ALEPH 92-69
PHYSIC 92-60
B. Bloch-Devaux and
A. Halley
18.5.1992

Minutes of the KINGAL Monte Carlo Meeting held on 11th May '92 in CERN

The meeting was called primarily to discuss needs, and techniques, for preparing a "Standard QQbar Monte Carlo" for generation and analyses during 1992. The discussion was entirely involved with the necessary input to a coherent MC production at the generator level, and did not involve itself with GALEPH issues of geometry description , calibration, Geant versions,etc.

Short, invited presentations were given on various aspects of comparisons between data and existing Monte Carlo, and the sensitivities of certain analyses to parameters and generator tunings.

Introductory Remarks and Technical Points : Brigitte Bloch-Devaux

In previous MC productions the various MC samples corresponding to differing detector configurations were not always generated with the same KINGAL input-parameter sets and decay tables. This led to confusion and problems for users, together with an increased level of complexity for the book-keeping. Mixing of events from different productions was quite troublesome. The idea this time is to have :

o A standard input-parameter set.

o A very limited number of data cards.

This should mean that generation of standard events is easier in the homelabs whilst making book-keeping simple, and reducing the chances of human error. The proposal (by Brigitte and Eric Lancon) was made for all KINGAL cards to be packed into a single EPIO file eg.

KINREF EPIO with reference number NREF which would be
stored on all computer KIN areas.

This would be automatically loaded by KINGAL prior to being updated by user data cards (if any). The contents of this file could be printed out on request and tools will be made available to inspect and edit its contents. The file could be updated periodically, triggering a change to the generator code number stored in the KRUN bank. The format suggested was :

100 000 * NREF + IGCOD where IGCOD is the usual generator code

This would lead to standard productions where the only necessary cards would be RUN, FILO, TRIG and RMAR cards. ie. this would replace the 700-odd lines of HVFL02 cards for example.
The contents of the KINREF file would also allow generator functions, such as vertex smearing, to be passed equally to all "popular" generators together with input-parameters which are the same for generators sharing the same hadronisation such as JETSET and ARIADNE. This would ensure that the user would get best-fitted parameters by default.

The following presentations were aimed at determining what information could be used to produce this default input-parameter set for the '92 production.

Report on the Inclusive Pi0 Spectrum : Corinne Goy

A brief report on the comparison between rates in data and MC was presented looking at the reprocessed 1991 inclusive Pi0 spectrum.

Pi0's are selected using GAMPEC information with the efficiency taken from the 1991-geometry version of the MC. The background is calculated in data however, and is found to be approximately 20% higher than in the MC.

A preliminary comparison of the Rate = $\dfrac{\text{Number of Pi0 in data}}{\text{Number of Pi0 in MC}}$

showed that, as a function of x, the discrepanies remained within 10% over most values of x up to 0.4. Statistical errors only were used. Averaging over all x, the mean number for R was 1.004 although some marked variations in x were evident.

Report on the Inclusive K0/Lambda "Situation" : Glen Cowan

Glen showed some results on the multiplicity per hadronic event of K0&K0bar and /\&/\bar from Bertram Rensch. These showed the variation of the mean multiplicity with the centre-of-mass energy :

- The K0&K0bar multiplicity was well-modelled by HVFL01 and JETSET(7.3) whereas the HERWIG(5.4) curve lies above the LEP measurements. After ALEPH tuning the HERWIG curve drops a little closer to the data points although the agreement remains worse than for HVFL01.

- The /\&/\bar multiplicity is again well-modelled by HVFL01 with HERWIG and JETSET providing a slightly worse agreement. However, under the ALEPH tuning procedure the HERWIG predictions climb quickly away from any agreement with data over all energies. Glen noted that the tuning procedure "needed refinement". The problem is related to the tuning of the shower cut-off or the maximum cluster mass (CLMAX) which are raised by the tuning and lead to more heavy meson production.

Looking in more detail at the ln(1/x) distributions; the K0&K0bar spectrum was again well-modelled by HVFL01 and less so by HERWIG and its tunings. The data seem to have a slightly harder spectra than predicted. The /\&/\bar ln(1/x)-spectrum shows similar behaviour, again except for the ALEPH tuning of HERWIG 5.4 where the overall number of /\&/\bar is massively overestimated.

Report on the Eta/Eta' "Situation" : Stephen Haywood

A brief report on how JETSET derives the production rates of Eta&Eta' in the LUND model was given. This is done in terms of the mixing angle between the quark flavours where the only difference between the Eta and the Eta' is in the sign of the s-quark contribution. The phase-space suppression of the heavier state is done in terms of the s/u ratio, when producing s-quarks from the sea, rather than during the creation of the

Eta' state, so that the larger meson mass of Eta' itself does not enter.

With a cut on the x of the Eta' at 0.1 :

```
    This leads to : 0.27                    Eta' per JETSET event
    whereas only  : 0.07 +/- 0.02 +/- 0.02  are found in data
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The x-distribution of Eta' shows a consistent overestimation of the production for all values of x whilst for the Eta the agreement is close in both HERWIG(5.4) and JETSET(7.3)

This discrepancy is of direct importance to the Bose-Einstein and Intermittency analyses, and indirectly to many hadronic studies as the Eta&Eta' are "a little factory" of pions and gammas in qqbar events.

eg. the 0.7 Eta' per JETSET event carry 3.9 GeV on average, producing 1.2 Pi+/- carrying 2.0 GeV and 2.3 Gammas carrying 2.0 GeV per event.
Changing the model to give the observed number of Eta' leads to a change of the charged multiplicity by -0.4 with little change in the charged energy.
The photon multiplicity falls by 1.0 units, which accounts for a fall of 0.6 GeV in the energy carried by the photons.

Techniques to correct the model for this discrepancy varied from :

- o Changing the mixing angle to an unphysical value. This has the unfortunate effect of producing too many Eta.

- o To "throw away" 80% of the Eta' as they are produced (in the JETSET routine LUKFDI) and force the model to find another quark/meson combination. This was suggested by Sjoestrand.

- o Rewrite the fragmentation part of JETSET.

After any of the above, it would be necessary to retune the QCD parameters. The last suggestion caused (some) slight hilarity(!).

A general consensus was reached that the second option was the best for the purposes of the '92 MC production and that a suppression factor for the Eta' production should be introduced. This is simple to do, but it would be preferable if this could be implemented in a standard way by the author of JETSET (T.Sjostrand).

Report on the Single Photon "Situation" : Frederic Perrier

A brief review of the Physics-Goals of the qqbar-gamma analysis was presented, emphasising it as a "probe of the parton-shower, free of fragmentation".

The standard MC is only needed in this analysis for ISR and Pi0 background subtraction purposes. They do not trust the MC and cross-check with data, leading to a rescaling of the Pi0 backgrounds by between 1.5->2.5, depending on its energy. However, they are obviously interested in having it resemble measured reality as closely as possible.
Various parton shower evolutions are being studied in the context of the JETSET, HERWIG and ARIADNE models where there is no clear sign that JETSET provides the best agreement in this field.
However further development of the various models is needed.
The following MC input and output criteria were defined as :

- o Inputs : A standard ALEPH qqbar MC incorporating our best knowledge is not necessary for this analysis, but IS "very helpful".

Tuned FSR generators are important although the qqbar-gamma measurement is not sensitive to small changes. This was demonstrated by a plot (by S. Thompson) of the qqbar-gamma rate between tuned and untuned HERWIG, which stays close to unity throughout.

o Outputs : The isolated Pi0 rate needs adjustment, together with a better description of rates and jets.

It would be preferred that little or no "ALEPH cooking" would be involved, rather that changes could be made in agreement with the generator authors.

Would it be possible to use isolated neutral hadrons and neutral jets in the parameter tuning?

A lively discussion ensued, with the consensus that using neutrals could be considered as a long-term goal although unlikely for the standard '92 production due to the time necessary to understand such effects fully. The question of what would happen if the ARIADNE parton-shower provided a better agreement than JETSET was also postponed until the development of ARIADNE stabilised somewhat. On the subject of providing the correct modelling of ISR it was stated that DYMU3 still represents the best knowledge that we have in this area.

> "It may be wrong, but it's still the best we have."

Finally, the Physics-Goal was restated as "not just fitting a bunch of parameters but establishing the parton-shower as a tool of QCD in action."

Sensitivity of Jet-Charge Analyses to MC Parameters : Ingrid ten Have

After briefly reviewing the basis of the jet-charge method, and its dependence on extracting "quark separation factors" using the Monte Carlo, the influence of the various '91 MC productions was detailed.

The separation factors are directly related to the degree with which a jet can be used to reconstruct the charge of its parent quark. These are used in the extraction of sin2thw from a measured charge asymmetry in data.

The major improvements in moving from the 1990->1991 Monte Carlo were :

- o JETSET(6.3) -> JETSET(7.3) including FSR,
- o M(Z0), Gamma(Z0) adapted to latest LEP measurements,
- o QCD parameters retuned and the heavy flavour epsilon parameters,
- o New masses for heavy flavoured mesons,
- o Changes to the HVFL decay tables.

In the case of c-quarks the jet-charge separation changed dramatically between the 1990 MC and the various attempts at the '91 generation. Even taking into account the effects of changes to the QCD tunings, the shift remained highly significant. It is clear from this that changes to the HVFL decay tables were responsible for such dramatic changes, especially in the case of D mesons where the specifc characteristics of its decays mode have a large influence on the quark charge reconstruction. However, such changes were made to the decay tables WITHOUT retuning of the QCD parameters to event shape distributions. This could have the effect of changing both the position of the mean and the width of the charge separation distributions.

Summarising these; the changes in the extracted sin2thw value amount to:

Delta(sin2thw) = 0.0034 from 1990 -> 1991 MC differences whereas
0.0038 is the published uncertainty due to fragmentation

The following requests were then made :

- For a unified tuning of the QCD parameters within the context of the latest HVFL decay tables which will be used for any MC production.
- Would it be possible to include jet-charge specific distributions into the QCD-parameter tuning process?

In the subsequent discussion, it was apparent that such distributions, corrected for the detector acceptance, could indeed be included in the fit. The consensus was that if this could be done in the timescale of two weeks then it could be included.

Foreseen (Minor) Changes from the Heavy Flavour Group : Alain Falvard

A summary of the previous HVFL02 meeting (of Wednesday 6th May) was given where the following changes were proposed :

- Branching Ratio (Psi -> e+e-, mu+mu-) changed to 6% from its current value of 7%. This would be done by changing the Branching Ratio (B -> ccbar + ...etc.)

```
                     |                      6
                     |__ Psi, Psi'...etc. * -
                                            7
```

  as this is the branching fraction which is actually measured when reconstructing Psi's using e+e- and mu+mu-. It was thought that this is a very simple change to implement (approx. 1 hour!).

- The decay mode : B -> (D** or D* Pi) + lepton,neutrino will be fitted in order to find the correct energy distribution in the B rest-frame as observed by ARGUS & CLEO. This was thought to take of the order of 2 weeks. The point was made that there are no other D** decay modes modelled, apart from the leptonic ones shown above.
- Implementation of internal bremsstrahlung in the processes :

  B -> lepton + neutrino + X and D -> lepton + neutrino + X

  This is under study but could be implemented rather simply by calling PHOTOS from KINGAL, however there are technical problems too. The suggestion was that, if this was ready on the timescale of 2 weeks for starting test productions, then it should be used.
- Fragmentation parameters (epsilon c and b) have to be changed when the QCD parameters are retuned. The values are adapted to reproduce to x_c and x_b distributions as fitted to the data. This was expected to be done soon after the retuned QCD parameters became available. It was suggested that this procedure might be iterated with Gerald's tune to ensure a good quality of fit throughout.

It was mentioned that the time scales (of roughly 2 weeks) could be reduced if this was thought necessary.

QCD Model Parameters : Gerald Rudolph

Previous QCD fits have been made using the "original" JETSET generator and did not take into account the modified decay tables and other "goodies" incorporated into the ALEPH HVFL series of generators. The general consensus was that such a coherent tuning is important for the standard '92 Monte Carlo.

Due to technical problems in running HVFL02 within the QCD tuning procedure, a comparison of the fitted parameter values between HVFL02 and JETSET(7.2) was only available at the moment. Using identical QCD parameters sets for the two he observes the following changes :

	JETSET(7.2)		HVFL02
o The mean charged multiplicity changes from	20.86	->	20.93
o The mean number of photons changes from	21.18	->	21.09

o Other changes in Pi, K, Eta and Eta' rates remained small while there are small, but significant, changes in the heavy D and B meson rates coming from the modified decay tables. Mixing was also observed(!) in the numbers of B0 mesons appearing in the event record although this is understood from the way HVFL stores the mixing history...

The differences in the fitted event-shape distributions such as the momentum spectra are below the 1% level except at the highest x where it rises to 2->3%. Hence, in such distributions he expects little differences when the parameters are retuned within the HVFL framework.

Several JETSET problems in particle distributions were then dicussed :

o The Pt_out tail is too low, and has consequences for the global fit as Lambda(Leading Log) is pulled up and distorts the 3-jet rate. So the fitted values of Lambda, Mmin, Sigma and B depend on which distributions are included in the fit. These differences are included in the systematic error.

o The shape of the x_p(charged) distribution has problems at around x_p = 0.15 which are related to the fact that there is a 900 MeV difference in the charged energy observed in the data and that modelled by the MC. Here, the sensitive parameter is the vector to pseudoscalar ratio for (u,d) quarks. Gerald mentioned that he had problems in generating the large numbers (3,000,000) of events necessary for tuning when he used values significantly higher from the 0.5 default value. Several offers of help, and ideas were made on how to circumvent this technical LUND problem.

o In an attepmt to solve the Eta&Eta' "situation", Gerald had also tried setting the mixing angle to various values with the conclusion that he hoped that the method of "throwing away" 80% of produced Eta' during the fragmentation routines in JETSET would work better. Changing the mixing angle still gives rates which are too high.

o The K0 spectrum is too high at low x. Neither this, or the Pt_out tail are understood.

o The measured <x_b> of 0.71 (+/- 0.01) in data can be obtained in the JETSET model using an epsilon_b value of 0.0045 (giving a <x_b> value of 0.708 in the MC) which could be taken for the first iteration by the Heavy Flavour Group for the epsilon parameter tuning.

Finally, he then discussed the tuning of the new HERWIG(5.4) version which has new hard-gluon matrix elements and FSR. This gives a better overall chi**2 but problems in the 2-jet rate and in the high-x regions of the fit distributions remain. Also, the /\&/\bar rate is "extremely" sensitive to the mass parameters M(gluon) and M(cluster max) in this model so that, without additional parameters, the tuning procedure ends up by dramatically overestimating the /\&/\bar rates.

Some technical questions were asked regarding the fitting techniques.

It turns out that it requires two weeks of VAX 3100 CPU time to generate the 3 million generator events used in the fits. This equates to 200,000 events at each of 15 points. Suggestions were then made for running this on a series of ALWS nodes where it should be possible to do it in the order of 1 day. Gerald said that the program had already be brought to ALWS.

Proposal for a Procedure : Alain Blondel

Alain briefly outlined how he thought an iterative tuning procedure might be done to make maximal use of :

- What physical observables we already have :

  Charged track multiplicity,
  Charged track momentum spectra,
  Kaon spectra and rate,
  Lambda spectra and rate,
  Lepton spectra and rates,
  Charge seperation for b-quarks etc.

- A FAST run using KINGAL+Decays+Cuts+Smearing procedure.

This engendered a lively discussion. It was observed that such a procedure did not take into account correlations between parameters, or non-linear effects coming from their variation. The general consensus seemed to be that we were in a good position to take into account the physical observables we have and that we have the tools to carry out a coherent tuning procedure taking this knowledge and systematic errors etc. into account.

General Discussion

The following discussion crystallised what precisely was going to be changed for the '92 productions. The could be summarised as follows :

First and Foremost : We should tune the QCD parameters using the full "best-knowledge" we have at the moment. Currently this is embodied in the HVFL02 generator.

(a) The Eta&Eta' rates would be fixed using a modification to the JETSET fragmentation routines.

(b) The Psi branching fraction will be changed to 6% from the previous 7% value.Semi-leptonic B decays will be updated accordingly.

(c) The (D** or D*Pi) + lepton,neutrino branching fraction will be fitted to the observed lepton energy distribution from ARGUS&CLEO and introduced into HVFL02.

(d) If internal bremsstrahlung processes in heavy flavour leptonic decays can be correctly implemented in the timescale for generation, then it will be included.

(e) The epsilon c and b parameters will be adapted to agree with the measured x_c and x_b in data.

(f) Some detector corrected distributions , related to K0 and /\0 production , are ready and will be introduced in the fits.
If a detector corrected jet-charge distribution could be made available in time for the QCD fits (2 weeks) then it could be used in the QCD parameter fitting procedure.

A request was made for more frequent meetings of this type, now that the uses of the MC has become so tightly intermingled between various analyses. The summary meeting, at which things should hopefully be fixed for production, was decided to be :

Tuesday the 2nd of June in the Afternoon.
Exact time and place will be announced by an Alnews.

Prepared by Andy Halley (12/5/92)
and B. Bloch-Devaux (18/05/92)

KINGAL Meeting
May 11, 1992
B. Bloch
(+ E. Lançon)

Remarks on last years productions :

- Productions corresponding to a particular set-up of the Detector were not always produced with the same set of KINGAL parameters
  - ⟶ troubles at analysis level
  - ⟶ confusion for users
  - ⟶ increased complexity for book-keeping
- Production should need a very limited number of Data cards
  - ⟶ easier for people in homelabs
  - ⟶ easier for book-keeping
  - ⟶ more robust against human errors
  - ⟶ easier to maintain as reference values are automatically loaded in all generators

Proposal: set up a REFERENCE SET to be used for productions.

- This file KINREF EPIO will reside on KIN areas.
- It will be automatically loaded by KINGAL before the user's Data card.
- Content can be inspected by setting the data card PREF (Print REFerence file)
- This file can always be overwritten (fully or partly) by user's data card (which are stored in the header of the file)
- The file has a version number NREF which is transmitted to the run header KRUN.

  First data word will be:

  100 000 * NREF + iGCOD (generator identifier)

  It's backward compatible as previous prods have NREF = 0

Production could be run with a very limited number of Data cards

```
RUN     NRUN      'TITLE OF RUN'
FILO    ' output device name'
TRIG    NEV1      NEV2
RMAR    iseed1    iseed2
```

Content of the Reference Set

It should be enough for the most 'popular' generators :

GENERAL + smearing of vertex position SVRT

HVFL02 + defaults settings of specific paramete

- mixing GMIX
- $b \rightarrow u$ GVBU
- semi_leptonic B decays GSEM
- .....

\+ modified settings of JETSET 73

JETSET 7.3 / JETSET 7B

\+ default settings of switches MSTJ
i.S.R , F.S.R. , Fragmentation

\+ default settings of parameters
QCD , fragmentation PARU, PARJ
PMA1
Decay tables and branching ratios
GRPL, GADM, GMOB

HERWIG 5.4 (no overlap with jetset)
\+ default setting of switches and param.
F.S.R. , QCD , decays GMAS
GSTA
GHWG, GGSW, GPAR

ARiADNE 4 (no overlap with herwig , no conflict with jetset 7.3)
\+ default setting of switches and param.
F.S.R , P_t cuts 4STA
PARA
GARi

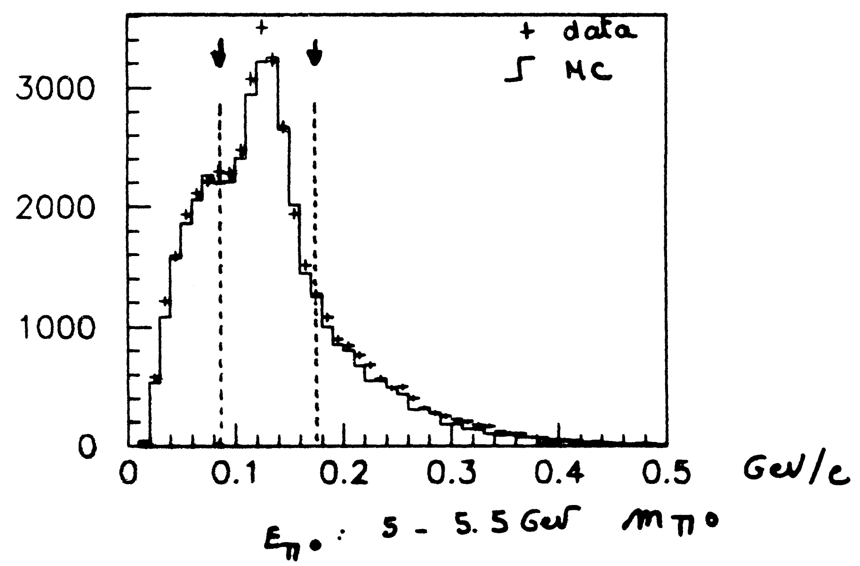
KINGAL meeting
C. Goy
11/05/92

π^0 inclusive spectrum

(> 5 GeV - non resolved)

- Selection : → { EGPC (gampec)
  Combinations inside same clust
  → 91 reprocessed data .
  → MC : 91 geom
  Lund 7.3

Signal



- Efficiency : taken from MC

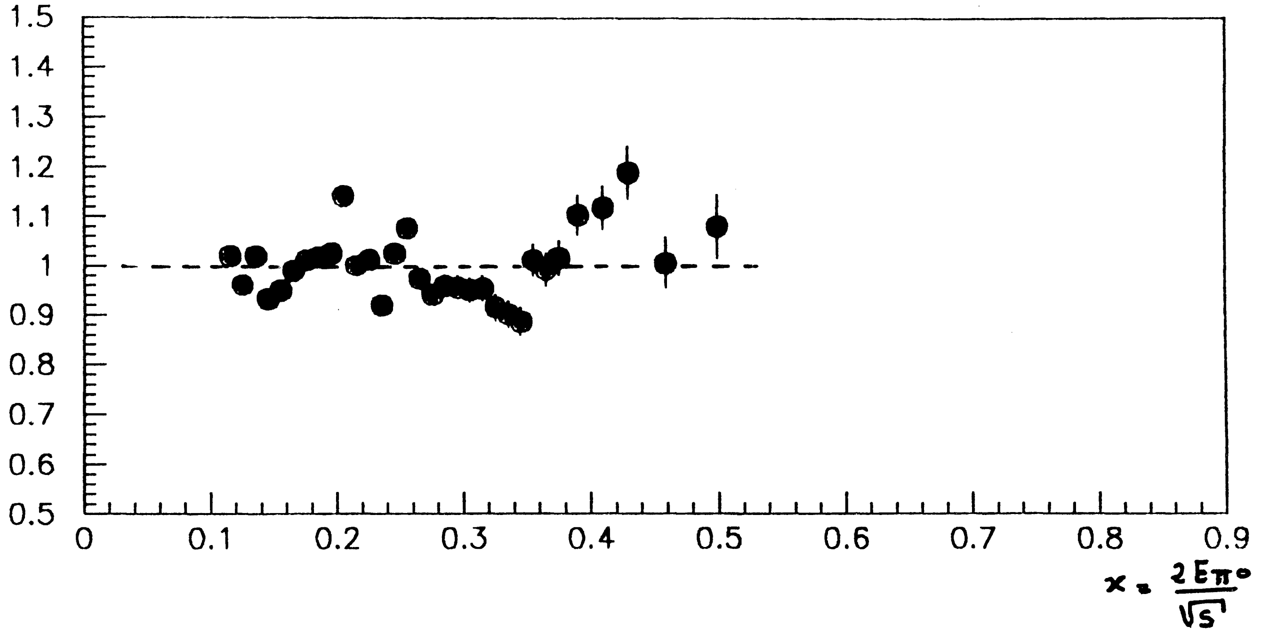
- Ratio $\frac{S}{B}$ fitted from the distribution
  (MC or data)

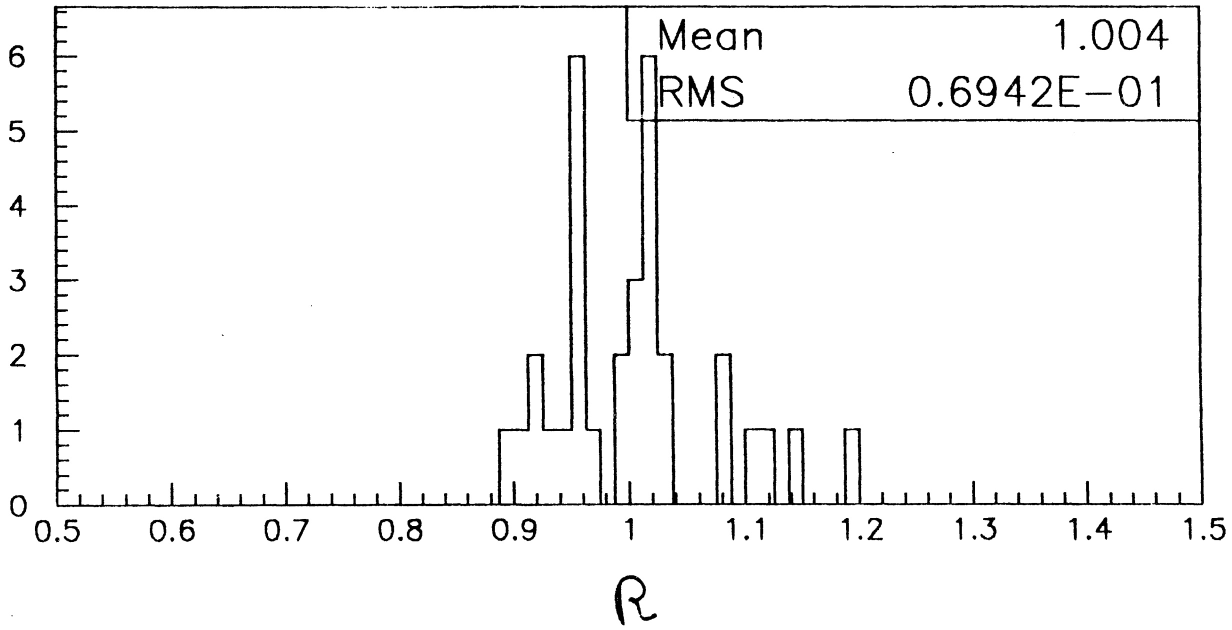
Background ~ 20% higher in the data

Comparison Data / MC

(preliminary - no systematic error)

$$R = \frac{Data(\#\pi^0)}{MC\ rec\ \#\pi^0}$$





KINGAL
MAY92

KINGAL Meeting

GLEN COWAN
(for Bertram Rensch)
11/5/92

Multiplicity per Hadronic Event

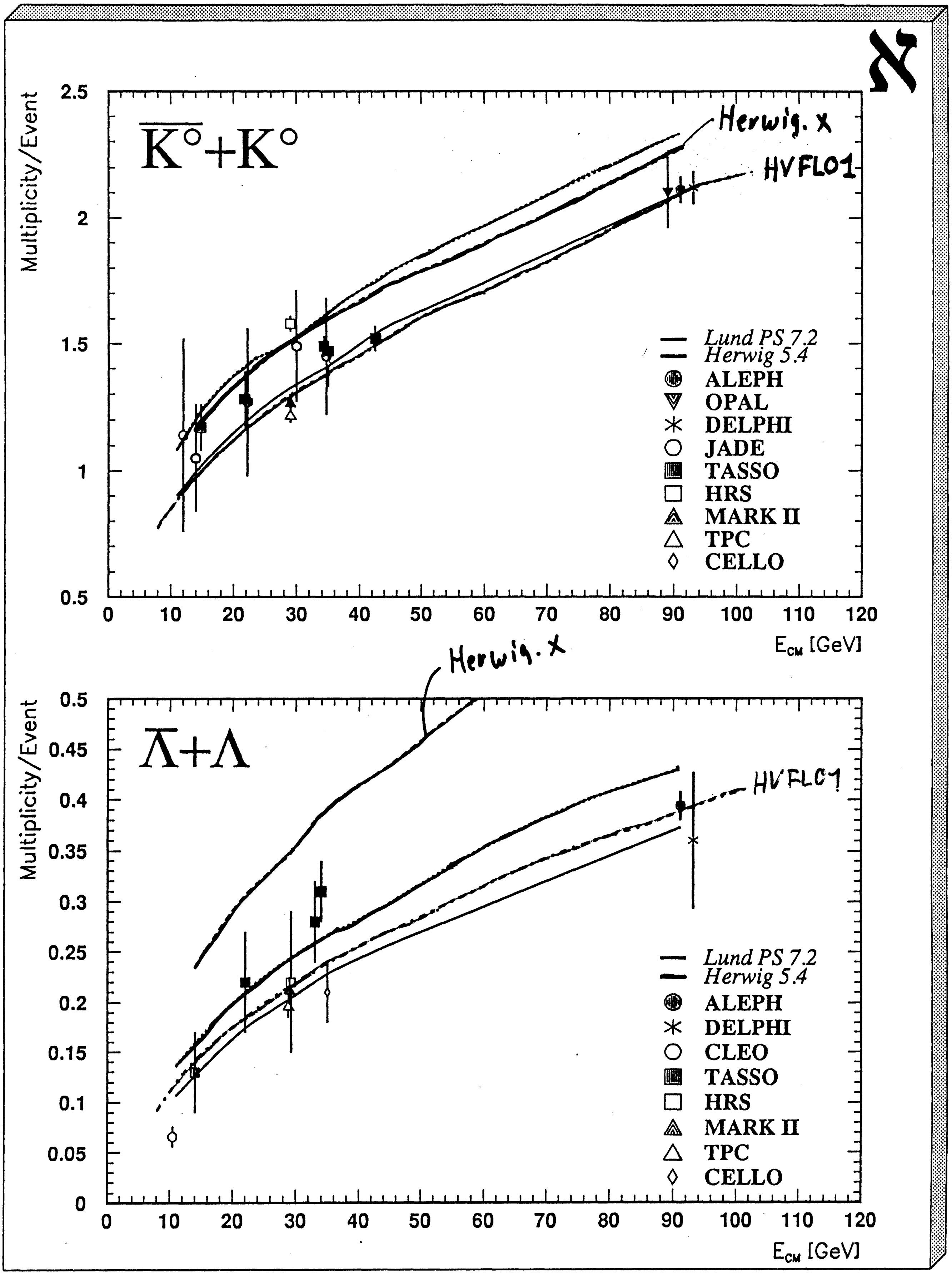


Abbildung 24a

Monte Carlo Predictions

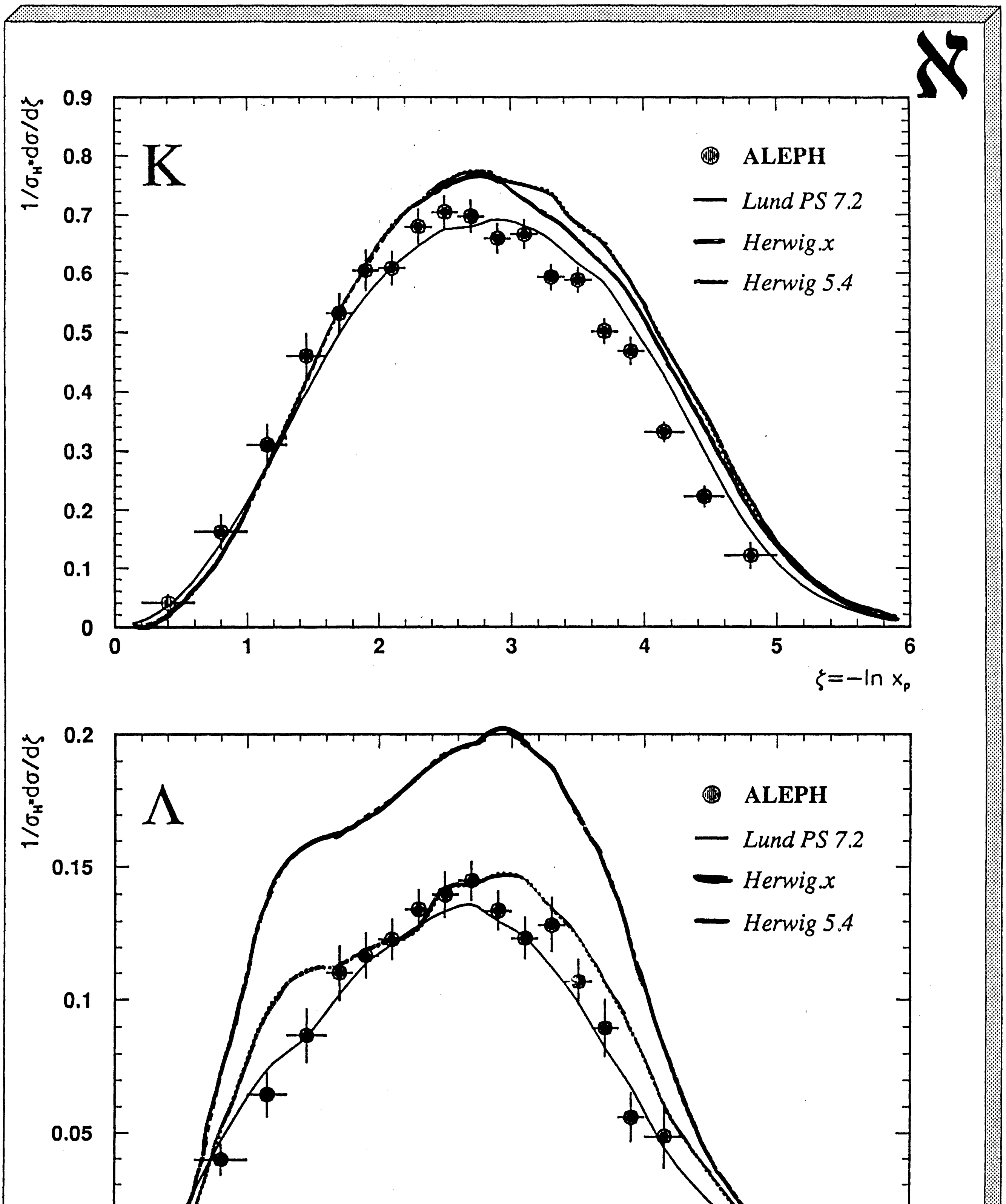


Abbildung Ksi

Monte Carlo Predictions

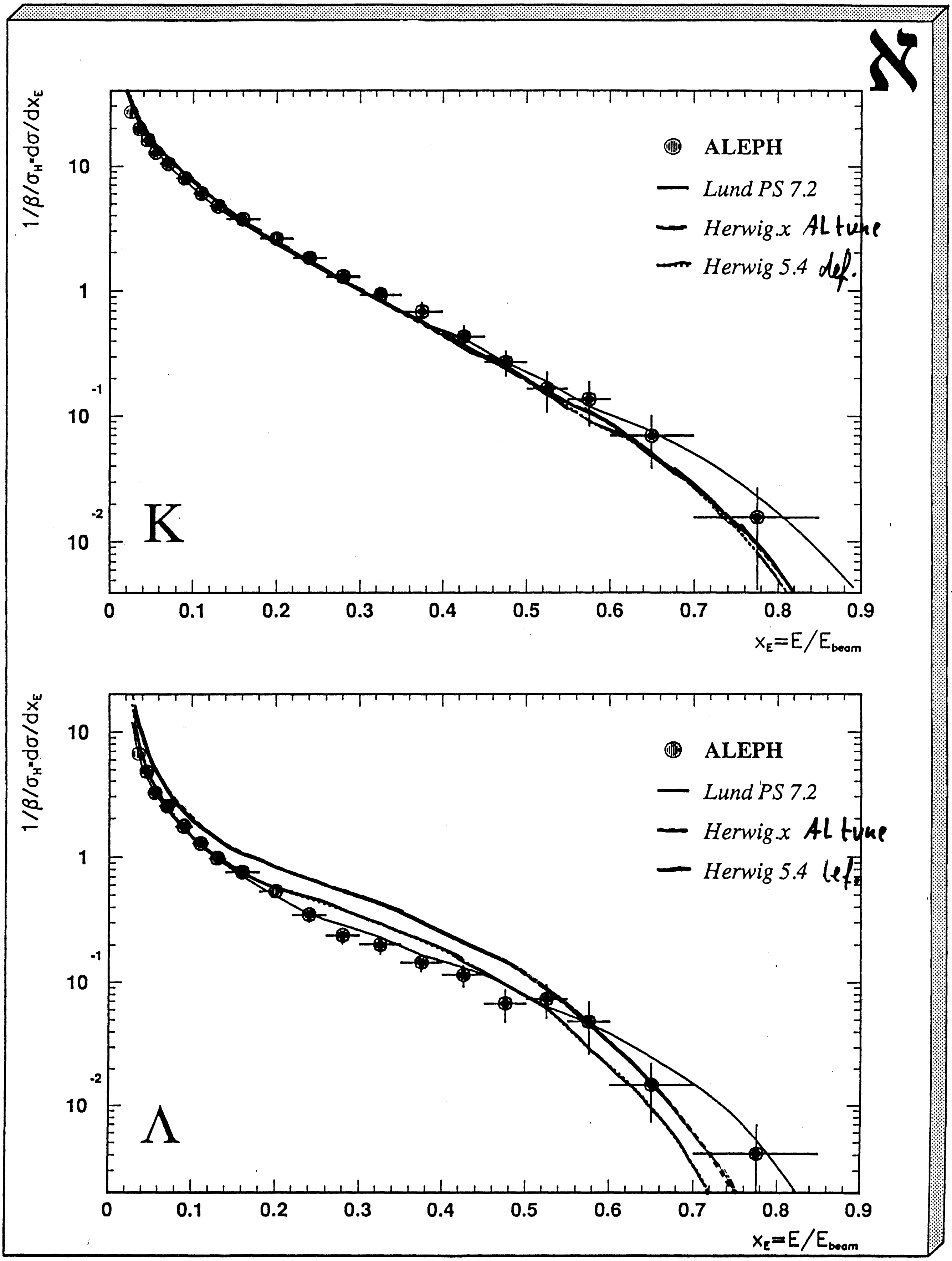


Abbildung Xb

KINGAL Meeting
SJH
11-5-92

$\eta + \eta'$ in Lund

- $\eta + \eta'$ are 0^- mesons (π, K, η)

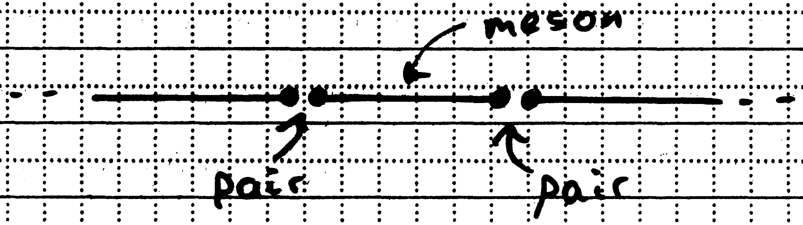
- In Lund, described in terms of quarks:

$$\eta = -\sin\theta\,\eta_1 + \cos\theta\,\eta_8 = \tfrac{1}{2}(u\bar{u} + d\bar{d} - \sqrt{2}\,s\bar{s})$$

$$\eta' = \cos\theta\,\eta_1 + \sin\theta\,\eta_8 = \tfrac{1}{2}(u\bar{u} + d\bar{d} + \sqrt{2}\,s\bar{s})$$

a) Choice of mixing angle not optimal ~1.5

b) Use effect mass of created pair
to determine strange suppression
- not meson mass ~3.0



⟹

- Possibilities:

i) Mixing angle - unphysical - too many η

ii) Throw away 80% η'

iii) Rewrite LUND

Then RETUNE

LUKFDI:
q_1
→ q_1 $\bar{q}_2$ q_2
└ meson

- Who Cares ? Bose-Einstein

  Intemittency ?

- In LUND, per $Z \to q\bar{q}$:

	0.7 η'	carrying	3.9 GeV
	1.2 $\pi^\pm$	"	2.0 GeV
→	2.3 γ	"	2.0 GeV

$\eta' \to$	$\eta \pi^+ \pi^-$	44%
	$\eta \pi^0 \pi^0$	21%
	$\rho \gamma$	30%
$\eta \to$	$\gamma \gamma$	40%
	$\pi^0 \pi^0 \pi^0$	32%
	$\pi^+ \pi^- \pi^0$	24%
$\rho \to$	$\pi^+ \pi^-$	100%

- Throw away 80% η'

$x > 0.1$	Lund	Data
η	0.26	0.30 ± 0.02 ± 0.0
η'	0.07	0.07 ± 0.02 ± 0.0

Change	Mult	Energy
γ	-1.0	-0.6 GeV
charged	-0.4	-0.4 GeV

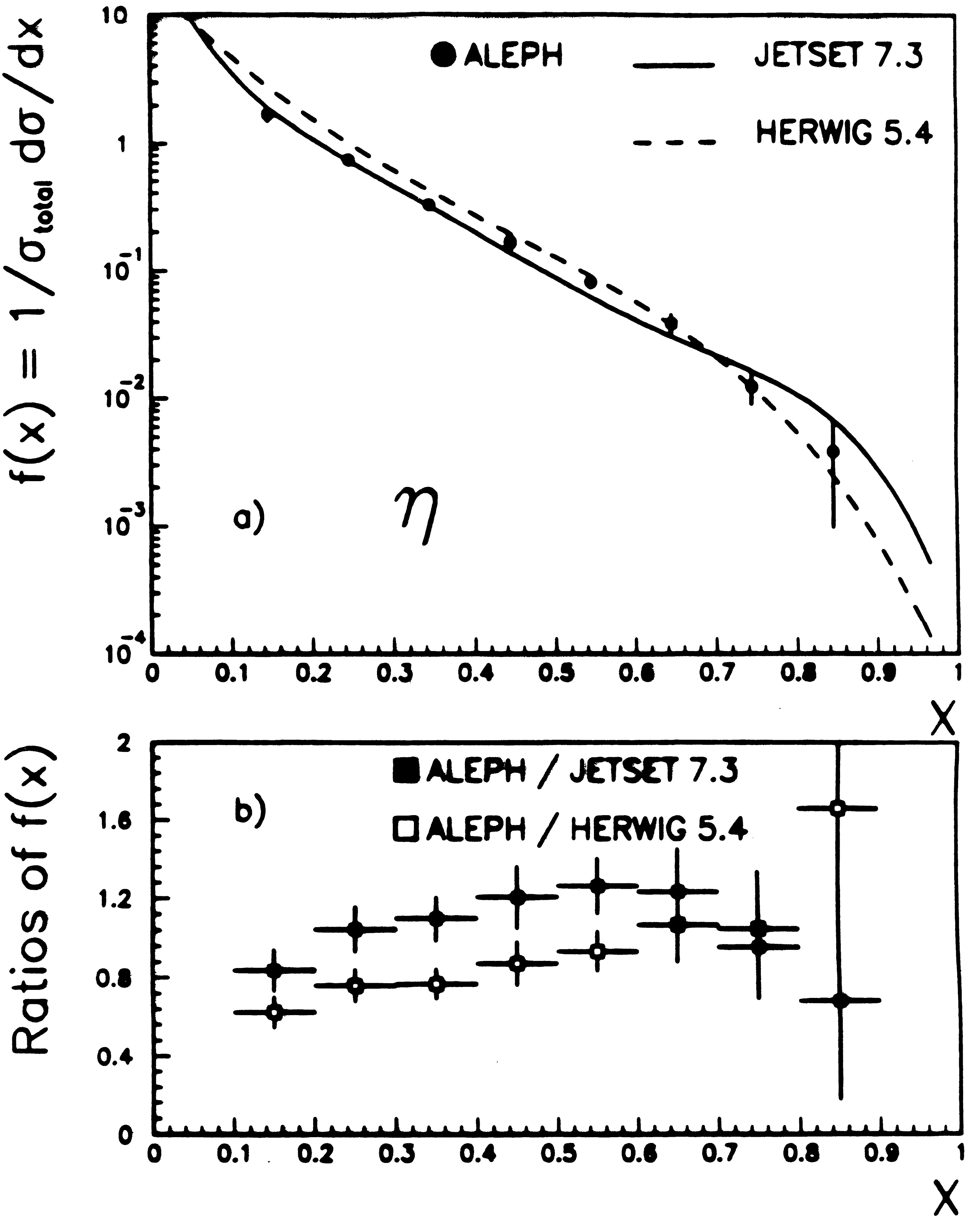


Figure 2: a) The corrected η fragmentation function compared with the predictions from JETSET 7.3 and HERWIG 5.4. b) The ratios of the fragmentation functions. All errors shown are statistical only.

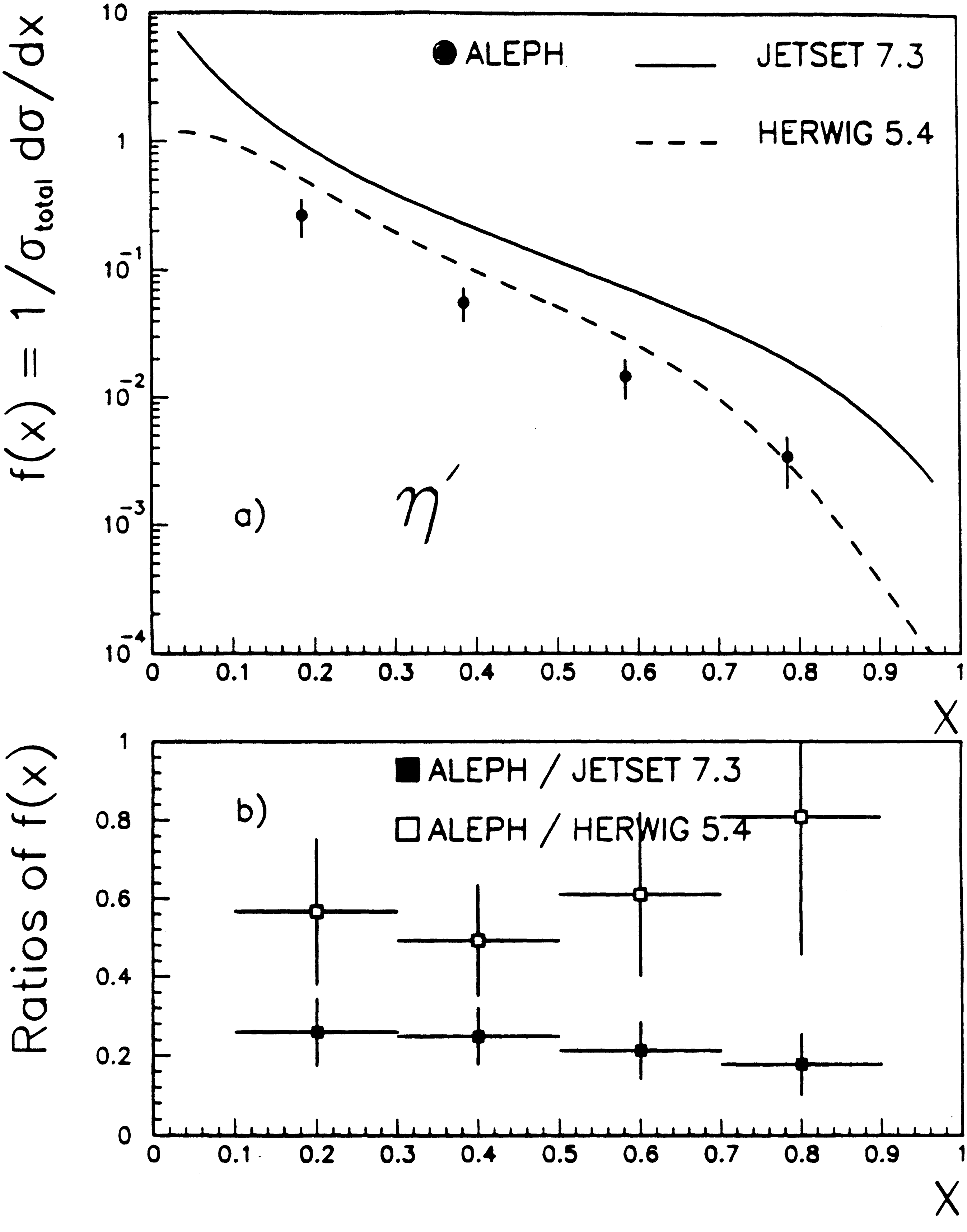


Figure 4: a) The corrected η' fragmentation function compared with the predictions from JETSET 7.3 and HERWIG 5.4. b) The ratios of the fragmentation functions. All errors shown are statistical only.

FREDERIC PERRIER
CE - SACLAY

MAY 11, 1992
KINGAL MEETING

$Q\bar{Q}\gamma$ AND MONTE-CARLOS

- $Q\bar{Q}\gamma$ MC NEEDS
- $Q\bar{Q}\gamma$ MC STATUS
- $Q\bar{Q}\gamma$ OUTLOOK FOR MC

PHYSICS GOAL: $Q\bar{Q}\gamma$ AS A PROBE OF PARTON-SHOWER FREE OF FRAGMENTATION

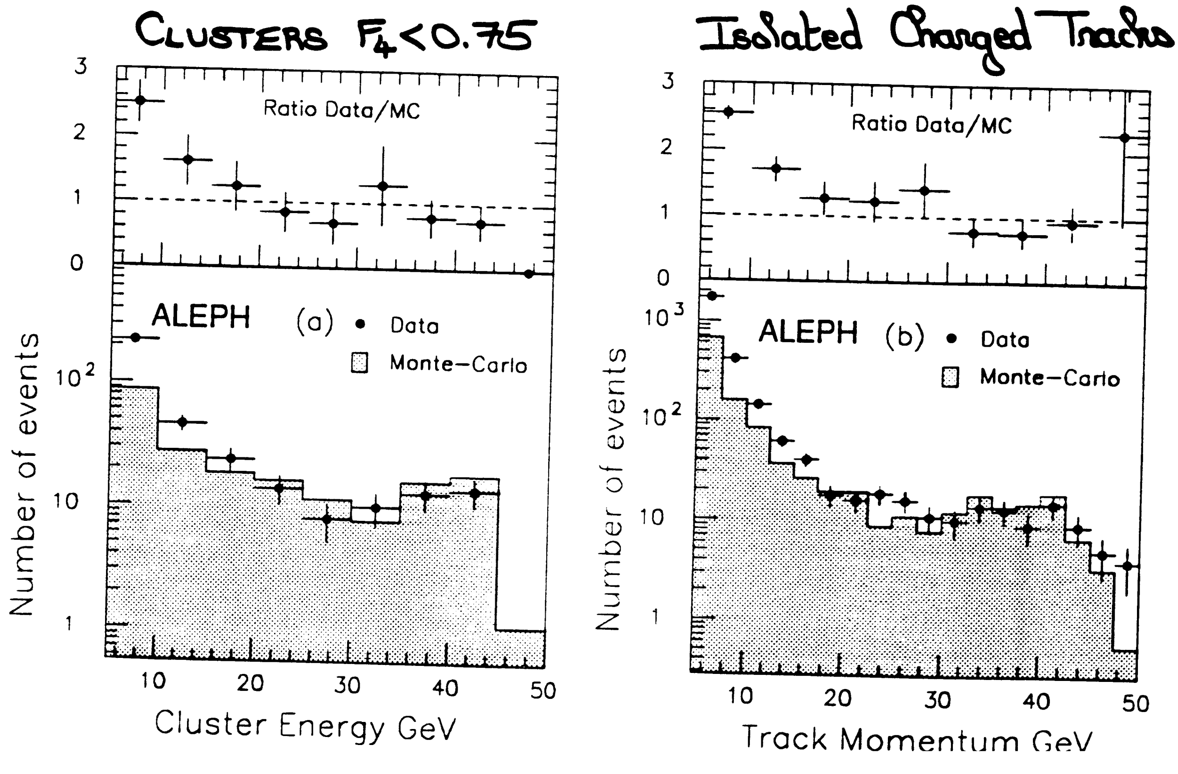
MC NEEDS : ① ISR AND π^0 BACKGROUND SUBTRACTION

USE "STANDARD" ALEPH $Q\bar{Q}$ MC

- DO NOT TRUST MC: CROSS-CHECK WITH DATA

$\longrightarrow$ RESCALE π^0 BACKGROUND BY 2.5 $5 < E < 10$ GeV
1.5 $10 < E < 15$ GeV

- **HOWEVER:** STILL USEFUL TO HAVE A DESCRIPTION AS CLOSE AS POSSIBLE TO REALITY.


CLUSTERS $F_4 < 0.75$

Isolated Charged Tracks

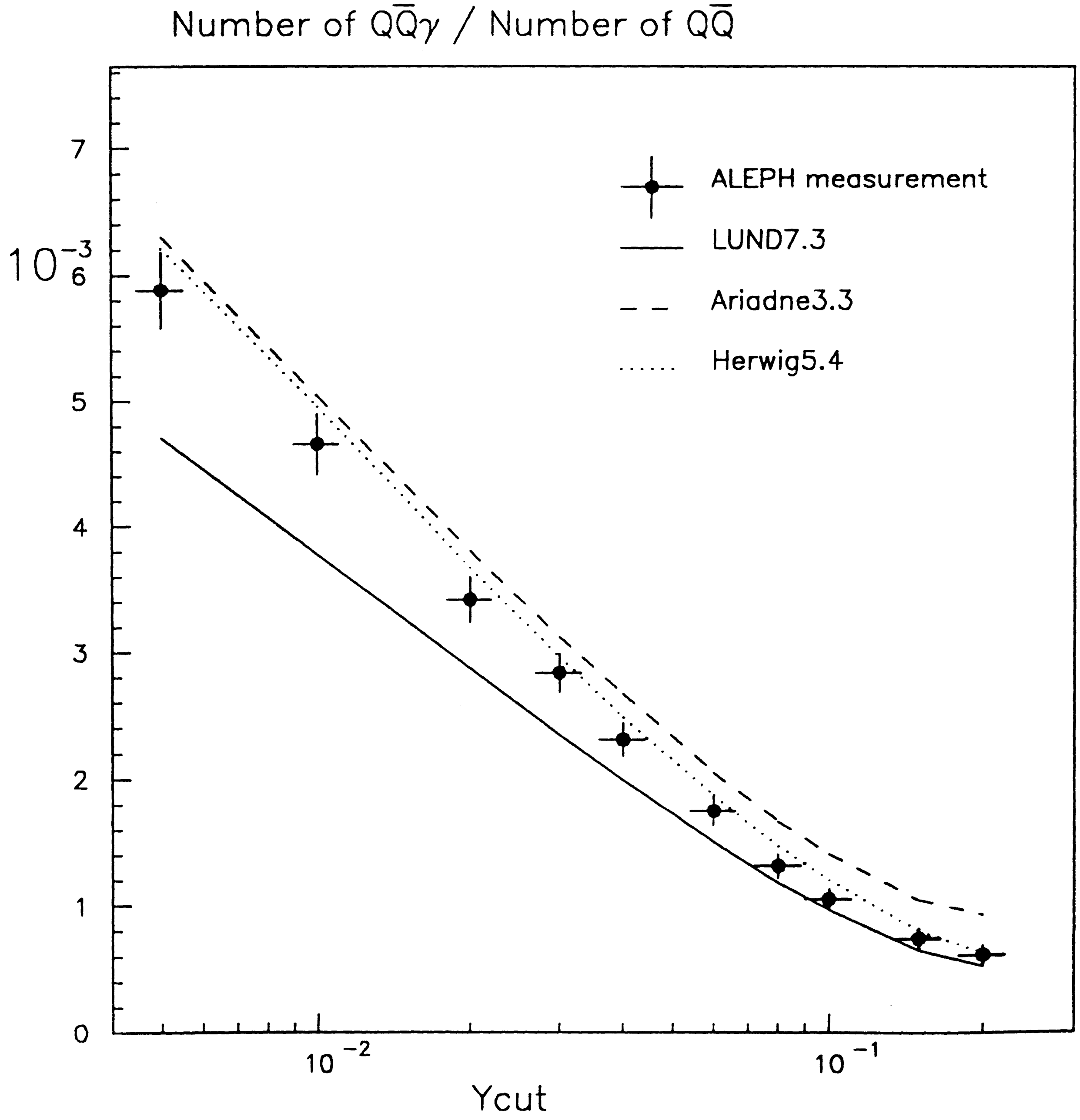
② FSR PREDICTION:

- JETSET 7.3 (PS)
- ARIADNE 3 & 4 (PS)
- HERWIG 5.4 (PS)
- GNJETS (ME)

QQ̄γ CAN TEST PARTON EVOLUTION

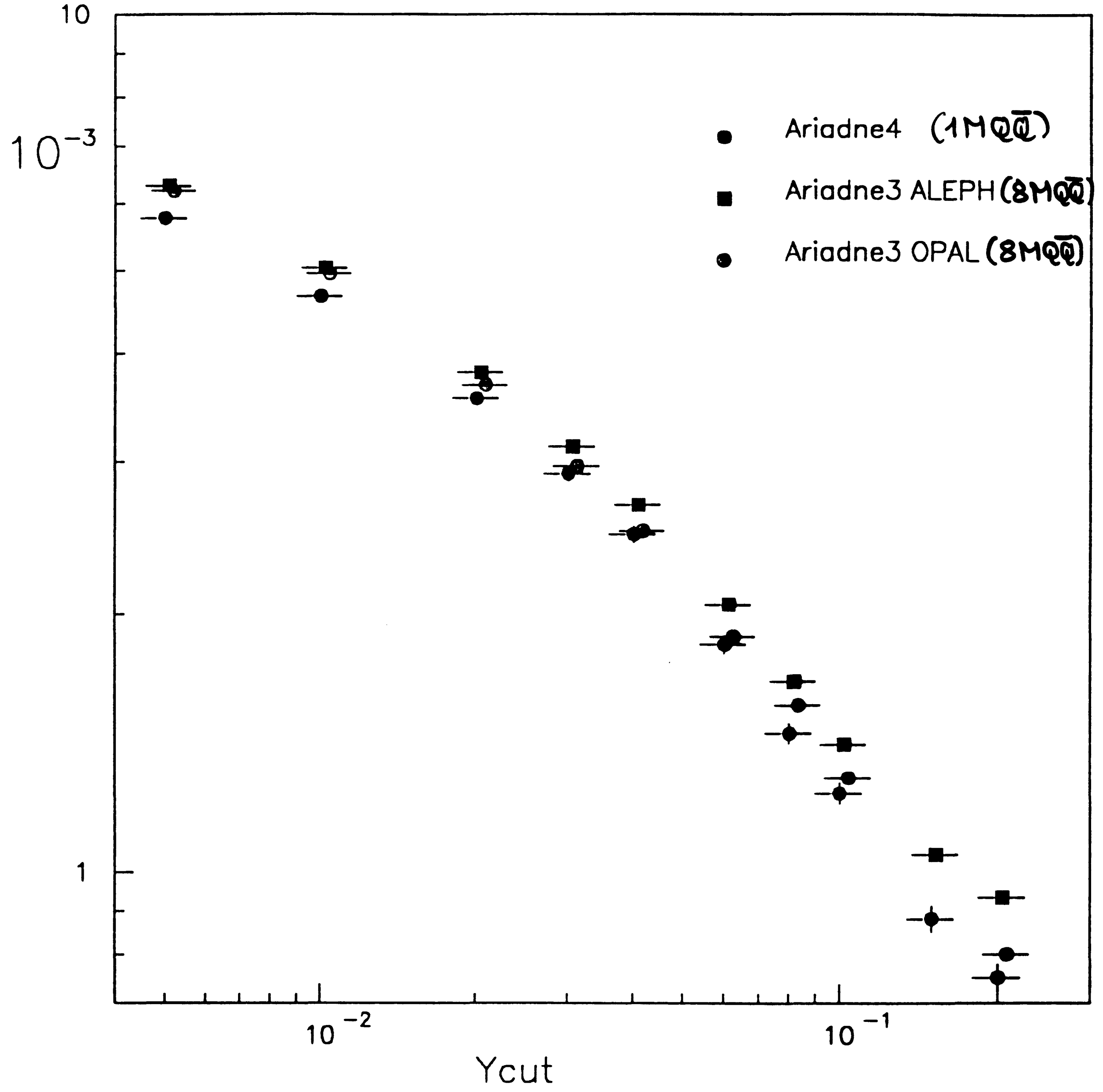
JETSET MAY NOT BE CORRECT

10/05/92 18.12

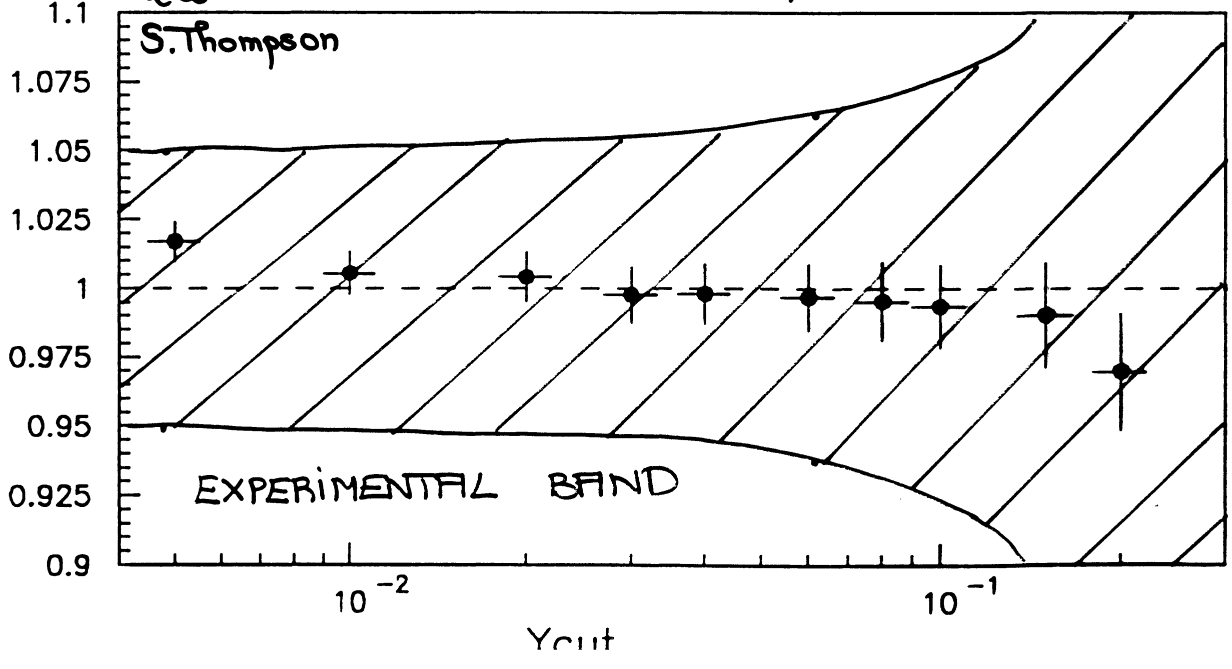


10/05/92 18.11

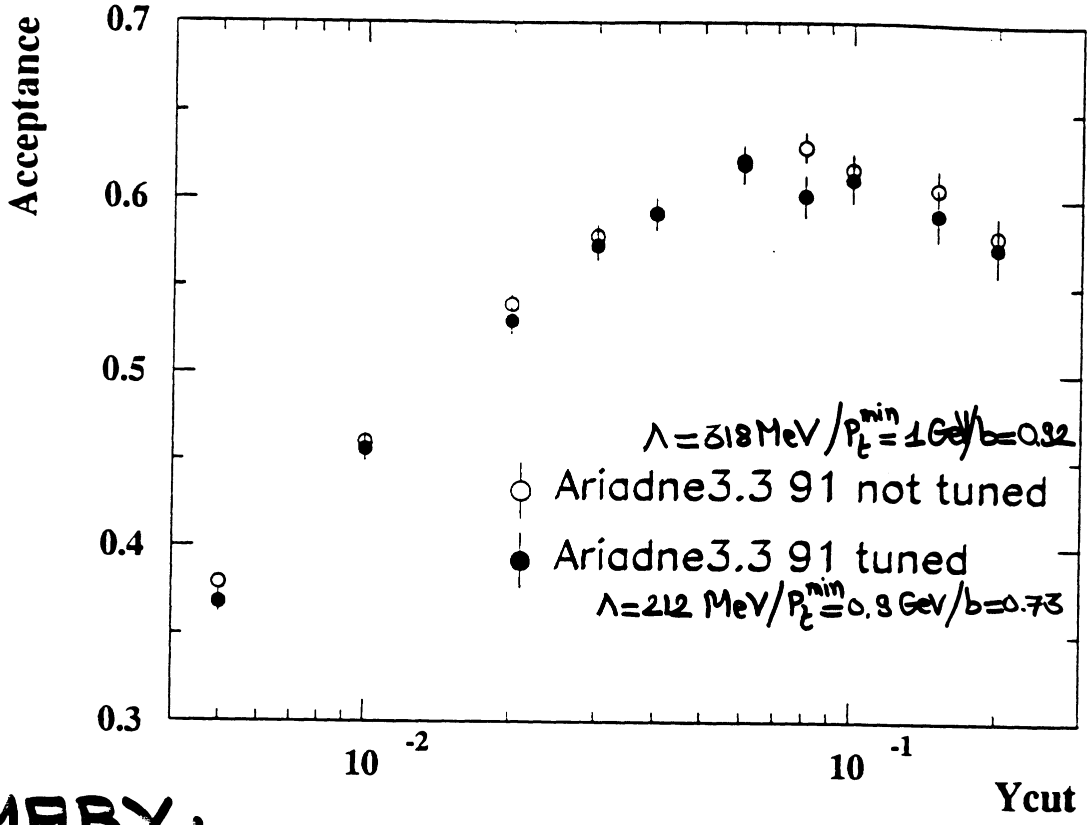
Number of $Q\bar{Q}\gamma$ / Number of $Q\bar{Q}$



QQ̄γ RATE HERWIG TUNED/HERWIG DEFAULT



③ ACCEPTANCE CORRECTION FSR:



SUMMARY:

MC INPUTS FOR $Q\bar{Q}\gamma$:

- "STANDARD" ALEPH $Q\bar{Q}$ MC

  "STANDARD" = BEST KNOWLEDGE

  NOT NECESSARY BUT VERY HELPFUL

- "TUNED" FSR MC GENERATORS

  "TUNED" = REPRODUCES PARTICLE DISTRIBUTIONS

  NOT SENSITIVE TO SMALL CHANGES

$Q\bar{Q}\gamma$ OUTPUTS FOR MCs:

- ISOLATED π° RATE ADJUSTMENT

  → BETTER DESCRIPTION OF RATES/JETS

  WHAT ABOUT ISOLATED NEUTRAL HADRONS AND HADRON NEUTRAL JETS?

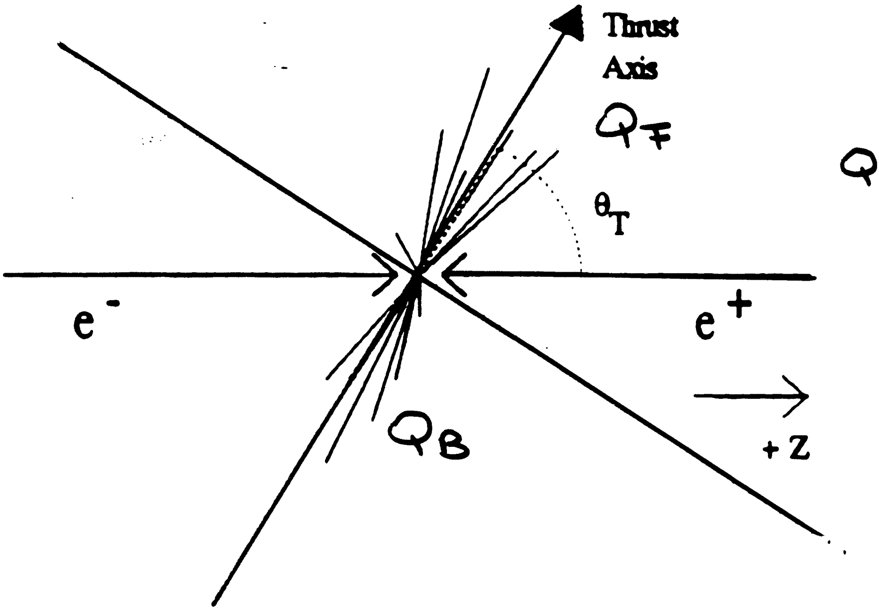
- $Q\bar{Q}\gamma$ GIVES INSIGHT ON PARTON SHOWER MECHANISM

  GOAL: NOT ONLY FITTING A BUNCH OF PARAMETERS BUT ESTABLISH THE PARTON SHOWER AS A TOOL OF QCD IN ACTION (NON PERTURBATIVE?)

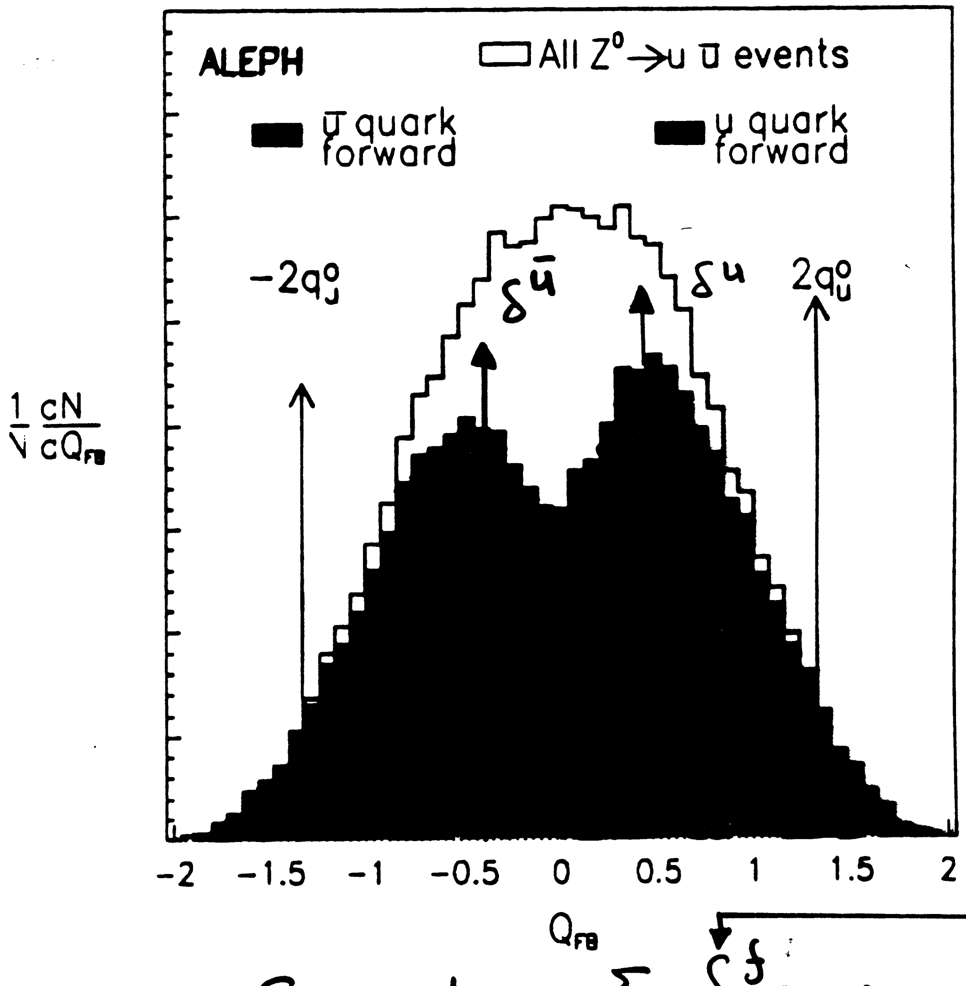
→ START A GLOBAL PHENOMENOLOGY OF THE PARTON SHOWER IN ALEPH ????

KINGAL Meeting 11/05/92 Ingrid ten Have

INTERPETATION OF Q_{FB} IN TERMS OF $\sin^2\theta_W$



$$Q_{FB} = Q_F - Q_B$$



$$\delta^f \equiv \langle Q_{FB} \rangle^{f,FW}$$

$$\langle Q_{FB} \rangle = C_{ACC} \cdot \mathcal{A}_e \cdot \frac{\sum_f \delta^f a_f v_f}{\sum_f (a_f^2 + v_f^2)}$$

MONTE CARLO

	1990 PUBL.	1991 ATTEMPT I		1991 FINAL D* / OLD. RECO		1991 FINAL D* / RECO	
δ^d	0.208	0.220	$+2.4\sigma$	0.223	$+2.2\sigma$	0.223	$+3\sigma$
δ^u	0.421	0.396	-5.0σ	0.401	-3.0σ	0.412	-1.8σ
δ^s	0.284	0.294	$+2\sigma$ 2.4σ	0.291	-0.9σ	0.300	$+3\sigma$
δ^c	0.171	0.123	-9.6σ	0.140	-4.6σ	0.137	-6.8σ
δ^b	0.217	0.221	$+0.8\sigma$	0.220	0.4σ	0.217	$+0\sigma$
	±0.003	±0.004		±0.006		±0.003	

<u>CHANGES MC 1990 → 1991:</u>

- LUND 6.3 → LUND 7.3
  1991 INCLUDES FINAL STATE RADIATION
- M_{Z^0}, Γ_{Z^0} ADAPTED
- QCD PARAMETERS + ε_b & ε_c CHANGED
- NEW MASSES HEAVY FLAVOUR MESONS
- CHANGES IN HVFL DECAY TABLES

CARD	Parameter	Parameter Codename or MC range and effect	1990 Value	1991 Value	
GLUN	$\sqrt{s}$	ECMS	91.2 GeV	91.2 GeV	
GSTA	Lund Code of final state part	ICOD	??	??	
PMA1 23 (PMAS 2)	Z mass		91.17 GeV	91.182 GeV	
PARJ 123 (PARE 6)	Z mass		91.17 GeV	91.182 GeV	
GDYM	Z mass	ZMASS	91.17 GeV	91.182 GeV	
PARJ 124 (PARE 7)	Γ_Z		2.5 GeV	2.484 GeV	
GDYM	Γ_Z	GAMM	2.5 GeV	2.484 GeV	ΔS^c
QCD Params					
PARJ 81 (PARE 21)	Λ_{QCD}	0.26 – 0.40 4.4 %	0.349 GeV	0.318 GeV	+0.024
PARJ 82 (PARE 22)	M_{MIN}	1.0 – 2.0 2.2 %	1.46	1.43	−0.0003
PARJ 21 (PAR 12)	σ_{MT}	0.34 – 0.40 1.9 %	0.340	0.360	—
PARJ 42 (PAR 32)	b	0.85 – 0.93 2.8 %	1.0	0.92	—
PAR 54 (PAR 44)	ϵ_c	0.002 – 0.071 3.7 %	−0.016	−0.040	−0.018
PARJ 55 (PAR 45)	ϵ_b	0.003 – 0.010 4.4 %	−0.008	−0.006	—

+0.006

SAMPLE $\Sigma \delta av$	1990	1991 NEW D	1991 FINAL D*/OLD RECO	1991 FINAL D* + RECO
u_type	0.592	0.519	0.541	0.549
d_type	0.709	0.735	0.721	0.740
TOTAL	-0.2583	-0.3047	-0.2865	-0.2965
$SIN^2\theta_W$	0.2288 ±0.0023	0.2322 ±0.0018	0.2310 ±0.0020	0.2317 ±0.0019

$\langle Q_{FB} \rangle = -0.0090 \pm 0.0009$

$\Delta SIN^2\theta_W = 0.0034$

ERROR ON $SIN^2\theta_W$ FROM UNCERTAINTIES IN THE FRAGMENTATION STUDY : 0.0038

⟹ REQUEST :

- WOULD IT BE POSSIBLE TO TUNE THE QCD PARAMETERS INCLUDING THE LATEST HVFL DECAY TABLES, i.e. THE ONES THAT WILL BE USED FOR THE MC PRODUCTION

⟹ QUESTION :

- WOULD THERE BE A POSSIBILITY TO INCLUDE A Q_{FB} - SPECIFIC DISTRIBUTION IN THE TUNING ??

A. FALWARD

11th MAY 92

KINGAL Meeting

(MINOR) MODIFICATIONS OF HVFL02

FROM Heavy Flavour GROUPS

SUMMARY OF THE DEDICATED MEETING WEDNESDAY 6th

- $BR(\psi \rightarrow e^+e^-, \mu^+\mu^-) \rightarrow 6\%$ (7% Before)

$$\Downarrow$$

$BR(B \rightarrow c\bar{c} + \cdots) \times \frac{7}{6}$, SINCE THIS BR IS MEASURED BY LOOKING FOR $\psi \rightarrow e^+e^-, \mu^+\mu^-$

$\hookrightarrow \psi, \psi', \ldots$

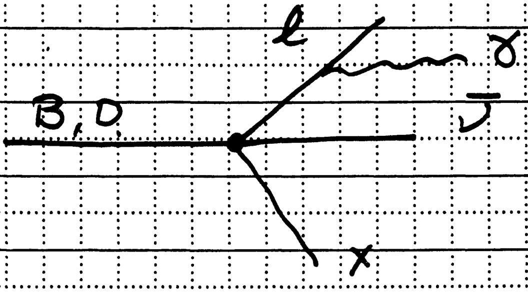
TIME SCALE : $\lesssim$ 1 hour.

- $B \rightarrow (D^{**}$ or $D^* \pi) + \ell + \bar{\nu}_\ell$

WILL BE FITTED IN ORDER TO FIND THE CORRECT LEPTON ENERGY DISTRIBUTION IN THE B REST-FRAME AS FOUND BY ARGUS + CLEO.

TIME SCALE : 2 WEEKS

- IMPLEMENTATION OF INTERNAL BREMS IN $B \to \ell + \bar{\nu}_\ell + X$ AND $D \to \ell + \bar{\nu}_c + X$ IS UNDER STUDY.



SHOULD SIMPLY BE DONE BY A "CALL PHOTOS" IN ASKUSE. BUT TECHNICAL PROBLEMS. NOT ESSENTIAL (THE EFFECTS CAN BE TAKEN INTO ACCOUNT BY WEIGHTING THE GENERATED EVENTS).
IF READY WE WOULD LIKE TO USE IT.

- FRAGMENTATION PARAMETERS OF C AND b.

IF QCD PARAMETERS ARE MODIFIED, WE HAVE TO ADAPT ϵ_b AND ϵ_c TO REPRODUCE X_c AND X_b AS FITTED ON DATA.

TIME SCALE $\lesssim$ 1 WEEK AFTER QCD PARAMETERS

ALL THE DELAY CAN BE REDUCED IF NECESSARY

KINGAL meeting
11 May 92
G. Rudolph

QCD model parameters

JETSET PS + string

HVFL02 — JETSET 7.2 comparison

<# particles/event> +anti p.	HVFL02	JETSET 7.2
charged ($e^\pm, \mu^\pm, \pi^\pm, K^\pm, p^\pm$)	20.93	20.86
photons	21.09	21.18
$\pi^\pm$	17.01	16.96
$K^\pm$	2.24	2.22
$p, \bar{p}$	1.18	1.16
π^0	9.63	9.65
$K^0_{S,L}$	2.03	2.10
η	1.20	1.20
η'	0.70	0.67
$D^0, \bar{D}^0$	.037 + .445 = .483	.037 + .415 = .451
D^+, D^-	.037 + .125 = .162	.037 + .170 = .207
$B^0, \bar{B}^0$	.043 + .305 = .347	.043 + .131 = .174
B^-, B^+	.042 + .129 = .172	.043 + .129 = .172
	↑ prim. ↑ second.	→ something goes wrong
# events	100 K	500 K

using identical parameter values:

$\Lambda_{LL} = .3185$ $\sigma = .360$ $\epsilon_c = .020$

$M_{min} = 1.43$ $A = .50$ $\epsilon_b = .015$

$B = .918$

xp(charged) distribution

xlow	xupp	JETSET7.2	HVFL02	difference (%)	data syst err(%)
0.0000	0.0050	265.6068	264.2380	-0.52	-
0.0050	0.0100	506.7869	506.4560	-0.07	2.1
0.0100	0.0150	450.6085	449.9100	-0.16	1.6
0.0150	0.0200	363.1584	363.4220	0.07	1.3
0.0200	0.0300	266.2926	268.1530	0.70	1.0
0.0300	0.0400	186.0464	187.4530	0.76	0.9
0.0400	0.0500	137.3767	137.7760	0.29	0.8
0.0500	0.0600	105.6653	106.3460	0.64	0.7
0.0600	0.0700	83.5867	83.8270	0.29	
0.0700	0.0800	67.3774	67.3130	-0.10	
0.0800	0.0900	55.4051	55.9820	1.04	
0.0900	0.1000	46.6444	46.8540	0.45	0.5
0.1000	0.1200	36.4493	36.5760	0.35	
0.1200	0.1400	26.9812	27.2055	0.83	
0.1400	0.1600	20.6308	20.7750	0.70	
0.1600	0.1800	16.0496	16.1270	0.48	
0.1800	0.2000	12.7644	12.7860	0.17	0.7
0.2000	0.2500	8.8445	8.8706	0.30	
0.2500	0.3000	5.4139	5.4714	1.06	
0.3000	0.4000	2.8378	2.8621	0.86	1.0
0.4000	0.5000	1.2051	1.1931	-1.00	1.2
0.5000	0.6000	0.5131	0.5122	-0.18	2.2
0.6000	0.7000	0.2155	0.2052	-4.78	3.0
0.7000	0.8000	0.0793	0.0772	-2.65	2.7
	areas =	20.87	20.93		

differences < 1 %

Expect little difference for HVFL02
fitted parameters

JETSET problems in particle distributions

- $P_{t,out}$ tail too low → no explanation

has consequences in global fit:

using $P_{t,out}$ in the set pulls Λ_{LL} up.

$\Lambda_{LL} = 0.30$ GeV from 3-jet rate alone.

compare also:

Λ_{LL}	M_{min}	σ	B	distributions used:
.318	1.43	.360	.918	× P_t^{out} P_t^{in} S A T m
.302	1.34	.361	.890	× $\langle N_{ch} \rangle$ S A T m

(covered in syst. error)

- Shape of x_p(charged) distribution at $x_p \approx 0.15$;

related to 0.9 GeV charged energy missing in MC

sensitive parameter: $\left(\frac{V}{V+P}\right)_{u,d}$ (=0.5 default)

- η' another attempt:

change 0^- mixing angle → changes η'/η

	-9.8° (def.)	-33°	Data
N_{ch}	20.81	20.42	
$\Sigma \lvert p_{ch} \rvert / E_{cm}$	0.614	0.608	
η	$.68 + .52 = 1.20$	$1.10 + .31 = 1.41$	
η $x > .1$	0.33	0.41	0.30±
η'	$.62 + .05 = 0.67$	$.24 + .03 = 0.28$	
η' $x > .1$	0.27	0.12	0.068 ±.024

↑ prim. ↑ second.

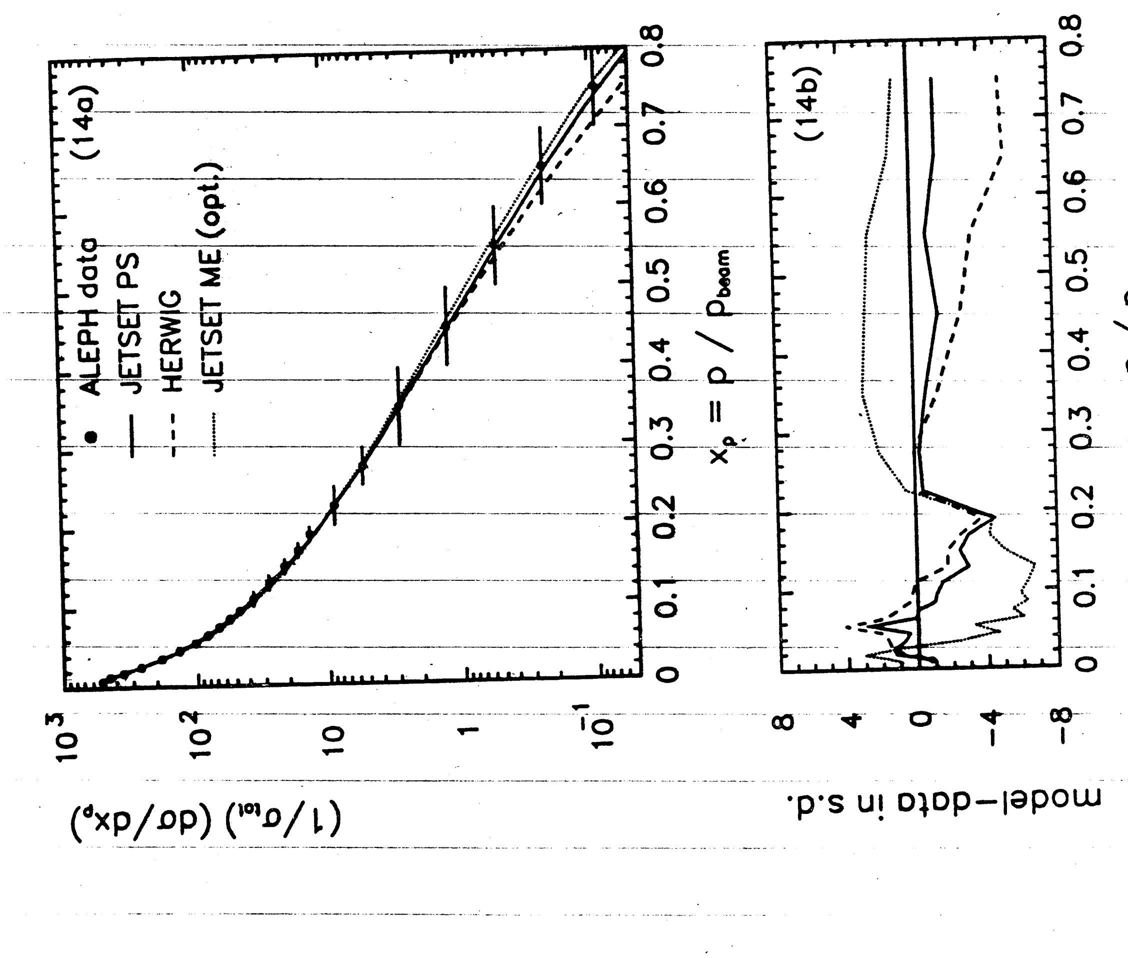
conclusion on η' ! $\eta'/\eta \approx$ ok.
but rates still too high
may be Steve's radical method works better

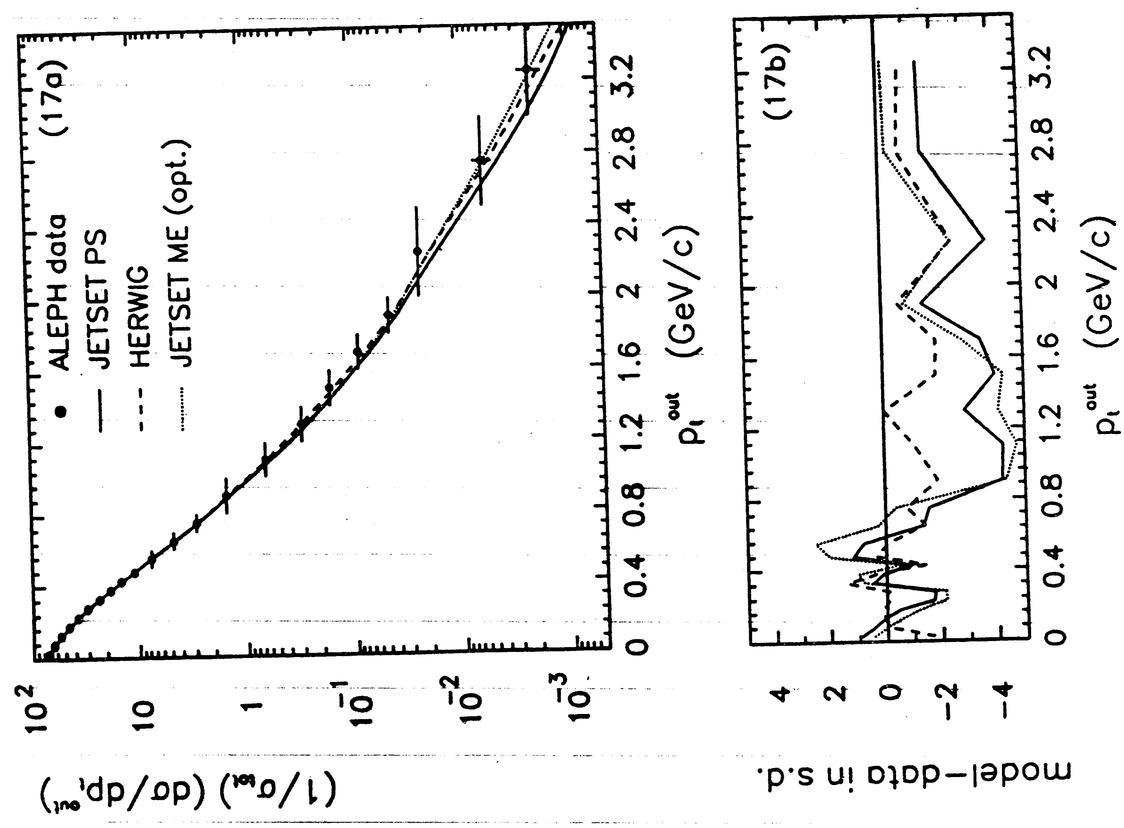
- K^0 spectrum too high at low x   ??

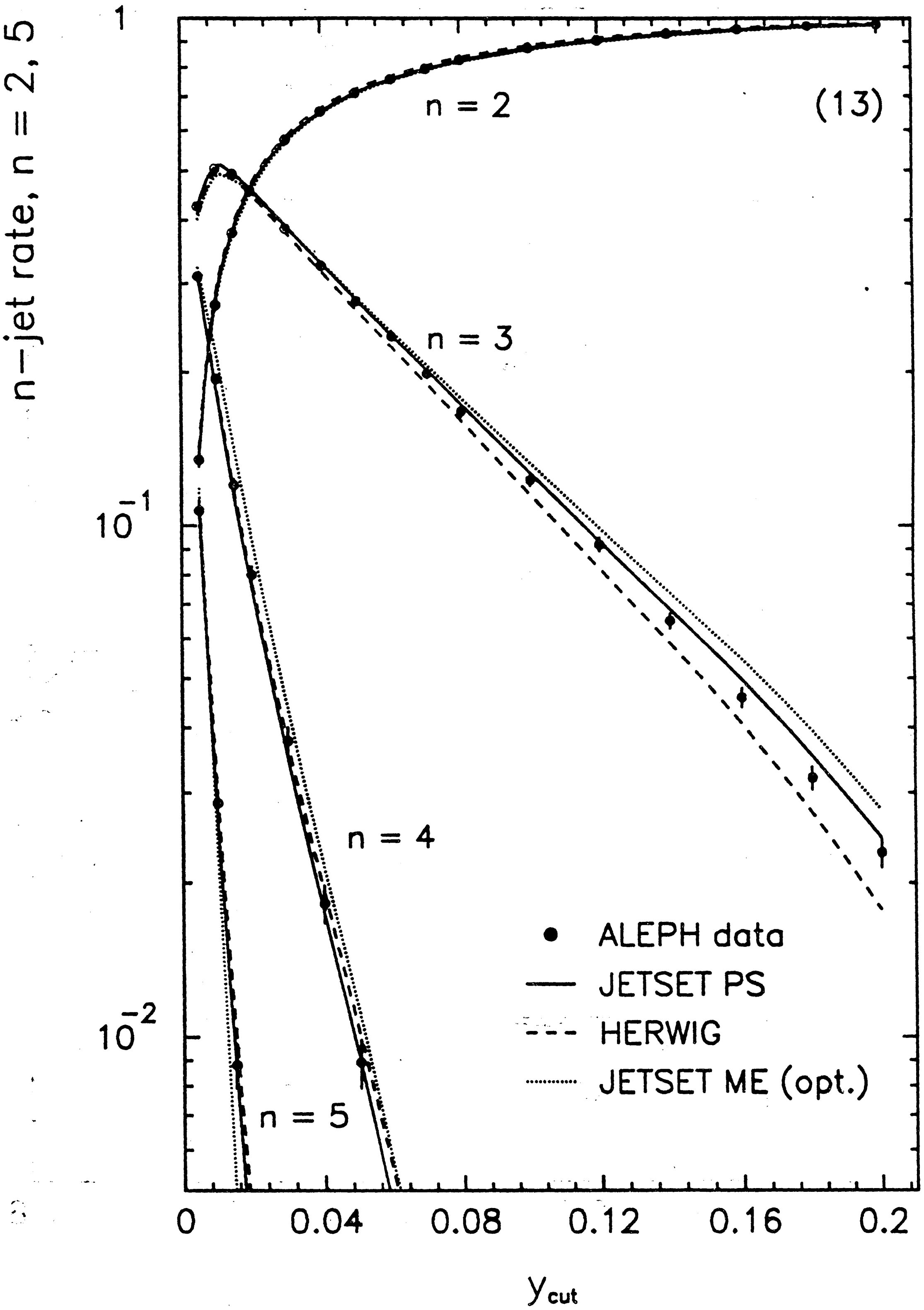
B fragmentation : adjust ϵ_b to describe data
$\langle x_E \rangle_B = 0.71 \pm 0.01$

ϵ_b	$\langle x_E \rangle_B$	
0.015	0.66	
0.006	0.700	
0.0045	0.708	→ take this
0.003	0.719	

using
best fit values
for the other
parameters


(14a)
ALEPH data
JETSET PS
HERWIG
JETSET ME (opt.)
$(1/\sigma_{tot})\,(d\sigma/dx_p)$
10^3
10^2
10
1
10^{-1}
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
$x_p = p\,/\,p_{beam}$
(14b)
model–data in s.d.
8
4
0
−4
−8


(17a)
ALEPH data
JETSET PS
HERWIG
JETSET ME (opt.)
$(1/\sigma_{tot})\,(d\sigma/dp_t^{out})$
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
0
0.4
0.8
1.2
1.6
2
2.4
2.8
3.2
p_t^{out} (GeV/c)
(17b)
model–data in s.d.
4
2
0
−2
−4


n−jet rate, n = 2, 5
1
10^{-1}
10^{-2}
0
0.04
0.08
0.12
0.16
0.2
y_{cut}
n = 2
(13)
n = 3
n = 4
n = 5
ALEPH data
JETSET PS
HERWIG
JETSET ME (opt.)

HERWIG new version 5.4 (31 Jan 92)

added  with $O(\alpha_s)$ ME

added final state γ emission

	default (OPAL)	best fit		Data
Λ_{LL}	0.18	0.152 ± .002		
M_{gluon}	0.75	0.876 ± .007		
$M_{cl\,max}$	3.35	3.70 ± .03		
R_3 (y_{cut} = .08)	0.178	0.170	was 0.161 in version 5.0	0.167 ± .00
particles/evt. :				
charged	20.84	20.92		20.85
photons	21.65	20.92		
$\Sigma E_{ch}/E_{cm}$	0.616	0.614		
$\Sigma E_{\gamma}/E_{cm}$	0.273	0.258		
η	1.43	1.32		
η x>.1	0.46	0.42		0.30 ± .03
η'	0.23	0.23		
η' x>.1	0.12	0.12		0.068 ± .024
K^0	2.13	2.31		2.11 ± .05
K^0 x>.1	0.70	0.71		0.73
Λ	0.37	0.59		0.39 ± .02
Λ x>.1	0.15	0.25		0.16
total χ^2		885	was 1135 in v5.0	

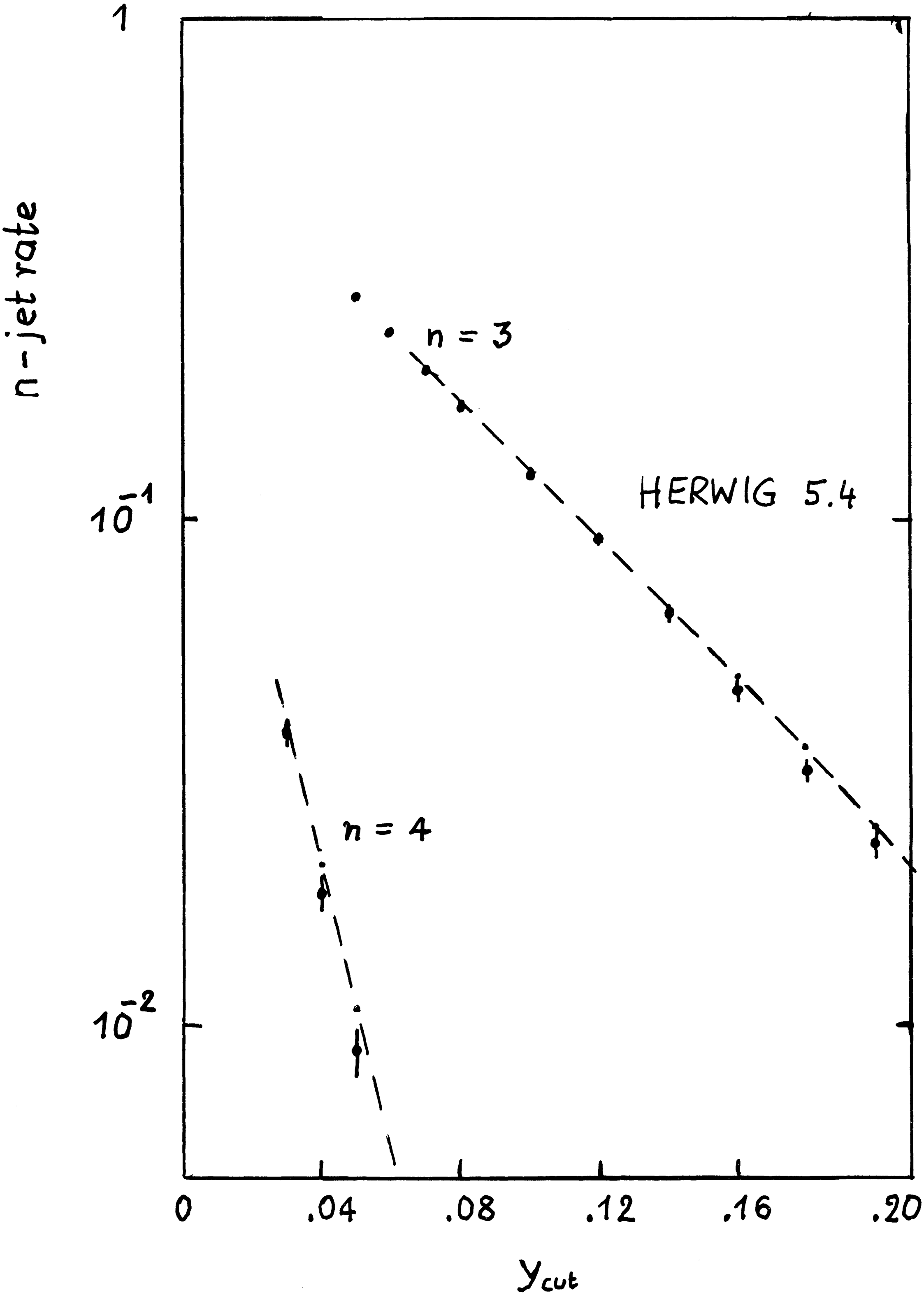
Note: VGCUT = 0 in both cases

remarks on HERWIG 5.4 :

Problems in hard gluon region now removed

Problems remain the same in 2jet peak
and in high-x regions

$\Lambda, \bar{\Lambda}$ rate very sensitive to mass parameters
M_{gluon} and $M_{cluster\ max}$
may be need additional parameter


1
n - jet rate
10^{-1}
10^{-2}
n = 3
n = 4
HERWIG 5.4
0
.04
.08
.12
.16
.20
y_{cut}

KINGAL Meeting
11/05/92
A. BLONDEL

① . NEED a REFERENCE SET.

Example : <u>INPUT SET for 1991 HVFL02</u> MC
(based ou LUND 7.3).
Save it on file known to all !

② . Define a list of MEASURED <u>NUMBERS</u>

(Preferably as uncorrelated as possible)

<u>ex</u>.

$\langle NCH \rangle$ σ_{NCH} (note that, since $\langle nCH \rangle * \langle P_{CH} \rangle = E_{cm}$, $\langle E_{neut} \rangle$ is unnecessary

$\langle P_{CH} \rangle$

$\langle \# K^0 \rangle$, $\langle P_{K0} \rangle$ [above $P_{K0} = 1$ Gev]

$\langle \# \Lambda^0 \rangle$, $\langle P_{\Lambda^0} \rangle$

$\langle P_\perp in \rangle$ or Y_4

$\langle P_\perp out \rangle$ or Y_3 called $\mathcal{O}_i$.

⋮

$\langle P_\perp^{leptons} \rangle \langle P_L^{leptons} \rangle$, $\langle \# leptons_{P_\perp > x}^{P_L > x} \rangle$

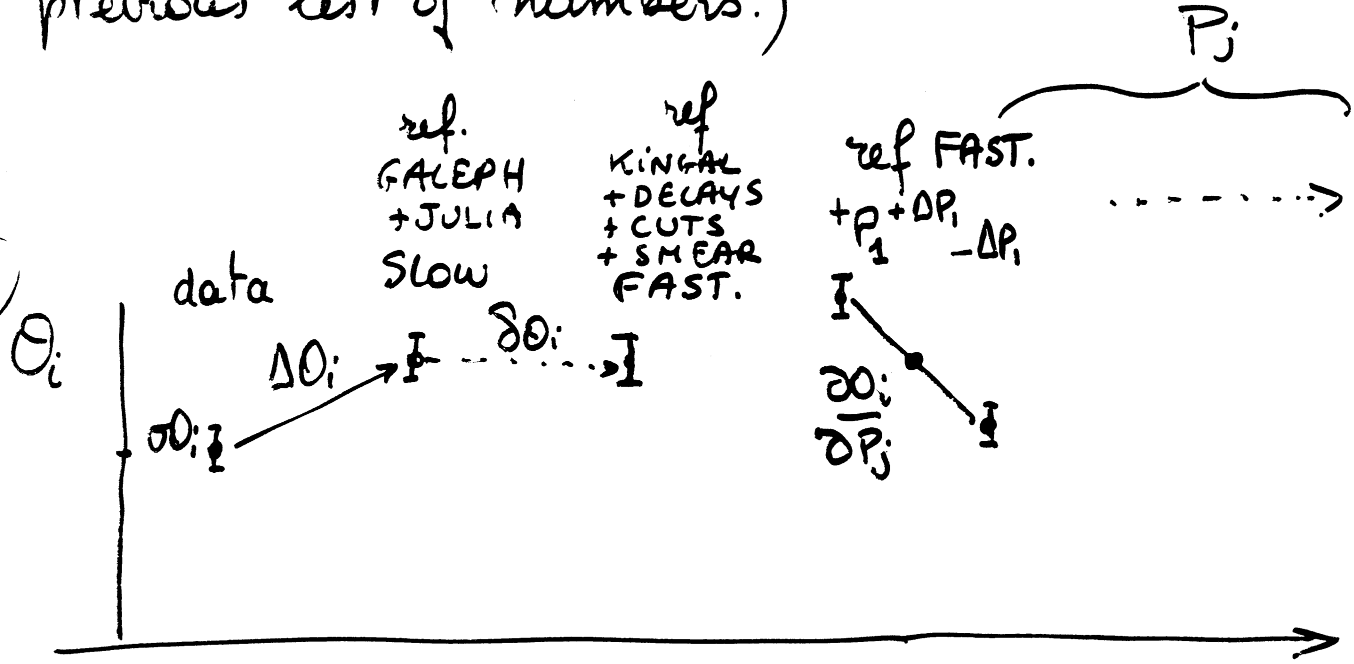
$\bar{\delta}$, ε^b , ... etc...

3) Define a list of parameters to be varied

P_j N parameters

(in fact this list should precede the previous list of numbers.)

4.



chose O_i so that $\left\{\frac{\partial O_i}{\partial P_j}\right\}$ is as diagonal as possible. (not obviously impossible)

need 2N + 1 RUNS of FAST

5 find P_j^{new} and their correlation matrix that minimize $\sum_i \left(\frac{\Delta O_i - \delta O_i}{\sigma O_i}\right)^2$

6. call P_j^{new} the new reference

7. Run full chain (SLOW) on new ref.
and verify that the assumption
of linearity and commutativity which
is implied in above procedure is correct.

8. if • NEW PARAMETERS are found
only 2 x NEW FAST Runs
are needed.

- Should be run with LARGELY different
value (from ref) so that derivative
is well calulated.
- all other parameters left at current
reference