Adaptive nonstandard FEM in calculus of variations.

The topic was carefully chosen in an area where Oberwolfach conferences on computational microstructures and nonstandard finite element methods had been co-organized by the senior member of the group. The combination of novel methods in an actual field of applications was addressed by experienced younger scientists. The topic of adaptive finite element methods and their a priori convergence analysis was new to the junior group members. The introduction into this area was focused on numerous short presentations running in parallel. The short presentations in the nice lecture hall allowed for a fundamental discussion of detailed aspects like the random marking, which is convergent almost surely. They combined the knowledge of group members with a strong background in probability theory with the state-of-the-art in computational PDE and highlighted the unique possibilities of HIM to invite gifted scholars from different mathematical areas with a common innovative goal in a pleasant and stimulating atmosphere for a longer period of time . The challenging novel area was addressed in teamwork e.g. by parallel reading some revealing key publications of some group members, explaining the main results and their mathematical proofs to the audience. The publication

Christoph Ortner, Dirk Praetorius : On the convergence of adaptive non-conforming finite element methods
<http://www.hausdorff-research-institute.uni-bonn.de/files/preprints/computational_mathematics/ancfem.pdf>
SINUM 2011

of Dirk Praetorius and Christoff Ortner is an example of synergy effects. Adaptive nonstandard finite element methods lead to a parameter-free robust numerical simulation for a surprisingly large class of variational problems. The two authors entered the HIM as non-experts on adaptive mesh-refinements, but were involved in related preparations of the paper by Carsten Carstensen: “Convergence of adaptive finite element methods in computational mechanics” and well trained during their time at HIM to prove the convergence of the fundamental nonconforming method. The two authors vaguely knew each other from their joint time at Vienna University of Technology, but worked in two different European countries. Without the opportunity of fruitful collaboration at HIM, this first seminal mathematical result, which stimulates a huge area of future research in computational nonlinear PDEs, could not be realized.