Table 3: Measurements of branching fractions for $X_{\overline{b}} \to X\tau^+\nu_\tau$ and other semi-inclusive modes. B semileptonic decays to final states with baryons have not been observed. The ARGUS result for $B \to D_s{}^- X\ell^+\nu_\ell$ has been rescaled using the PDG value for $D_s^+ \to \phi\pi^+$.

Mode	Expt.	Ref.	B(%)
$X_{\overline{b}} \to X\tau^+\nu_\tau$	ALEPH	[3]	$4.08 \pm 0.76 \pm 0.62$
$X_{\overline{b}} \to X\tau^+\nu_\tau$	ALEPH (prelim.)	[4]	$2.76 \pm 0.47 \pm 0.43$
$B \to D_s{}^- X\ell^+\nu_\ell$	ARGUS	[20]	< 0.9 (90% CL)
$B \to \overline{p}X\ell^+\nu_\ell$	ARGUS	[5]	< 0.16 (90% CL)

The challenge for inclusive measurements is to determine what part of the observed lepton momentum spectrum is due to leptons from b-hadron decay (primary leptons) and what part is due to leptons from charm decay (secondary leptons) or to other sources (misidentified hadrons, photon conversions, $J/\psi(1S)$ decays, *etc.*). The standard technique is to fit the observed lepton momentum spectrum to a sum of the shapes expected for primary and secondary decays, after subtracting out backgrounds from other sources. Thus, a large part of the effort (and uncertainty) in the analysis is in the determination of these shapes.

Experiments at the $\Upsilon(4S)$ (ARGUS and CLEO) use theoretical models to describe the primary lepton spectrum. Some of these models have free parameters that are determined from the fit. The ACCMM model [12], for example, is based on an inclusive calculation of b-quark decay, and it has parameters corresponding to the c-quark mass and the Fermi momentum of the spectator quark, among others. A commonly used exclusive model is ISGW [13], in which the dominant contributions to the primary spectrum are from $B \to \overline{D}\ell^+\nu_\ell$ and $B \to \overline{D}^*\ell^+\nu_\ell$, with some $B \to \overline{D}^{**}\ell^+\nu_\ell$. Here, D^{**} refers to a mixture of p-wave and radially excited charm mesons. CLEO finds [9,10] that the amount of $B \to \overline{D}^{**}\ell^+\nu_\ell$ in this model is too low to adequately describe the lepton momentum spectrum, so a modified version of the ISGW model, ISGW**, has been created. In ISGW**, the D^{**} fraction is allowed to vary, but the D^*-to-D ratio is fixed at the value (2.3) predicted by ISGW. The fit to the CLEO data using ISGW** is significantly better than that using ISGW.

The shape used to describe the secondary lepton spectrum in these fits, although somewhat more complicated to obtain, is based on data. The DELCO charm-decay lepton spectrum [14] is fit to a theoretical model (ACCMM) and then boosted according to the inclusive D-meson momentum spectrum measured at the $\Upsilon(4S)$. Future measurements should be able to use a charm lepton spectrum obtained by summing the spectra for the known exclusive charm semileptonic modes, which account for most of the inclusive rate.

LEP experiments (ALEPH, DELPHI, L3, and OPAL) measure $\mathcal{B}_{SL}$ by fitting the spectra of p and p_T (the momentum transverse to the jet axis) in single lepton and dilepton events. The shape of the primary spectrum is taken from CLEO or ARGUS, so that model-related uncertainties in these experiments are propagated into the LEP results. (This uncertainty is part of the third error in the LEP results given in Table 2. Its size depends on the specific details of the analysis.)

The extraction of the B semileptonic branching fraction from the momentum spectrum of single leptons, therefore, relies on models. In CLEO, which currently has the largest data sample, the spread of values obtained using different models is comparable to the experimental errors. The dominant experimental errors are due to tracking and lepton identification uncertainties, which are expected to decrease in the future.

The ARGUS collaboration [6] has introduced a second method, using dilepton events, that substantially reduces the need for models. One lepton (the "tagging lepton") is required to have high momentum and is thus nearly always primary. The analysis then examines the momentum spectrum of the second lepton in the event. By requiring that both leptons be in the same hemisphere, events in which the two leptons come from the decay chain of a single B meson (produced nearly at rest at the $\Upsilon(4S)$) are effectively removed. Thus, (1) the tagging lepton is primary, and (2) the leptons are from different B mesons. Then, unless mixing occurs, a lepton whose charge is opposite to that of the tagging lepton must be primary, while one with the same charge as the tagging lepton must be secondary. One corrects for mixing by using the known mixing probability. The relative charges of the two leptons, therefore, can be used to separate the primary and secondary spectra of the second lepton. There is a lower momentum cutoff due to experimental acceptance, however, and a small extrapolation, based on models, is required to obtain the total semileptonic rate. The results of this measurement are in agreement with the single-lepton value, although with a poorer statistical error. This method also very much reduces the sensitivity to any possible non-$B\overline{B}$ decays of the $\Upsilon(4S)$, which are assumed to be negligible in the single-lepton method.