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PHYSIC 89-25
S. Dugeay
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Sylvie Dugeay

MEETING OF THE HEAVY FLAVOUR GROUP

Minutes of the meeting held at Cern on 8 March 1989

PRESENT

B. Deschizeaux	
M. Talby	(Annecy)
S. Natali	
M. Maggi	(Bari)
A. Falvard	
P. Henrard	
D. Pallin	
P. Perret	
F. Prulhiere	(Clermont-Ferrand)
G. Capon	(Frascati)
J. Hearns	
S. Thompson	
A. Halley	(Glasgow)
A. Putzer	(Heidelberg)
P. Dornan	
S. Dugeay	
I. Tomalin	(Imperial College)
T. Ruf	(Karlsruhe)
C. Benchouk	
A. Bonissent	
S. Papalexiou	(Marseille)
M. Bosman	
P. Cattaneo	
H. Moser	(MPI Munich)
A. Lusiani	
R. Tenchini	(Pisa)
P. Colas	
C. Klopfenstein	
E. Locci	
E. Monnier	
A. Roussarie	(Saclay)
D. Cinabro	(Wisconsin)

1) We started with a report of the "**Hadronic Decays Subgroup** " activities, given by Alois Putzer. He recalled the physics goals of the group and listed the topics already treated, namely Monte-Carlo comparisons and improvements, b selection using shape variables and the study of some exclusive and inclusive final states. For the Athens meeting, prospects for seeing various decay modes in the 1989 run as well as determination of more general quantities, such as the $b\bar{b}$ rate at the Z^0 peak, fragmentation parameters, should be investigated.

2) Andre Roussarie gave a status report for the "$B \rightarrow e$ **Subgroup**". He summarized the work done by P. Perret on the B_d^0 decay into $l^- \overline{\nu} D^{\star +}$ with the $D^{\star +}$ going into $D^0 \pi^+$, with the aim to determine the helicity nature of the $D^{\star +}$. The actual experimental results from ARGUS and CLEO are contradictory and this measurement may help to resolve different semileptonic decay models and hence on the lepton spectrum knowledge, which provides one way to measure V_{bu}.

With regard with the Athen request, ie physics with 5,000 to 50,000 Z^0, he presented an estimation of what could be obtained with 100,000 Z^0. Mainly, besides the obvious work of tuning the MC, performing data-MC comparisons and cross-checks of selection criteria, we can hope for the following :

1 - from Sphericity Product : 6000 $b\bar{b}$ events with a 50 % purity.

2 - from Tagging by Charm Spectroscopy :

$\star$ inclusive $D^{\star +} \rightarrow D^0 \pi^+$. This selects essentially B_d^0 mesons and one can expect some 200 (500) events in the channel $D^0 \rightarrow K^- \pi^+$ ($K^- 3\pi$). These numbers are coming only from the relevant branching ratios. Contribution from $c\bar{c}$ events is of the same order.

$\star$ inclusive $D_s \rightarrow \phi \pi$. 180 events are expected coming from B_s, but as much from other B species and from $c\bar{c}$ events.

(Someone stated here that direct charm studies at LEP could be of some interest as well.)

3 - from Electron Tagging. With typical cuts such as $P > 3\ GeV$ and $P_T^{J-e}(e\ removed) > 1.5\ GeV$, a 50 % efficiency can be achieved for b semileptonic events with 88 % purity, which corresponds to about 1800 events. For mixing studies 300 dilepton events are expected, a statistic close to that of UA_1 but far cleaner. A further possibility is to tag an electron and a charmed meson. In addition to the fact of being free of B semileptonic cascade and c background this could be a quite clean way to tag the B type, as a lepton and a D^+ (D^0, D_s) sign more likely a B^+ (B^0, B_s). Adding contribution from μ, one can expect 55 $l\ D^{\star +}$ and 18 $l\ D_s$ events.

In conclusion, if we divide those numbers by 2 to 20, 1989 will be more a year of tuning and checks than of improving results.

3) A study of "**Final State $l^- K^+ K^+ X$ in the Same Jet as a Signature of $B_s^0 - \overline{B}_s^0$ Mixing** "was reported by Pierre Henrard. A precise measurement of the x_s mixing parameter is interesting as it might, depending on its value, be an indication of new physics ($x_s < 3$) or put constraint on the CP violation phase ($x_s > 3$), assuming the top mass will be known. At LEP energy we will measure a global mixing parameter χ by the dilepton method, sum of the χ_d and χ_s weighted by the probabilities to produce a B_d and a B_s respectively. As we know these last two numbers very badly and not so precisely χ_d, it will be very difficult to extract χ_s with a reasonable accuracy. An enrichment of the event sample in B_s is then necessary and Pierre has investigated some ways to do it. Time dependent methods required some 10^8 $b\bar{b}$ events and hence are not envisageable. Among time integrated methods, one of the most promising and statistically accessible to LEP, is to study electric sign correlations in a lKK system. This tagging has been initially suggested by *Ali and Barreiro*. The method is however only sensible to a χ_s range less than 2, usefull if χ_s is smaller than the Standard Model predictions. For 10^6 Z^0, the statistical error will be 8 %, and the systematic error will be dominated by the incertainty of some 15 % on the B_s production rate.

4) Sylvie Dugeay came back again to the "**Fragmentation Parameters Choice** ", as Gerald Rudolph from the $Q\overline{Q}$ physics group reported at the last Aleph week the result of their studies on this subject. Their favourite value for the ϵ_c parameter disagrees with that of Dugeay-Henrard. He used a different method to adjust the Peterson parameters, ie he fitted the experimental x spectrum at a centre of mass energy of 35 GeV and came to the conclusion that the same value should be used for the c and b quark, which is the value we recommended for the b quark. This however leads to a quite hard fragmentation for the c quark, much harder than the one of the b, which does not fit with experimental results. We should discuss this with him, to understand precisely what he did and eventually come to an agreement. For now, our recommended values seem still valid.

5) Alain Falvard gave some news about "**The Heavy Flavour Generator**".

- $b \rightarrow u$ *transition* : there will be new models available in addition to the free quark model already implemented, and also the possibility for the user to choose its favourite final states.

- *B semileptonic decays* : four models will be released, from Korner Schuler (KS), Grinstein Isgur and Wise (GIW), Pietschmann, and Bauer Stech and Wirbel (BSW). They are described in Alain previous talks.

- *D meson decays* : a recent update has been done by Pierre Henrard.

- *B hadronic decays* : Two body decays are implemented, the standard Lund procedure being used for the other cases. It is possible now to generate $B \rightarrow \psi X$ decays where the X system is more complicated than the usual 2-body mode given by Lund.

- *initial state generator* : Beside the LUND and BREM5 generators, it is now possible to generate only single particle, and it is forseen to implement the WEBBER Monte-Carlo. **Warning** : a comparison of the asymmetry distributions of the b quark before and after parton showering between Lund and Brem5 has revealed a substantial discrepancy, removed by the use of the PARE(6) parameter to set the Z^0 mass to 92 GeV, instead of the actual setting PMAS(2). So, change that in your data cards file.

6) Thomas Ruf from the ARGUS experiment described their "**Monte-Carlo Generator for Heavy Meson Decays : the MOPEK package**". Based on the *Bauer, Stech and Wirbel* model, it has 3 decay types :

- 1. Two body decays, where 2 free parameters are to be determined by data. It gives a good description of many D and D_s decays, and hopefully, the theory works as well for B decays.

- 2. Semileptonic Decays, where the hadronic matrix element of the following decay modes are computed according to the BSW model :

$B \rightarrow l\overline{\nu}X$, $\quad X = D^\star, D, \rho, \pi, \;\; l = e, \;\mu, \;\tau$

$D \rightarrow l\overline{\nu}X$, $\quad X = K^\star, K, \rho, \pi,$

$D_s \rightarrow l\overline{\nu}X$, $\quad X = K^\star, K, \eta, \eta', \phi, \;\; l = e, \;\mu.$

In the new version of MOPEK, the Korner Schuler (KS), Grinstein Isgur and Wise (GIW), and Free Quark models are implemented. The predictions of BSW, KS and GIW models are given, showing a fair agreement for the $b \rightarrow c$ transition but large discrepancies for the $b \rightarrow u$ one.

- 3. Others : If most of the decays of charmed mesons are well described by the 2 body and semileptonic decays (about 85-90 %), it is not so for beauty particles (about 40 %). For those, the same scheme as for semileptonic decays is used, but instead of a $l\overline{\nu}$ pair, a $q\overline{q}$ pair is generated and then fragmented, using an energy dependant multiplicity distribution and a phase space model for the momenta.

7) A.O.B.

Peter Dornan announced that ARGUS has retracted its result on B meson decay into protons : they are using now new algorithms for the dE/dx analysis and the proton signal has disapeared.

That particle identification is also our weak point was raised by Alois. He noticed that no progress has been made on this subject since the last November meeting. There are also some points needing clarification, such as :

- Heavy Flavour data : How to define the best strategy to select b and c events and organize the structure of the Heavy Flavour samples ?

• Heavy Flavour tool package : Should we have some tools specific to HF analysis and should they be part of the ALPHA program ?

• Define basic distributions, for example Monte-Carlo and other experiments plots, which can be easily accessed and printed by any user.

• Collect general information on the detector response, such as trigger efficiency, energy resolution, ...

NEXT MEETINGS

Monday, April the 24 th, 10h : $B\overline{B}$ Mixing subgroup

Monday, April the 24 th, 16h30 : B Lifetime subgroup

Monday, April the 24 th, 16h : $B \rightarrow e\nu X$ subgroup

Wenesday, April the 26 th, 11h : Hadronic Decays subgroup

Wenesday, April the 26 th, 14h : General Heavy Flavour Meeting