The fundamental triple-deck problem governing turbulent marginal separation for infinite global Reynolds number *Re*, that is in the formal limit $Re^{-1} = 0$, was derived by means of an asymptotic analysis of the Reynolds-averaged Navier–Stokes equations in terms of the small (positive) parameter α, which measures the slenderness of the turbulent boundary layer undergoing separation. As has been expected, turbulent marginal separation turns out to be associated with a strong viscous/inviscid interaction of the boundary layer with the external irrotational bulk flow. The most surprising and instructive result is the finding that the local deceleration of the flow upstream of separation due to the pressure gradient induced by the boundary layer displacement provides the relevant physical mechanism leading to flow detachment. This is a characteristic which definitely contrasts the accelerating effect of the local pressure drop on the upstream side in laminar interacting-boundary-layer problems known so far. Analogous to the theory of two-dimensional incompressible laminar marginal separation, the turbulent case is described in canonical form by a one-parameter family of solutions. Both the theoretical background and numerical solutions of that problem are presented in [1] and [2].

In order to solve the canonical fundamental elliptic partial integro-differential equation, an efficient direct numerical method has been developed (and is still being refined). As that numerical procedure effectively copes with the problem of seeking an eigensolution of the interaction problem which is triggered by prescribing an appropriate downstream state, it is intended to be applied to a broader class of related problems arising in interacting-boundary-layer theory also. In this context we mention, amongst others, the presently (elsewhere) intensely debated phenomenon of non-uniqueness and the occurrence of turning points in the solutions of laminar triple-deck problems, the asymptotic formulation of weak hydraulic jumps observed in single- or two-layered thin-film flows, and critical transonic slender-nozzle flows.

The asymptotic description of marginal separation in the primary limit $\alpha \to 0$ serves as a basis for the current investigation of the influence of high but finite values of *Re* on the flow close to the surface. In a first step, a rather complex multi-layered asymptotic splitting of the flow has been detected by accordingly perturbing the present wake-type formulation of a turbulent boundary layer near separation and taking into account the interaction strategy outlined above. The resulting uniformly valid flow description explains the gradual transformation of the celebrated logarithmic law of the wall holding for attached flow towards the square-root behaviour matching the streamwise velocities in the viscous wall layer and the wake regime on the verge of separation, [3]. It is found, however, that the asymptotic analysis of the time-mean motion is not capable of providing the correct continuation of the skin-friction law into regions showing reverse flow. We therefore propose to supplement it with a rational investigation of the coherent motions characterising the viscous near-wall region in the limit $Re \to \infty$. This study is planned to be carried out in a future research project.

A further aspect of research interest concerns the prediction of separated-flow regimes having a streamwise extent which is asymptotically larger compared to that in the present approach. The corresponding limiting form of the fundamental interaction problem is seen to be covered by a local theory of turbulent break-away separation under investigation, [4].

[1] SCHEICHL, B. & KLUWICK, A. 2006 Turbulent Marginal Separation and the Turbulent Goldstein Problem. *AIAA Journal* (submitted). See also *AIAA paper 2005-4936*.

[2] SCHEICHL, B. & KLUWICK, A. 2006 Turbulent Marginal Separation: A Novel Triple-Deck Problem for Turbulent Flows. Accepted for publication in *Progress in Turbulence II* (ed. J. Peinke, M. Oberlack, A. Kittel & S. Barth). Springer Proceedings in Physics, Springer.

[3] SCHEICHL, B. & KLUWICK, A. 2006 On Turbulent Marginal Separation: How the Logarithmic Law of the Wall is Superseded by the Half-Power Law. Accepted for presentation at the *International Conference: Boundary and Interior Layers (BAIL). Computational & Asymptotic Methods, 24th–28th July, 2006, Göttingen, Germany*.

[4] SCHEICHL, B. & KLUWICK, A. 2006 On the Brillouin–Villat Condition in Connection with Turbulent Massive Separation. Accepted for presentation at the *International Symposium on Trends in Applications of Mathematics to Mechanics (STAMM), July 10–14 2006, Vienna University of Technology, Vienna, Austria*.