

ODTÜ RESEARCH FROM CELLS TO SPACE

HORIZON 2020

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ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY





NANOBIOSSENS - Nanosensors based on Nanomaterials

Funding Scheme: FP7-PEOPLE-IRSES	Project Coordinator: Dr. Burcu AKATA KURÇ	Project Budget: 333,000.00 EUR
www.nanodev.mnt.metu.edu.tr		

“ABILITY TO ORGANIZE NANOMATERIALS ON SOLID SURFACES OF ANY TYPE IS THE ULTIMATE WAY TO BEGIN USING NANO-MATERIALS IN NANO-DEVICES”

The first FP7 Marie Curie IRSES project that is supported in Turkey has been successfully completed and its sequel IRSES project NANODEV has started in January 2013.

The primary objective of NANOBIOSSENS is to bring together an international and interdisciplinary group of research teams having different areas of expertise to share the knowledge of different elements for building nano-biosensors. The development of future devices requires controlled assembly and placement of individual and/or multiple nano-building blocks into desired locations. By the accomplishment of this research proposal, the advantages of the integration of nanomaterials into the structure of biosensors became feasible. Experts in the field of chemical engineering, biomedical engineering, materials science, physics, chemistry, and biology contributed to NANOBIOSSENS. Different pieces of work were constructed into each other to first of all study their “separate” roles in that assembled piece of work. While this project was completed in 2012, its sequel NANODEV has started in 2013. NANODEV aims to test the advanced nanomaterials, in two of the most appealing applications namely “biosystems” and “solar energy”, by assembling integrated nanodevices. NANODEV will gather for the first time a list of nanomaterials, their properties, their modification methodologies, the technique to use these raw materials in device parts, and actual data obtained from such important application areas.



Dr. Haluk KÜLAH

“INNOVATIVE AND INTERDISCIPLINARY
RESEARCH, FOCUSING ON REAL PRODUCTS”

Research Field: MEMS sensors, BioMEMS, and
MEMS-based energy scavenging

Prominent Project: “ODTÜ MEMS Research and Applications Center”
(Project Coordinator: ODTÜ; Dr. Külah took part as Researcher)

Funding Scheme: FP7-REGPOT-2009

Project Budget: 2,700,000.00 EUR

Dr. Haluk Külah received his B.Sc. and M.Sc. degrees in Electrical Engineering from ODTÜ. He received a Ph.D. degree in Electrical Engineering from the University of Michigan, Ann Arbor. From 2003 to 2004, he was employed as a Research Fellow at the Department of Electrical Engineering and Computer Science, University of Michigan. In 2004, he joined the Electrical and Electronics Engineering Department of ODTÜ. His research is focused on MEMS sensors, mixed-signal interface electronics design for MEMS sensors, BioMEMS, and MEMS-based energy scavenging. Dr. Külah is the Deputy Director of the ODTÜ-MEMS Centre.

Dr. Külah’s research group is working on the development of MEMS-based biomedical tools since 2004. Dielectrophoresis, resonance-based gravimetric sensing, CMOS sensors, and electrochemical sensors have been the major research areas. His research group also works on micro-scale energy harvesting, vibration-based, thermoelectric, and RF energy harvesters together with their low power interface electronics. As a result, Dr. Külah has 9 patents and more than 100 publications with over 500 ISI citations.

Dr. Külah’s interdisciplinary research group includes collaborators from different disciplines ranging from ODTÜ Biology Department Cancer Research Laboratory; Hacettepe University Medical School; Gazi University Medical School; Gazi University Faculty of Pharmacy; ODTÜ Mechanical Engineering Department; and ODTÜ Chemical Engineering Department.

Dr. Külah’s research is funded by various national and international agencies and companies, including Intel Inc., IBM, European Union 7th Framework Programme, Turkcell, The Scientific and Technological Research Council of Turkey (TÜBİTAK), and The Ministry of Science, Industry and Technology.



Dr. Yeşim AYDIN SON

“GENOMICS FOR BETTER HEALTHCARE”

Research Field: Genomics

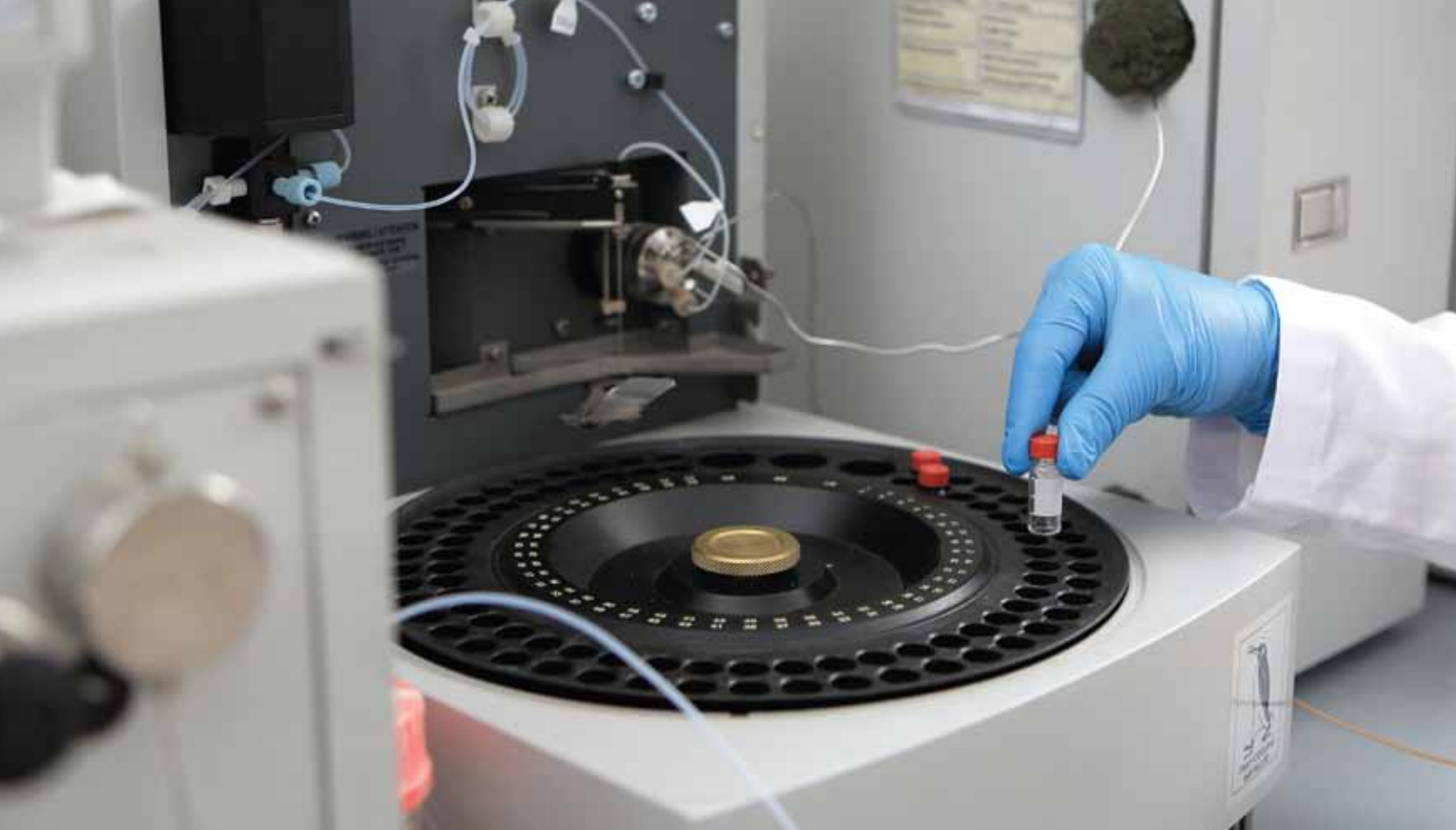
Prominent Project: ODTÜ - SNP - A new genomic test based on SNP

Funding Scheme: ODTÜ

Dr. Yeşim Aydın Son is a medical scientist holding an M.D. and a Ph.D. in Genome Sciences and Technologies. She is the head of the Health Informatics Department and faculty member of the Bioinformatics Program of ODTÜ. Main focus of her research is modelling of chronic and complex diseases based on integrated genomic and clinical data. After validation of the models, their implementation as clinical decision support systems will be aiding healthcare providers to use genomic information for diagnosis and treatment of patients.

Her group has released a java-based integrated software called ODTÜ-SNP. ODTÜ-SNP also provides discovery of genes and pathways related to diseases. pi-SNP, the web-service of ODTÜ-SNP, is released in 2014 (<http://pi-snp-test.ii.metu.edu.tr/>). Her group continues to investigate the application of different data mining approaches and they have recently shown that the SVM-ID3 hybrid method outperforms only SVM for modelling prostate cancer. Genotyping and analysis of clinical data of Schizophrenia, Bipolar Disorder, Alzheimer’s and Parkinson’s Diseases, diabetes and various cancers are among her on-going projects.

In 2012, she was awarded with an entrepreneurial funding to start-up the GENformatik Company in ODTÜ Teknokent. GENformatik is now developing a new genomic test based on SNP profiling for the determination of drug side effects in schizophrenic patients. GENformatik is also funded by the EuroSTAR Program to develop a diagnostic test for rapid monitoring of viral infections in bee colonies.



Understanding the biochemical changes entailing spontaneous differentiation of colon cancer cells

Funding Scheme: The Scientific and Technological Research Council of Turkey (TÜBİTAK) and Turkish Academy of Sciences - The Young Scientists Award Programme (TÜBA-GEBİP) **Project Coordinator:** Dr. Sreeparna BANERJEE

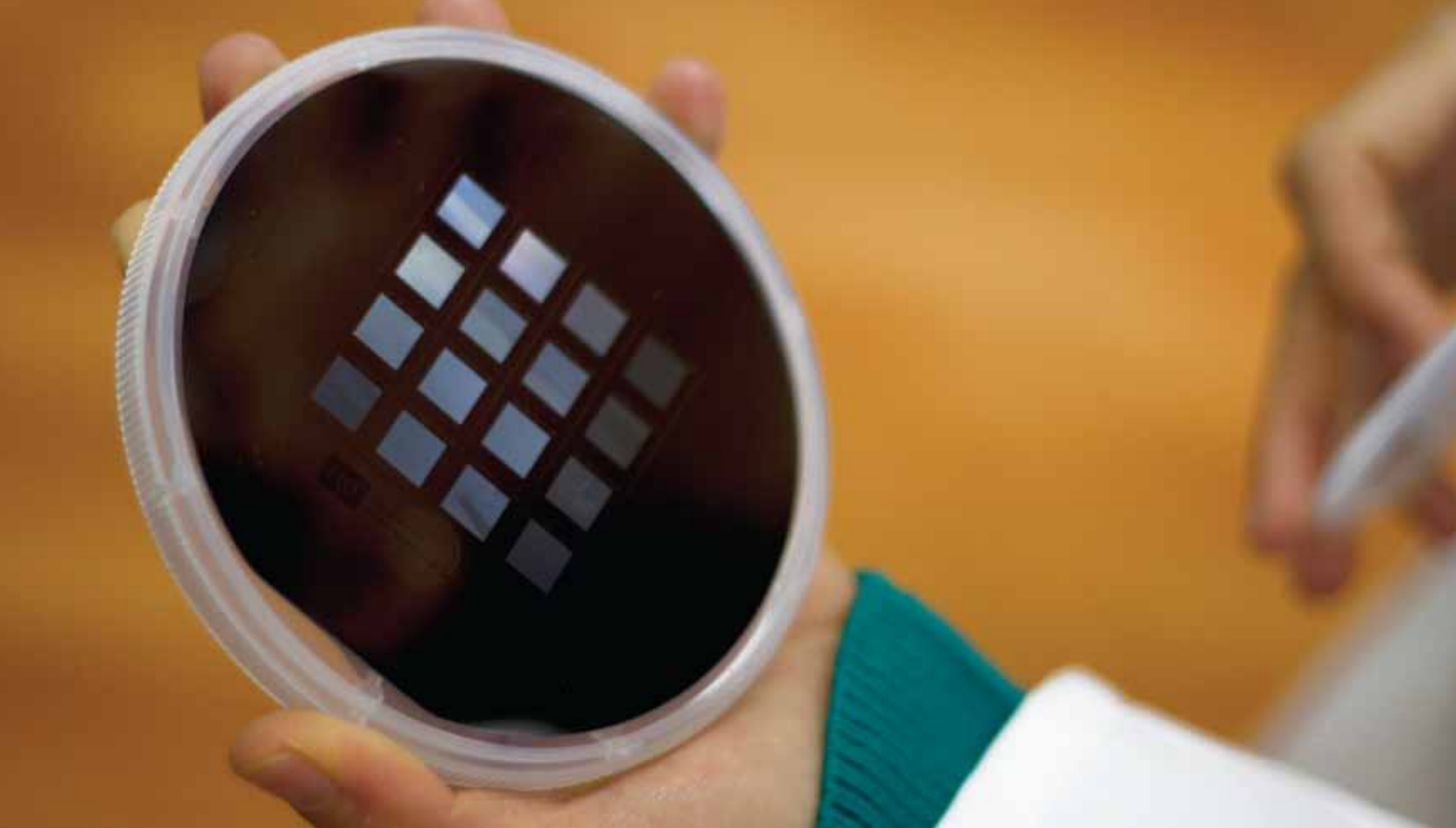
Project Budget: 333,000.00 EUR

“SPONTANEOUS DIFFERENTIATION OF COLON CANCER CELLS REVEAL MARKED CHANGES IN CELLULAR BIOCHEMISTRY”

Cellular differentiation in the gastrointestinal system is a process by which the cells cease proliferation, acquire the ability to specialize and carry out their specific function of digestion and absorption of nutrients. Cancer is associated with a de-differentiated and inflammatory phenotype. The process of differentiation entails communication and interaction with the cellular microenvironment and a loss of this in cancer cells helps the process of malignant transformation.

We have used the colorectal cancer cell lines Caco-2 and HT-29 that can spontaneously undergo differentiation upon contact inhibition, or on glucose deprivation respectively, in vitro. We have shown that the inflammatory transcription factor nuclear factor kappa B (NF-κB) is inhibited in the course of differentiation, which can lead to the loss of an inflammatory phenotype. CCAAT enhancer binding protein (C/EBP-β), a transcription factor involved in the process of adipocyte differentiation, was activated during Caco-2 differentiation, which in turn induced the cells to undergo autophagy, a mechanism of cell death that may reduce inflammation in the colon. Additionally, we have used these cells as a model of mesenchymal to epithelial transition and have shown dynamic epigenetic regulation of cancer testis antigens, a group of proteins that have important implications in the development of cancer therapeutics.

These studies highlight the significant alterations in cellular characteristics when a cell changes from a non-differentiated to a more specialized phenotype. Models such as the Caco-2 cell line will help us understand the biochemical basis of cellular differentiation and open up new doors to design better therapeutic interventions.



BIOMATEN – CENTER OF EXCELLENCE IN BIOMATERIALS AND TISSUE ENGINEERING EXCELLENCE IN REGENERATIVE MEDICINE

“The only center in Turkey focusing on Biomaterials and Tissue Engineering and is both a site for experimental analysis/testing and scientific and industrial guidance”

Director: Prof. Dr. Vasif HASIRCI <http://biomaten.metu.edu.tr/en/>

“BIOMATEN CAN PERFORM RAPID PROTOTYPING WITH ITS UP-TO-DATE EQUIPMENT”

BIOMATEN is the only center in Turkey which focuses on Biomaterials and Tissue Engineering and is both a site for experimental analysis/testing, and scientific and industrial guidance. A typical example for both aspects is the biodegradable implant studies involving the academia and medical sector.

The Center, with its up-to-date equipment, can produce implants with rapid prototyping and perform analysis with microCT. Biodegradable implants, tissue engineering of various tissues and regeneration are among the topics studied here are international levels. Controlled release systems and drug delivery are among its other fields of expertise. The members of BIOMATEN are also experienced in computer analysis of loading behavior of soft tissues, finite element modelling of amputee residual limb and prosthetic socket interface, soft and hard tissue biomechanics, computerized 3-D gait and motion analysis, postural dynamics and stability, synthetic biology, biosensors, cell imaging and trafficking, biological applications of nanoparticles, development of disease models and osteoporosis, bioceramics, glass surfaces, sol-gel chemistry, wound dressing materials, responsive hydrogels, enzyme immobilization, and bone cements.

BIOMATEN has strong relations with the medical sector and collaborates with SMEs at various technoparks and industrial sector groupings on the development of various devices. Some of the BIOMATEN members are involved in SMEs established in technoparks. BIOMATEN is a member of INOVANKARA, where the scientific and technological knowledge produced is shared with the industry and their networking and partnering activities are facilitated.

The Center has an interdisciplinary group of researchers from Biological Sciences, Biomedical Engineering, Chemistry, Engineering Sciences, Metallurgical and Materials Engineering, Biotechnology, and Mechanical Engineering Departments.



Since its founding in 2011, a total of 35 M.Sc. and Ph.D. theses have been completed, 92 articles published in peer reviewed international journals along with 131 presentations in international conferences. Also 6 patent applications were made. Currently, the Center is involved in 49 projects funded by ODTÜ sources and 25 projects funded by national and international sources (June 2014).

In the Center, research on tissue engineering in 2D and 3D using bioreactors is carried out to study various artificial tissues. Various characterization tests along with cytotoxicity testing are performed for both the research performed at the Center and also for the industry. Critical Facilities of the Center include Mechanical Characterization, Imaging, Cell Culture, Polymer Processing (Injection Molding, Compounding-Extrusion, Rapid Prototyping, Nano-microparticle production (Spray Dryer), Motion and Gait Analysis, and Bioceramic Production and Processing which are also open for use by the academia and the medical sector.

The center was established in ODTÜ in 2011 with funding from the Ministry of Development of Turkey then State Planning Organization. The Director of BIOMATEN, Dr. Vasif Hasirci, has been involved in research and teaching in the fields of biomaterials and tissue engineering for several decades. He is also the President of the Biomaterials and Tissue Engineering Society (Turkey) and one of the founders of the Graduate Departments of Biotechnology, Micro and Nanotechnology, and Biomedical Engineering and currently is the Head of the Biomedical Engineering Department. He is one of the founders of BIOMED the international Biomedical Science and Technology Symposia. Dr. Hasirci also serves on the Editorial Boards of several important international scientific journals including Biomaterials, and Nanomedicine. He has 5 patents and patent applications, published more than 160 SCI journal papers. Dr. Hasirci has been a Fulbright Fellow twice, and worked at Drexel University (Philadelphia) and Northeastern University (Boston). He was recognized as a “Fellow of Biomaterials Science and Engineering” at the 2012 World Biomaterials Congress and he is also a Fellow of Science Academy (Turkey) and Fellow of the Royal Society of Chemistry (UK). Dr. Hasirci currently serves as a member of the ODTÜ Administrative Board.



REFRESH - Adaptive Strategies to Mitigate the Impacts of Climate on European Freshwater Ecosystems

Funding Scheme: FP7-COOP-ENV	Project Coordinator from ODTÜ: Prof. Dr. Meryem BEKLİOĞLU
Project Budget: 7,000,000.00 EUR	cordis.europa.eu/projects/rcn/93578_en.html

“ODTÜ IS CONTRIBUTING TO REFRESHING ADAPTIVE STRATEGIES” TO THE MITIGATION OF THE IMPACTS OF CLIMATE CHANGE

REFRESH is concerned with climate change, land use (e.g. agriculture), eutrophication and water demand, all of which affect freshwater ecosystems. REFRESH has the two main goals of increasing our understanding of how freshwater ecosystems will respond to the environmental changes driven by climate, land use, water use and pollution over the next 50-60 years and translating this knowledge into a form that can be used by water managers. This can then feed into the design of cost-effective restoration and management programmes that will account for the projected future impacts and will support efforts to achieve and maintain compliance with the Water Framework Directive and Habitats Directive. The project highlights specific adaptive measures to minimise the impacts of these global changes. Due to its role of representing freshwater ecosystems in the Mediterranean region and its great performance in REFRESH (2010-2014), ODTÜ is now involved in a new 4 year FP7 funded project entitled MARS - Managing Aquatic Ecosystems and Water Resources under Multiple Stress (2014-2018). MARS addresses the impact of multiple stressors on European freshwater and transitional ecosystems and operates at three scales: (i) At the water body scale, to enhance the mechanistic understanding of stressor interactions and their impact upon water resources, status and ecosystem services through multi-factorial experiments and long-term data analyses; (ii) at the river basin scale, it will characterise relationships between multiple stressors and ecological responses, functions, services and water resources, and assess the effects of future land use and mitigation scenarios in 16 European river basins; and (iii) at the European scale. ODTÜ is involved in MARS at these three scales through taking part in mesocosms experiments that explores the impacts of extreme weather events (e.g. heat waves, floodings) on ecosystem structure, functions and services using several response groups from phytoplankton to fish, through further elaborating earlier studies initiated at REFRESH project on Lake Beyşehir and its catchment land-use- lake ecosystem multiple stressor interactions at river basin scale, and largely through taking part in Pan-European data analysis. Outcomes of MARS will support managers and policy makers in the practical implementation of the Water Framework Directive (WFD), of related legislation and of the Blueprint to Safeguard Europe's Water Resources by advising the 3rd River Basin Management Planning cycle and the revision of the WFD and by developing new tools for diagnosing and predicting multiple stressors in water resource management.



Dr. Barış SALİHOĞLU

“A BLOOMING CAREER DEVOTED TO BRIDGING MARINE ECOSYSTEM AND BIOGEOCHEMISTRY RESEARCH”

Field of Research: Marine Sciences

Prominent Project: EURO-BASIN – European Union Basin-scale Analysis

Funding Scheme: FP7-COOP-ENV

Project Coordinator from ODTÜ: Dr. Barış SALİHOĞLU

Project Budget: 8,950,000.00 EUR

www.ims.metu.edu.tr/cv/BarisSalihoglu

Dr. Barış Salihoğlu got his doctoral degree from the Center for Coastal Physical Oceanography, Old Dominion University, USA; his post-doctoral research position in Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (LEGOS)-CNRS, Toulouse, France and his Marie Curie Intra-European Fellowship in the Institute of Marine Sciences, ODTÜ, which is also his current affiliation.

Dr. Salihoğlu started his career by studying the effect of climate variability (i.e. ENSO event) on the Pacific Ocean ecosystem. He continued his studies on the interactions between environment/climate and the oceans ecosystem. Within the scope of the FP7-COOP MEECE project the capacity to forecast the impact of climate change 100 years into the future on the Black Sea ecosystem was developed for the first time. Within the scope of this project a strong circle of collaborating institutes was also formed, which further led to other successful FP7 projects (i.e., EURO BASIN, OPEC, etc.). Over the years, Dr. Salihoğlu has either led or contributed to numerous projects that focused on a diverse spectrum of topics within several projects like BLACK-MODE (FP6-IEF) - Trophic Controls in the Black Sea Ecosystem, SESAME (FP6-IP) - Southern European Seas: Assessing and Modelling Ecosystems Changes Sustainable Development, Global Change and Ecosystems , CITYZEN (FP6-IP) - MegaCITY - Zoom for the Environment, MEECE (FP7-COOP-ENV) - Marine Ecosystem Evolution in a Changing Environment, ODEMM (FP7-COOP-ENV) - Options for Delivering Ecosystem-Based Marine Management, MyOcean (FP7-COOP-SPACE) –Development and Pre-operational Validation of Upgraded GMES Marine Core Services and Capabilities.

Some implementation projects of the GMES Marine Core Service he has contributed to include EURO-BASIN (FP7-COOP-ENV) “European Union Basin-scale Analysis, Synthesis and Integration”; OPEC (FP7-COOP-SPACE) “Operational Ecosystem: Ecosystem forecast products to enhance marine GMES applications”; and PERSEUS (FP7-COOP-OCEAN) “Policy-oriented Marine Environmental Research for the Southern European Seas”. He is in the process of coordinating a consortium for a H2020 call under the Blue Growth focus area.



Dr. Bilge DEMİRKÖZ

“FROM DARK MATTER TO THE POSSIBILITY OF ANTIGALAXIES: TRYING TO UNDERSTAND WHAT WE - AND THE UNIVERSE - ARE MADE OF”

Research Field: Physics - Dark Matter

Prominent Project: “DarkMatterAMS”

Funding Scheme: FP7-PEOPLE-CIG

Project Budget: 100,000.00 EUR

Dr. Demirköz got her B.Sc. in the fields of Physics and Mathematics at MIT, USA and continued her studies in the same university for three years at Ph.D. level. She received her doctoral degree from Oxford University, UK and conducted research at CERN. Dr. Demirköz, who took part in the ATLAS Experiment, is currently a faculty member of the Physics Department at ODTÜ.

Alpha Magnetic Spectrometer (AMS) is a multi-purpose particle physics experiment that was carried to the International Space Station with the launch of Space Shuttle Endeavour flight STS-134 on the 16th of May, 2011. AMS-02 was installed to its final position on the 19th of May, 2011 and has been taking cosmic-ray data since then. AMS has already collected billions of particles in low earth orbit and is now under a calibration and data validation period. AMS will measure cosmic-ray spectrum for photons and charged particles, as well as for primary elements upto Fe with unprecedented accuracy. Specifically, the energy spectra of photons, electrons, positrons and anti-protons can contain signatures of dark-matter annihilation in the galactic halo and the ODTÜ team will concentrate its efforts on understanding these spectra.

Dr. Demirköz was awarded as a TED Fellow (2011), an Associate Member of the Turkish Academy of Sciences (2012), and the Ten Outstanding Young Persons (TOYP) award by JCI-Turkey (2013).



PROTECTIVE EQUIPMENT

Eye Protection: Goggles or Face Shield

Hand Protection: Gloves

Respiratory Protection: None Required

Other: Vent Hood

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