A PROGRAMME FOR HIGH-RESOLUTION RESEARCH WITH THE EUROPEAN HYBRID SPECTROMETER IN 1982-1983: A SUMMARY

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1. OUR AIM

- To determine accurately the properties of the short-lived ($\sim 10^{-13}$ s) particles (c, b, ..., τ ...):
  - lifetimes,
  - branching ratios (Cabibbo-allowed or not),
  - spectroscopy: D^*, Σ_c^*, Λ_c^*, ...
- To study production mechanisms (hadronic and photonic):
  - cross-sections (SPS/ISR),
  - correlations (short-range, flavour flow, ...),
  - diffraction/fragmentation/central production,
  - dependence upon E_{inc}, $quark_{inc}$, A, ...

2. WHAT DO WE NEED?

- Resolution of the vertex detector:

  50 μm for $\tau \approx 8 \times 10^{-13}$ s,
  20 μm for $\tau \approx 2 \times 10^{-13}$ s,
  10 μm for $\tau \approx 10^{-13}$ s.

  These numbers (the first two at least) are based on experience, scanning efficiencies, etc., for bubble-chamber film with good contrast, hadronic production at SPS energies, etc.

- Rates, i.e. not necessarily 10^4 events badly reconstructed, but a few hundreds of well-constrained, well-identified events.

  Two factors can be considered:

  a) The intrinsic rate of data acquisition given by rapid-cycling bubble chambers, including scanning-analysis rates (not useful to produce 10^6 events if we can digest 10^4/year!).

  b) Acceptance of downstream spectrometer, gamma detectors, particle identifiers, which are essential for the identification of rare events.

  With HOLEBC + EHS, classical optics, and hadron beams, we can expect:

  20 tracks/expansion, duty cycle $\sim$ 2%, 30 Hz,
  10 cm of H_2, interaction trigger of $\sim$ 20 mb
  → 1 evt/μb/day
  (at least the same rate with RCBC, and probably more).

  With HOLEBC holography, these rates may be increased by 20 to 50 but a more sophisticated trigger will then be necessary.

3. ACCOMPLISHED IN 1979-1981

1979 - NA13 - "bare" LEBC - 50 μm, 13 'candidates' → cross-section.

1980 - NA16 - LEBC + EHS → D^0, $D^{\pm}$ lifetimes and production characteristics.

1981 - NA26 - HOLEBC + EHS → 20 μm with classical optics.

4. PLANS FOR 1982

- To accumulate a few hundreds of D^0, $D^{\pm}$, and a few tens of $F^{\pm}$, $\Lambda_c^{\pm}$, with HOLEBC (classical optics) and EHS.

  15 days of 360 GeV π^-p and 15 days of 360 GeV/c proton-proton, giving 10^6 pictures.

  The total of completely reconstructed c's could be of the order of 30 $F^{\pm}$, 150 $D^{\pm}$, 150 D^0, 100 $\Lambda_c^{\pm}$.

- To test RCBC with three normal views plus one high-resolution channel giving $\sim$ 35 μm over 40 cm (and only used for scanning).

  10^6 pictures taken with RCBC could provide > 150 $D^{\pm}$ completely reconstructed, the associated charm being searched for by effective mass and kinematics.

5. PHOTOPRODUCTION IN 1983

Using HOLEBC in the holographic mode ($R \leq 10$ μm) triggering on hard photons and hadronic final states, a sensitivity of 10 evt/nb could be reached. Many technical questions need to be solved (holography, tagged photon beam, trigger, electromagnetic background, upgrading of spectrometer for $\sim$ 70 GeV incident particles, etc.).

If technically feasible, this experiment could provide several thousands of c's and several tens of b's.

I believe that such a major step should be taken in the best possible conditions, by adding to the spectrometer a good streamer chamber in the vertex magnet of EHS (see E. Johansson's talk). This streamer chamber would increase significantly the acceptance and efficiency for low-momentum tracks, would allow the detection of a sizeable fraction of strange particles associated with c's and b's, and could provide particle identification.

6. MORE PROPOSALS

With the advent of high-resolution bubble chambers and the completion of EHS (more particle identification, gamma detection, calorimetry), we have a beautiful tool to study heavy flavours. There are many other possibilities than those discussed above (see Niels Doble's talk on beam possibilities). We need more proposals.