



Summer School in Forschungszentrum Jülich
3 Weeks

Giorgi Tukhashvili

I. Javakhishvili Tbilisi State University

Master of Physics(Elementary Particles Theory)

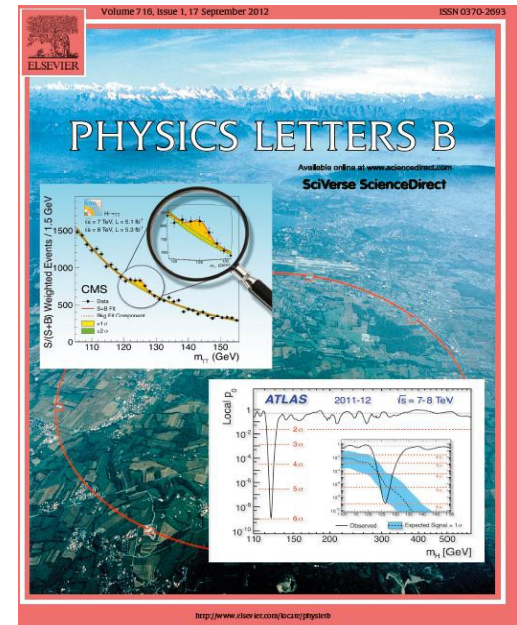
Supervisors: G. Tsitsishvili & M. Eliashvili

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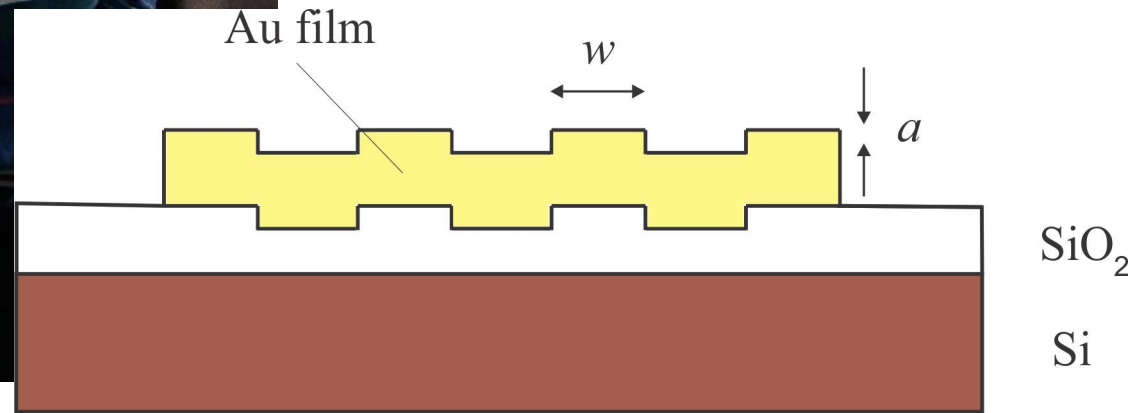
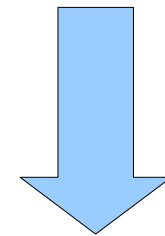
Just What a Theoretician Needs

Peter Grünberg Institute (PGI)

Prof. Avto Tavkhelidze guided into the institute and gave as an introductory talk about his and his colleges work



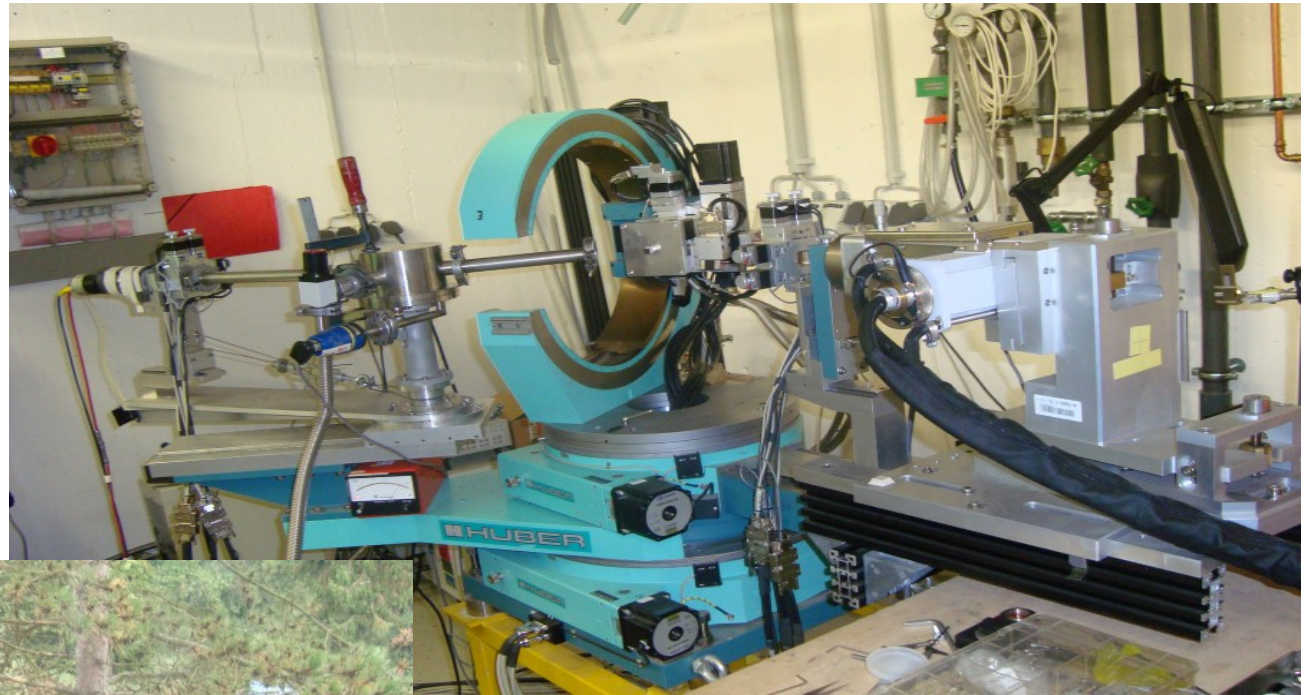
Fabrication of nanostructured thin films & Investigation of its Work Function reduction



Peter Grünberg Institute (PGI)

X-Ray Laboratory

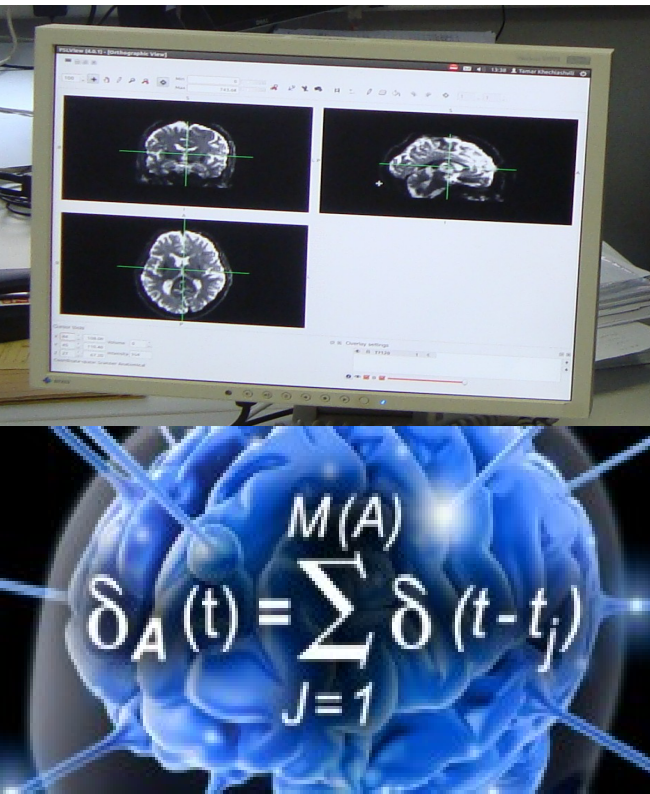
5 Different X-Ray spectrometers to study different characteristics of the materials for different purposes



Modern laboratories to measure resistance, inductance and other characteristics of metals and semiconductors with high precision.

Institute of Neuroscience and Medicine (INM)

1000 Brains Project - Modeling the Human Brain



Mathematics gives us
some explanations!

I appointed myself as a
volunteer for scanning
my brain. 😊

The most powerful
magnetic Tomography
apparatus in Europe
(B=15Tesla).



M. Kelenjiradze with his
Phantom

Central Institute for Engineering, Electronics and Analytics (ZEA)

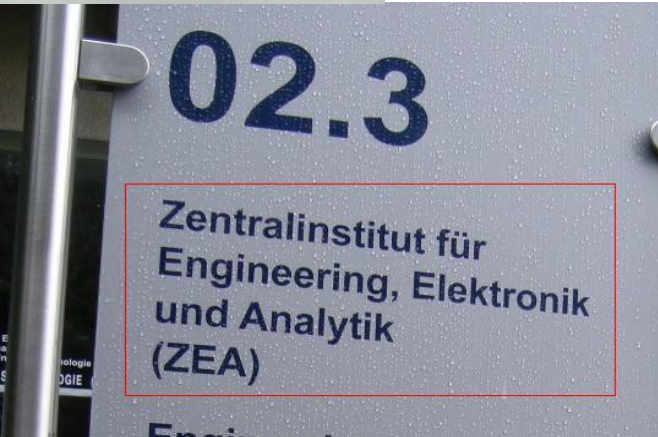
Here the Possibilities are Infinite

Only thing one needs - Imagination



Dito Shergelashvili with
his little COSY model →

← Roman soldier made with
3D metallic printer.
Amazing



Institute for Nuclear Physics (IKP)

- ◆ IKP-1 – **Experimental Hadron Structure**
Fundamental Symmetries
Detector Development
- ◆ IKP-2 – **Experimental Hadron Dynamics**
Nucleon Nucleon Measurements
Spin Physics
- ◆ IKP-3 – **Theory of the strong interactions**
Effective Meson-Baryon Lagrangians
Non linear meson field theories
- ◆ IKP-4 – **Large-Scale Nuclear Physics Equipment**
Accelerator Research and Studies of Medium-Energy Hadron Physics
Research and Development for the "High-Energy Storage Ring"

Cooler Synchrotron(COSY)

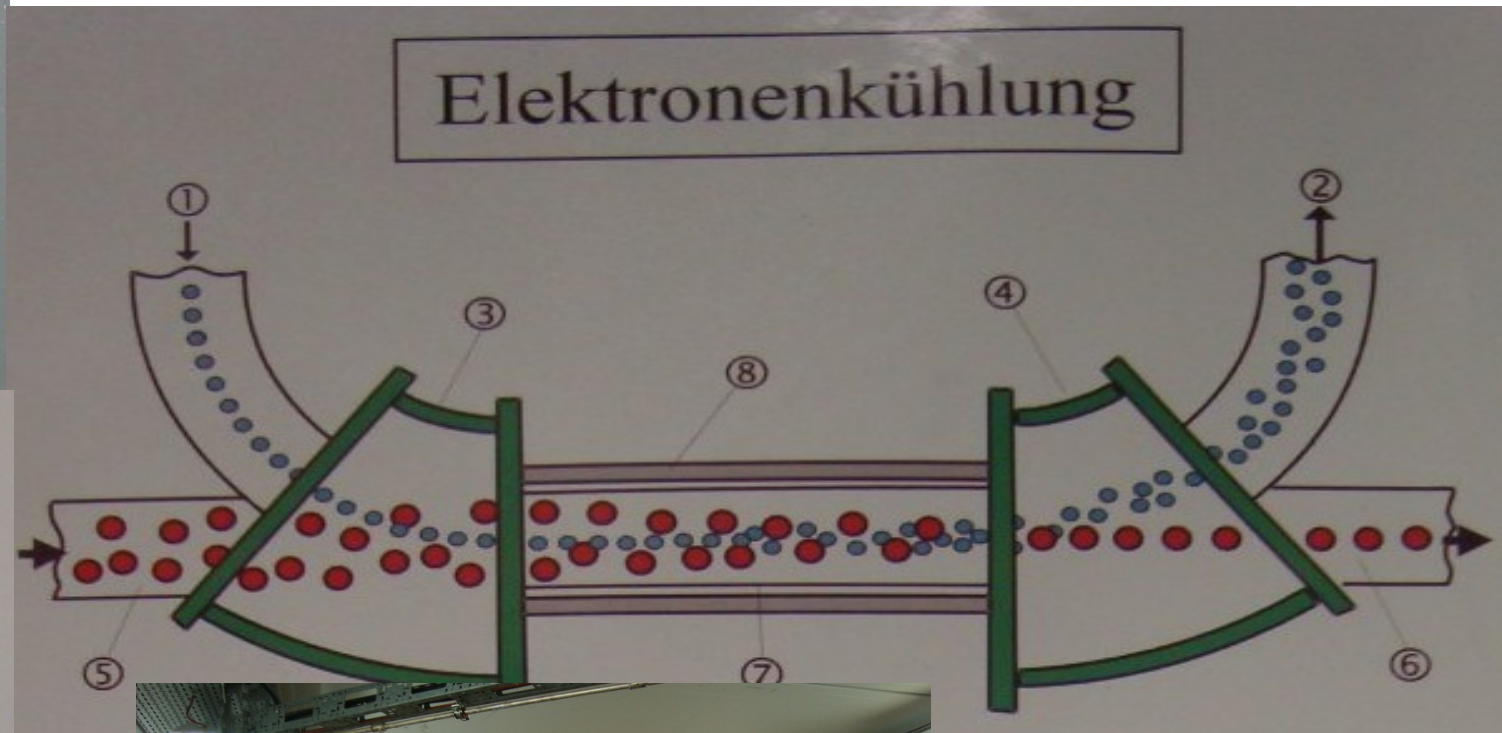
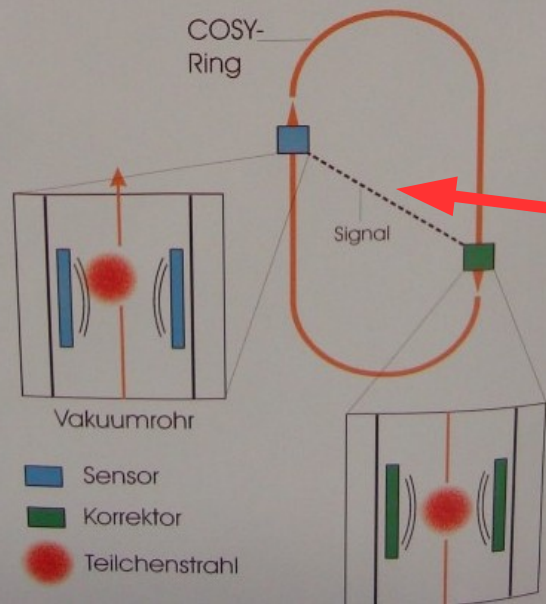
Lectures from Prof. M. Nioradze helped me to understand how it works

07.3

Cooler Synchrotron (COSY)

Eingang E1

Stochastische Kühlung



Necessary Condition

$$V_e = V_p$$

New Blood for COSY

Jülich Electric Dipole Investigation(JEDI)

Ordinary Quantum Mechanics(Stationary Case):

$$\mathbf{d}(\mathbf{r}) = -e \int d\mathbf{r} \Psi^\dagger(\mathbf{r}) \hat{\mathbf{r}} \Psi(\mathbf{r})$$

If the wave function has P symmetry: $\Psi(\mathbf{r}) \rightarrow \Psi(-\mathbf{r}) = \Psi(\mathbf{r})$

$$\int d\mathbf{r} \Psi^\dagger(\mathbf{r}) \hat{\mathbf{r}} \Psi(\mathbf{r}) = \int d\mathbf{r} \Psi^\dagger(-\mathbf{r}) (-\hat{\mathbf{r}}) \Psi(-\mathbf{r}) = - \int d\mathbf{r} \Psi^\dagger(\mathbf{r}) \hat{\mathbf{r}} \Psi(\mathbf{r}) = 0 \longrightarrow \mathbf{d}(\mathbf{r}) = 0$$

Predictions of the Standard Model for Neutron:

$$d_n = (0.4 \pm 0.2) \left[\chi m_* (4e_d - e_u) \left(\bar{\theta} - \frac{1}{2} m_0^2 \frac{\tilde{d}_s}{m_s} \right) + \frac{1}{2} \chi m_0^2 \left(\tilde{d}_d - \tilde{d}_u \right) \frac{4e_d m_d + e_u m_u}{m_u + m_d} + \frac{1}{8} \left(4\tilde{d}_d \alpha_d^+ - \tilde{d}_u \alpha_u^+ \right) + (4d_d - d_u) \right] \sim 10^{-31} e \cdot cm$$

Expected limit while JEDI:

$$d \leq 10^{-29} e \cdot cm$$

Do we have NP?

Is the SM all that we need?

$$L = -\frac{1}{4} Tr [F_{\mu\nu} F^{\mu\nu}] + [i\bar{\Psi} \not{D} \Psi + \Psi_i Y_{ij} \Psi_j \phi + h.c.] + D_\mu \phi D^\mu \phi - V(\phi)$$

Does this Lagrangian give us the complete view of Particle Physics?

Trip to Köln and Aachen- Nice Time & Good Memories



Thanks To:

- ◆ **Dr. Hans Stroeher** – For giving the opportunity to visit and spend 3 weeks in forschungszentrum.
- ◆ **Dr. Andro Katcharava** – For guiding into the forschungszentrum and for support to finding master thesis supervisor.
- ◆ My Georgian colleagues - new and old friends **M. Kelenjiradze, D. Shergelashvili, M. Jabua, D. Chiladze, D. Mchedlishvili, G.Macharashvili** and **Zara Bagdasarian** - For their support
- ◆ My Lecturers – **Prof. M. Eliashvili, Prof. N. Shatashvili, Prof. M. Gogberashvili, Prof. M. Tabidze, etc.** – For trusting me.

Whole forschungszentrum Community

Any Questions?

20.09.13

Thank You For Your Attention!