

# Alexei Smirnov Fest

GGI, 28th June 2012

Yasaman Farzan (IPM, Tehran)

Michele Frigerio (L2C, Montpellier)

Cecilia Lunardini (Arizona State, Phoenix)

**in**visibles  
neutrinos, dark matter & dark energy physics



The Abdus Salam  
International Centre  
for Theoretical Physics



Once upon a time, in Moscow...

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Volume 48B, number 3

PHYSICS LETTERS

4 February 1974

## ASTROPHYSICAL UPPER BOUNDS ON NEUTRINO-NUCLEON CROSS-SECTION AT ENERGY $E \geq 3 \times 10^{17}$ eV

V.S. BEREZINSKY and A.Yu. SMIRNOV  
*Academy of Sciences, USSR*

Received 10 October 1973

The possibility of experiments with cosmic neutrinos of energy  $E > 3 \times 10^{17}$  eV is discussed. The upper bound on neutrino-nucleon cross-section  $\sigma < 9.3 \times 10^{-30}$  cm<sup>2</sup> is obtained from the zenith angular distribution of extensive air showers under some particular astrophysical assumptions.



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21 + 2012 - 1973 = Alexei Fest

10:00 **Yoichiro Suzuki** (University of Tokyo): **Past, Present and Future of Neutrino Oscillation Experiments (25')**

10:30 **Evgeny Akhmedov** (Max Planck Institute, Heidelberg): **Paradoxes of Neutrino Oscillations (25')**

11:00 – 11:30 Coffee break

*Chair:*  
**Carlos Peña-Garay**  
(IFIC, Valencia)

11:30 **Veniamin Berezinsky** (INFN, Laboratori Nazionali del Gran Sasso): **UHE cosmic neutrinos: failures and hopes (25')**

12:00 **Amol Dighe** (Tata Institute of Fundamental Research): **Supernova Neutrinos (25')**

12:30 – 14:00 Lunch break

14:00 **Georg Raffelt** (Max-Planck Institute for Physics, Munich): **Collective neutrino flavor oscillations (25')**

14:30 **Michele Maltoni** (Instituto de Física Teórica/UAM-CSIC): **Sterile Neutrinos (25')**

15:00 **Pedro De Holanda** (Unicamp): **Solar neutrinos and neutrino physics in Brazil (25')**

15:30 **Michael Schmidt** (University of Melbourne): **Flavour structure from the seesaw (25')**

16:00 – 16:30 Coffee break

*Chair:*  
**Daniel Hernandez**  
(ICTP, Trieste)

16.30 **Hisakazu Minakata** (Tokyo Metropolitan University): **Neutrino Oscillation and Neutrino Velocity (25')**

17.00 **Rabindra Mohapatra** (University of Maryland): **Neutrino mass models - an SO(10) perspective (25')**

17:30 **Alexei Smirnov** (ICTP, Trieste): **Brief remarks & conclusions (25')**



# Teaching science



# Teaching science

- numberless lectures around the world & master classes (Diploma Programme at ICTP)



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- a few selected PhD students: Russian standards
  - ▶ day by day, a method for physics



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- **a few selected PhD students:** Russian standards
  - ▶ day by day, a method for physics
- **a dozen of young postdoctoral fellows**
  - ▶ pivotal to become authoritative in your field

# Thinking science

- Alexei talks (and thinks) a lot about *physics*
  - *Not about work (administration, etc.)*



# MikheevSmirnovWolfenstein effect

– *Mikheev and Smirnov, Sov.J.Nucl.Phys. 42 (1985),  
Yad.Fiz. 42 (1985), Nuovo Cim. C9 (1986)*

- Ultimate solution to the solar neutrino problem
- Wide and profound implications
  - *Earth, supernovae, early universe, stellar jets,...*
- From editorial rejections to textbook physics

# Large Mixing Angle

- “Seesaw enhancement of lepton mixing”  
– *Smirnov, PRD 48, 1993*
- “Is large lepton mixing excluded?”  
– *Smirnov, Spergel & Bahcall, PRD 49, 1994*



- “Is a large mixing angle MSW effect the solution of the solar neutrino problems?”  
 – *Bahcall, Krastev & Smirnov, PRD 60, 1999*

TABLE III. LMA versus vacuum oscillations. Section III contains a quantitative discussion of the day-night integrated effect, the zenith angle dependence of the rate, and the day-night spectrum test. Seasonal effects are discussed in Sec. IV and spectrum distortion is discussed in Sec. II.

Phenomenon	LMA	Vacuum
Day-night integrated effect	Small but non-zero	Zero
Zenith-angle dependence of rate	Small but non-zero	Zero
Day-night spectrum test	Small but non-zero	Zero
Spectrum distortion	Flat relative spectrum	Can explain upturn at large energies
Seasonal effect	Eccentricity dominates	Can be large and energy dependent

- “Neutrino mixing and quark-lepton complementarity”
  - *Minakata & Smirnov, PRD 70, 2004*
  - *Petcov & Smirnov, Phys. Lett. B 322, 1994*

$$\sin\theta_{13} = -\frac{1}{\sqrt{2}} \sin\theta_C(1 - |V_{cb}| \cos\delta) + V_{ub},$$

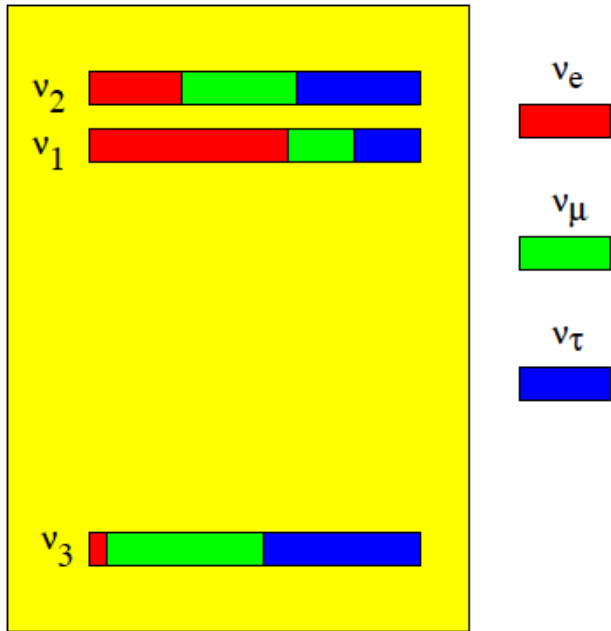
$$\sin^2\theta_{13} = 0.026 \pm 0.008$$



# Broad look at neutrinos

- “Cosmic neutrinos of ultra-high energies and detection possibility”
  - *Smirnov and Berezhinsky , Astrophys.Space Sci. 32 , 1975*
- “Neutrino mass spectrum and neutrinoless double beta decay”
  - Klapdor-Kleingrothaus, Päs and Smirnov, PRD 63, 2001

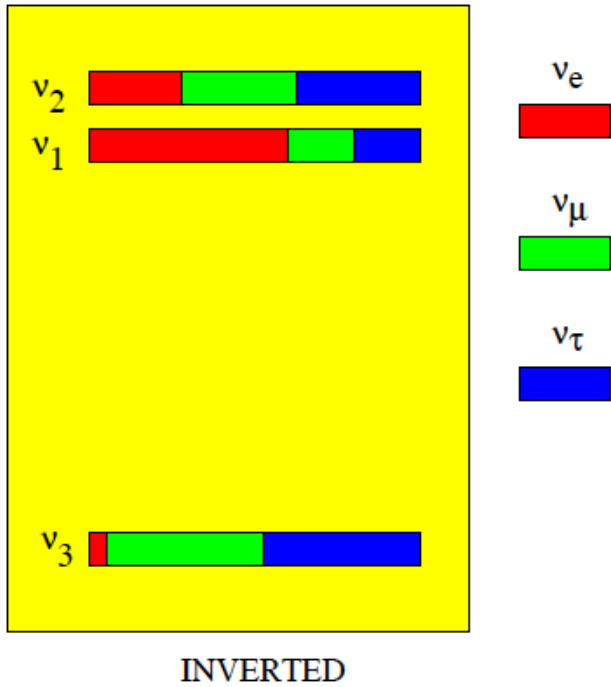
# Masses and mixing *"box diagrams"*



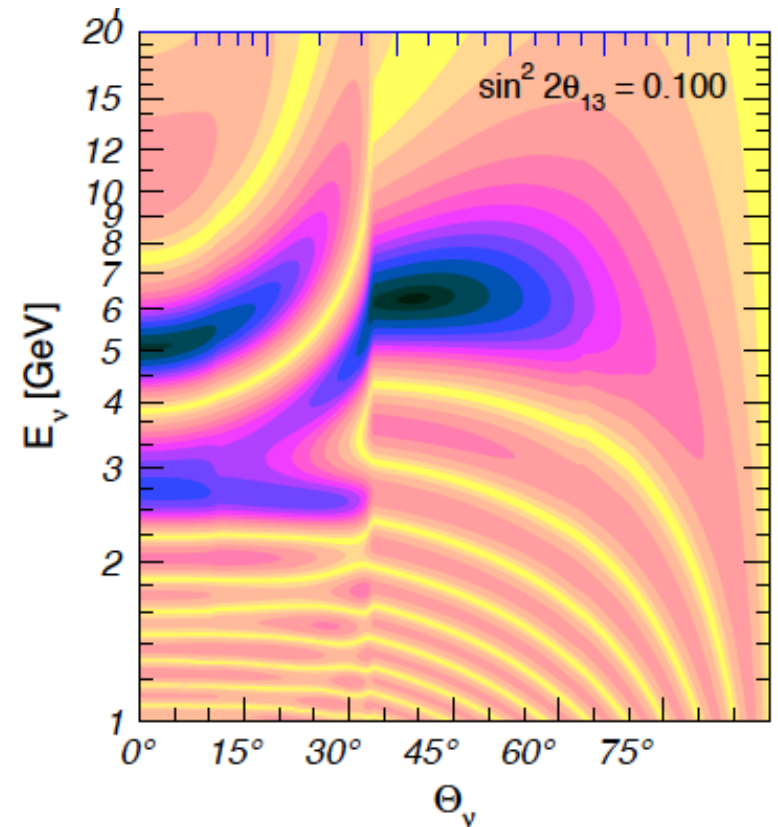
INVERTED



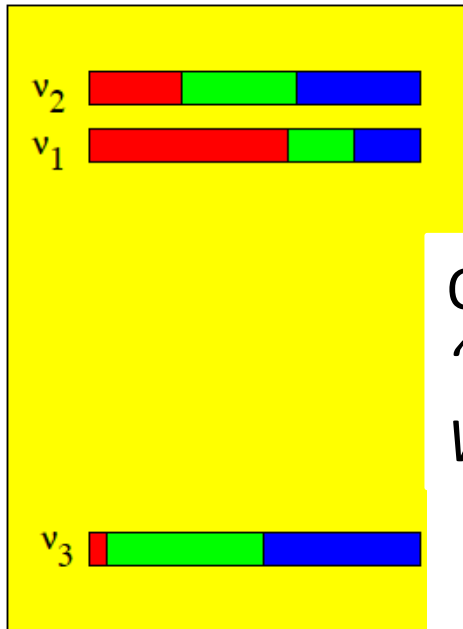
# Masses and mixing "box diagrams"



# Oscillations in Earth "oscillograms", With Akhmedov & Maltoni



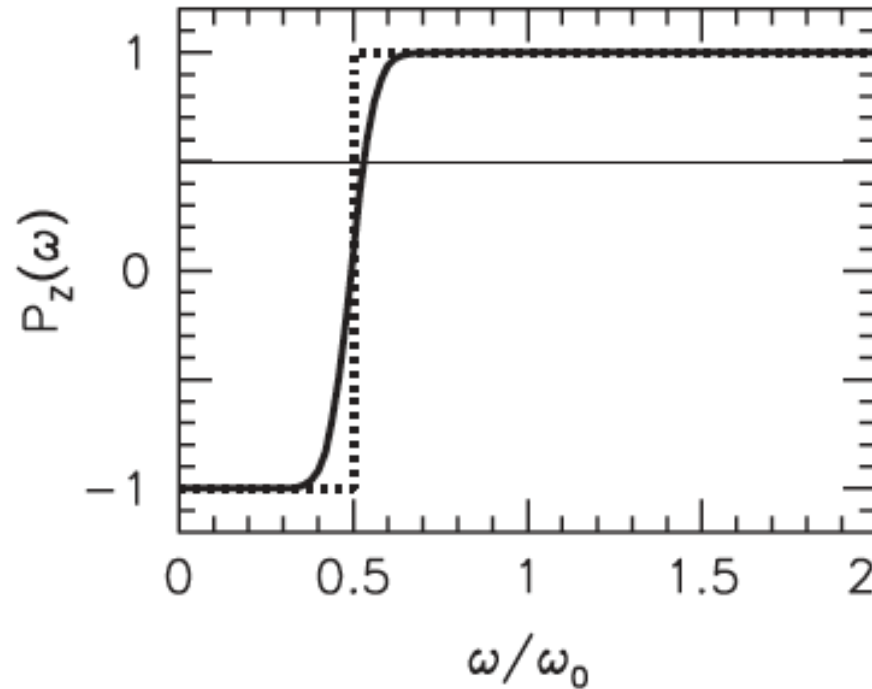
Masses and mixing  
*"box diagrams"*



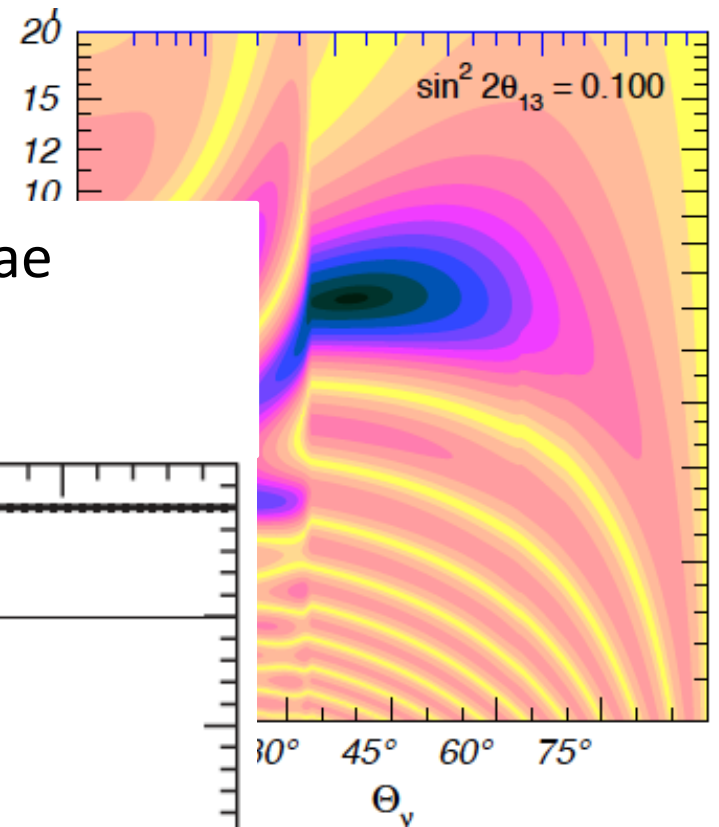
$\nu_e$   
  
 $\nu_\mu$

INVERTED

Oscillations in supernovae  
*"spectral splits",*  
*With Raffelt*



Oscillations in Earth  
*"oscillograms",*  
*With Akhmedov & Maltoni*





My most important lesson

*“First think, then do”*

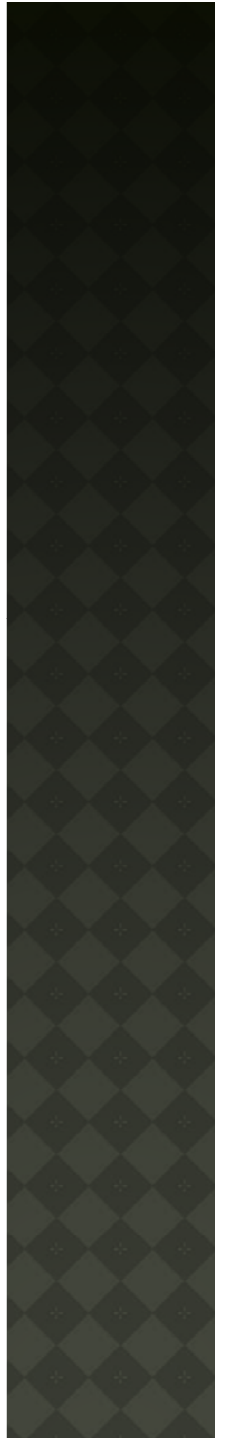
*A. Yu. Smirnov*

# IMPACT OF ALEXEI ON RESEARCH IN DEVELOPING COUNTRIES

# MY PERSONAL FEELING

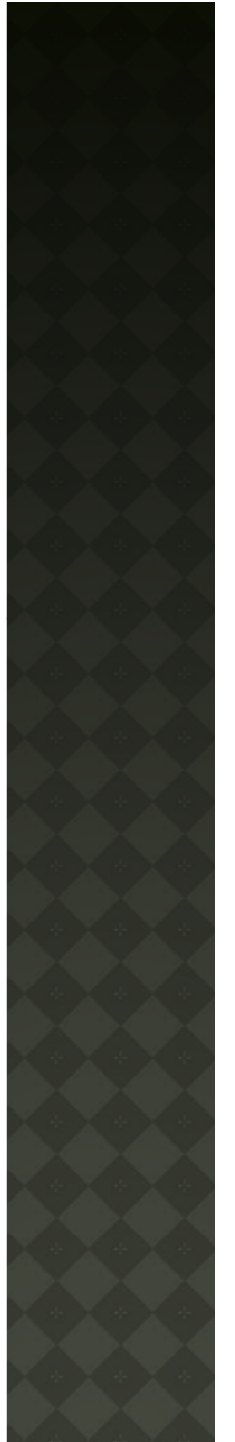
I feel I still desperately need to learn more from him.

8 years of graduation, I still feel like his student.





ICTP



ICTP



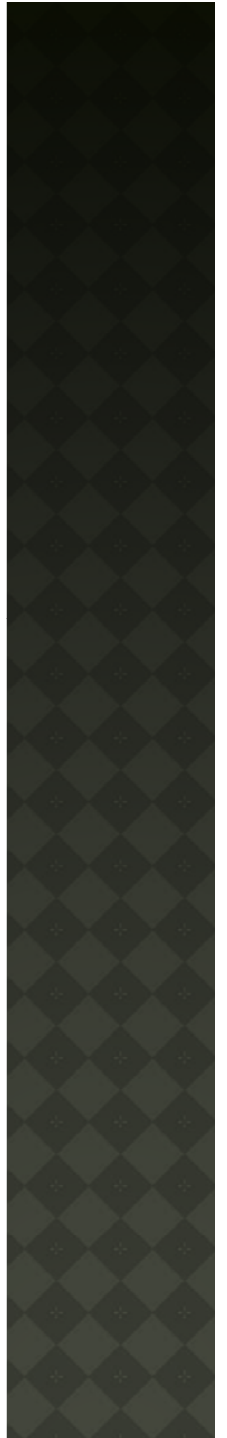




# MISSION OF ICTP

- ◉ Promote research in developing countries

- ◉ Very ambitious task



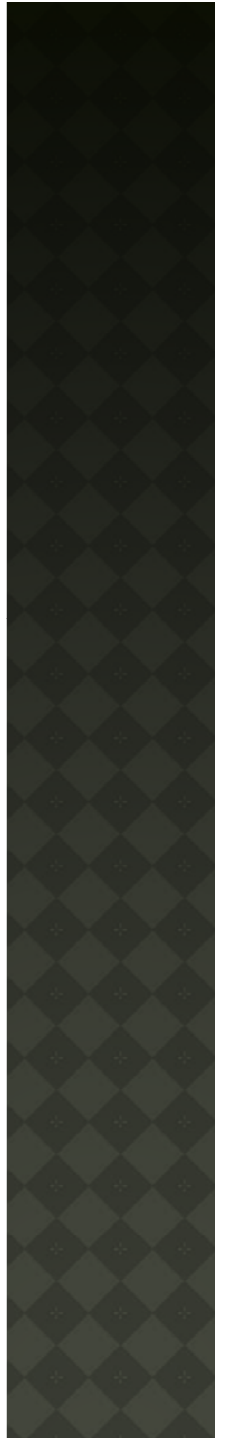
# ACTIVITIES AT ICTP

- ◎ DIPLOMA course
- ◎ Organizing meetings
- ◎ Associate scheme

Supporting meetings at developing countries

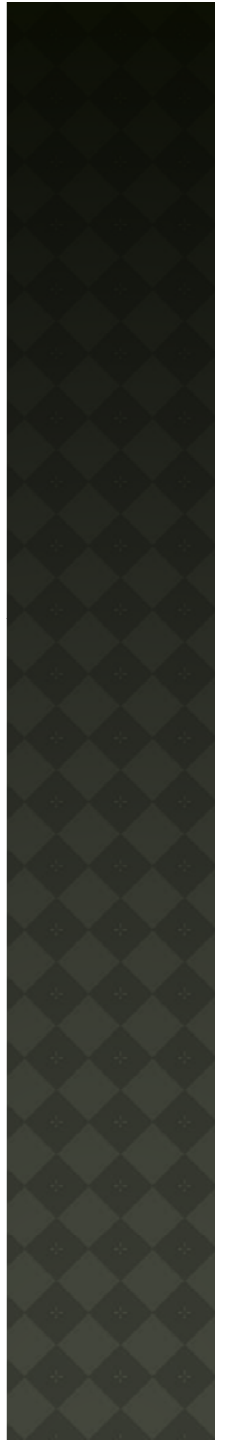
Supporting networking

.....



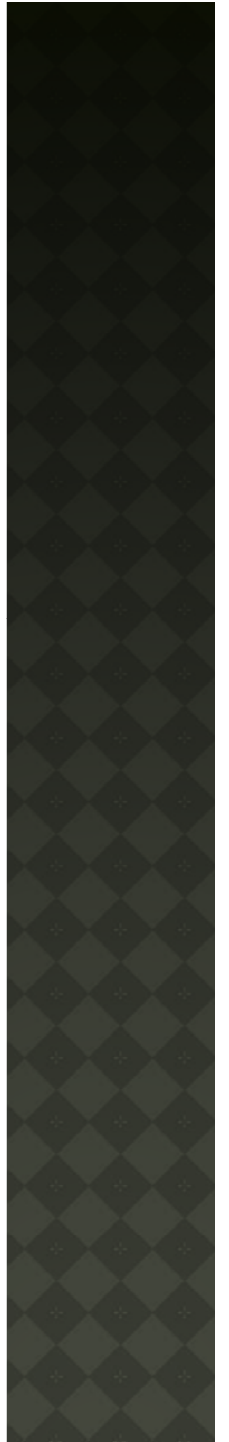
# WHAT MORE

- ⦿ All of this is **great but not** enough
  
- ⦿ Person to person level contact is crucial



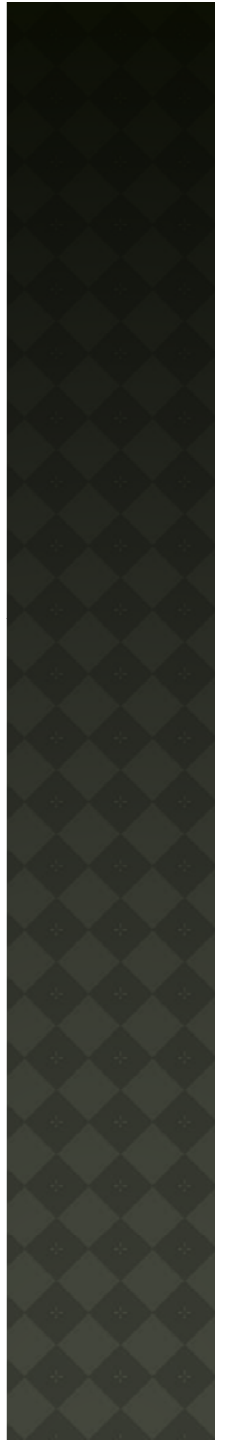


ICTP WOULD BE EMPTY IF



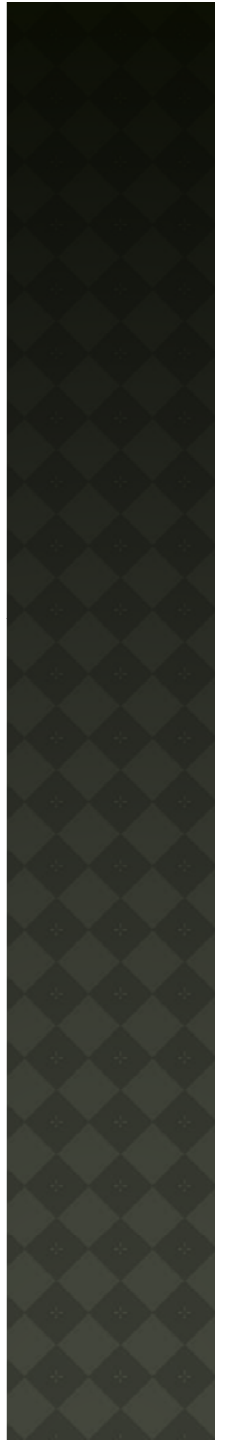
# ICTP WOULD BE EMPTY IF

- It only organized conferences .....



# BUT ICTP IS MORE

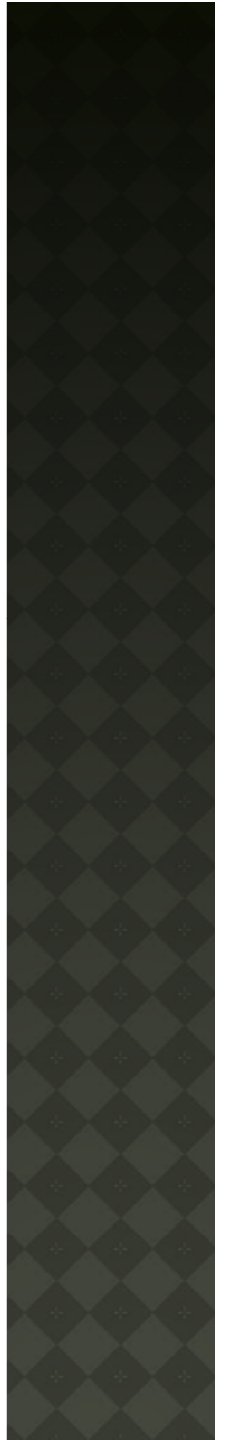
- It has world-class scientific research culture  
Thanks to its scientific staff.



# WHAT WE NEED

- ⦿ Serious physics talk

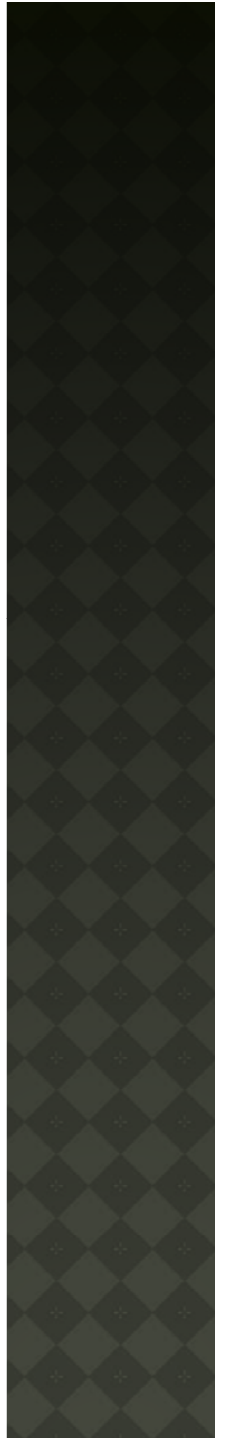
- ⦿ Scientific Criticism





# WHAT WE NEED

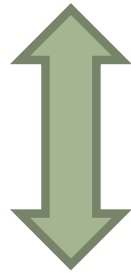
- ◎ Serious physics talk
- ◎ Scientific Criticism
- ◎ (not just talking politics!!!)



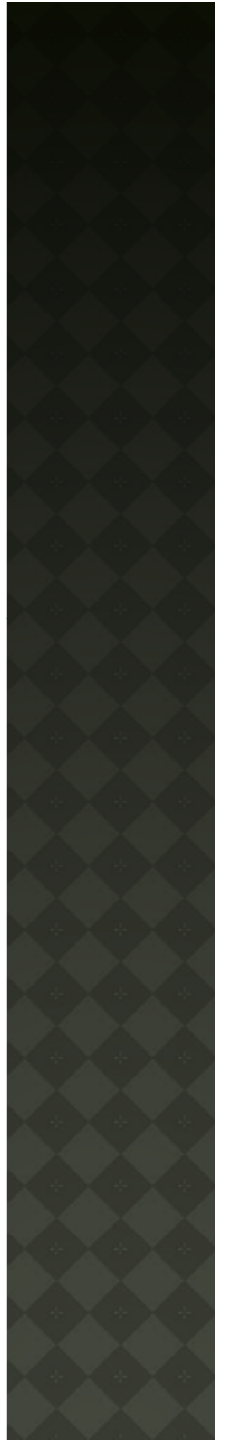
# SETTING THE STANDARDS

- ⦿ Rushing to publish

- ⦿ Vs



- ⦿ Quality work



# INTRODUCING PHENOMENOLOGY

⦿ In my country:

⦿ Experimental research

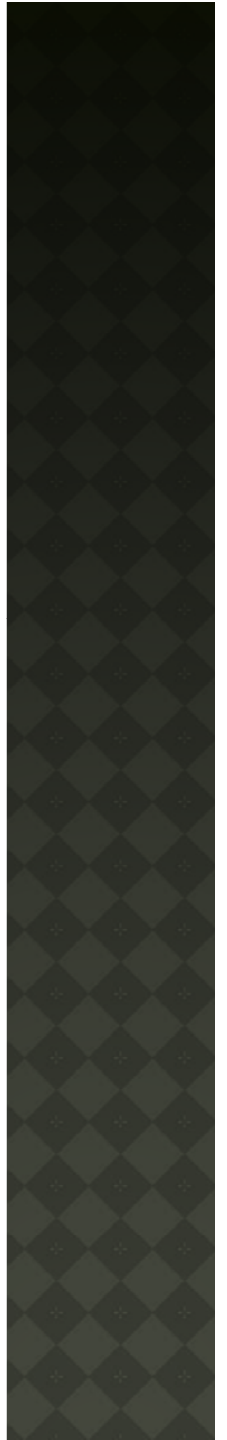
OK!

⦿ Mathematics and pure theory

OK!

⦿ Phenomenology

Oops!



# ALEXEI'S IMPACT

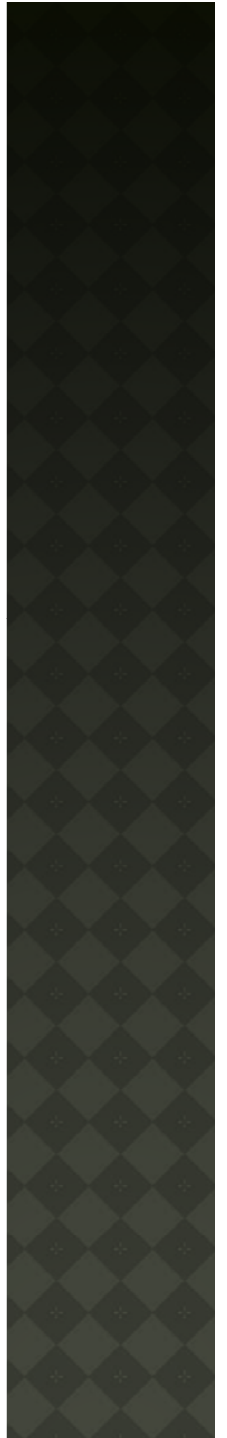
- ◎ If a world-class scientist such as Prof Smirnov considers himself a phenomenologist then ...



# SCIENTIFIC ETHICS

- ◎ Giving credit

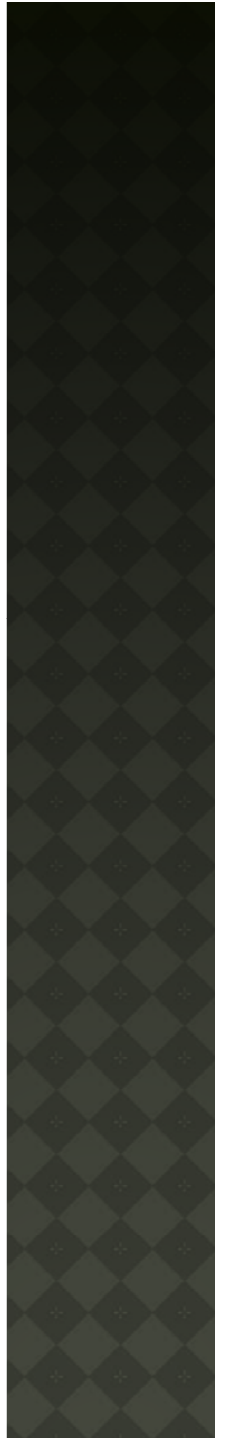
- ◎ Giving references



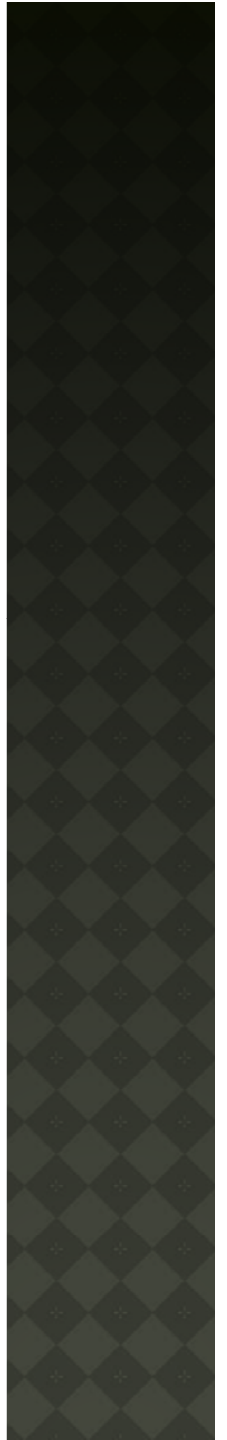
# ALEXEI LECTURES IN IRAN

- Meeting in 2006

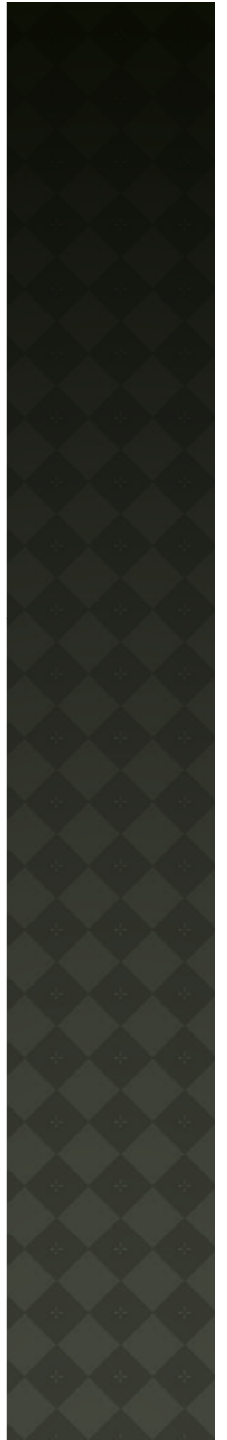
- Meeting this year



- ◎ Just a few faces of Alexei's multi-faceted impact



- ◎ We owe Alexei so much! We wish we have the honor to benefit from his contribution and knowledge for next 100 years ahead!





## ALEXEI'S QUOTE

◎ “Don’t Jump!”

