Nonproliferation Through Science Cooperation

ISTC: 13 years – experience and new trends.

Review of ISTC support for basic research

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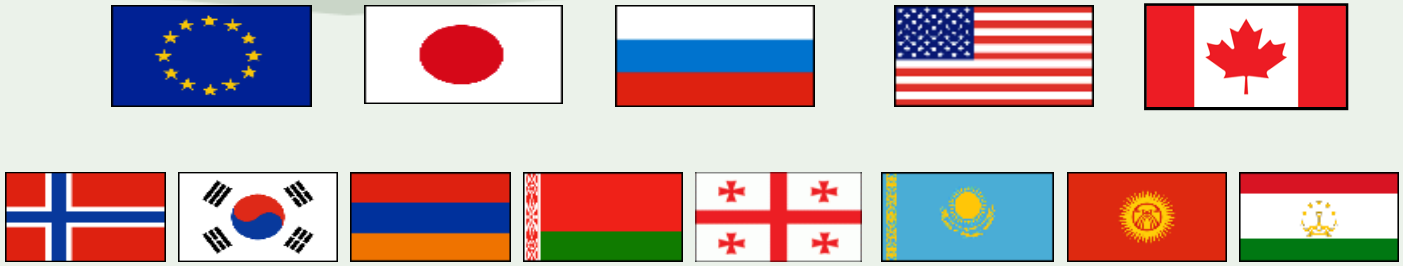
Professor
Deputy Executive Director

Dubna, 21 June 2007

ISTC Basic Objectives



- Provide weapons experts in the CIS the opportunity to redirect their talents to peaceful activities
- Contribute to solution of national and international science and technology problems
- Reinforce the transition to market economies
- Support basic and applied research
- Integrate CIS scientists into global scientific community

Thirteen Years of Accomplishment

Where we were 13 years ago:

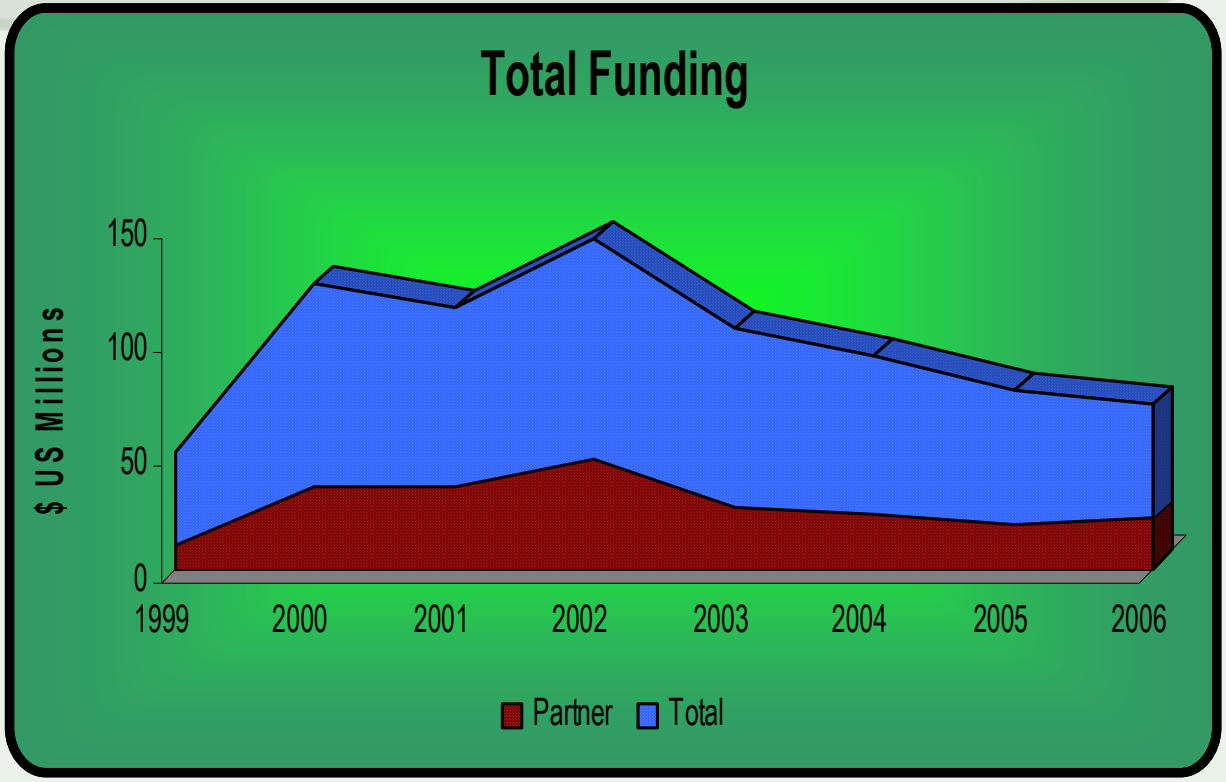
At the beginning of operation in 1994, ISTC funded 92 projects worth $46 million.

The Secretariat employed 41staff members.

Where we are now:

At this moment, ISTC funds 823 active projects worth over $316 million.
The Center operates with a staff of 217. In addition to the Moscow Secretariat, the ISTC operates additional 6 regional offices in CIS.

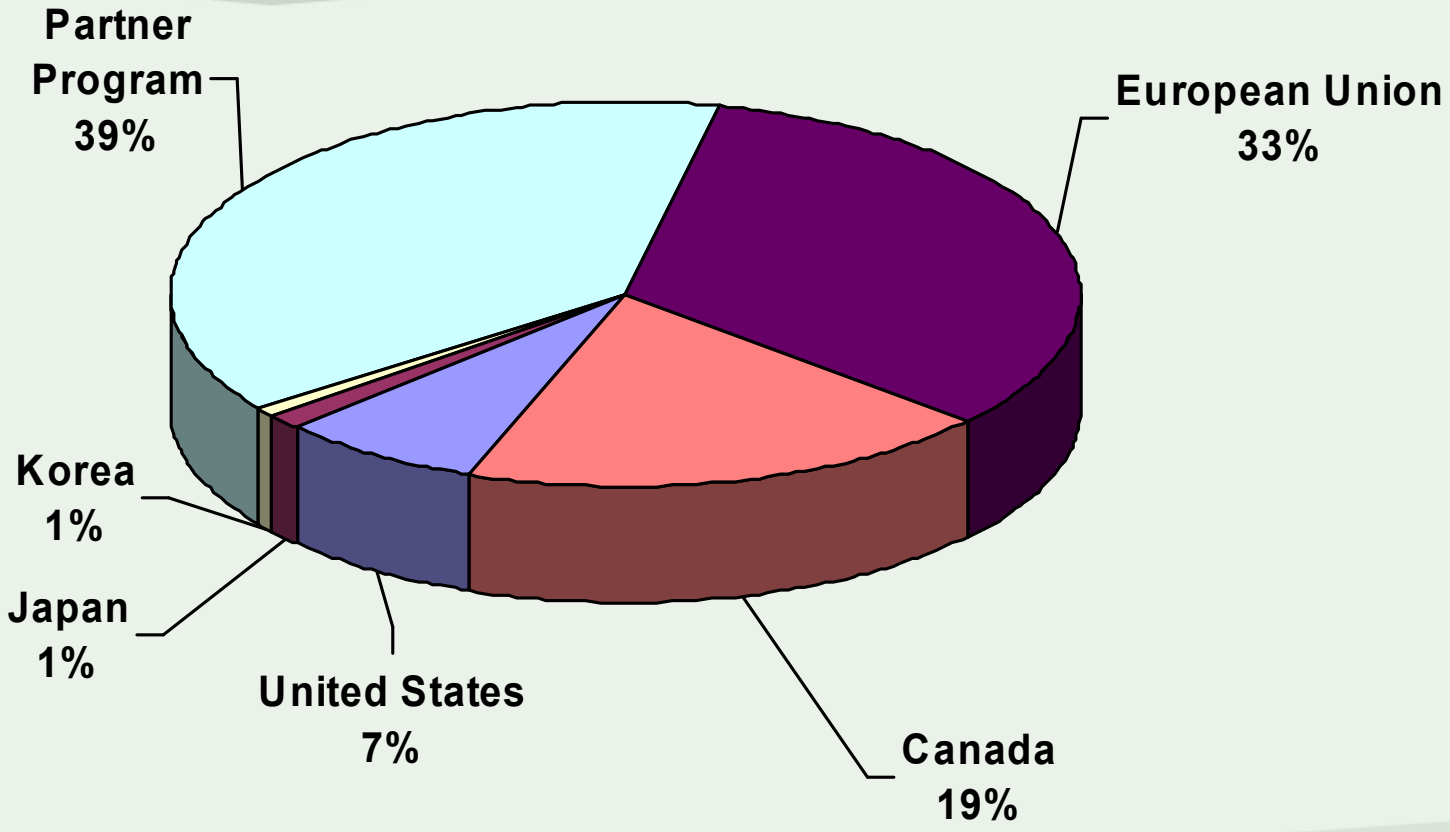
Thirteen Years of Accomplishment



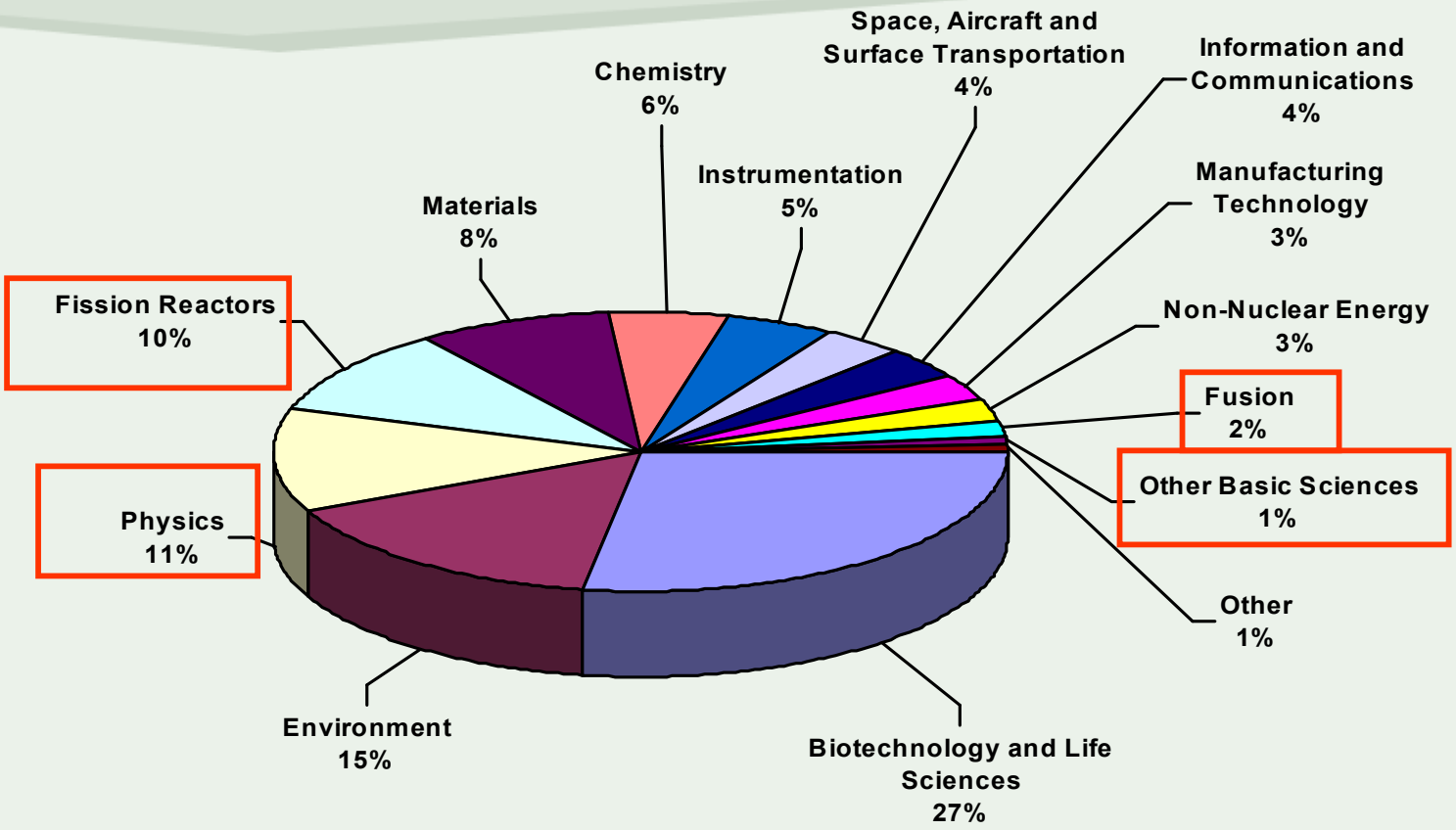
Where does this funding go?:

In 13 years of operation ISTC has funded 2476 Regular and 617 Partner Projects with a total budget of $ 750 millions supporting over 67,000 scientists

ISTC Projects Funded in 2006 ($49.4 million)



Overall ISTC Project Funding by Technology Area



Some examples of the projects in muons (catalysed fusion)

Project #0025: MUON Catalyzed Fusion

Kurchatov, VNIIEF Sarov

- Study of the most important characteristics of the muon catalysed fusion (μCF) in the triple H/D/T mixture of hydrogen isotopes including measurements of the coefficient of muon sticking to helium at high density of deuterium mixture and high tritium concentration (up to 20-60%) as well as fusion neutron yield in the triple hydrogen isotope mixture H/D/T at the pressure as high as 80 MPa and in the temperature region 20 - 800 K.
- Theoretical modelling of the μCF process.
- Experimental demonstration of the intensive 14-MeV neutron source on the basis of μCF cycle.

- Project started 1993-1995

Project #0892: μCF-Based 14-MeV Intense Neutron Source

Kurchatov, VNIIEF Sarov, JINR

- The final product of the project is the technical task for the project of the intense 14-MeV neutron

Project not approved

ISTC and CERN – Supporting “BIG SCALE” PHYSICS

Focus – trying to catch all muons!!

Status of ISTC Projectsrelated to CERN

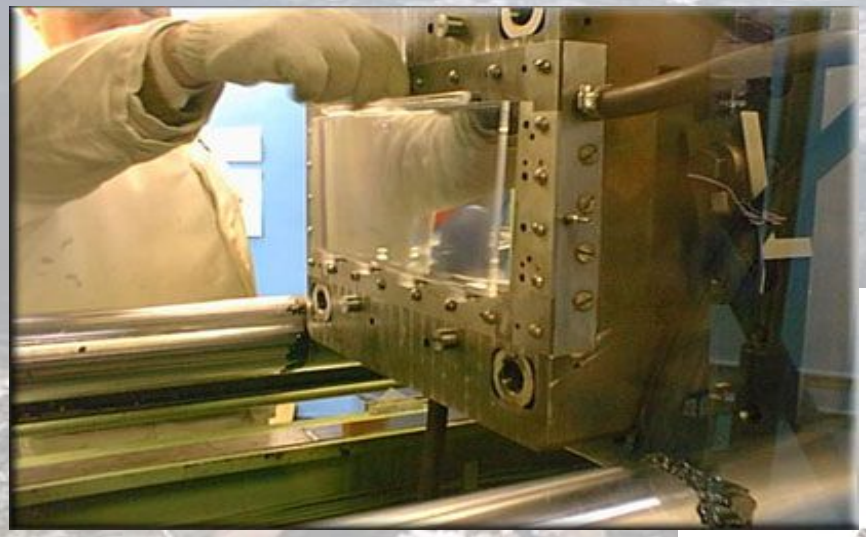
- From 1995: 34 projects, some of them with multiple extensions, among them:
  - **14 Regular projects**
  - **14 Regular projects with CERN co-funding**
  - **5 Partner Projects**
- More than 3/4 of the projects are successfully completed and the others are continuing
- Total projects volume 27.6 M$US
  - of which ISTC contributed 10.6 M$US

Liquid krypton calorimeter for NA 48 # 121

CERN - Dubna - Khrunichev ~ 670 k$US; 1995 - 97

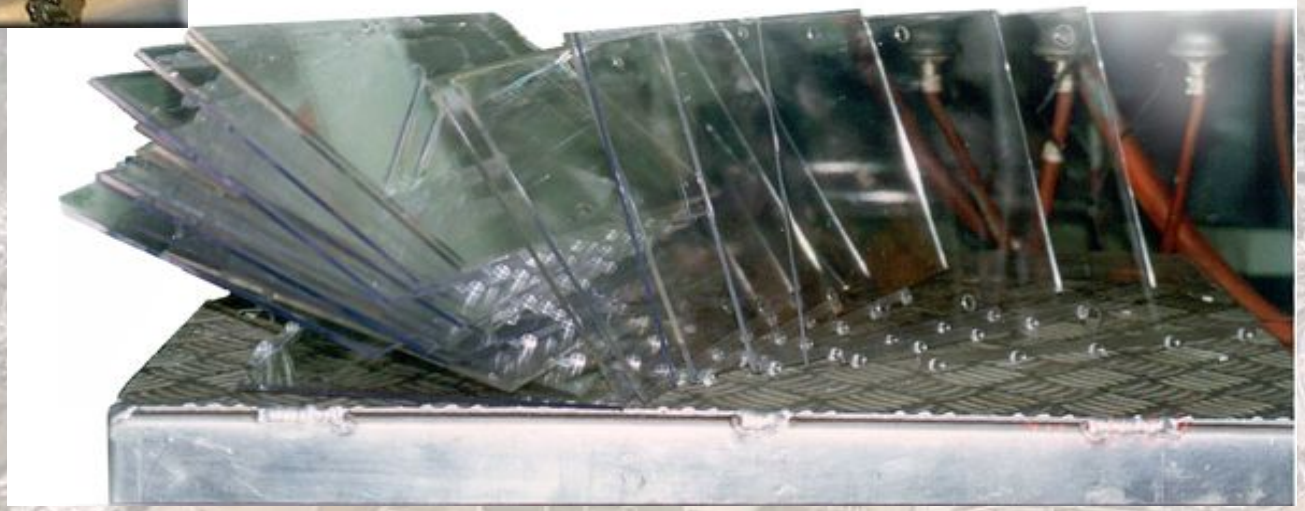
Scintillating tiles for ATLAS # 515 Protvino - Lutch

1996 – 2002 Technology development fully funded by ISTC.
Construction of 70 tons of big-scale scintillating tiles : 450’000 tiles



know-how

- **high optical transparency**
- **adaptation of U-tiles technology for molding of scintillation tiles**
- **stable quality**



Development of Technology for the production of Titanium alloy Tie rods for ATLAS - Lutch

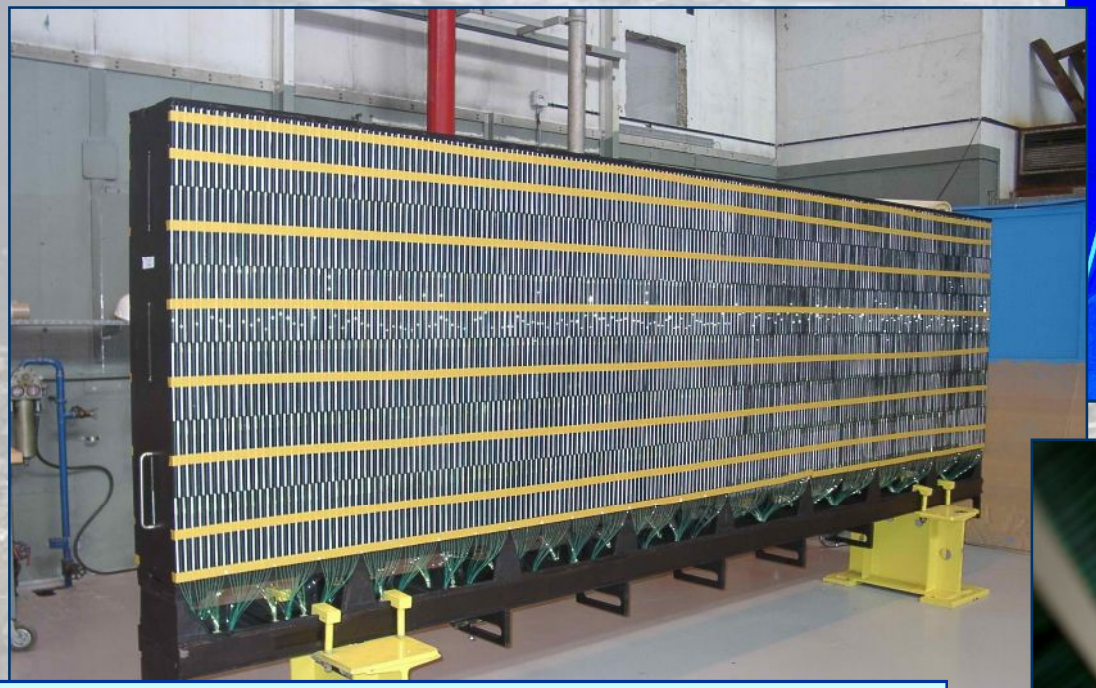
- special alloy fabrication
- special mechanical treatment (forging)

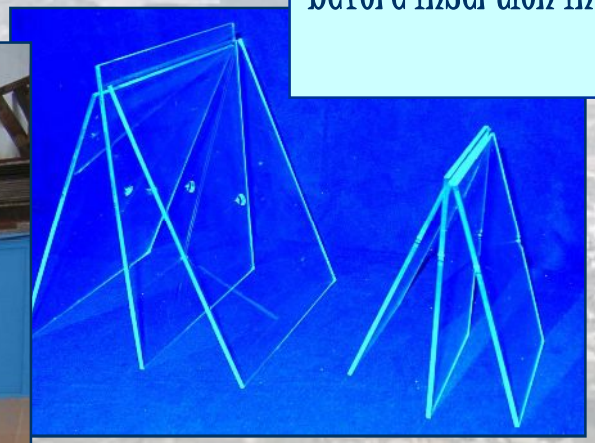
40 engineers and physicists (from 1996 till now)

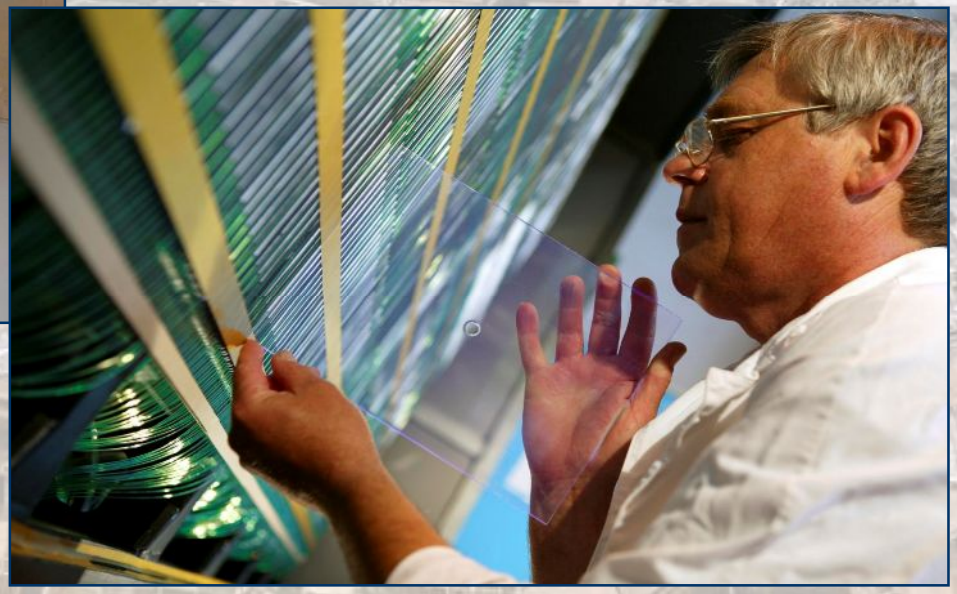
through 5 extensions of #515;
funding shared between ISTC and CERN;
40 engineers and physicists (2000 - 2004);
Spin off - commercial contract with CMS full
funded by CERN

Scintillating tiles for the LHCb Hadron Calorimeter PP # 2719, Protvino - Lutch (Spin off #1610 and # 515)

Scintillating tiles of two types just before insertion into **HCAL**







The first HCAL (August'03);
By 2007 already produced 86000 tiles for 50 modules

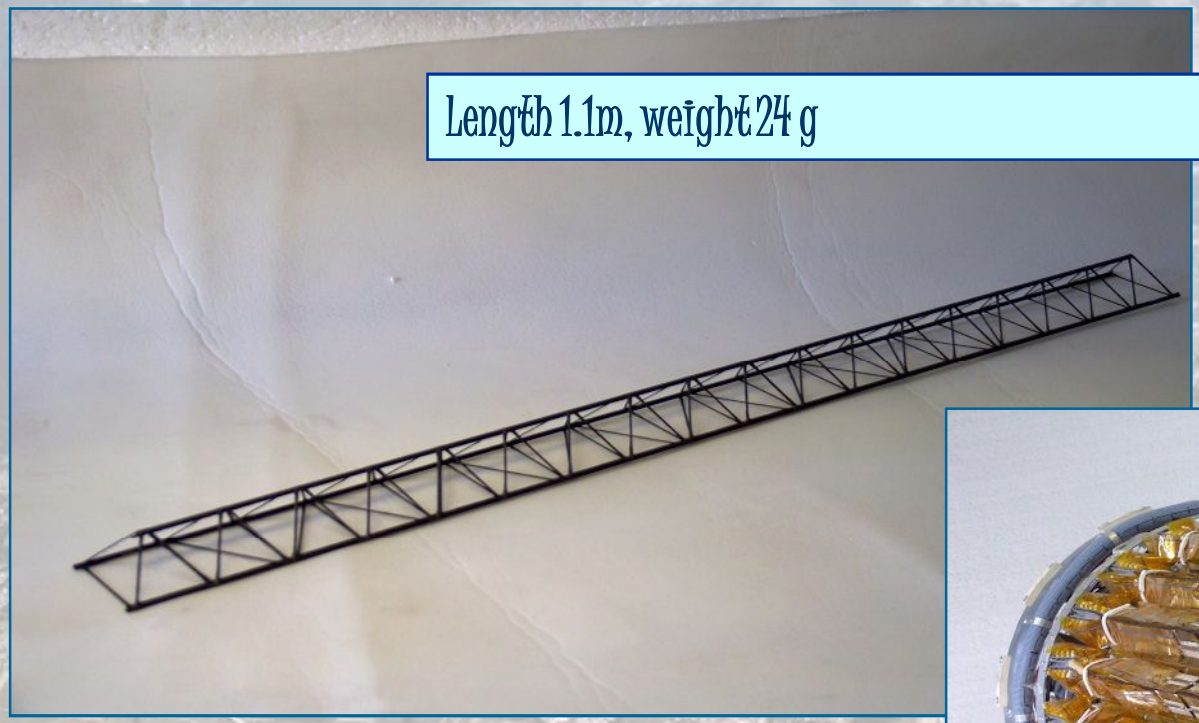
Bogoroditsk $PbWO_4$ Crystals for the CMS Ecal

354 - # 354 B

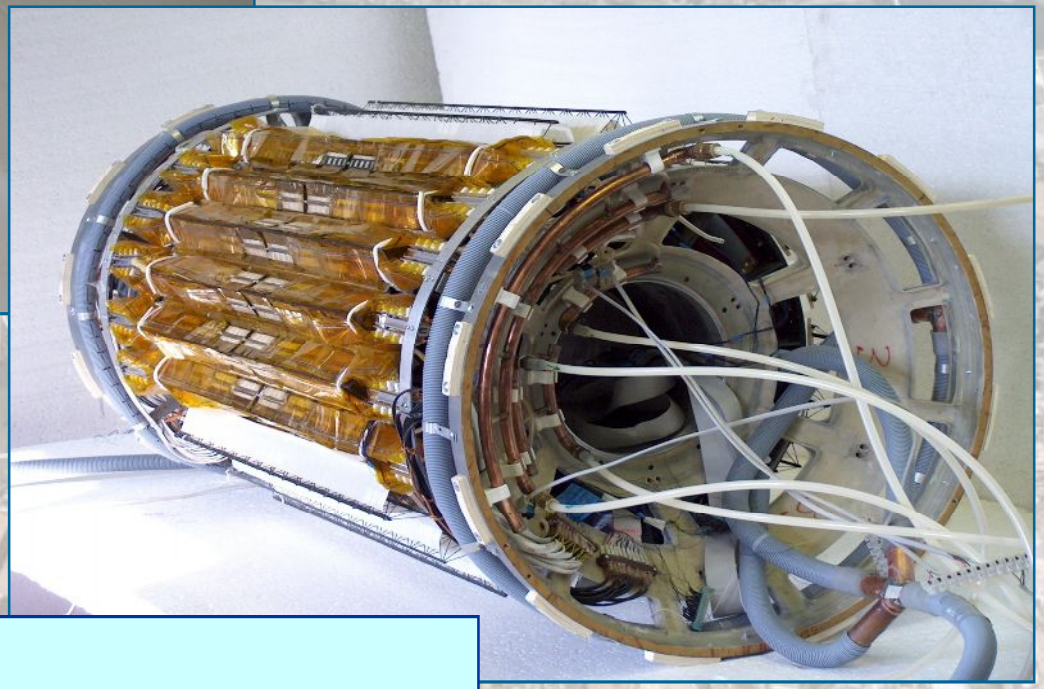
#1718

62'000 + 15 000 crystals needed for CMS Electromagnetic Calorimeter

Super light carbon support frame for ALICE
345 - # 1666, St-Pt. State University - CKBM (St-Pt)

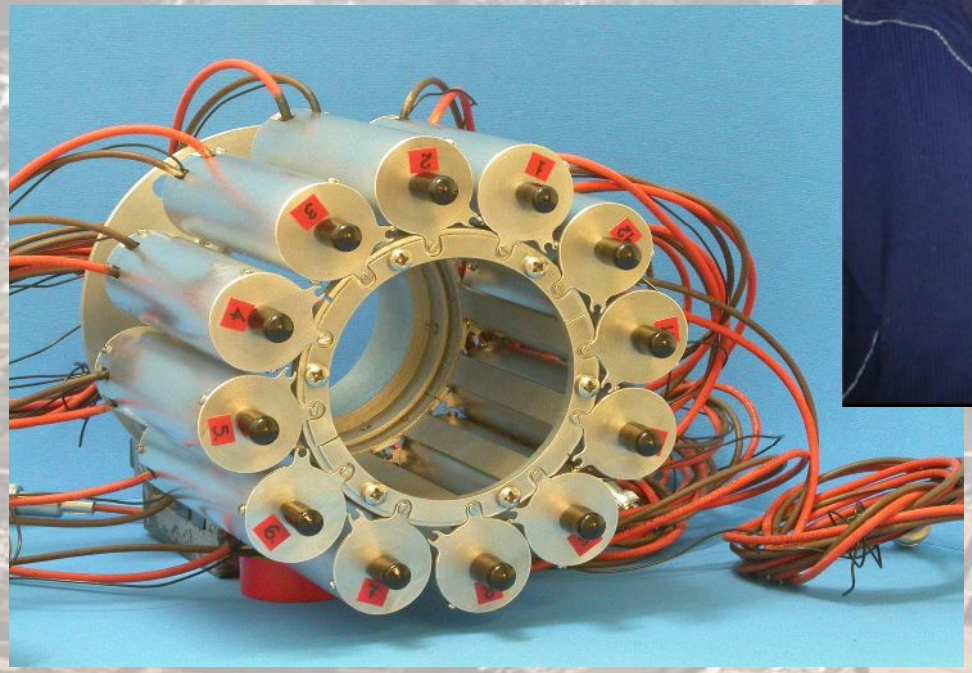


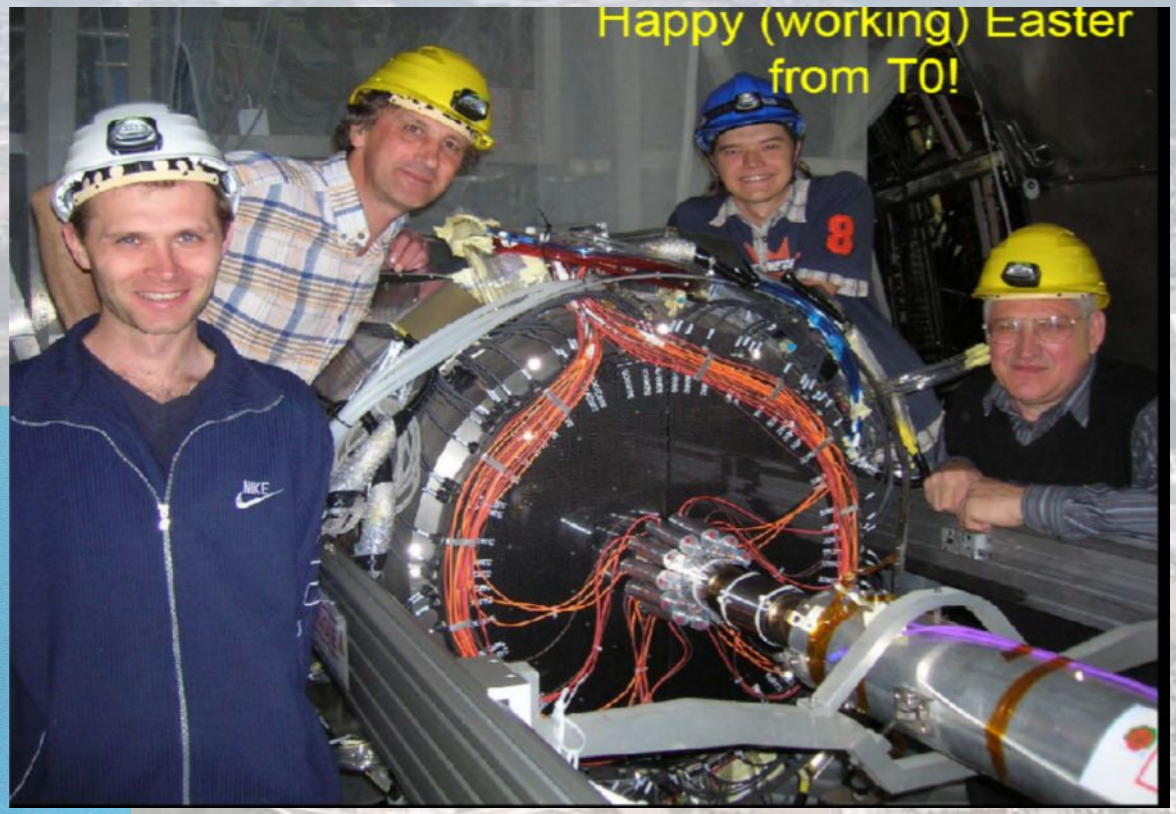
Length 1.1m, weight 24 g



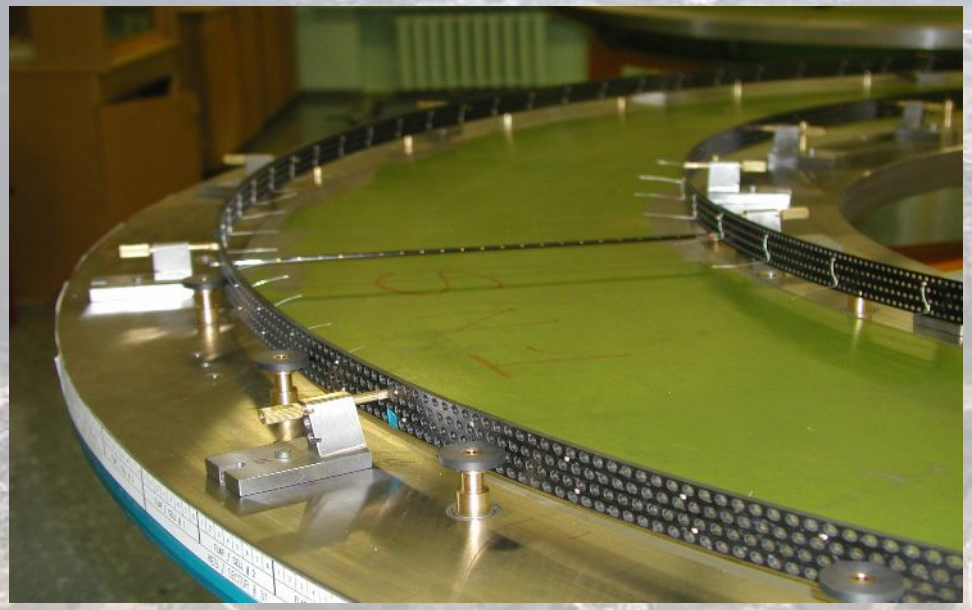
Full-scale carbon fibre model (>2000 components)

Starting trigger detector (T0) for ALICE # 2880 INR - Institute of Pulse technique, Moscow

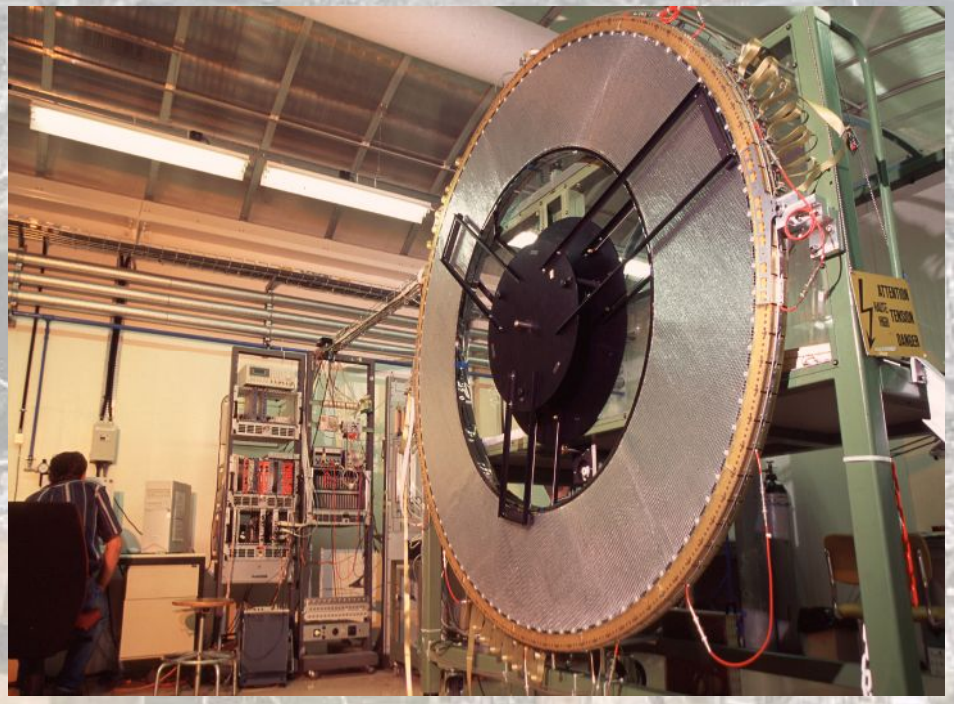




441 MEPhI - PNPI - «Mashinostroitel» plant (Perm) Technology for the production of Carbon-fibre rings for the ATLAS TRT - spin off PP #1800 for the production of 350 C-fibre rings for a total value of 2 M$ (US)



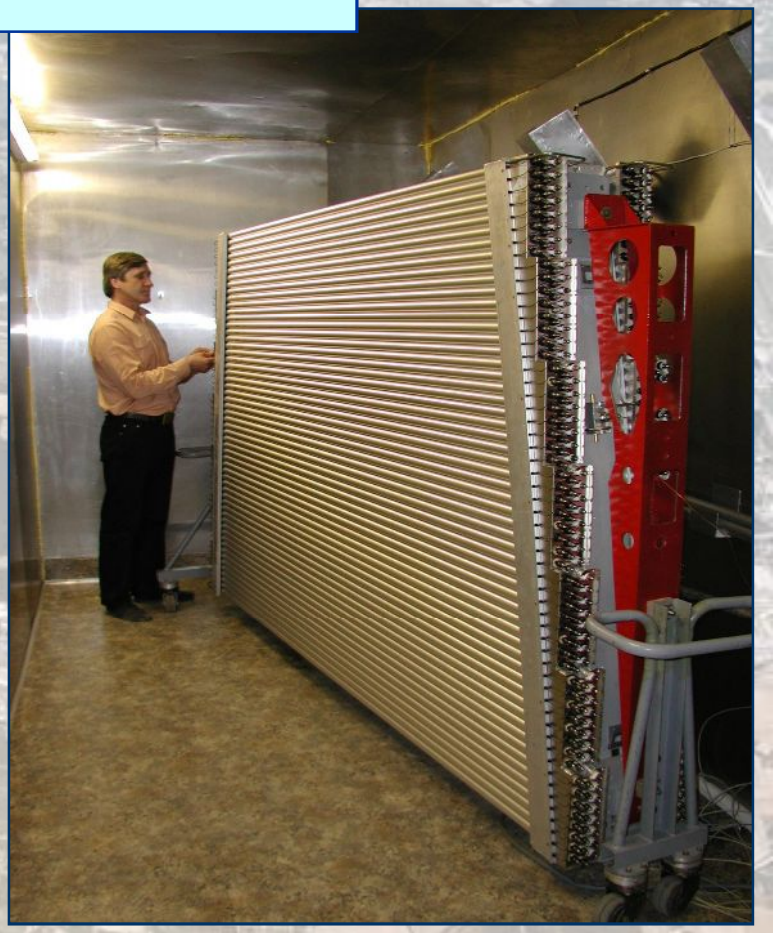
The ring characteristics:
light weight and high modulus,
high accuracy of hole drilling



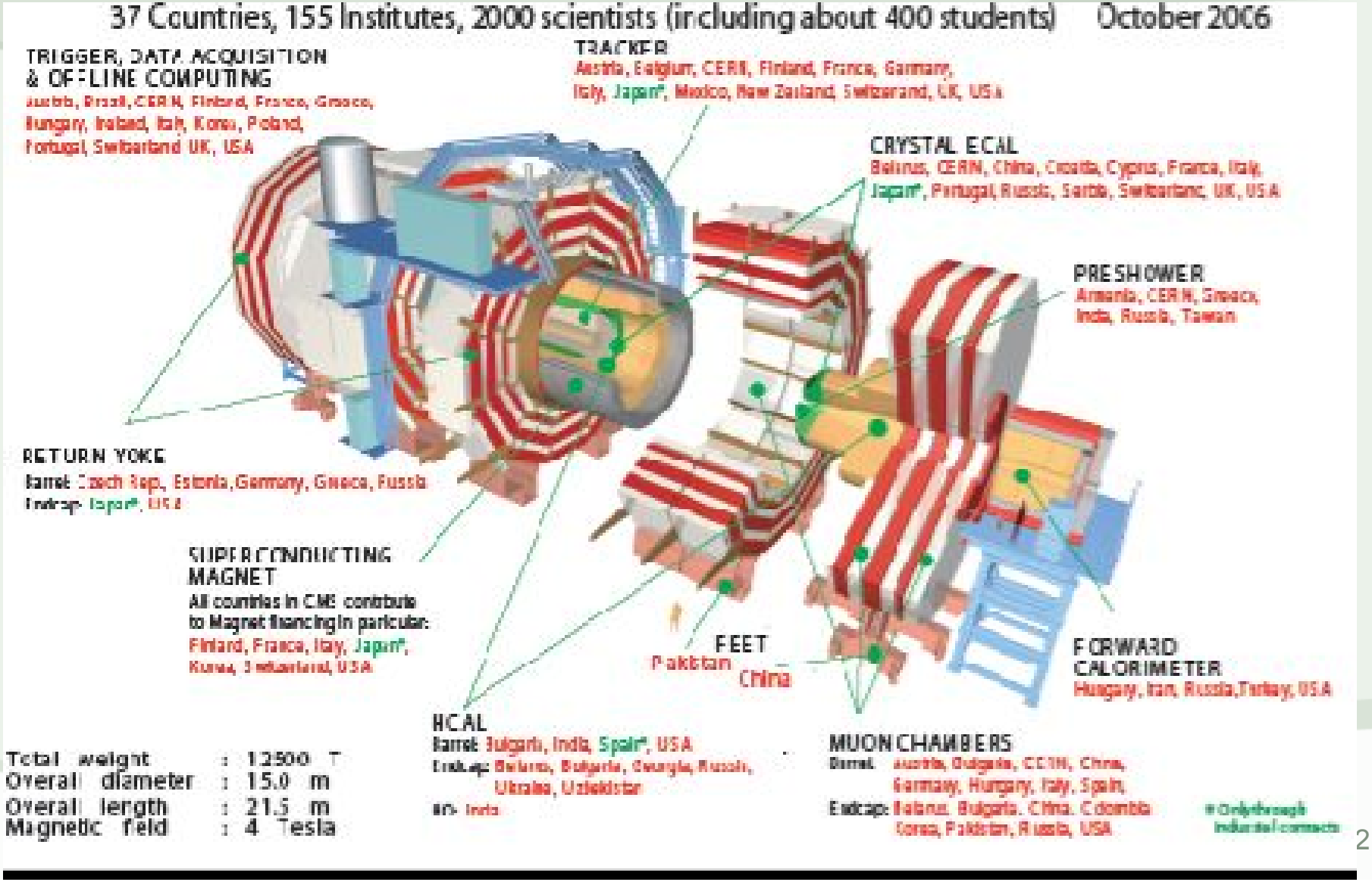
Each pair of rings supports about 3000 straw tubes used to track relativistic charged particles

Monitor Drift Tubes (MDT) Chambers for precise measurements of muon trajectories in the ATLAS Muon Spectrometer # 1639; Protvino, Dubna, Snejinsk 2001 - 2010

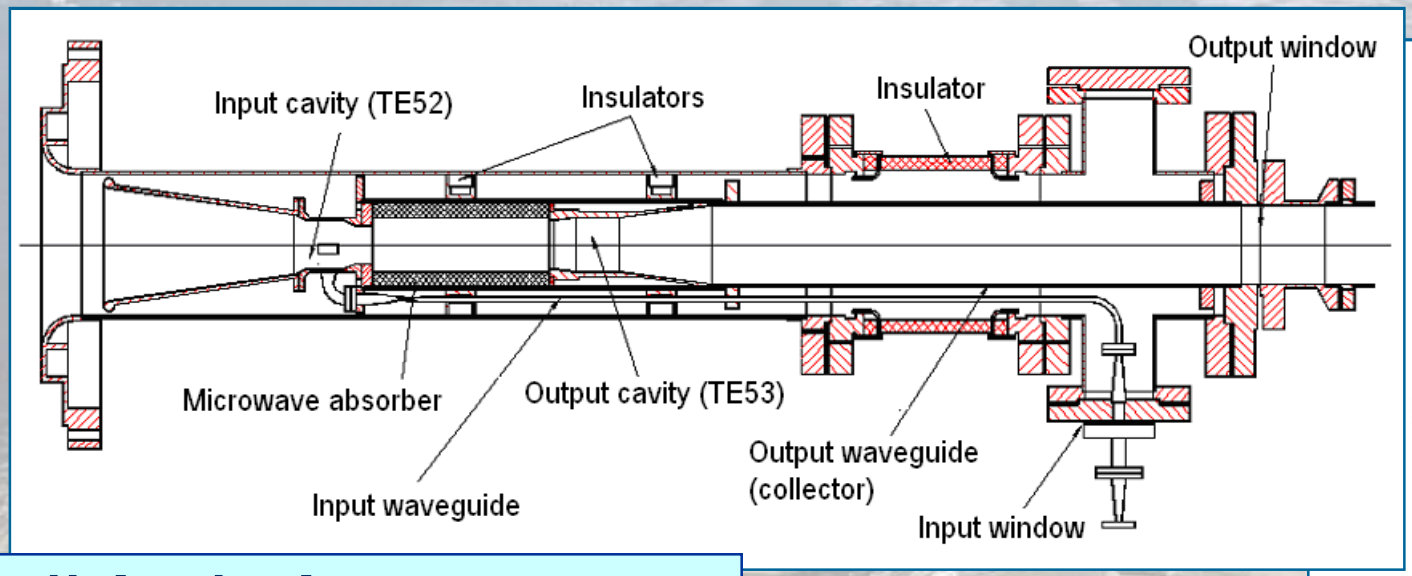
208 MDT Chambers should be produced with highest uniformity



CMS Collaboration

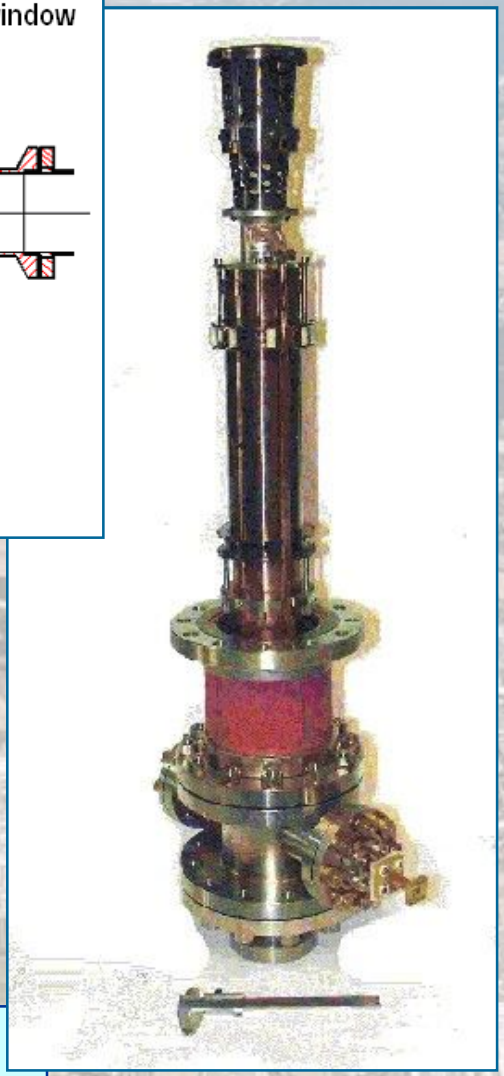


CLIC study - Project # 3169 - Novgorod Institute of Applied Physics



Gyroklystron schematics

CERN is studing the feasibility of building a 3 TeV linear collider based on high wave accelerating structures operating at 30 Ghz



Assembled gyroklystron

Ongoing ISTC Projects

Partner Projects (funding from CERN):

- #2719 LHCb/ IHEP,Protvino/ Lutch, Podol'sk : 240 k$US
  Experimental modules and scintillating tiles for HCal
  Oct. 2003 - Oct. 2007 (multiple prolongations)

to be prolonged without any changes of funding

- #3438 CMS / BTCP,Bogoroditsk 30 k$US
  R&D for mass production of $PbWO_4$ endcap crystals (spin off #1718)
  Jan. 2007 - Jan. 2010

Co-funding Projects:

- #1639 ATLAS/ IHEP,Protvino/ Snejinsk : ISTC: 375 k$US, CERN: 506 k$US
  Design and development of Tracking detector (Muon Drift Tube chambers) 2001 - 30 Nov.2008 (due to great success had multiple prolongations) Has been extended till June 2010 with CERN add. funding of 230 **k$US**

- #3169 CLIC collaboration/ Institute of Applied Physcics, N.Novgorod
  Feasibility of building of Compact Linear Collader (CLIC)
  ISTC: 175 k$US, CERN: 60.40 k$US Oct. 2005 - Oct. 2008

Ongoing ISTC Projects

Projects funded by EU:

•#2888 ALICE/INR/ Central Design Bureau of Machine Building, Moscow
Development and design of Start detector for trigger and Time-of-Flight Systems for the ALICE experiment.

June 2005- June 2007 270 k$US

Just successfully finished

• #3016 ATLAS/RFNS-VNIITF,Snejinsk 220 k$US
Calculation of thermal regime in the critical area of the ATLAS muon spectrometer Oct. 2005 - Oct. 2007

Pending Projects:

• #2887 St-Pt University + Institute of Electro-physical Apparatus (NIIEFA) Development of ion-therapy in radio oncology and mammary gland diagnostics system, estimated cost: 240 k$US

Ongoing ISTC Projects

Projects funded by EU:

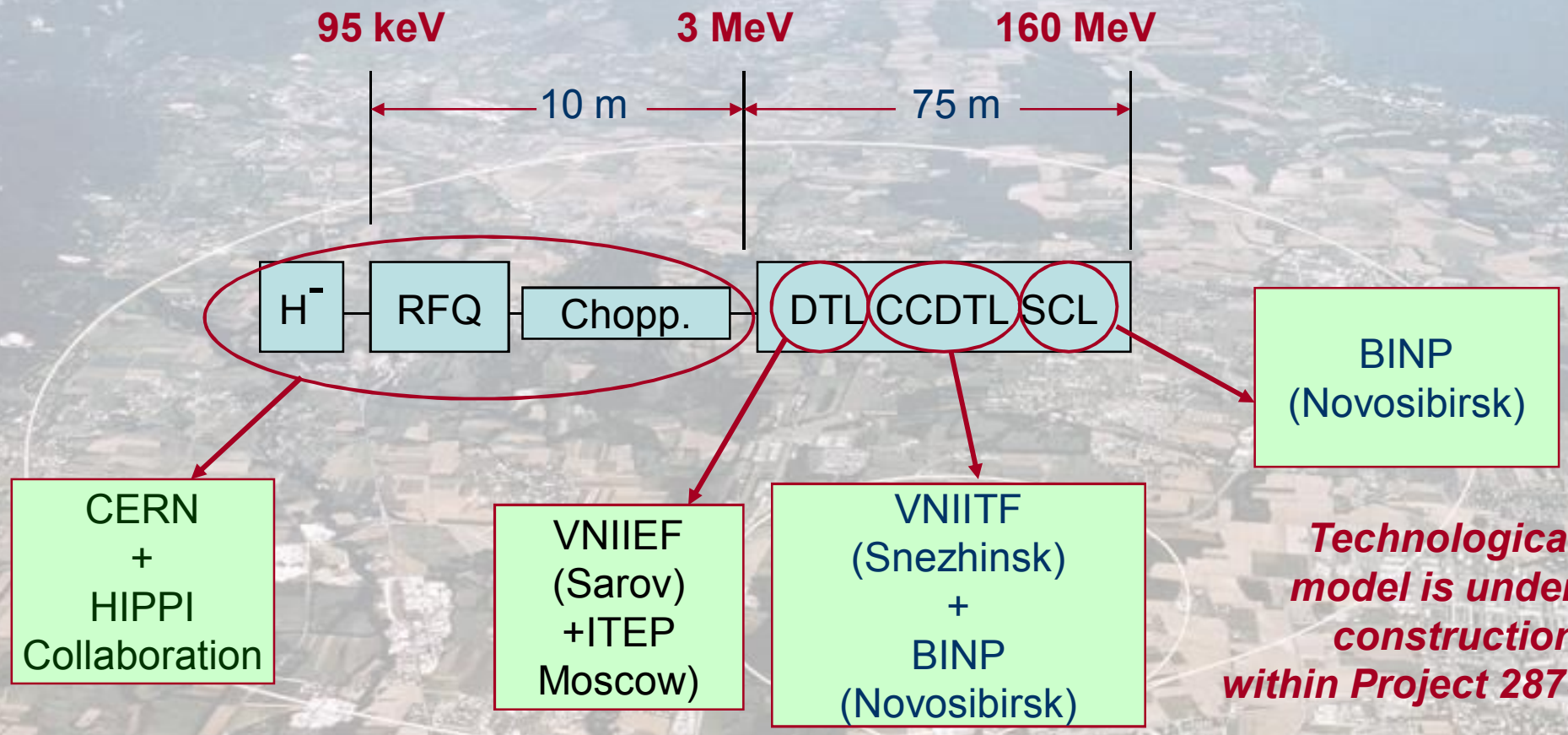
for Linac 4 & SPL

- #2875 - Novosibirsk/**RFNS-VNIITF,Snejinsk**: 550 k$US
  Coupled Cavity Drift Tube Linac Structure + cold model of SCL structure (100-200 MeV)

- #2888 - ITEP,Moscow/VNIIEF,Sarov: 500 k$US
  Drift Tube Linac (DTL) structure with magnetic focusing ("Alvarez") (3-40 MeV)

- #2889 - IHEP,Protvino/VNIIEF,Sarov: 500 k$US
  DTL structure with focusing by RF quadrupoles (DTL-RFQ) (3-40 MeV)

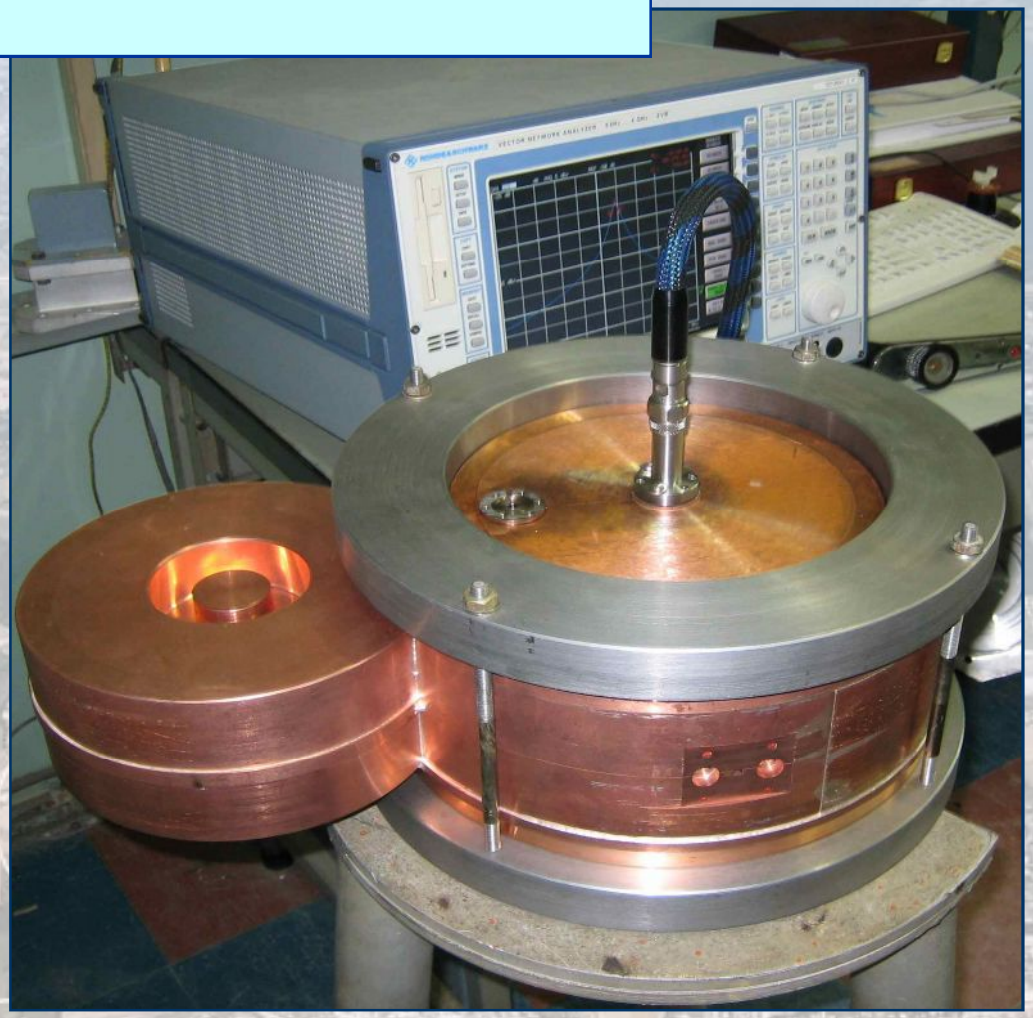
Projects funded by EU for Linac 4 & SPL



Technological model is under construction within Project 2875

Full-size prototypes are under construction within Projects 2888 and 2875

Rf measurements of the mechanical assembly before end plates brazing



SCL brazing assembly before loading into the vacuum furnace (coupling cell on top of the accelerating cell)

Summary of experience of the collaboration between Russian Institutes (RI), Russian Weapon Institutions (RWI) and ISTC

- All projects except one which was stopped due to a drastic increase of price on the raw materials (and a long administrative procedure) has been a great success
- **RWI refocus their efforts on applied and innovative R&D**
- **RWI got the** opportunity to use their scientific and technological expertise in solving the tasks of modern science
- **Use of the excellent pre-existing collaboration network CERN-RI**
- **Integration of RWI in the international community (>600 RWI engineers and technicians worked for the CERN projects)**
- Transfer of knowledge between **RWI, RI and** EC research Institutes
- Ability to work with financial constraints

Benefits for CERN and the LHC experiments

- CERN found additional competent partners
- Successful developments of several new technologies:
  - → PbWO4 crystals,
  - → very light composite structures
  - → machining of unusual pieces with Titanium and Tungsten,
  - → diffusion welding of large mass steel blocks,
  - → technology of glass fiber composite,
  - → molding of scintillation tiles

Still negative:

Lack of spin off and follow up of the projects to redirect RWI to civil production - SUSTAINABILITY IS A KEY!!

Where we are headed

After thirteen years of operations, the ISTC:

- **is a catalyst for innovation and technology development**
- **integrates CIS scientists into global, worldwide collaboration network**
- **supports science that is truly "in demand" and "on demand"**
- **understands that end of an ISTC project does not necessarily mean end of the process**
- **has morphed into a matchmaking agent for bringing together promising CIS science with private companies and industrial entities**
- **supports reconstruction and build-up of self-sustained civil research infrastructure**

Where we are headed

Programmatic Approach

- **Alignment of ISTC project activities with national priorities of the ISTC Parties**
- **Identify areas of technical strength and scientific expertise of ISTC project participants**
- **Transforms projects into "sustainable programs", maximizing efficiency and relevance to international science and cutting-edge research**
- **Secretariat is currently preparing reports on various technical areas**

Where we are headed

ISTC helps scientists move away from financial reliance on ISTC and develop the skills and capabilities to attract other income.

- **Commercialization Support Program (creates sustainable civilian jobs for former WMD scientists)**
- **Competency Building Program (provides business training to former WMD scientists)**
- **Increase number of commercial Partners funding projects**
- **Create systemic links with international research initiatives/activities**

Where we are headed

ISTC's original mission is not completed. Even though a significant number of FWS have retired or been re-absorbed, significant needs continue to exist in Russia & in CIS countries, and new institutes continue to open their doors to ISTC collaboration

It is clear that nonproliferation and sustainability are highly linked concepts – but what are the methods for working towards these dual goals?

Lasting objectives:

Last but not least:

ISTC's mission in its depth has always been to be a successful PEACE project stimulating and supporting integration of Russian and CIS scientific communities into international SCIENCE COMMUNITY in order to make EARTH a better place to live!