

# Electromagnetists and Metamaterialists Meet in Central Asia

**B**ianisotropics 2006, the conference on electromagnetics of complex media and metamaterials, was held September 25-27, 2006. The meeting place was Samarkand State University in Uzbekistan.

Mosaic-plated monumental mausoleums, round mosque-guarding minarets, stalactite-ornamented vaults forming *mithrabs* for the faithful. Sunlight reflecting from tens of thousands of majolica tiles. Glimmering hues, turquoise, green, white. On the streets, women in colorful dresses strolling with proud posture. Men relaxing, heads covered with an octagonal cap, seemingly unaware of the Western-constructed concept of time. Laughing children always eager to greet the stranger. This is Samarkand, the fabulous city of Timur Lenk and Omar Khayyam, and the venue of the eleventh international conference on complex media and metamaterials. The meeting was held September 25-27, 2006, and it continues the series of meetings on the electromagnetics of exotic materials in even more exotic places. The first conference of this kind was held in Espoo, Finland, in February 1993, followed by meetings in Gomel, Belarus (October 1993); Perigueux, France (1994); State College, Pennsylvania (1995); the river-channel system between St. Petersburg and Moscow (1996); Glasgow, United Kingdom (1997); Brunswick, Germany (1998); Lisbon, Portugal (2000); Marrakech, Morocco (2002); and Ghent, Belgium (2004). This time, we came together in the Republic of Uzbekistan (Figure 1).

Bianisotropics meetings have always had a truly international character. In particular, the aim has been to collect and bring together engineers and scientists from East and West to meet each other and share ideas. This has required special efforts and sacrifices, in order to assist people from less-developed countries to travel to distant locations. The Samarkand meeting was again a testimony to the success of this policy. Interaction among the participants was truly fruitful for everyone (Figure 2).



**Figure 1. Participants of Bianisotropics 2006 in front of the Registan square. Behind can be seen the three madrasahs: Ulug Bek (l), Tilla Kori (c), and Sher-Dor (r).**



**Figure 2a. Nader Engheta reciting Omar Khayyam.**



**Figure 2b. Raj Mitra reciting Raj Mitra.**

Another, more recent characteristic of the bianisotropics conferences is that they have been moving from the marginal into the mainstream. This is a consequence of the increased interest in materials effects in the electromagnetics and microwave communities. Large research programs and networks on electromagnetics of materials are being funded in Europe, the USA, and elsewhere. This field of research has indeed experienced a renaissance. Chiral media, magnetic materials, and magnetoelectrics are only some examples of research topics about which new articles and books keep appearing. One could perhaps even say that a new paradigm

has developed in the science of electromagnetics: metamaterials. By this term, experts often refer to an aggregate of strongly and/or interestingly reacting elements and scatterers that form an effective substance. Their hope is that this research will provide us with “new” materials, which qualitatively surpass our previous achievements in the design of electromagnetic composites.

The sessions of Bianisotropics 2006 were held in the Samarkand State University, which was kindly offered to us by the Chair of the conference, Academician Oblokul Kuvandikov, who also provided media coverage (Figure 3) for our event. The other organizing institution was the Institute for Theoretical and Applied Electromagnetism of the Russian Academy of Sciences in Moscow. Its representatives, Dr. Alexei Vinogradov and his assistants, put very large efforts into helping foreign participants with the unavoidable bureaucracy and paperwork.

The talks in the meeting covered a broad spectrum of theory, modeling, and applications of material effects in electromagnetics, from low frequencies through microwaves into infrared and optics. Several novel ways to achieve negative permittivity and permeability with clever arrangements of convoluted wire elements were proposed, followed by intensive discussions regarding the potential responses of these structures to field excitation. Questions were asked – and hopefully, also partially answered – about the possibilities of assigning effective material parameter values to such ordered constructions. The potential “killer application” of metamaterials – the extremely sensitive, “perfect” imaging device – is a powerful driving force for this research. (Think only of the increase in the capacity of DVDs if the laser spot is decreased to half-size!) Sub-wavelength imaging can also be achieved without negatively refracting media, as was shown in Pavel Belov’s presentation. Furthermore, fascinating phenomena were discussed related to the field behavior near wedges when the wedge permittivity becomes negative.

Complementing the technical program, Academician Kuvandikov arranged wonderful excursions for the meeting guests into the historical sights of Samarkand and Bukhara. These cities offer plentifully of mosques, mausoleums, madrasah schools, and even an observatory from the 15th century (Figure 4). This observatory was built by Timur Lenk’s grandson, Ulug Bek, the Emir of Samarkand. Ulug Bek was not so much of a warrior as his



Figure 4. The observatory of the scientist-sultan Ulug Bek from the 1420s has been renovated. Information is given here in Uzbek, Russian, and English (note that the Uzbek language is today written in Latin script, the writing system having been changed several times during the last century among Arabic, Cyrillic, and Latin).



Figure 5. The Sher-Dor madrasah from the 17th century.



Figure 3. Bianisotropics 2006 attracted attention in the Uzbekistan press. This article (in Russian) appeared in *Samarkand messenger*. Another extended article about the meeting, and nanotechnology in general, (by Professor Kuvandikov) was published in the Uzbek-language magazine *Marifat*.

feared grandfather, but a patron of arts and sciences, and a practicing astronomer, himself. Of Ulug Bek’s instruments, we saw the remains of the grand fixed-meridian quadrant of 23 meter radius. With this, he mapped and determined the exact positions of fixed stars with amazing accuracy, and published extensive catalogues of them.

The scientific program of Bianisotropics 2006 reached its culmination Tuesday evening, when our excursion brought us inside the majestic Sher-Dor madrasah (Figure 5). Our group had carried along a laptop, a projector, and a large white screen through the city tour. On the courtyard of the madrasah were divans, which we instantly occupied, and watched Alexei struggle to set up the presentation system and find electricity to power it. He finally succeeded. The only speaker of the evening was called to stage: Nader

Engheta. Dusk fell. Surrounded by stately columns and the exquisite symmetry of the mosaic decorations, Nader gave the talk "Optical-Field Nanocircuits Using Nanomaterials" in his always-eloquent manner. Sunset had relaxed us from Ramadan boundary conditions. The feeling was unforgettable.

Despite the Central Asian darkness, I suspect I was able to distinguish, from a distant somewhere, the benevolent and approving smile of Ulug Bek.

The *Proceedings of Bianisotropics 2006* can be accessed at the Electromagnetics Laboratory Web site:  
<http://www.tkk.fi/Units/Electromagnetics/Bianisotropics2006.pdf>

Ari Sihvola  
Helsinki University of Technology  
Electromagnetics Laboratory  
P.O. Box 3000, FI-02015 TKK  
Finland  
E-mail: [ari.sihvola@tkk.fi](mailto:ari.sihvola@tkk.fi)

## An Ode to Bianisotropics 2006

The Bian'06 conference was held in the fair city of Samarkand, In Uzbekistan, which for me was always a mystical dreamland. The delegates hailed from lands both near and far away, From Finland, France, Russia, the UK and even the good old USA.

We heard talks on metamaterials with epsilon and mu going to infinity in the limit, Nader Engheta, the "teacher," gave his speech in a medrasseh, and was quite a hit. After listening to all these talks my brain is so full that I can no longer think, All I keep mumbling to myself is: Hey, I badly need a drink.

So my friends, please raise your glasses and join me in a few toasts, To Profs. Kuvandikov, Vinogradov and their crew who have been such gracious hosts.

Raj Mittra  
319 Electrical Engineering East  
The Pennsylvania State University  
University Park, PA 16802 USA  
E-mail: [Mittra@enr.psu.edu](mailto:Mittra@enr.psu.edu) 