

Denys M. Natarov

SCIENTIFIC REPORT
of the stay at IETR, Université de Rennes 1, France
in August 2010, in the framework of the ESF Network “Newfocus”

Topic: “Resonances in the scattering and focusing of waves by periodically structured ensembles of metal and dielectric wires”

Purpose of the visit

In this complex work we are going to study the 2-D scattering and focusing of electromagnetic waves by discrete reflectors and lenses made of large collections of periodically structured sub-wavelength-size circular cylindrical scatterers, i.e. wires.

Description of the work carried out during the visit

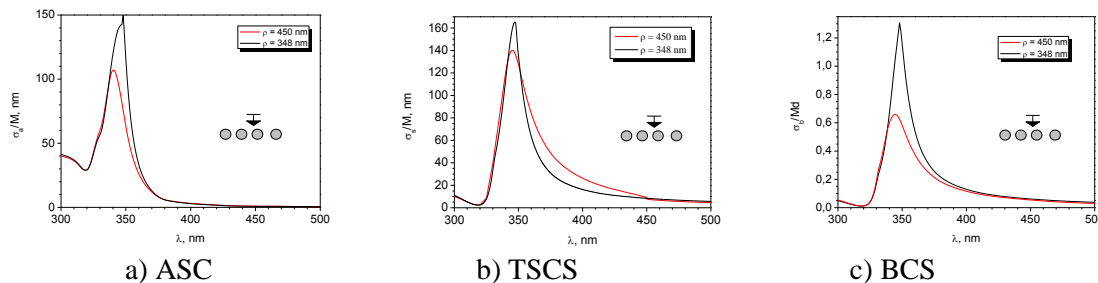
During my visit from 1st to 30th August 2010 I have:

- investigated plane wave diffraction on the dense and sparse grids of large number of silver wires
- calculated their characteristics: absorption, total scattering, and radar cross-sections,
- investigated enhancement of plasmon resonance in this structure,
- wrote a paper for a technical journal.

Description of the main results obtained

I have calculated accurate results for the total scattering and absorption cross-sections (TSCS and ACS) for the H-polarized plane wave diffraction by finite linear grids of closely packed sub-wavelength wires with the numbers of elements up to 1000. A 2-D diffraction problem with rigorous boundary conditions has been treated by the partial separation of variables using local polar coordinates of each scatterer. This has enabled us to reduce it to a Fredholm second kind block-matrix equation with favorable features. The results of my research have been used to write a short technical paper.

In the Figure below, presented are the plots of ACS, TSCS, and backward scattering cross-section (BSCS) normalized by the number of wires M , as functions of wavelength for the sparse grids of 800 silver wires with radius 25 nm and two different periods: 450 nm and 348 nm, under the broadside incidence. The grids with the both values of period are sparse, because $\rho \gg a$. If the period is considerably detuned from the plasmon resonance wavelength, as with $\rho = 450$ nm, then the cross section curves, after normalization by M , are very close to the similar curves for a stand-alone circular sub-wavelength circular cylinder. However, if two resonances are tuned together (i.e. for $\rho = 348$ nm), the cross-sections per one cylinder at the broadside illumination become significantly larger than for detuned resonances. In the Figure, one can see small narrow peaks on the top of the broad plasmon resonances for each of the cross-sections: this is the grid-type resonance.



Thus, I have demonstrated two different kinds of resonances: plasmon-type (for the noble-metal wires) and grid-type, and studied how they depend on the number of sub-wavelength wires in the dense grids. If the number of grid elements gets larger, a narrow peak associated with the grid-type resonance on the wavelength very close to the grid period also gets sharper. An interesting observation, which seems to escape the attention of researchers earlier, is that, unlike the sparse grids, in the case of dense grids the resonance values of TSCS and ACS are opposite in the sense that they are seen as minima of the former quantity and maxima of the latter one. These effects are studied further in the on-going research.

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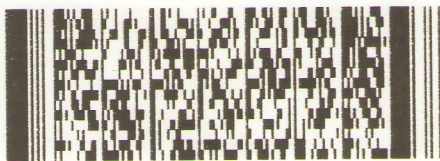
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ФН 2039003467 ІД 0003115293
ЗН ВХ5000002374 ПН 031152920399
ЧЕК № 964378
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ВІДП. 04
ВІД СТРАХУВАННЯ:ОБОВ'ЯЗК.ОСОБ.
ВІД НЕЩ-Х ВИПАДК.НА ТРАНСПОРТІ
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РЕЙС N 653
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ТАРИФ 10,87-А
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СТ.ПОСЛУГИ 10,79-А
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ПДВ *А 20.00% 19,94
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ФІСКАЛЬНИЙ ЧЕК

ECONOMY
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To PARIS /CDG
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PERIODE DE POINTE TGV 5214	01FENETRE	
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Départ 30/08 à 06H10 de RENNES	Classe 2	VOITURE 06
Arriv. à 09H14 à AEROPORT CDG2 TGV	PLACE ASSISE 61	
PERIODE DE POINTE TGV 5254	01COULOIR	
CARTE 12-25 A PRESENTER-ECH/REMB SOUS CONDITIONS		SALLE

Départ à de ***	Classe *
Arriv. à à	

Prix par voyageur : 37.00	Prix EUR **37.00
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RENNES 3081005573



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Ukraine International Airlines Booking Confirmation - R5ZLV

bookinghelp@flyuia.com <bookinghelp@flyuia.com>
 Кому: DEN.NATAROV@gmail.com, ibe-emailcopy@ps.kiev.ua

28 июля 2010 г. 17:46

Ukraine International Airlines

This is your passenger itinerary and receipt email

IMPORTANT - YOU MUST PRESENT THIS EMAIL OR CONFIRMATION PAGE FOR CHECK-IN. IT IS NOT NECESSARY TO GO TO THE TICKET DESK

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Dear Mr DENYS NATAROV

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You will also need the following to check-in for your flight

1. Travel within Ukraine: photo identification such as Domestic Passport or Drivers Licence (with photo), etc. for each adult travelling
2. International travel: valid International passport and visa (where required)

Fare Conditions

- Minimum Stay: Saturday night
- Maximum Stay: 1 Month
- Baggage Allowed: 20 kgs (7 kgs cabin)
- Panorama Club Miles? Yes, 100 %
- Before departure: penalty USD100
- After Departure: No Refund
- Partly used ticket: charge USD100
- Unused Ticket: change USD 50

PASSENGER DETAILS

NAME STATUS PANORAMA CLUB NO.
 Mr DENYS NATAROV Adult

ITINERARY

OUTBOUND Kiev-Borispol Int To Paris-Roissy:Terminal 2B Economy Cabin

DATE	DEPART	ARRIVE	FLIGHT/CLASS
01 August 2010	06:30	09:10	PS 0701 L

RETURN Paris-Roissy:Terminal 2B To Kiev-Borispol Int Economy Cabin

DATE	DEPART	ARRIVE	FLIGHT/CLASS
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01.10.2010

Gmail - Ukraine International Airlines ...

30 August 2010 12:35

16:40

PS 9282 L

PAYMENT DETAILS

PAYMENT:	Visa	FARE:	398.00 USD
CARD NUMBER:	xxxxxxxxxxxx1404	TAXES & CHARGES:	165.40 USD
CARD HOLDER:	NOSYCH ALEXANDER	TOTAL:	563.40 USD
		AMOUNT DEBITED:	563.40 USD

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