Major Achievements of Burak ÖZBAĞCI

"*Surgery on contact 3-manifolds and Stein surfaces*", Bolyai Society Mathematical Studies, 13. Springer-Verlag, Berlin; János Bolyai Mathematical Society, Budapest, 2004. 281 pp. (joint with András I. Stipsicz)

The groundbreaking results of the near past — Donaldson's result on Lefschetz pencils on symplectic manifolds and Giroux's correspondence between contact structures and open book decompositions — brought a topological flavor to global symplectic and contact geometry. This topological aspect is strengthened by the existing results of Weinstein and Eliashberg (and Gompf in dimension four) on handle attachment in the symplectic and Stein category, and by Giroux's theory of convex surfaces, enabling us to perform surgeries on contact 3-manifolds. The main objective of the book of Özbağcı and Stipsicz is to provide a self-contained introduction to the theory of surgeries one can perform on contact 3-manifolds and Stein surfaces. The authors adopt a very topological point of view based on handlebody theory, in particular, on Kirby calculus for 3- and 4-dimensional manifolds.

Surgery is a constructive method by its very nature. Applying it in an intricate way one can see what *can* be done. These results are nicely complemented by the results relying on gauge theory — a theory designed to prove that certain things *cannot* be done. The authors freely apply recent results of gauge theory without a detailed introduction to these topics; rather giving a short introduction to some forms of Seiberg-Witten theory and some discussions regarding Heegaard Floer theory in two Appendices. As work of Taubes in the closed, and Kronheimer-Mrowka in the manifold-with-boundary case shows, the analytic approach towards symplectic and contact topology can be very fruitfully capitalized when coupled with some form of Seiberg-Witten theory. On the other hand, Lefschetz pencils on symplectic, and open book decompositions on contact manifolds are well-suited for the contact Ozsváth–Szabó invariants. Under some fortunate circumstances these dual viewpoints provide interesting results in the subject.

"*Lefschetz fibrations on compact Stein surfaces*", Geometry & Topology 5 (2001) 319–334 & Erratum: 939–945 (joint with Selman Akbulut).

In this article, Akbulut and Özbağcı proved that every compact Stein surface admits a Lefschetz fibration over the 2-disk and conversely every Lefschetz fibration over the 2-disk is a compact Stein surface. The result was independently proved by Loi and Piergallini using different methods. The method of Akbulut and Özbağcı is much more explicit in terms of constructing the fibration in the theorem. As a result of this article one can construct an open book decomposition compatible with a contact structure presented by a Legendrian surgery diagram in the standard contact 3-sphere.

“*Signatures of Lefschetz fibrations.*” Pacific J. Math. 202 (2002), no. 1, 99–118.

In this article, Özbağcı develops an algorithm to compute the signature of a smooth 4-manifold which admits a Lefschetz fibration over D^2 or S^2, using the global monodromy of this fibration.

“*Invariants of contact structures from open books.*” Trans. Amer. Math. Soc. 360 (2008), no. 6, 3133–3151 (joint with John B. Etnyre).

In this article, Etnyre and Özbağcı define three invariants of contact structures in terms of open books supporting the contact structures. These invariants are the support genus (which is the minimal genus of a page of a supporting open book for the contact structure), the binding number (which is the minimal number of binding components of a supporting open book for the contact structure with minimal genus pages) and the norm (which is minus the maximal Euler characteristic of a page of a supporting open book).

“*Noncomplex smooth* 4*-manifolds with genus-*2 *Lefschetz fibrations.*” Proc. Amer. Math. Soc. 128 (2000), no. 10, 3125–3128 (joint with András I. Stipsicz).

In this article, Özbağcı and Stipsicz construct noncomplex smooth 4-manifolds which admit genus two Lefschetz fibrations over 2-sphere. Examples of such fibrations were also constructed independently by Ivan Smith. The fibrations are necessarily hyperelliptic, and the resulting 4-manifolds are not even homotopy equivalent to complex surfaces. Furthermore, these examples show that fiber sums of holomorphic Lefschetz fibrations do not necessarily admit complex structures.

“*Contact* 3*-manifolds with infinitely many Stein fillings.*” Proc. Amer. Math. Soc. 132 (2004), no. 5, 1549–1558 (joint with András I. Stipsicz).

In this article, Özbağcı and Stipsicz proved the existence of an infinite family of contact 3-manifolds each admitting infinitely many non-diffeomorphic Stein fillings. These are the first such examples that appeared in the literature. They use Lefschetz fibrations to construct the Stein fillings and they compute the first homology groups of these fillings to distinguish them.

“*Milnor fillable contact structures are universally tight.*” Math. Res. Lett. 17 (2010), no. 6, 1055–1063 (joint with Yankı Lekili).

In this article, Lekili and Özbağcı showed that the canonical contact structure on the link of a normal complex singularity is universally tight. As a corollary, they showed the existence of closed, oriented, atoroidal 3-manifolds with infinite fundamental groups which carry universally tight contact structures that are not deformations of taut (or Reebless) foliations.

"*Symplectic fillings of lens spaces as Lefschetz fibrations.*" J. Eur. Math. Soc. (JEMS) 18 (2016), no. 7, 1515–1535 (joint with Mohan L. Bhupal).

In this article, Bhupal and Özbağcı construct a Lefschetz fibration over the disk on any minimal (weak) symplectic filling of the canonical contact structure on a lens space. Using this construction, they prove that any minimal symplectic filling of the canonical contact structure on a lens space is obtained by a sequence of rational blowdowns from the minimal resolution of the corresponding complex two-dimensional cyclic quotient singularity.

The article of Bhupal and Özbağcı is the first article *with a Turkish address* that appeared in the Journal of the European Mathematical Society.

"*Fillings of unit cotangent bundles of nonorientable surfaces.*" Bull. Lond. Math. Soc. 50 (2018), no. 1, 7–16 (joint with Youlin Li).

In this article, Li and Özbağcı proved that any minimal weak symplectic filling of the canonical contact structure on the unit cotangent bundle of a nonorientable closed connected smooth surface other than the real projective plane is s-cobordant rel boundary to the disk cotangent bundle of the surface. If the nonorientable surface is the Klein bottle, then they showed that the minimal weak symplectic filling is unique up to homeomorphism.

"*Genus one Lefschetz fibrations on disk cotangent bundles of surfaces.*", to appear in Revista Matemática Iberoamericana.

In this article, Özbağcı describes a Lefschetz fibration of genus one on the disk cotangent bundle of any closed orientable surface S. As a corollary, he obtains an explicit genus one open book decomposition adapted to the canonical contact structure on the unit cotangent bundle of S.