

# Quarks

**u, d, s, c ,b**  
(not t or b')

**20 papers**  
**51 measurements**

Figure 2: The allowed region (shown in white) for up quark and down quark masses. This region was determined in part from papers reporting values for  $m_u$  and  $m_d$  (data points shown) and in part from analysis of the allowed ranges of other mass parameters (see Fig. 3). The parameter  $(m_u + m_d)/2$  yields the two downward-sloping lines, while  $m_u/m_d$  yields the two rising lines originating at (0,0).

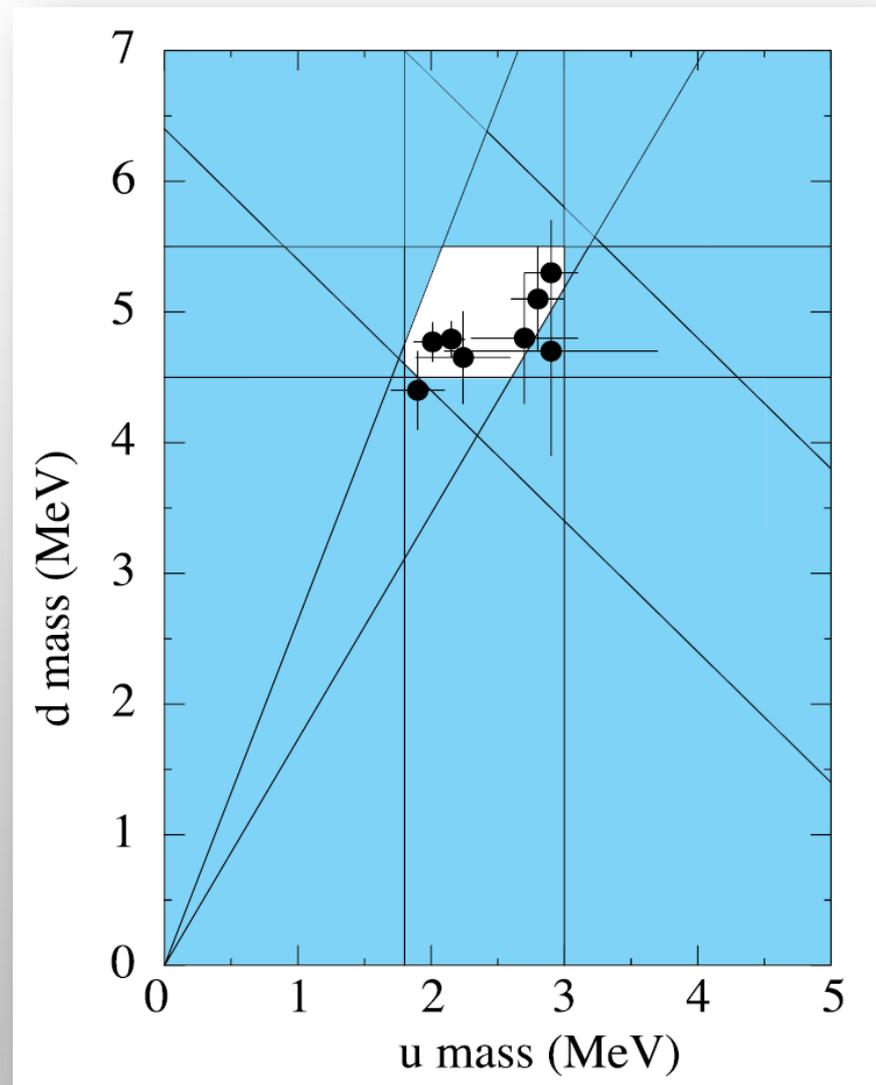
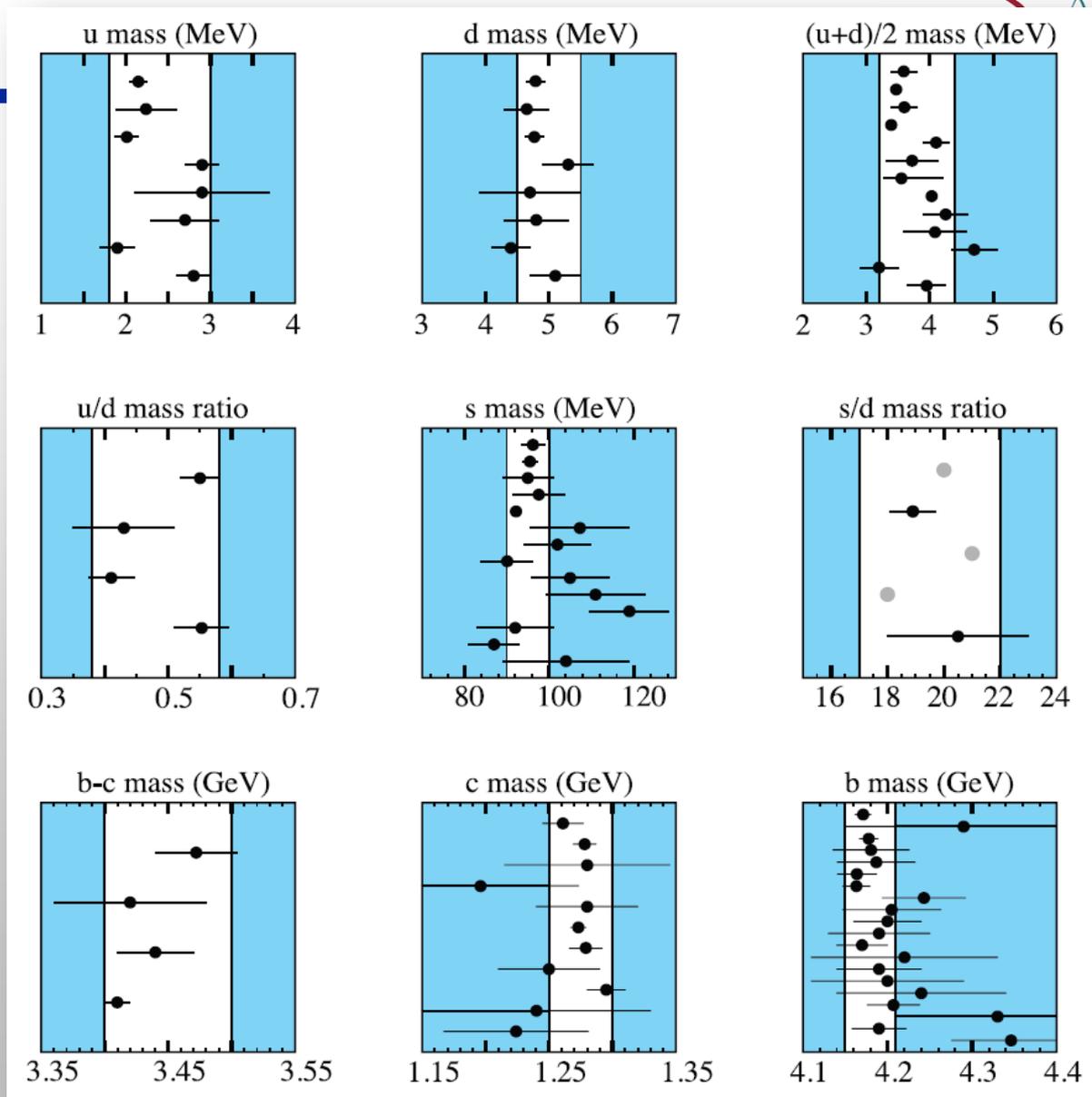


Figure 3. The values of each quark mass parameter taken from the Data Listings. Points from papers reporting no error bars are shown as open circles. Arrows indicate limits reported. The grey regions indicate values excluded by our evaluations; some regions were determined in part though examination of Fig. 2.



## Two slides from Charles Wohl about:

- **Neutron Lifetime**
- **Proton Charge Radius**
- **Baryon Resonances  $N^*$ ,  $Y^*$**

## STABLE BARYONS (*p* through $\Omega^-$ )

Encoder: Chris Grab. New data entries: 32.

- *The neutron lifetime*—For several years there was 6-1/2 standard deviation disagreement between seven older measurements (giving the 2010 value below) and the lifetime obtained by SEREBROV 05 ( $878.5 \pm 0.8$  s). It made little sense to average everything together. Since the 2010 Review, however, a new value and a revised older value lie between the extremes, and we now average the best seven measurements. We have been careful to consult with experts.

$$\text{2010 Review: } \tau_n = 885.7 \pm 0.8 \text{ s}$$

$$\text{2012 Review: } \tau_n = 880.1 \pm 1.1 \text{ s } (S = 1.8)$$

- *The proton charge radius*—We use the 2010 CODATA value here, but there is the same kind of problem as there was with the neutron lifetime: Most measurements use  $ep \rightarrow ep$  interactions; but a 2010 experiment using the  $\mu p$ -atom Lamb shift is eight times more precise but seven standard deviations away from the  $ep$  value.

- In cases such as these, a header note in the data block explains what we have done, and why.

## *BARYON RESONANCES ( $N^*$ , $Y^*$ )*

*Encoders: Ron Workman, Eberhard Klempt. New entries:  $N^*/Y^*$  569/14.*

- There are *many* new results from partial-wave analyses of  $\pi N$  and  $\gamma N$  reactions—pole positions and residues, Breit-Wigner masses and widths, branching fractions, photon decay amplitudes—largely from the Bonn-Gatchina group (Anisovich, Klempt, et al; the group published in 2010, then summarized a lot of work in 2012, so the number of “used” values is much smaller than 569). The new values required a re-evaluation of the star ratings of some of the  $N$ ’s and  $\Delta$ ’s and a major rewriting of the note, “ $N$  and  $\Delta$  Resonances.”
- Since Eberhard is there, he might like to say a few words.