweighed events, MODE=2 for weighted events
C   If some other setting is desired, set MODE here

C...Only 2 and 3 work witn MG-ME files, otherwise wrong cross-section

c   MODE=4
C.....4 means unweighted in and unweighted out
C......All events accepted. XWGTUP is stored by Pythia, its average is used
C......as a cross section.

c   MODE=3
C.....3 means unweighted in and unweighted out
C......All events accepted. XWGTUP ignored by Pythia. XSECUP is used
C......as a cross section. For MG-ME reads run constants from weighted
C......events fole (fort.77) and events from unweighted events file (fort.
78)

c   MODE=2
C.....Means weighted in and unweighted out
C......Events selected according to maximum weight. XSECUP=(weights sum) is
C......used as a cross section. For MG-ME reads run constants and events
from
```

MC4BSM Today

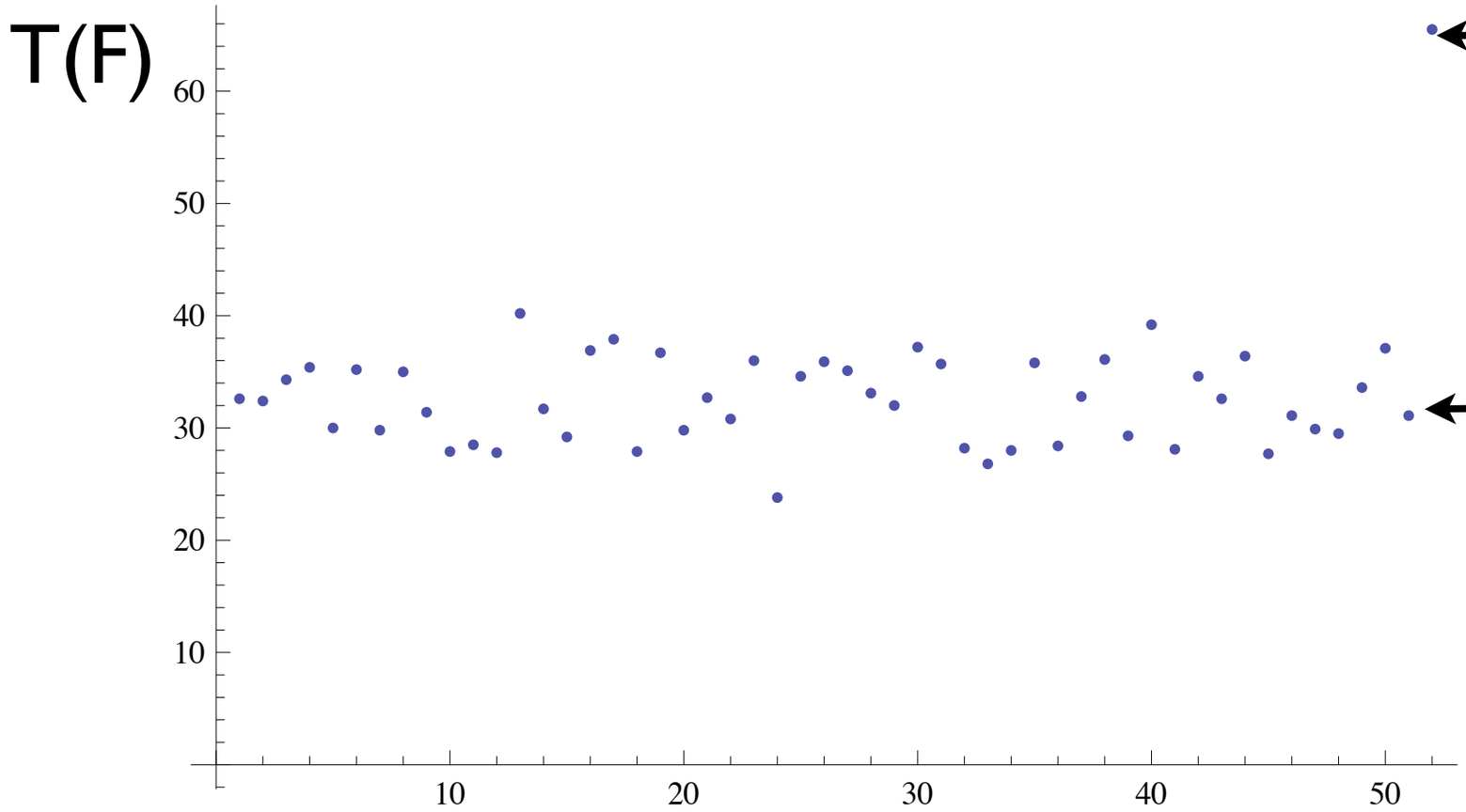


[+ many others - apologies if I missed your favorite generator]

2012: Entering the Data-Driven Era



50-Year Air Temperature Record for Ithaca, NY

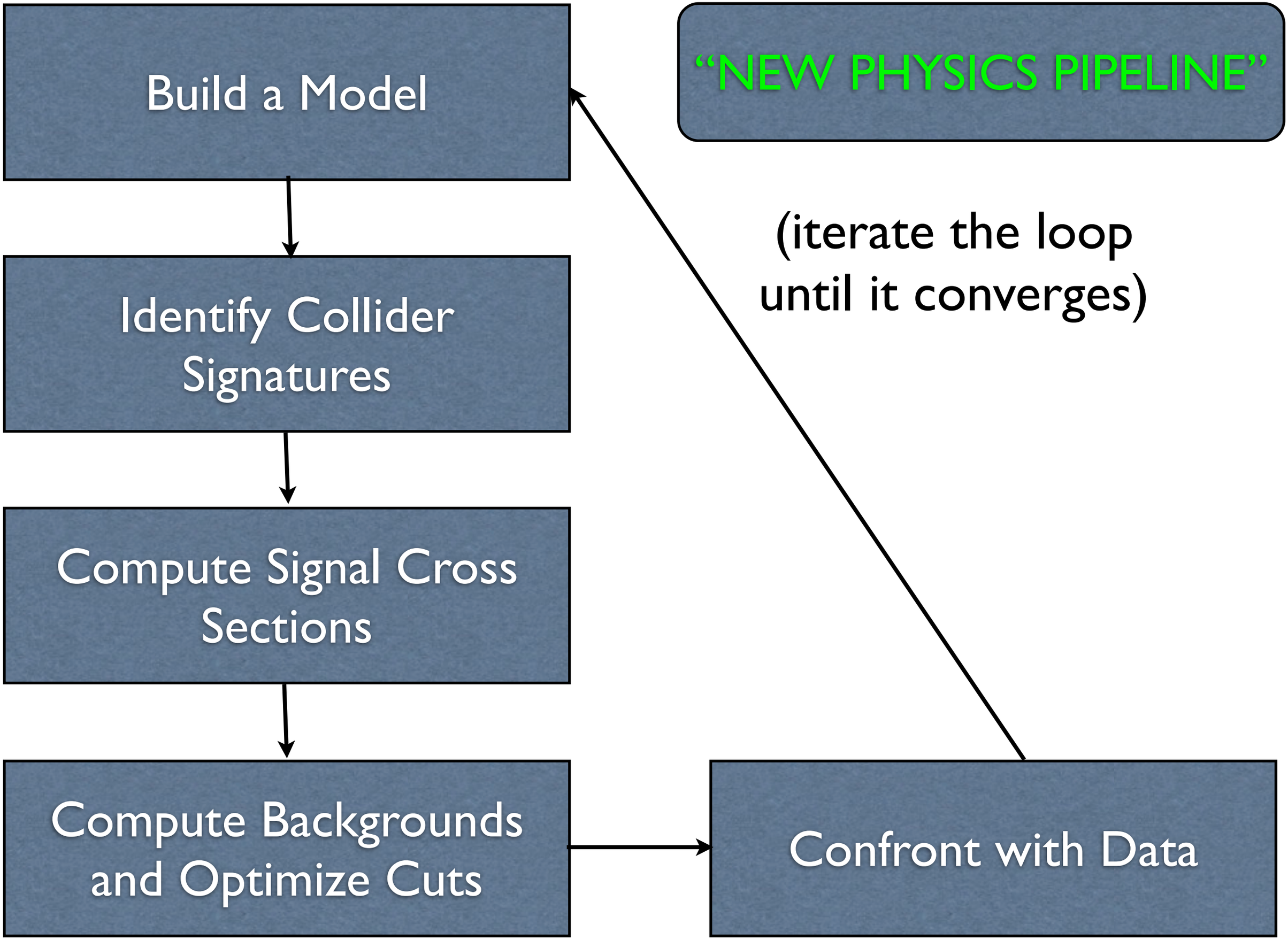


March 21, 2012

$T = 65.5\ (9\sigma)$

March average

$T = 32.4 \pm 3.7$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"NEW PHYSICS PIPELINE"
(iterate the loop until it converges)

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Talks + Discussion Session Saturday

Enjoy the Workshop!