



# Search for Charged Higgs Bosons in DELPHI

**Mattias Ellert**  
**Uppsala University**



# Models



- **Charged Higgs bosons are predicted by extensions to the Standard Model**
- **In particular those models containing a second Higgs doublet field**



# Pair Production at LEP



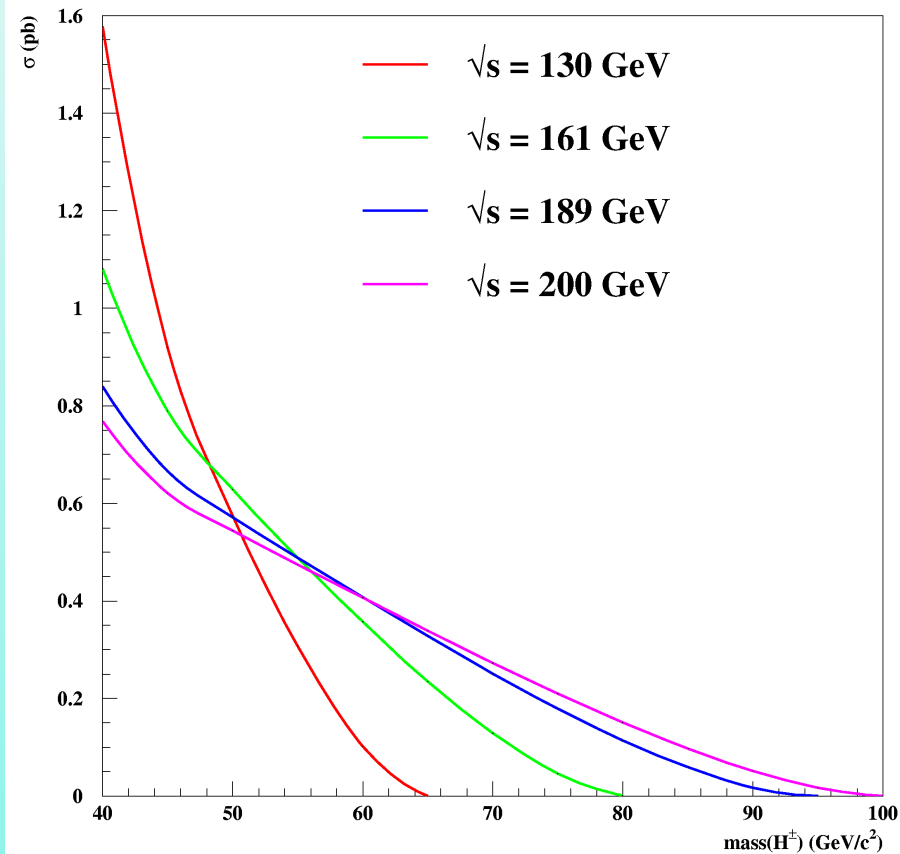
$$e^+ e^- \rightarrow Z^0 / \gamma \rightarrow H^+ H^-$$

**The cross-section depends on the collision energy and the mass of the charged Higgs boson  $H^\pm$**



# Cross-section

## $H^+H^-$ production cross-section





# Three Different Final States



- **Hadronic**

$$- H^+ H^- \rightarrow c \bar{s} \bar{c} s$$

- **Semileptonic**

$$- H^+ H^- \rightarrow c \bar{s} \tau^- \bar{\nu}_\tau / \tau^+ \nu_\tau \bar{c} s$$

- **Leptonic**

$$- H^+ H^- \rightarrow \tau^+ \nu_\tau \tau^- \bar{\nu}_\tau$$



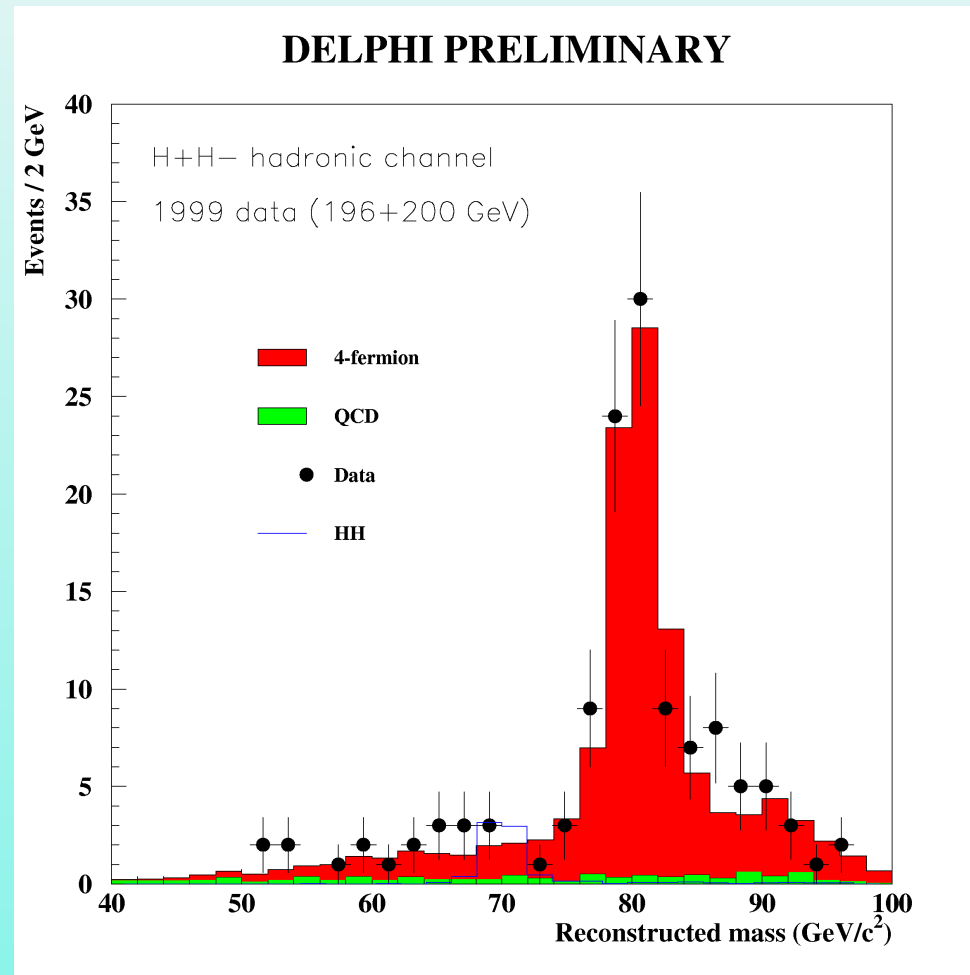
# Hadronic Channel



- 4 hadronic jets
- mass reconstruction using a kinematic fit of 2 equal mass objects
- discrimination against  $W$  pairs using production angle measurements, and c- and s-quark tagging



# Hadronic Channel





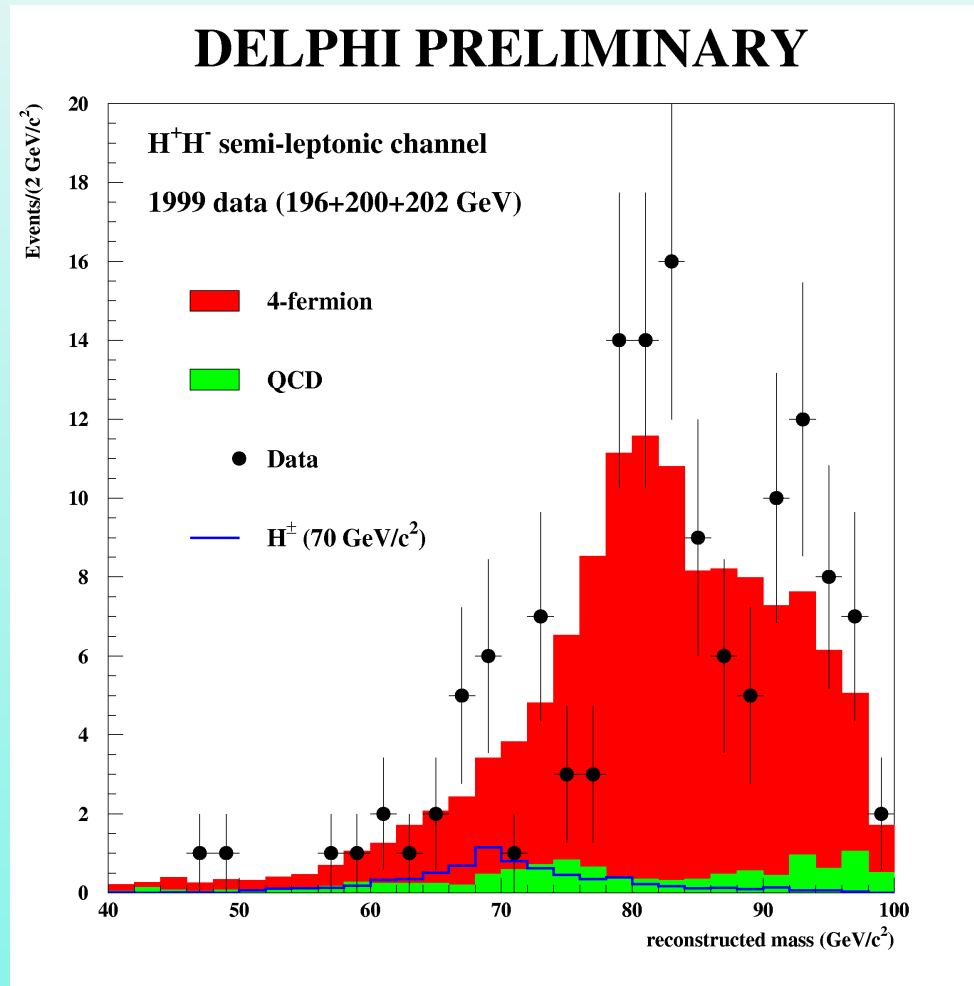
# Semileptonic Channel



- **Two hadronic jets and one slim  $\tau$  jet**
- **Mass reconstruction possible**
- **Discriminator against  $W$  pairs based on production and decay angles,  $c$ - and  $s$ -quark probability and  $\tau$  polarisation estimators**



# Semileptonic Channel





# Leptonic Channel



- **2 slim jets + missing energy**
- **Discriminator against  $W$  pairs based on the jet polar angles and the  $\tau$  polarisation estimator**
- **No mass reconstruction**



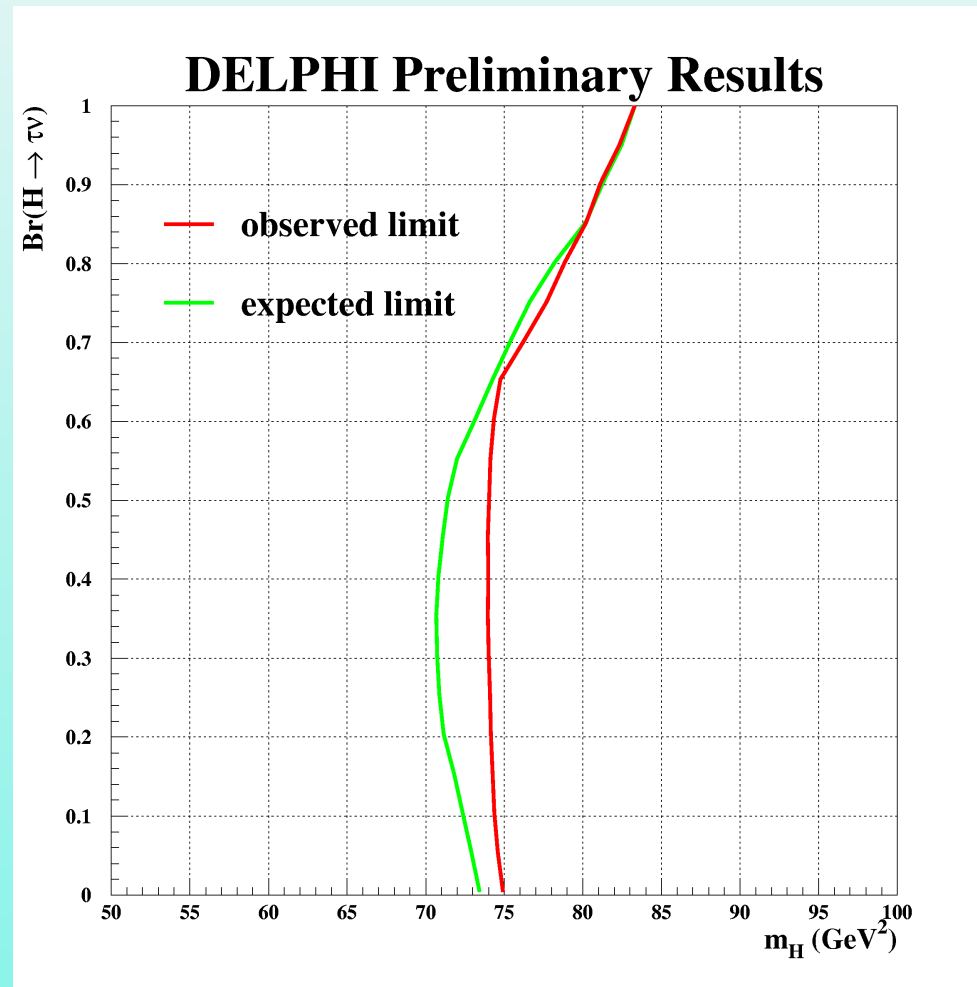
# Exclusion Limit



- **No significant excess found**
- **A 95% exclusion limit is set in a parameter space spanned by  $m(H^\pm)$  and  $BR(H^+ \rightarrow \tau^+ \nu_\tau)$  using a likelihood ratio Monte Carlo method**



# Exclusion Limit





# Conclusion

- **Observed mass limit at  $73.9 \text{ GeV}/c^2$   
for all  $\text{BR}(H^+ \rightarrow \tau \nu_\tau)$**
- **Expected mass limit at  $70.7 \text{ GeV}/c^2$   
for all  $\text{BR}(H^+ \rightarrow \tau \nu_\tau)$**