New paper draft

Constraints on the d/u ratio at large x

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(Dated: September 19, 2011)

Recently the ratio of neutron to proton structure functions F_2^n/F_2^p was extracted from a phenomenological correlation between the strength of the nuclear EMC effect and the inclusive electron nucleon cross section ratio at $x > 1$. Within conventional models of nuclear smearing, this "in-medium correction" (IMC) extraction constrains the size of nuclear effects in the deuteron structure functions, from which the neutron structure function F_2^n is usually extracted. The IMC data determine the resulting proton d/u quark distribution ratio at $x \to 1$ to lie in the range $0.14 - 0.32$ with a 90% confidence level. This is well below the SU(6) symmetry limit of 0.5 and well above the scalar diquark dominance limit of 0.

Theoretical corrections to the deuteron structure function

$$F_2^d(x,Q^2) \;=\; \int dy\, f_{N/d}(y,\gamma)\, F_2^N\left(\frac{x}{y},Q^2\right) \;+\; \delta^{(\mathrm{off})} F_2^d(x,Q^2),$$

$$\delta^{(\mathrm{off})} F_2^d(x,Q^2) \;=\; \int \frac{d^3p}{(2\pi)^3}\left(1+\frac{\gamma p_z}{M}\right) \mathcal{C}(y,\gamma)\,|\Psi_d(p)|^2\,(p^2-M^2)\,\frac{\partial F_2^N(x/y,Q^2,p^2)}{\partial p^2}\bigg|_{p^2=M^2} \quad (2)$$

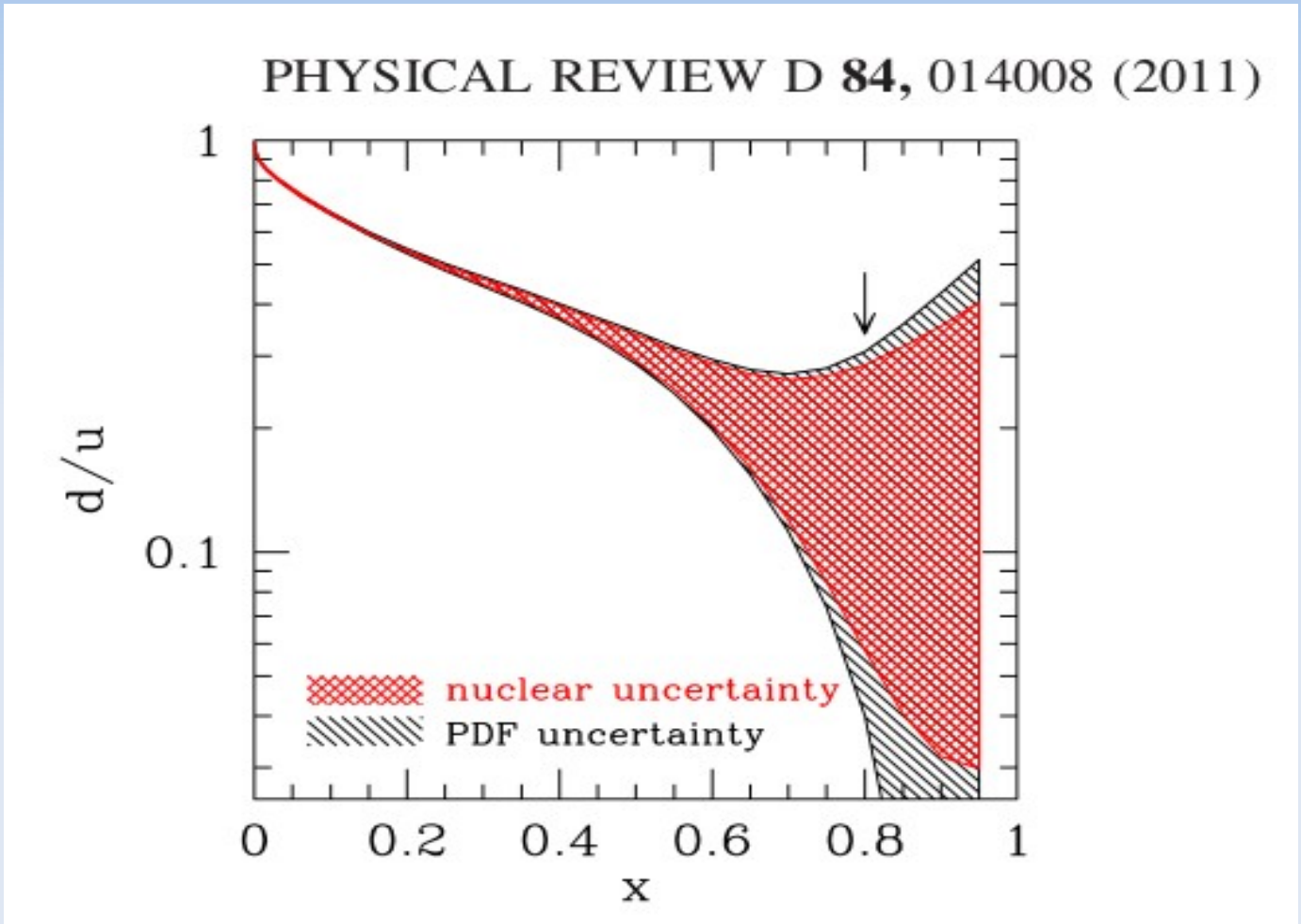
Swelling level

Average Virtuality

$$\lambda \;=\; \frac{\partial \Lambda^2}{\partial \log p^2}\bigg|_{p^2=M^2} \;=\; -2\frac{\delta R_N}{R_N}\frac{\delta p^2}{M^2},$$

Theory correction depends only on λ!

Uncertainties in theoretical parameters leads to large uncertainty on d/u at $x \rightarrow 1$



d/u($x \rightarrow 1$)

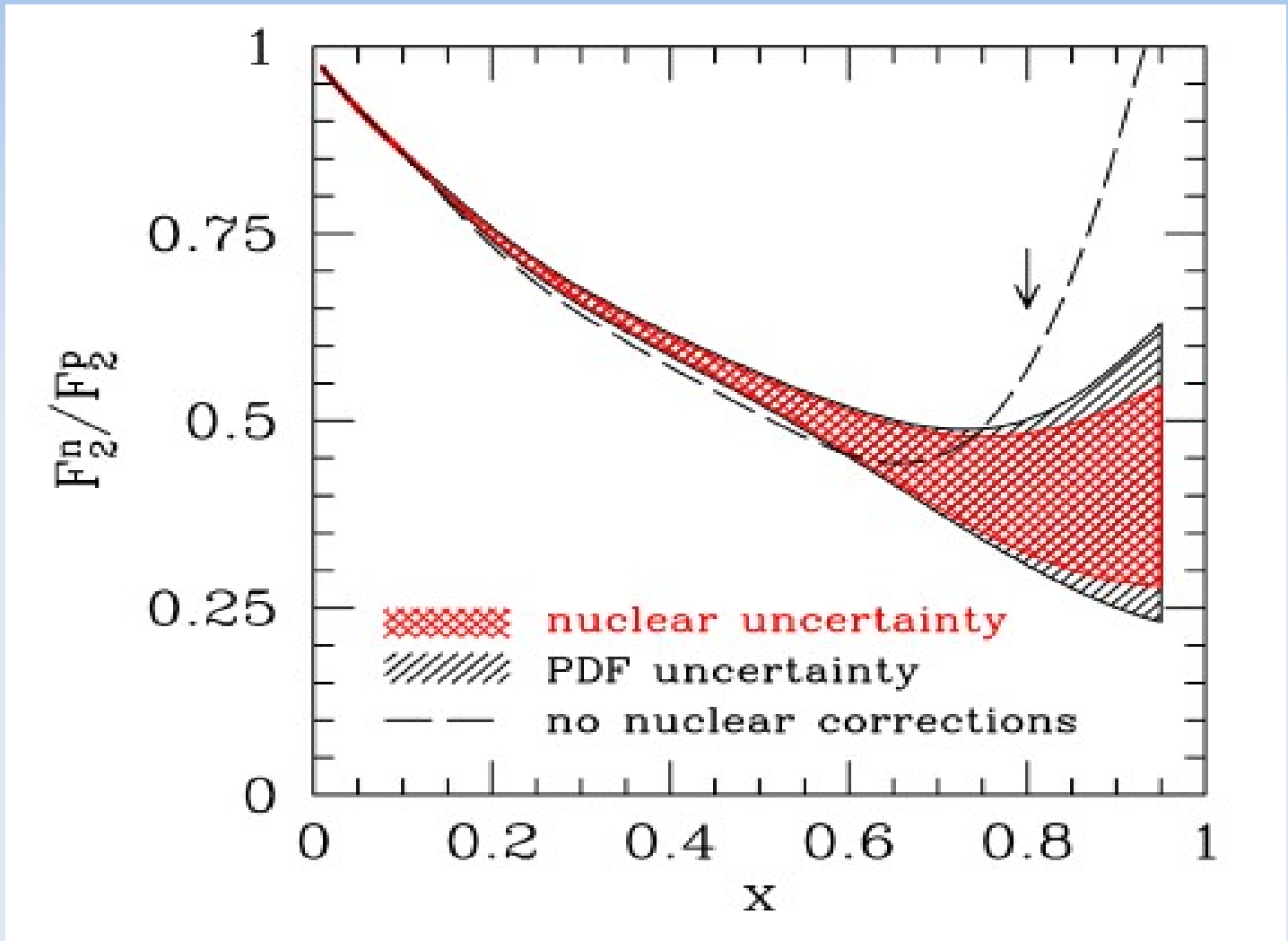
SU(6): d/u=**0.5**

pQCD: d/u=**0.2**

Scalar diquark dominance: d/u=**0**

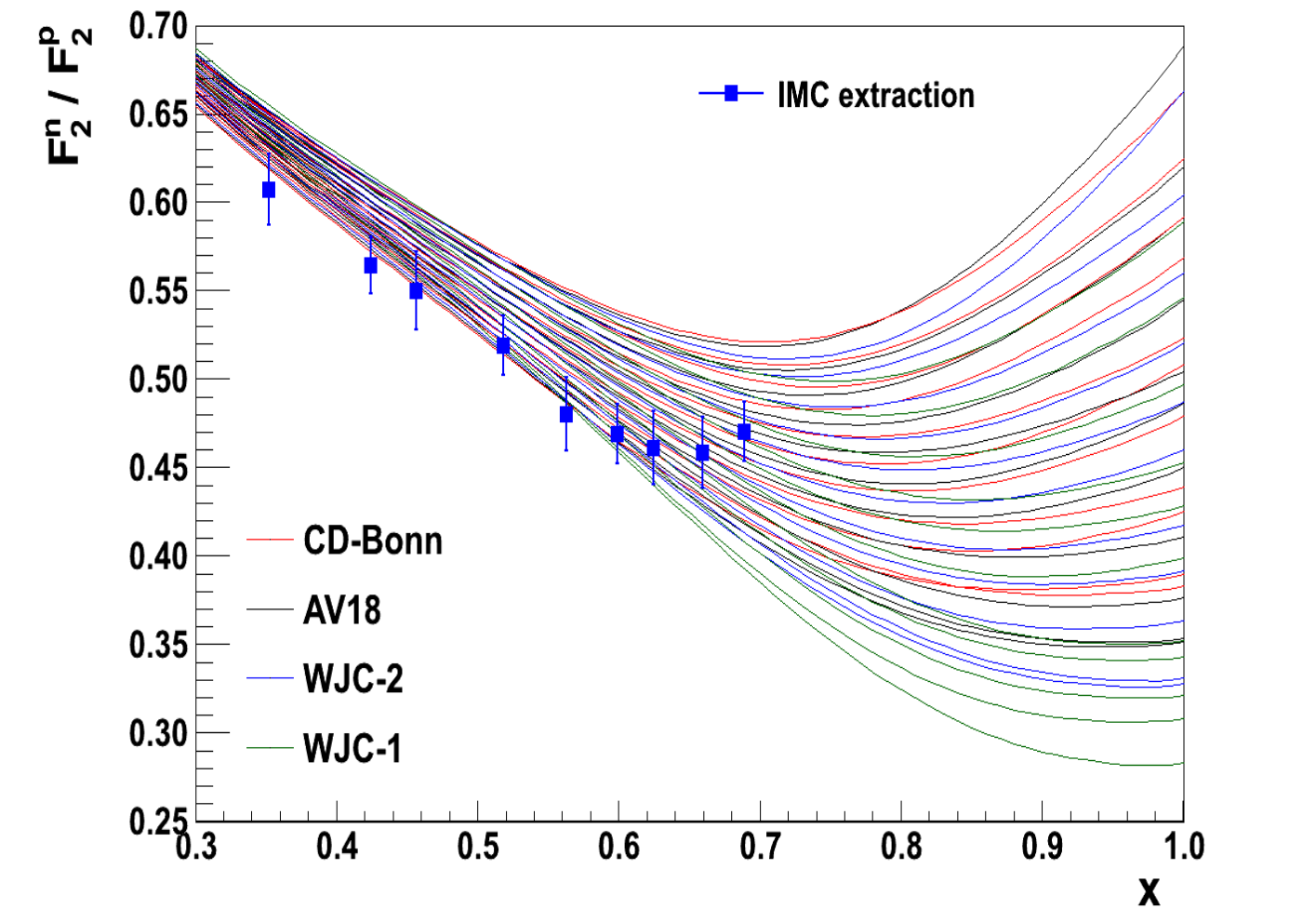
- Swelling levels considered: 1.5-1.8%
- Average virtuality calculated using AV18, CDBonn, WJC1 and WJC2 wave functions.

Theoretical Uncertainty Band



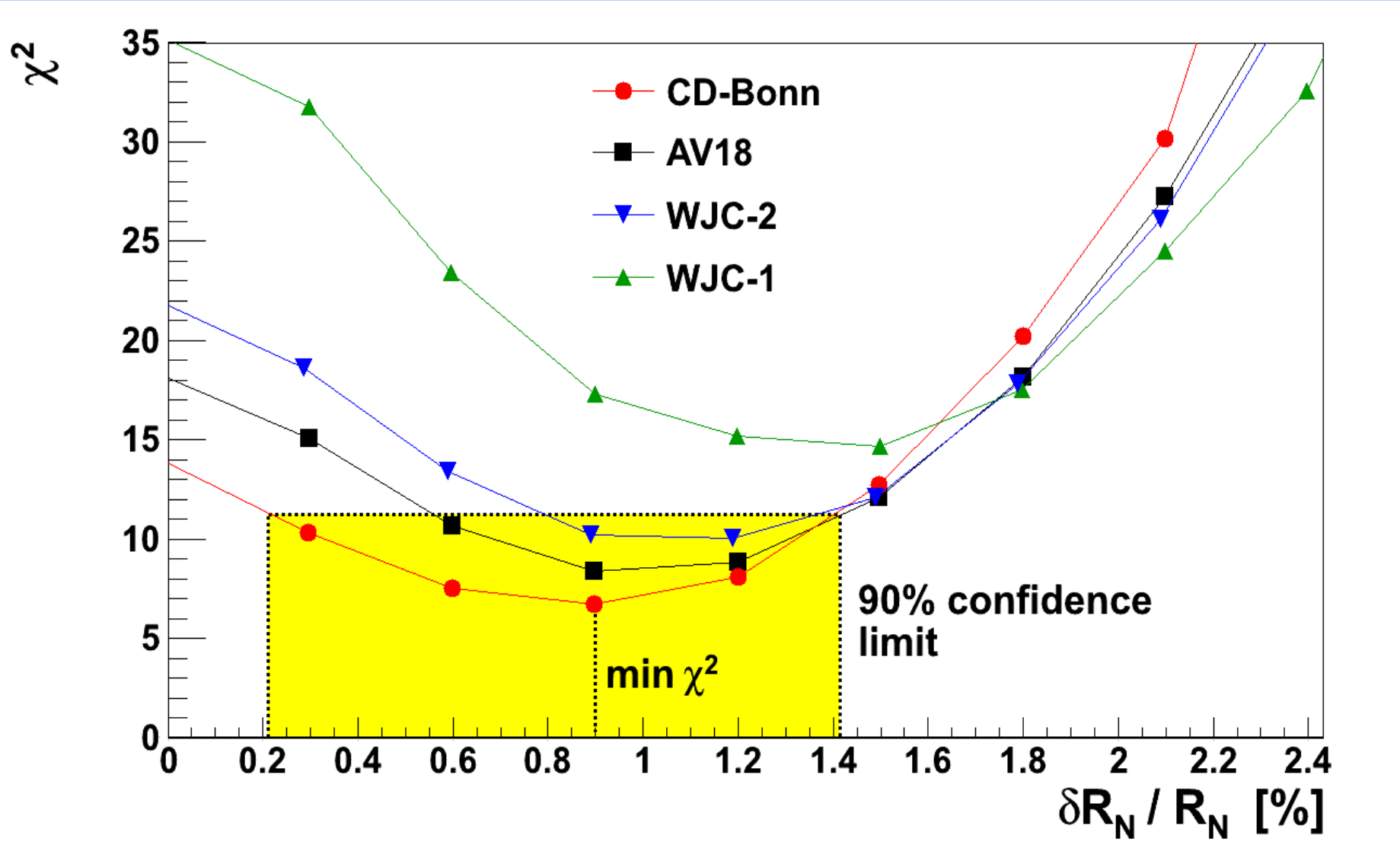
- Swelling levels considered: 1.5-1.8%
- Average virtuality calculated using AV18, CDBonn, WJC1 and WJC2 wave functions.

A Decomposition of the theoretical uncertainty band

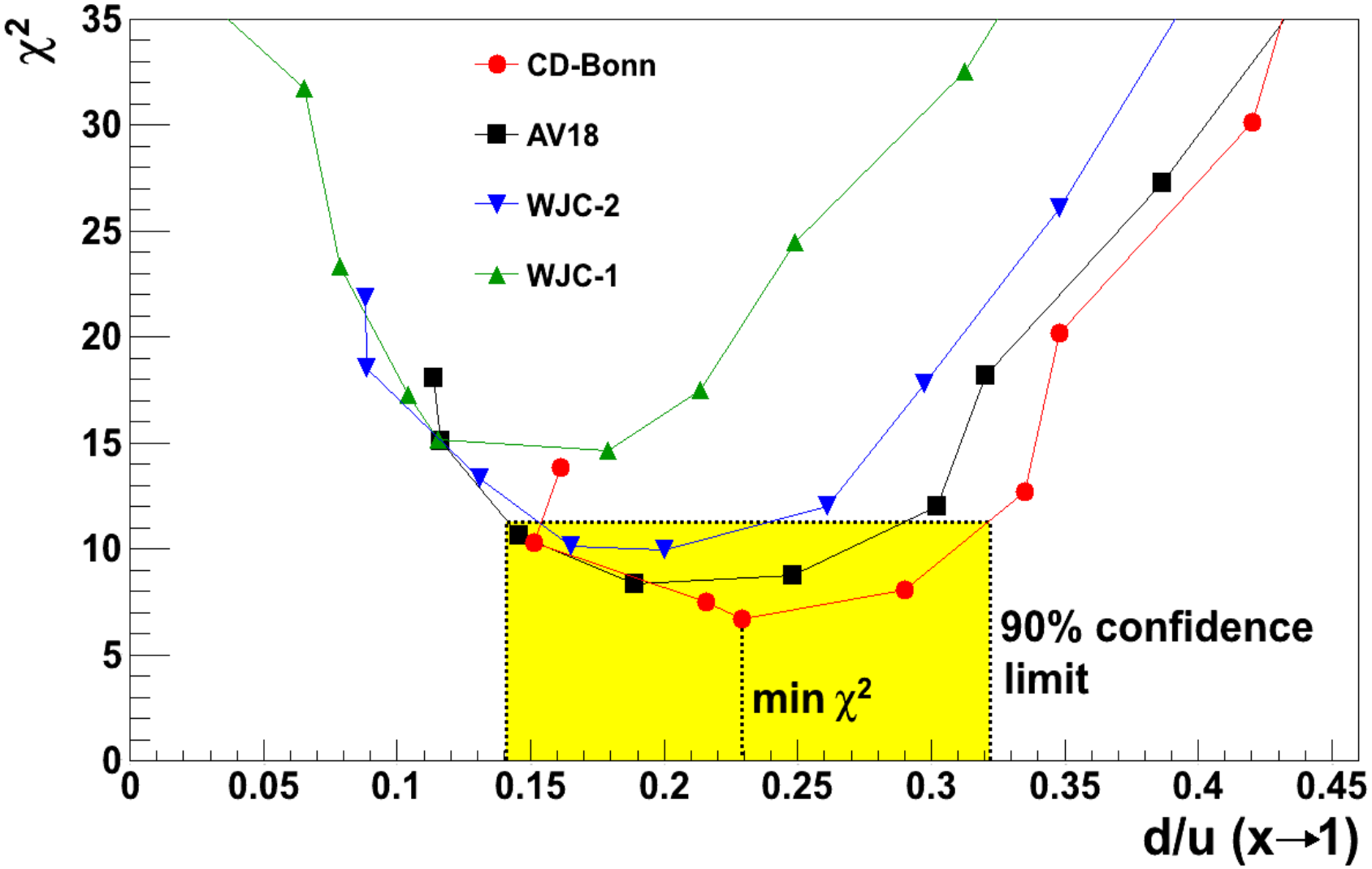
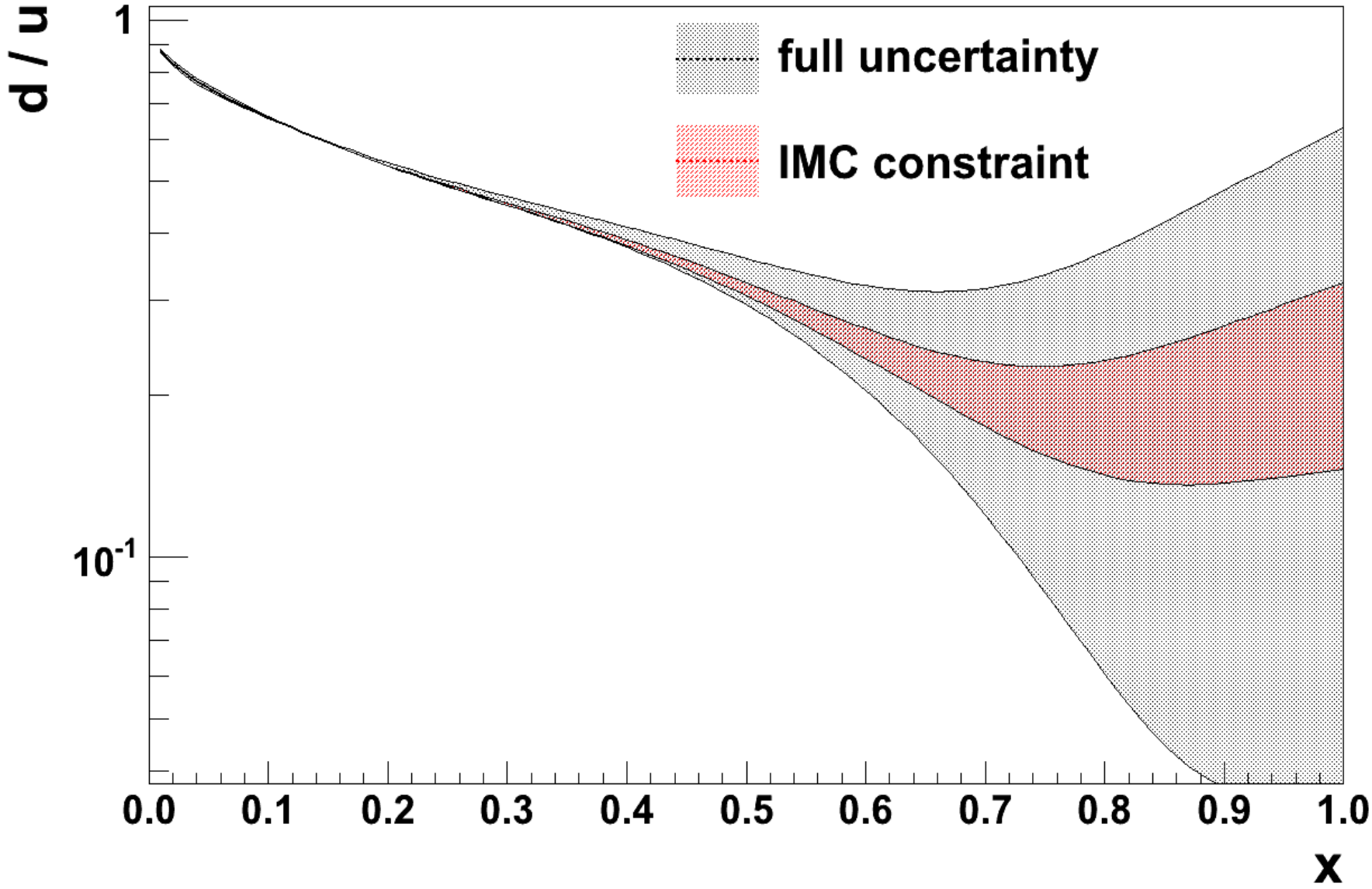


- Swelling levels considered: 0-3% (in increments of 0.3%)
- Average virtuality calculated using AV18, CDBonn, WJC1 and WJC2 wave functions.

Fitting to the IMC extraction



Fitting to the IMC extraction



Reduced uncertainty on d/u ratio at $x \to 1$