Modified law of the wall leading to turbulent channel flow universal velocity profiles valid down to \( Re_\tau = 395 \) GREGOIRE WINCKELMANS, UCL, Louvain School of Engineering, LAURENT BRICTEUX — Velocity profile modeling is revisited using the results from databases of turbulent channel flow DNS at \( Re_\tau = u_\tau h/\nu = 2000, 950, 550, \) and 395. We consider the turbulent region: \( y^+ = Re_\tau \eta \) (with \( \eta = y/h \) larger than 70). A new model for the effective turbulent viscosity, \( \nu_t = -\frac{u'v'\partial u}{\partial y} \), is proposed, that fits well the DNS results all the way to the channel center. The velocity profile is then obtained by integration: it corresponds to a “modified law of the wall,” \( \frac{1}{\kappa} \left( \log(y^+ + y^+_0) - \eta \right) + C \), with the added classical “law of the wake,” \( D g(\eta) \). The new \( -\eta \) term in the modified law of the wall is really required in such still limited Reynolds number channel flows, as an important correction to the usual log term: both terms “work together,” as both are multiplied by the same \( \frac{1}{\kappa} \) value (recall that \( D \) is not related to \( \kappa \)). Only at the highest Reynolds numbers does this correction become negligible. As to the \( y^+_0 \) shift in the log term itself (value around 6), something also recently proposed by Spalart et al (Phys. Fluids in press), it too is required as a consequence of the \( \nu_t \) near wall behavior. The present velocity profile is quite universal: it fits very well, with the same value of all constants, all \( Re_\tau \) cases. In particular, the von Kármán constant is obtained as \( \kappa = 0.37 \): same as Zanoun et al (Phys. Fluids 15 (10):3079, 2003), and close to 0.38 as Spalart et al.