

Zurab Tavartkiladze
(AIP & Ilia St. Uni)

Research and Activities of
Particle Physics Department
at
Andronikashvili Institute of Physics

KEK Group Visit at AIP - Tbilisi, Sept 24, 2010

Divisions of Particle Physics Department (PPD)

- **Particle Theory Group**
- **Cosmic Ray Physics Group**
- **High Energy Physics Group at Accelerators**

**Consists of 28 Members (including researchers, engineers,
programmers and students)**

i.e. In theory 14, in Cosmic Rays 9, Accelerators exp. 5


Presentations by:
T. Barnaveli **L. Chikovani,**

Particle Theory Group

People:

Juansher Chkareuli	Department Head
Merab Gogberashvili	Senior Researcher
Ilia Gogoladze	Senior Researcher
Archil Kobakhidze	Senior Researcher
Mikhail Maziashvili	Senior Researcher
Joseph Manjavidze	Senior Researcher
Zurab Tavartkiladze	Senior Researcher
Juansher Jejelava	Researcher / PhD student*
Zurab Kepuladze	Researcher / PhD student*
Giori Tatishvili	PhD student*
Luka Megrelidze	MSc student*
Data Mania	MSc student*
Jaba Chelidze	MSc student*
David Gordeladze	MSc student*

*** All PhD and MSc students have a study at *Ilia State University***

Research (theory)

Research topics & Interests of the group members:

- Quark-Lepton Unification, Problem of Flavor
- Neutrino Physics
- Grand unification, Supersymmetry & Supergravity, Superstring phenomenology
- Local and Global Conservation Laws
(Baryon, Lepton numbers, P, CP Violation)
- Spontaneous Violation of Lorentz Invariance, Origin of Symmetries, Physical & Astrophysical consequences

Research (theory)

Research topics & Interests of the group members (cont.d):

- **Extra Space-Time Dimensions**
- **Quantum Gravity Phenomenology**
- **Cosmology:**
Early Universe, Inflation, Baryon Asymmetry,
Phase Transitions in QFT,
Problem of Dark Matter & Dark Energy

Research (theory)

Important and Interesting Results:

Flavor Physics -

- **SU(3) family symmetry in quark-lepton sector introduced in 1980**
[Chkareuli, JETP Lett 32, 671 (1980)];
- **SU(3)-flavor & GUT** [Berezhiani, Chkareuli, Sov. J.Nucl.Phys. 37, 1983];
- **Lepton Number violation in Supersymmetric GUTs, Rare procs.**
[Chkareuli, Gogoladze, Kobakhidze., Phys. Rev. D62, 015014];
- **O(3)-Gen. sym. in E6 GUT: fermion masses & neutrino oscillations**
[Stech, Tavartkiladze, Phys. Rev. D70, 035002]

Realistic Grand Unified Theories -

- **Natural solution of Doublet-Triplet splitting problem**
[Chkareuli, Froggatt, Gogoladze, Kobakhidze, NPB 594, 23;
Berezhiani, Tavartkiladze, Phys. Lett. B409, 1997;
Tavartkiladze (with Babu, Pati), JHEP 1006, 084 (2010)]

Research (theory)

Important and Interesting Results (cont.d):

Extra Space-Time Dimensions, Brane Models-

-Solution with warped geometry in 5D theory was found;

Localization of 4D gravity at boundary

[Gogberashvili, Mod.Phys.Lett. A14, 2025; Int.J.Mod. Phys. D11,1635]

Lorentz violation inspired models-

- Interesting physical and astrophys. implications

[Azatov, Chkareuli, Jejelava, Kepuladze, Tatishvili,...

hep-th/0412225; Phys.Rev.D73:065026,2006; Eur.Phys.J.C55:309;

Phys.Lett.B659:754; arXiv:1008.3707]

- New prospects for flavor non-conservation..

(four PhD researchers involved)

GR & Quantum Gravity Phenomenology

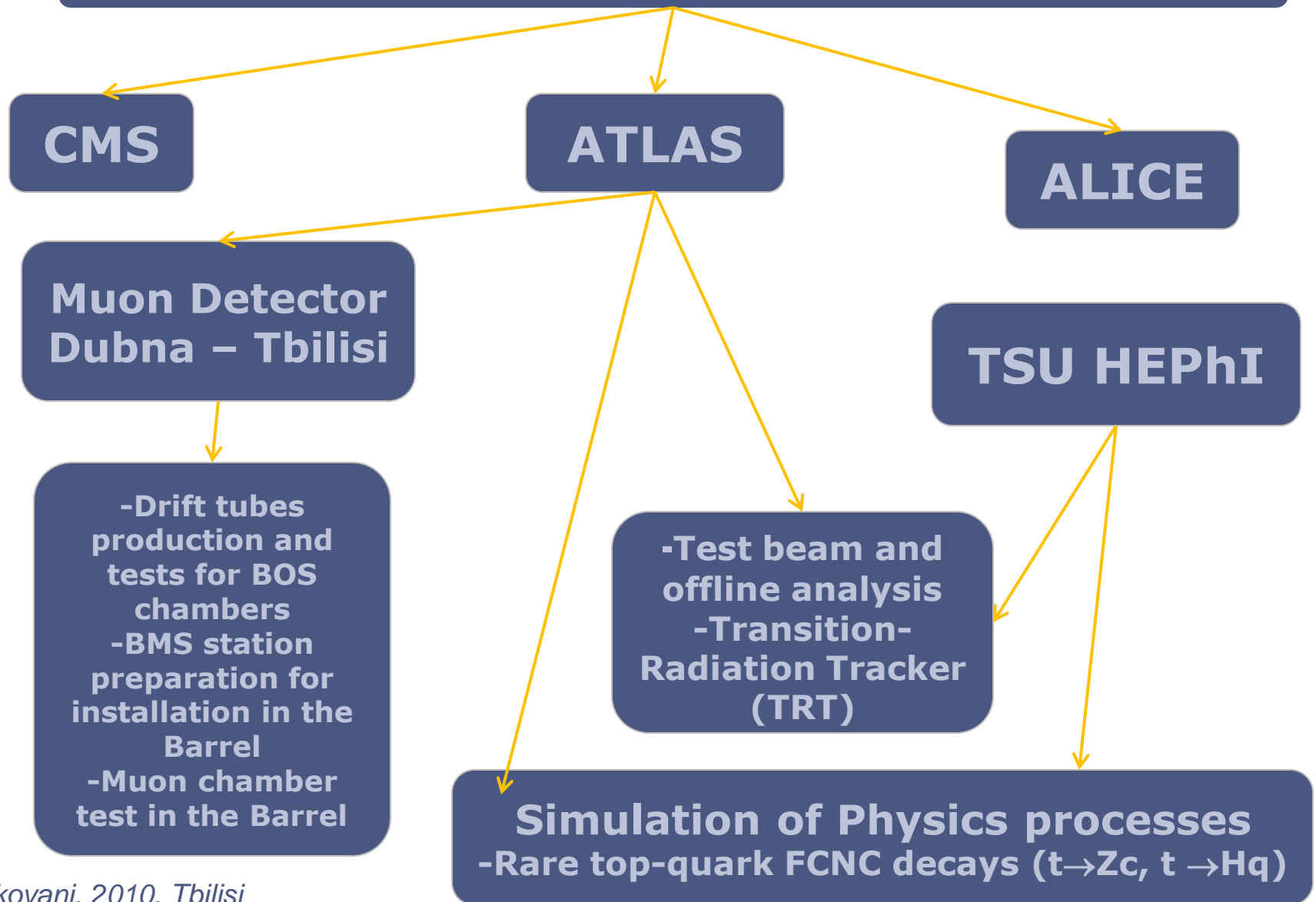
- Novel insights for dark energy (coincidence) problem

[Maziashvili, PLB 652, 165; Int.J.Mod.Phys. D16, 1531]

-Quantum gravity running/reduction shed some light to dimensionality of the world [Maziashvili, Int.J.Mod.Phys D18,2209]

Research: High Energy Physics Group at Accelerators

E.AndronikaShvili Institute of Physics



Research: High Energy Physics Group at Accelerators

Research topics of the group members and some interesting results

- Top Quark Physic at LHC –ATLAS; members of Top Properties Group; Study of ATLAS sensitivity to FCNC top decays
(talk by L. Chikovani)

Results: -Sensitivity to the FCNC $t \rightarrow Hu/c$ and $t \rightarrow Zu/c$ decays was estimated for luminosities 10 & 100 1/fb at 7, 10, 14 TeV in C.of. masses

-95% CL limits on the branching ratios (in the FCNC top decay signal absence) were obtained

From AIP L. Chikovani, 3 students, V. Ciskaridze

Research: High Energy Physics Group at Accelerators

Research topics & some interesting results (cont.d)

- **Searches for Lepton Flavor Violation in Higgs decays $h_0 \rightarrow \mu \tau$ at LHC with the CMS detector**
by Dr. Lali Rurua

Results: Publications (for last 5 years)

J.Phys. G34, 2307-2455, 2007;

J.Phys. G34, 995-1579, 2007;

CERN-LHCC-2006-001; CMS-TDR-008-1, 2006;

Eur.Phys.J. C40, s2.1-s2.13 (2005);

CERN-LHCC-2005-025, 2005.

*From AIP L. Rurua. Close and active
collaboration with CERN*

Research: Cosmic Ray Physics Group

Research topics of the group members and some interesting results

- **Investigation of the high energy cosmic ray Extensive Air Showers (EAS)**
[Talk by Dr. Tengiz Barnaveli]

sub directions:

1. EAS correlated in time
2. Gamma showers

3. The peculiarities' of EAS muon and Hadron component spectra (as a function of the primary energy)

Results: 1) Established that EAS bursts are correlated in time. Accepted as one of the priority direction in this experiment.

2) Studied peculiarities' of EAS muon and hadron component spectra

3) The Gamma showers are under intensive investigation

Results (of last 5 years) are presented in 5 publications

Cosmic Ray Physics Group (cont.d)

- **Scientific-Educational Project in Cosmic Ray Physics**
GEorgian Large-area Angle and TIme Coincidence Array (GELATICA)

Investigation of Extensive Air Showers by means of the Network of the Cosmic Rays Stations in Georgia

Participants: *Bagaturia Yu., Iashvili A., Javrishvili A., Kakabadze L., Kokorashvili D., Kut Chadze Z., Rurua L., Svanidze M., Tskhadadze E., Verbetsky Yu.*

Investigation of the Extensive Air Showers (EAS) by means of spatially separated EAS detector systems timed by the GPS. *Stations will be allocated in high schools and universities. Currently three CR stations operate.*

AIM: find correlations in the arrival times and directions of separate air showers over large distances

Collaboration and Contacts:

Close collaboration & contacts with scientists from various international institutions & research centers

CERN (Switzerland)

International Center for Theoretical Physics (ICTP)

SLAC (USA)

Niels Bohr Institute

ITP, Heidelberg University

Glasgow University, PPT

University of Maryland

Oklahoma State University, HEP

The Bartol Research Institute

University of Melbourne

University of Liverpool

University of Helsinki

University of Porto

Moscow Engineering Physics Institute

Lebedev Institute

Erevan Physical Institute

Teaching and Education

Department plays very active role in education.

Tasks: Teaching, Preparing and training of young scientists ;

**Providing the base for full pledged educational program
in Theoretical and Experimental Physics**

- **Setup for educational experiment in cosmic rays**
(by Cosmic Ray Physics Group members)
- **Four department professors** (Chkareuli, Bagaturia, Maziashvili, Tavartkiladze) **are teaching at *Ilia State University*** (Center for Elementary Particle Physics see details at: <http://www.cepp.iliauni.edu.ge/>)
- **All present 8 students (3 PhD and 5 MSc students), related to Our group, have a study at Ilia St. University**

Teaching and Education (cont.d)

Teaching program offered by Center for El. Particle Phys. (Ilia St. Univ.)

Mandatory courses for MSc students

- Special and General Theory of Relativity
- Quantum Theory of Particles and Fields
- Introductory Course to Cosmology
- Theoretical Particle Physics - Standard Model and Beyond
- Special Course on Gravity

Optional courses

- Experimental High Energy Physics
- Basics of Classical Astrophysics
- Topological Aspects in Condensed Matter Physics
- Theory of Superconductivity
- Elements of Set Theory
- Group Theory and Geometric Structures

***Students are invited and strongly encouraged
to come in the center for
Becoming Experts in the field !***

Publications of Particle Physics Department

Last 5 years: 172 papers in total

150 papers by Particle Theory Group

7 papers by Cosmic Ray Physics Group

**15 papers by High Energy Physics Group
at Accelerators**