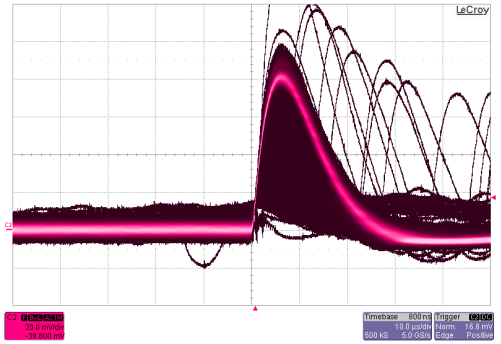
Bridging the gap between technology and innovation

Summary

A National Research Institute its potentials & needs

Two examples

A common strategy



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"***Investing in research and innovation is a priority for the development of our country and the primary task for public and private subjects consists in making available adequate resources and instruments to face the difficult challenges posed by a widely globalized society***".

- ". This free translation of the words of the President of the Italian Republic, Giorgio Napolitano, give a clear image of the paramount importance attributed to the themes bound to research and the consequent industrial innovation and social evolution.
- As seen from the point of view of basic research, whose mission lies in investigating nature's lows, through undiscovered paths and finding new unique solutions, this implies a concrete effort in order to get involved in the processes of transferring specific competences. This leads to the valorization of technology and methods resulting from the research work, and requires that scientists also get involved in the management of innovation processes.

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INFN
A national distributed technology platform

CNTT

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Besides the birth of Spin-off Technology Transfer up to now ?

- List of potentials
- Expositions & Shows
- Catalogs

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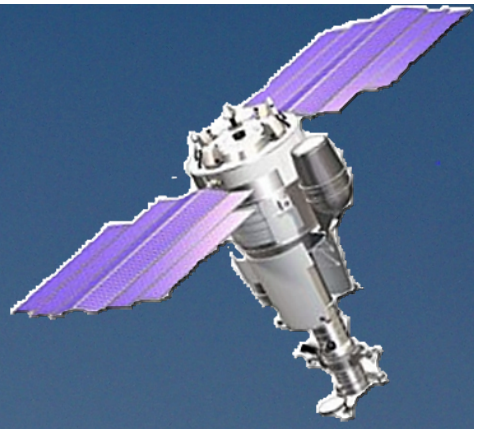
COMMITMENT

- Technology transfer is one of the major challenges INFN faces: the ***Institute has to look at this activity as an urgent issue coming from the society*** ***that, while recognizing the very high level of research carried on in the fields of nuclear, particle and astroparticle physics, expects that some of the technological assets of INFN should be exploited also for the creation of wealth.***

RUSSIAN ITALIAN COLLABORATON EXPERIENCE IN SPACE SCIENCES



P A M E L A Satellite experiment

Payload for Antimatter / Matter Exploration and Light-nuclei Astrophysics

OUTLINE

- Italian Russian project short Overview
- next step

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Formation of expert community in the fields of education, science and technologies»
(Settembre 26-27 2013 , Trieste, Italia

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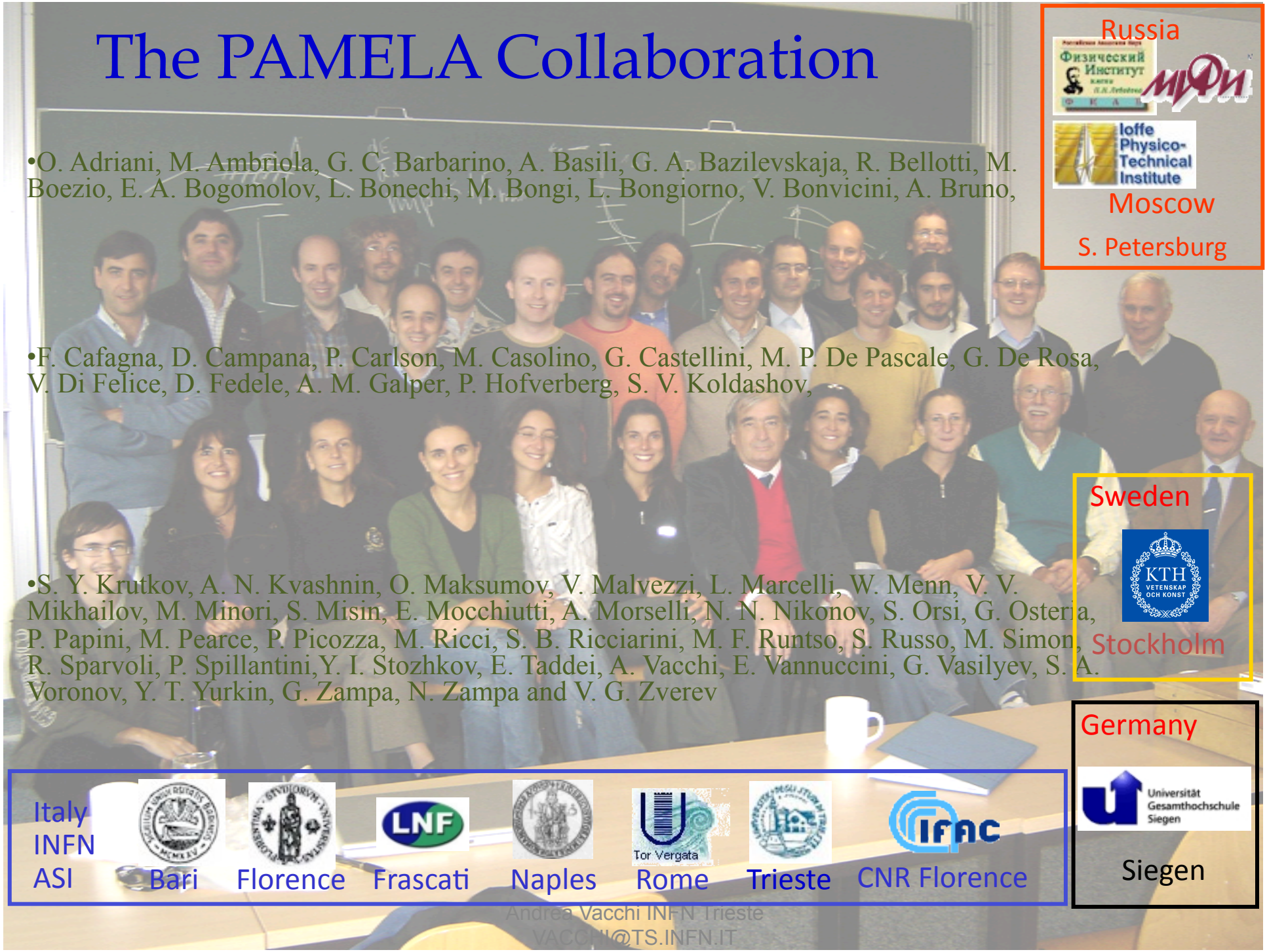
The PAMELA Collaboration



•O. Adriani, M. Ambriola, G. C. Barbarino, A. Basili, G. A. Bazilevskaja, R. Bellotti, M. Boezio, E. A. Bogomolov, L. Bonechi, M. Bongi, L. Bongiorno, V. Bonvicini, A. Bruno,

•F. Cafagna, D. Campana, P. Carlson, M. Casolino, G. Castellini, M. P. De Pascale, G. De Rosa, V. Di Felice, D. Fedele, A. M. Galper, P. Hofverberg, S. V. Koldashov,

•S. Y. Krutkov, A. N. Kvashnin, O. Maksumov, V. Malvezzi, L. Marcelli, W. Menn, V. V. Mikhailov, M. Minori, S. Misin, E. Mocchiutti, A. Morselli, N. N. Nikonov, S. Orsi, G. Osteria, P. Papini, M. Pearce, P. Picozza, M. Ricci, S. B. Ricciarini, M. F. Runtso, S. Russo, M. Simon, R. Sparvoli, P. Spillantini,Y. I. Stozhkov, E. Taddei, A. Vacchi, E. Vannuccini, G. Vasilyev, S. A. Voronov, Y. T. Yurkin, G. Zampa, N. Zampa and V. G. Zverev

Russia

Moscow

S. Petersburg

Sweden

Stockholm

Germany

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Italy
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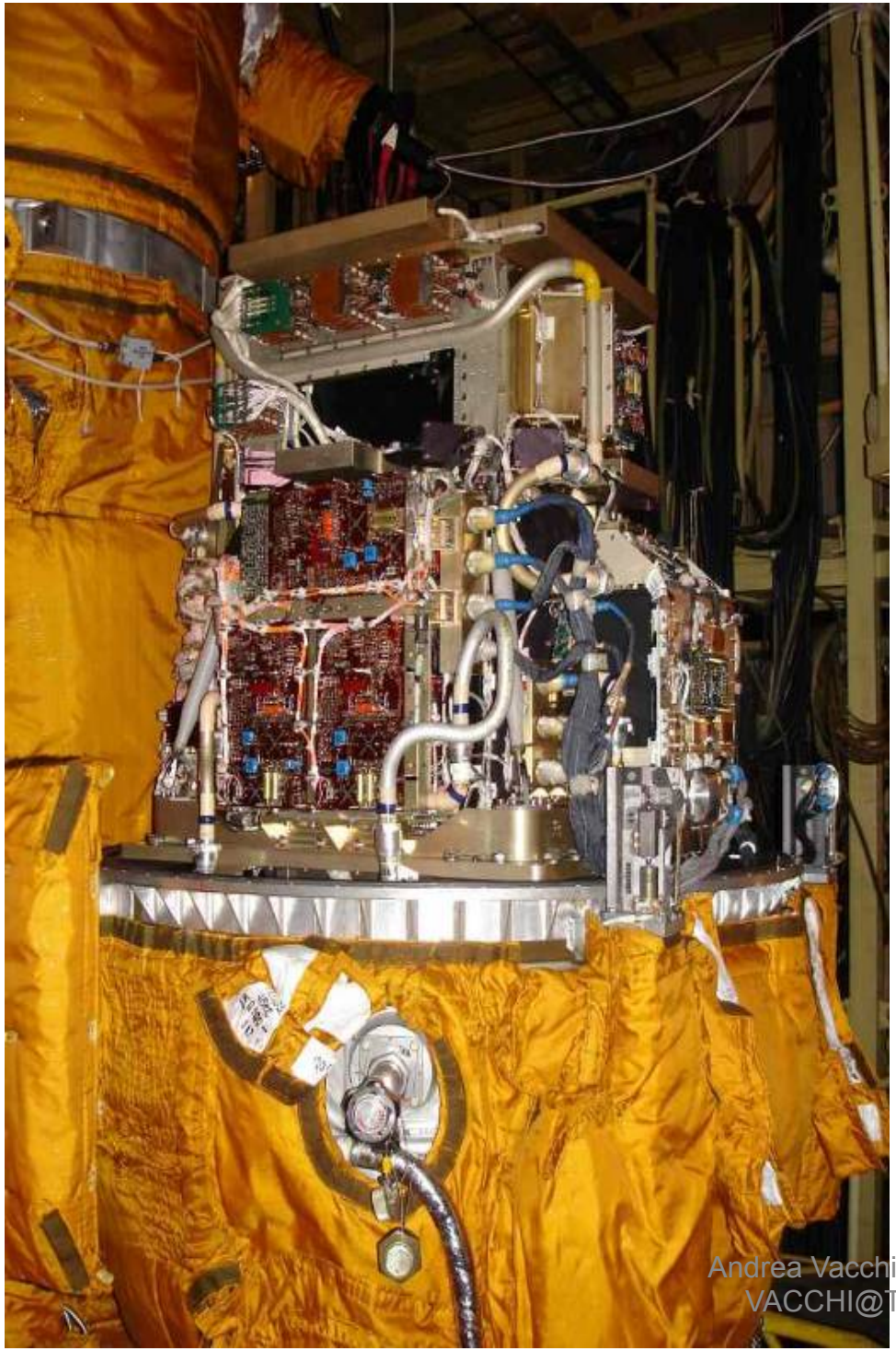

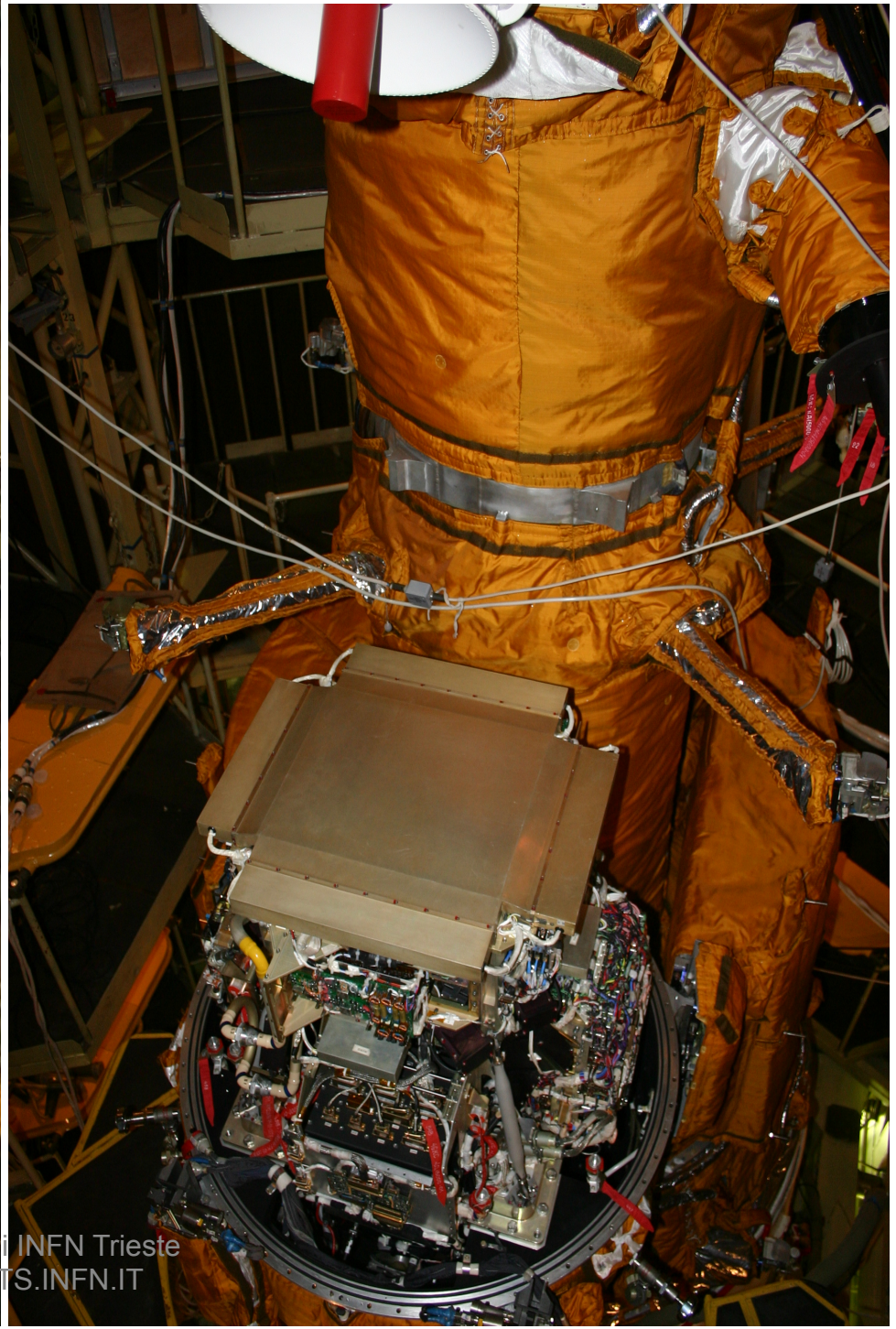

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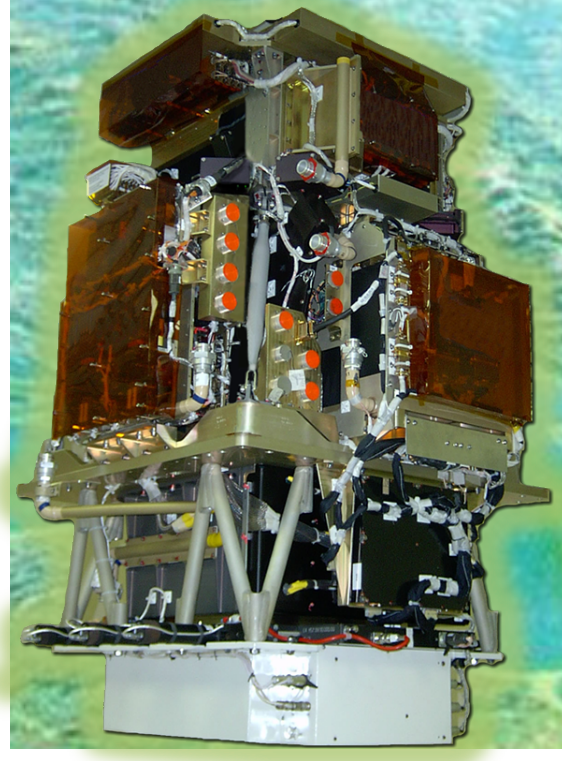
Resurs-DK1 satellite

• PAMELA installed in a pressurized container

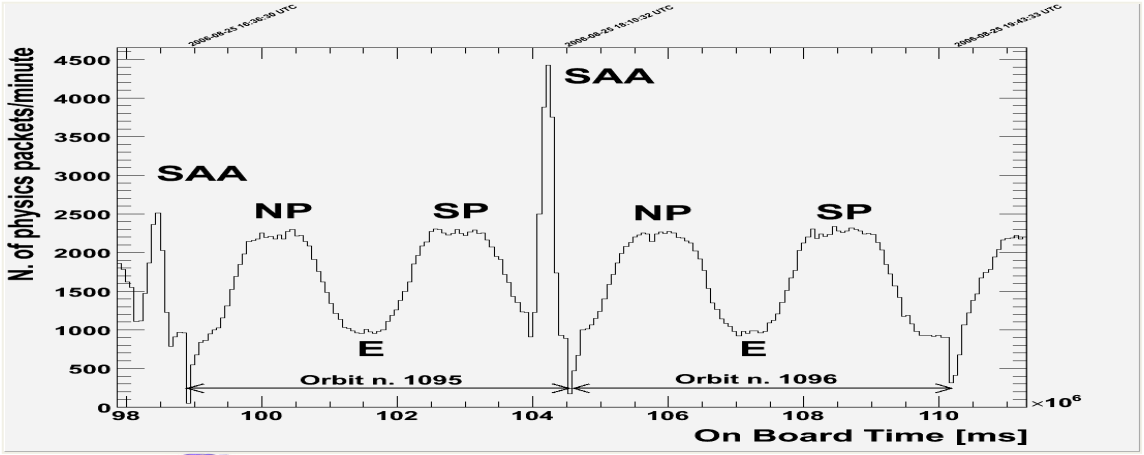
Mass: 6.7 tonnes
Height: 7.4 m
Solar array area: 36 m^2

- **Main task: multi-spectral remote sensing of earth's surface**
- **Built by TsSKB Progress in Samara, Russia**
- **Lifetime >3 years (assisted)**
- **Data transmitted to ground via high-speed radio downlink**
  ~16 GB per day



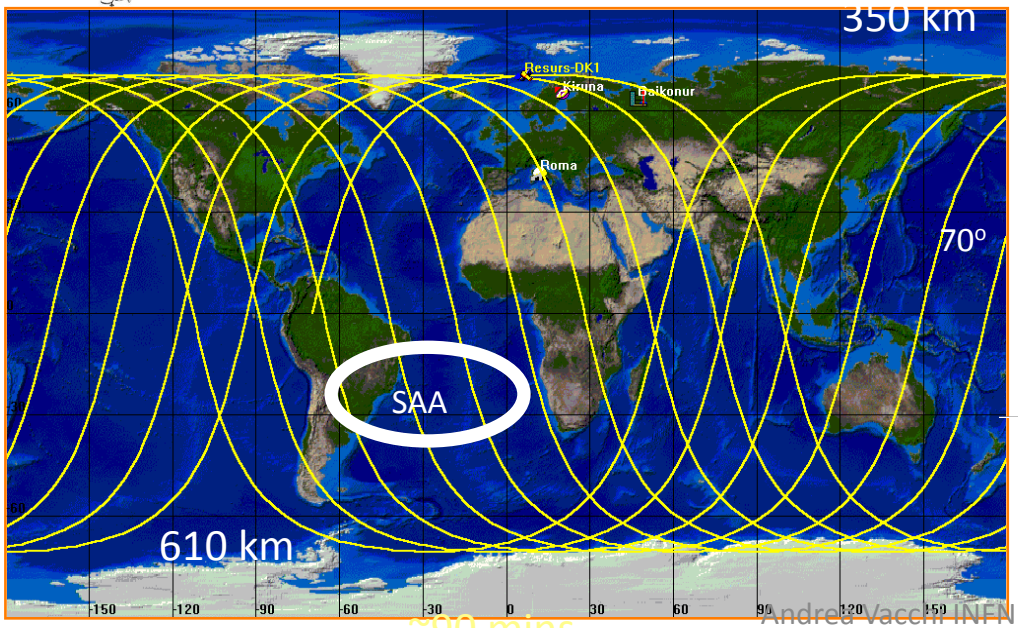
GF: 21.5 cm^2 sr
Mass: 470 kg
Size: 130x70x70 cm^3
Power Budget: 360W

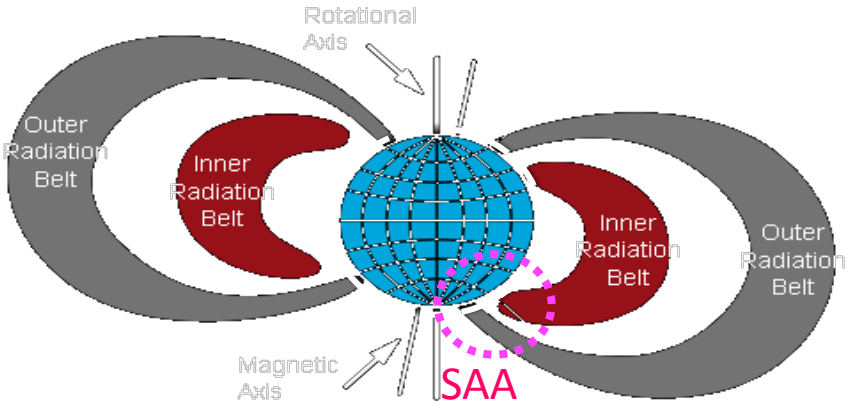
Orbit and geomagnetic cutoff



- Quasi-polar and elliptical orbit (70.0°, 350 km - 600 km)
- Traverses the South Atlantic Anomaly
- Crosses the outer (electron) Van Allen belt at south pole

PAMELA





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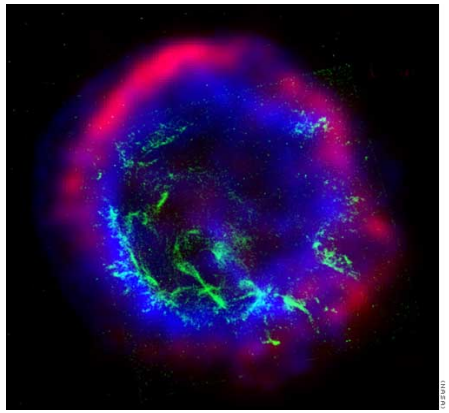
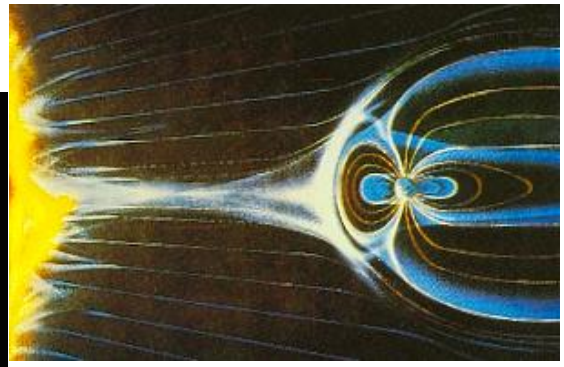
Scientific goals

- **Search for dark matter annihilation**

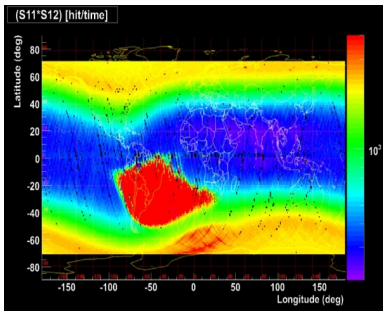
- Search for antihelium (primordial antimatter)
- Search for new Matter in the Universe (Strangelets?)

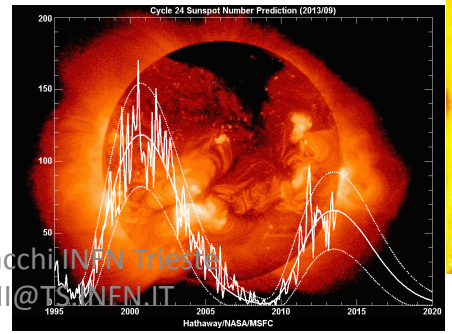


- Study of cosmic-ray propagation (light nuclei and isotopes)
- Study of electron spectrum (local sources?)



- Study solar physics and solar modulation
- Study terrestrial magnetosphere





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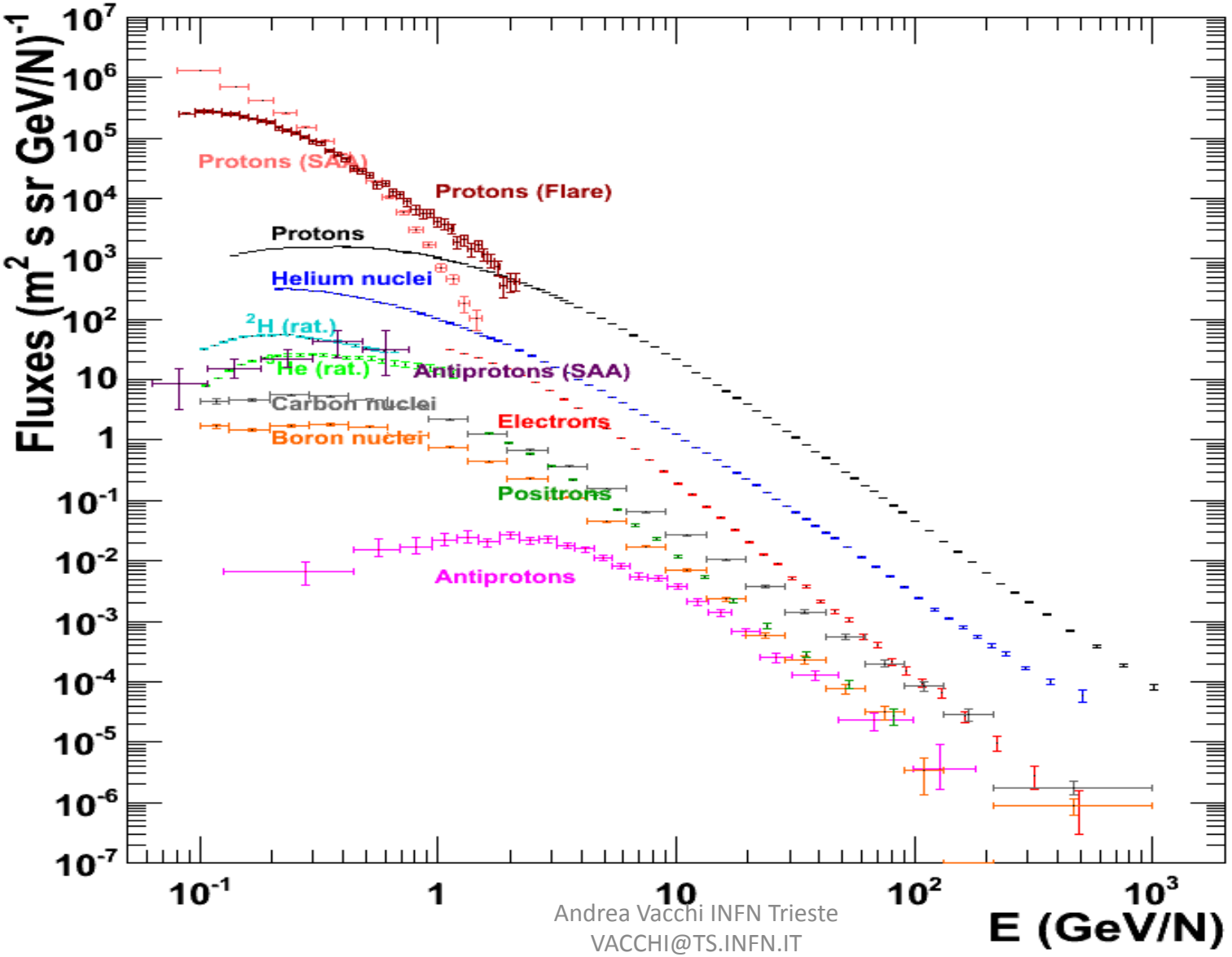
Summary of PAMELA results



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11. **The CMS experiment at the CERN LHC**
(1072) CMS Collaboration (S. Chatrchyan (Yerevan Phys. Inst.) *et al.*). Aug 2008. 361 pp.
Published in **JINST 3 (2008) S08004**
DOI: 10.1088/1748-0221/3/08/S08004
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12. **Review of Particle Physics (RPP)**
(1013) Particle Data Group Collaboration (J. Beringer (LBL, Berkeley) *et al.*). 2012. 1528 pp.
Published in **Phys.Rev. D86 (2012) 010001**
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Pamela =>

13. **An anomalous positron abundance in cosmic rays with energies 1.5-100 GeV**
(1012) PAMELA Collaboration (Oscar Adriani (Florence U. & INFN, Florence) *et al.*). Oct 2008. 20 pp.
Published in **Nature 458 (2009) 607-609**
DOI: 10.1038/nature07942
e-Print: arXiv:0810.4995 **[astro-ph]** | PDF
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Record dettagliato - Citato da 1012 record

14. **Five-Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Data Processing, Sky Maps, and Basic Results**
(963) WMAP Collaboration (G. Hinshaw (NASA, Goddard) *et al.*). Mar 2008. 43 pp.
Published in **Astrophys.J.Suppl. 180 (2009) 225-245**
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References | BibTeX | LaTeX(US) | LaTeX(EU) | Harvmac | EndNote
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Il most cited =Pamela =>

Most Cited Astroparticle Physics Articles

The most cited articles published since 2007, extracted from SciVerse Scopus.

Parameterized beyond-Einstein growth

Volume 28, Issues 4-5, December 2007, Pages 481-488

Linder, E.V. | Cahn, R.N.

A single parameter, the gravitational growth index γ, succeeds in characterizing the growth of density perturbations in the linear regime separately from the effects of the cosmic expansion. The parameter is restricted to a very narrow range for models of dark energy obeying the laws of general relativity but can take on distinctly different values in models of beyond-Einstein gravity. Motivated by the parameterized post-Newtonian (PPN) formalism for testing gravity, we analytically derive and extend the gravitational growth index, or minimal modified gravity, approach to parameterizing beyond-Einstein cosmology. The analytic formalism demonstrates how to apply the growth index parameter to early dark energy, time-varying gravity, DGP braneworld gravity, and some scalar-tensor gravity. © 2007 Elsevier B.V.

PAMELA - A payload for antimatter matter exploration and light-nuclei astrophysics

Volume 27, Issue 4, April 2007, Pages 296-315

Picozza, P. | Galper, A.M. | Castellini, G. | Adriani, O. | Altamura, F. | Ambriola, M. | Barbarino, G.C. | Basili, A. | Bazilevskaja, G. A. | Bencardino, R. | Boezio, M. | Bogomolov, E.A. | Bonechi, L. | Bongi, M. | Bongiorno, L. | Bonvicini, V. | Cafagna, F. | Campana, D. | Carlson, P. | Casolino, M. | De Marzo, C. | De Pascale, M.P. | De Rosa, G. | Fedele, D. | Hofverberg, P. | Koldashov, S.V. | Krutkov, S.Yu. | Kvashnin, A.N. | Lund, J. | Lundquist, J. | Maksumov, O. | Malvezzi, V. | Marcelli, L. | Menn, W. | Mikhailov, V.V. | Minori, M. | Misin, S. | Mocchiutti, E. | Morselli, A. | Nikonov, N.N. | Orsi, S. | Osteria, G. | Papini, P. | Pearce, M. | Ricci, M. | Ricciarini, S.B. | Runtso, M.F. | Russo, S. | Simon, M. | Sparvoli, R. | Spillantini, P. | Stozhkov, Yu.I. | Taddei, E. | Vacchi, A. | Vannuccini, E. | Voronov, S.A. | Yurkin, Y.T. | Zampa, G. | Zampa, N. | Zverev, V.G.

The PAMELA experiment is a satellite-borne apparatus designed to study charged particles in the cosmic radiation with a particular focus on antiparticles. PAMELA is mounted on the Resurs DK1 satellite that was launched from the Baikonur cosmodrome on June 15th 2006. The PAMELA apparatus comprises a time-of-flight system, a magnetic spectrometer, a silicon-tungsten electromagnetic calorimeter, an anticoincidence system, a shower tail catcher scintillator and a neutron detector. The combination of these devices allows antiparticles to be reliably identified from a large background of other charged particles. This paper reviews the design, space qualification and on-ground performance of PAMELA. The in-orbit performance will be discussed in future publications. © 2006 Elsevier B.V. All rights reserved.

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The Gamma-400 MISSION

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Cooperation in the design and production of scientific equipment

Russian scientific organizations	Foreign scientific organizations
LPI RAS – Leading Institute	INFN (Italy) – Converter/Tracker and Calorimeter
NRNU MEPhI – TOF and A/C detectors	INAF (Italy) – Converter/Tracker
NIIEM — design, temperature control system	Taras Schevchenko National University (Ukraine) — Ukrainian main collaborator
NIISI RAS — electronics	CrAO (Ukraine) — ground-based observations
Ioffe Institute — Konus-FG burst monitor	IKI (Ukraine) — magnetometer
IKI — star sensor	ISM (Ukraine) — scintillators
IHEP — calorimeters, scintillators	KTH (Sweden) — anticoincidence
TsNIIMASH — space qualification	

GAMMA-400

- Mission approved by ROSCOSMOS (launch currently scheduled by November 2018)
- GAMMA-400 will be installed onboard the platform “Navigator” manufactured by Lavochkin
  - Scientific payload mass 4100 kg (rocket changed from Zenith to Proton-M)
  - Power budget 2000 W (like previously)
  - Telemetry downlink capability 100 GB/day
  - Lifetime ~ 10 yrs

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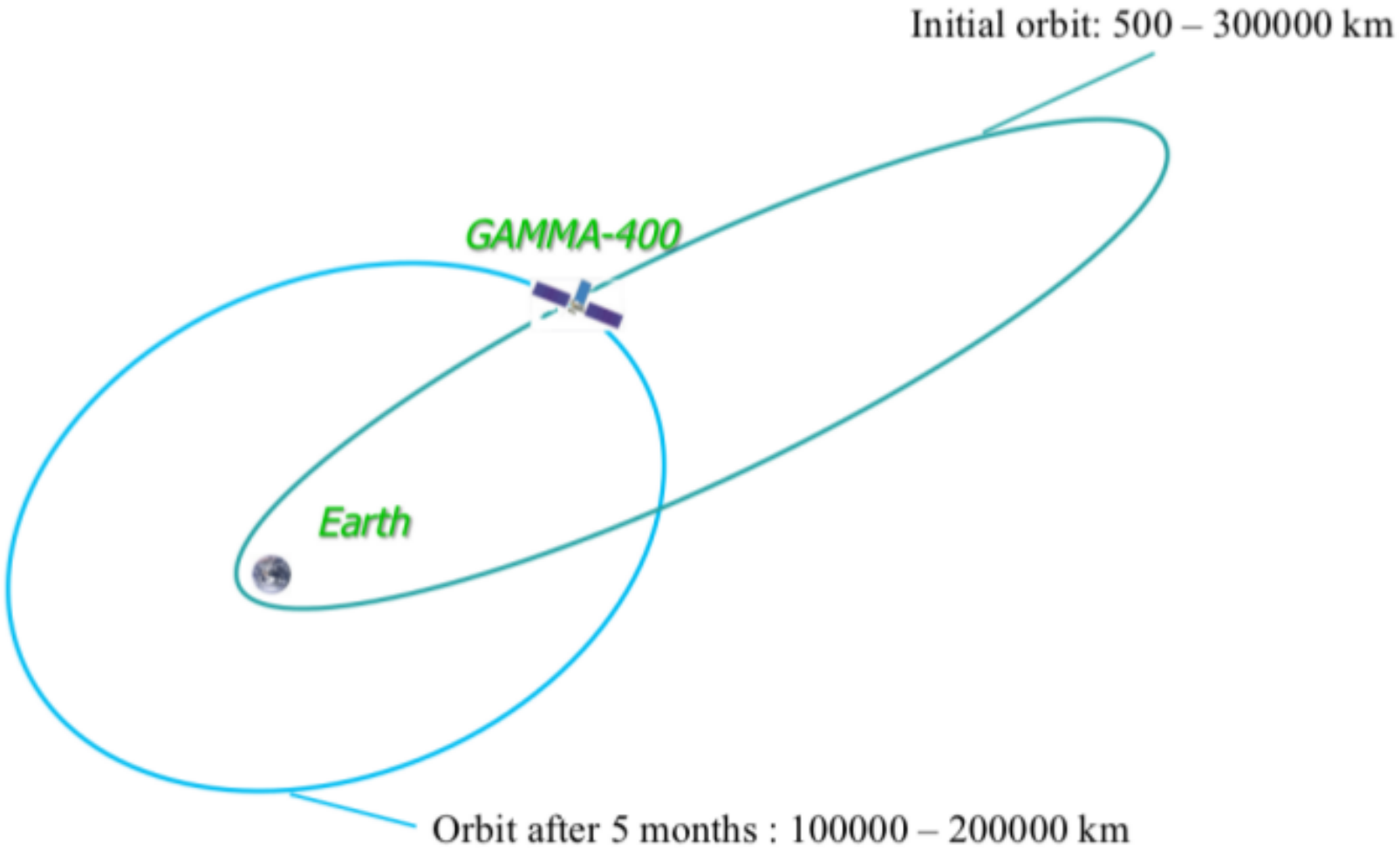
GAMMA-400



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GAMMA-400

- Original Russian design focused on:
  - High Energy Gamma-rays (~ 10 GeV – 3 TeV)
  - High energy electrons (e^+ and e^-) up to TeV
- Scientific objectives (from Russian proposal):
  - "To study the nature and features of weakly interacting massive particles, from which the Dark Matter consists"
  - "To study the nature and features of variable gamma-ray activity of astrophysical objects, from stars to galactic clusters"
  - "To study the mechanisms of generation, acceleration, propagation and interaction of cosmic rays in galactic and intergalactic spaces"

GAMMA-400: steps during 2012/13

- Definition through MC simulations of the best configuration for a dual instrument for photons (30 MeV - > 300 GeV) and cosmic rays (electrons > 1 TeV and high-energy cosmic-ray nuclei, p and He spectra close to the "knee" region (10^{14} – 10^{15} eV) ⇒ **GAMMA-400/E2**;
- Agreement on a jointly defined apparatus that, taking into account the currently available resources, optimizes the scientific performance and significantly improves over the previous B1 version ⇒ **GAMMA-400/B2**
- Development, construction and test of a prototype of homogeneous calorimeter with 130 CsI(Tl) cubic crystals.
- Agreement on the preparation (in progress) of a MoU between Russian Agencies and INFN for the Russian funding of the design and construction of the Converter/ Tracker by INFN:
  - 10 planes (20 views, 10X and 10Y), planar dimensions ~ 1 m^2, 2000 silicon strip detectors
- Preparation of a GAMMA-400 document for CSN 2;
- After these 2 years of R&D, the Collaboration will ask for a scientific approval.

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Improvements in the GAMMA-400 design and performance

- During the last two years, a great deal of effort has been deployed by the Italian collaboration in order to significantly improve the scientific characteristics of the G-400 mission. The guidelines of this work have been:
  A. to define the best configuration for a dual instrument for photons (30 MeV - > 300 GeV) and cosmic rays (electrons > 1 TeV and high-energy cosmic-ray nuclei, p and He spectra close to the "knee" region (10^{14} – 10^{15} eV): E1 version.
  B. to agree upon a jointly defined dual instrument that, taking into account the currently available financial resources, optimizes the scientific performance and improves them with respect to the B1 version: this new "baseline" version, called B2, has been agreed upon by both (Russian and Italian) sides during a collaboration meeting held in Moscow in February 2013.

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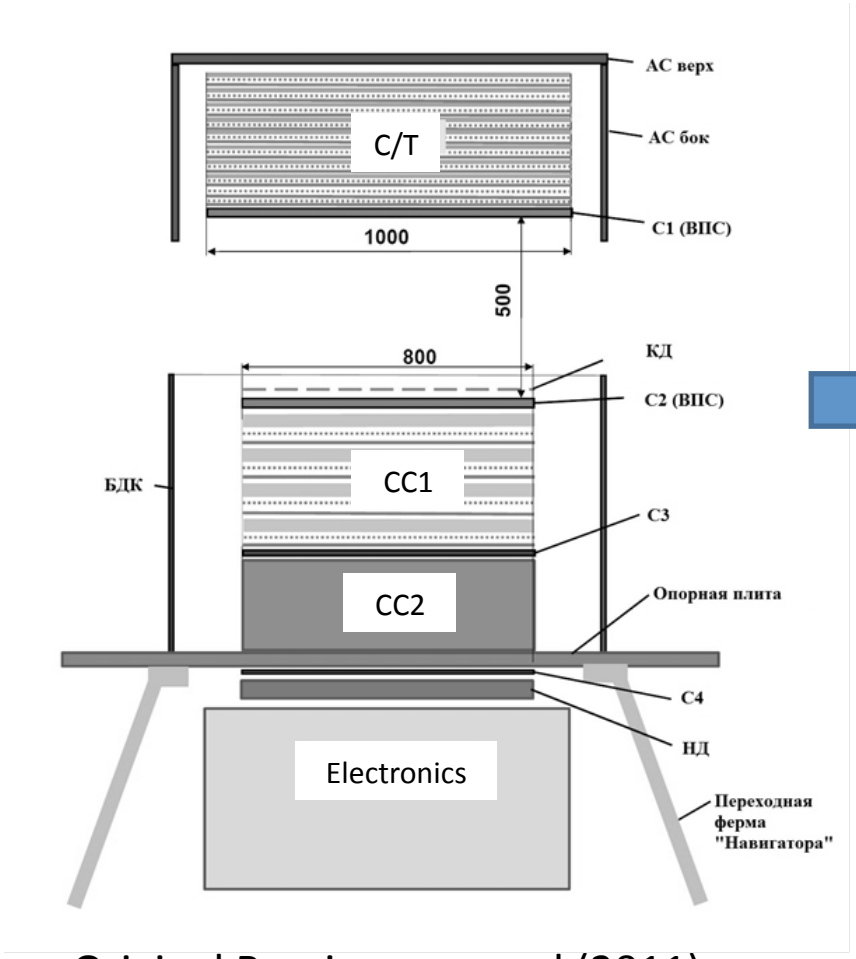
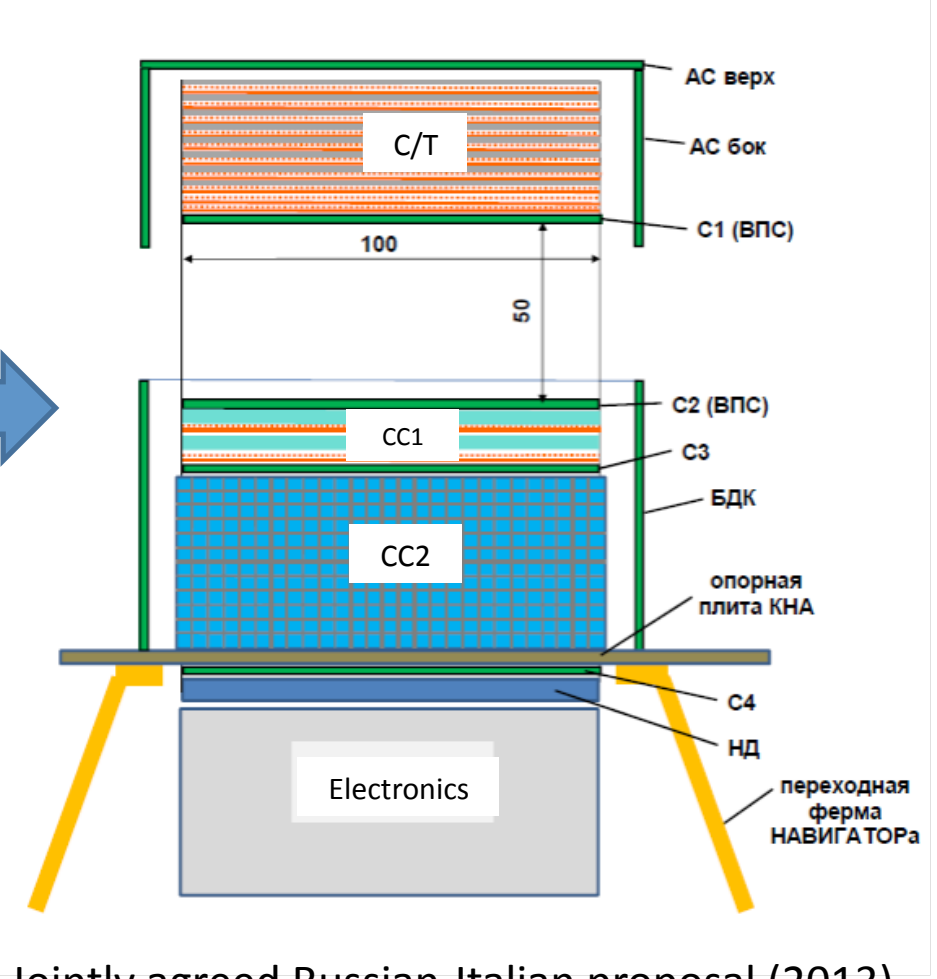
GAMMA-400

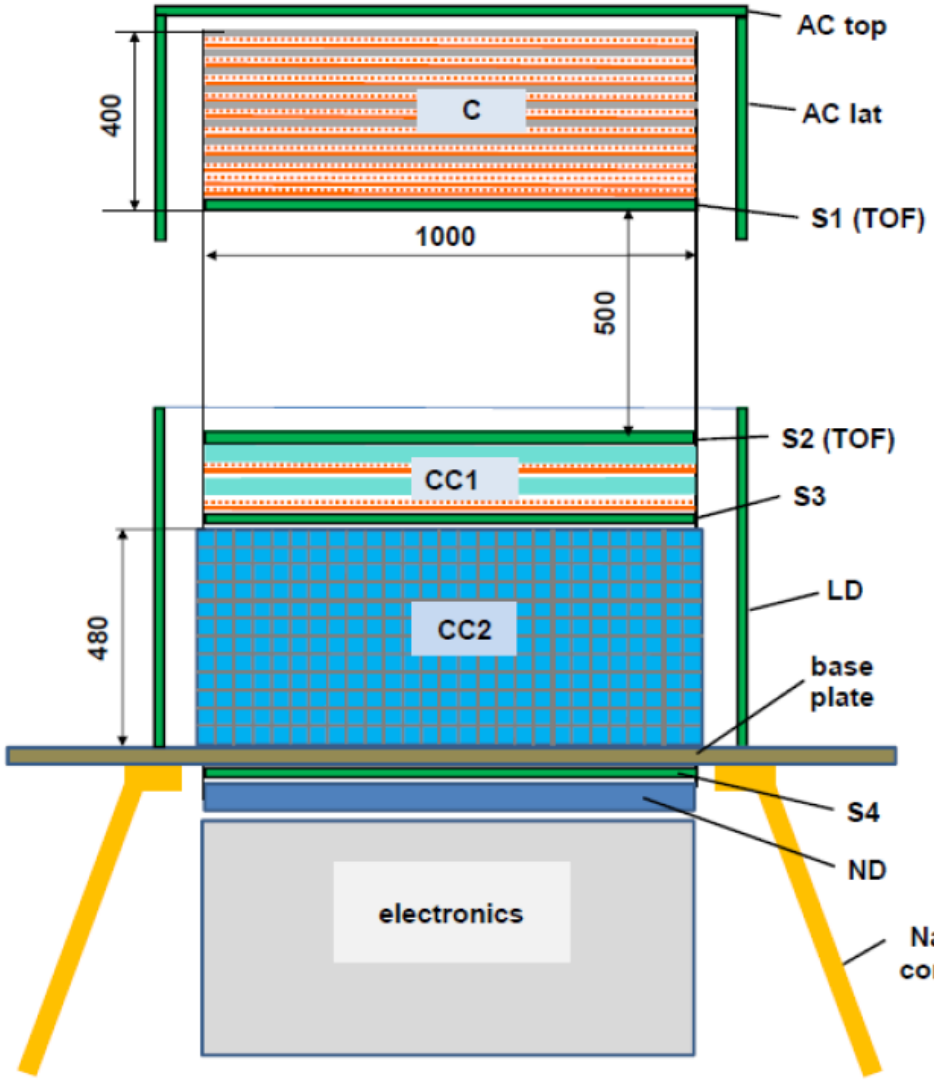


Original Russian proposal (2011)



Jointly agreed Russian-Italian proposal (2013)

The new B2 baseline



AC - anticoincidence detectors (AC top , AC lat)

C - Converter-Tracker - total 1 Xo
8 layers W 0.1 Xo +Si (x,y) (pitch 0.1mm)
2 Si(x,y) no W

S1, S2 - TOF detectors

S3, S4 calorimeter scintillator detectors

CC1 - imaging calorimeter (2Xo)
2 layers: CsI(Tl) 1Xo + Si(x,) (pitch 0.1 mm)

CC2 - electromagnetic calorimeter
CsI(Tl) 23 Xo 3.6x3.6x3.6 cm^3 - 28x28x12=9408 crystals

LD - 4 lateral calorimeter detectors

ND - neutron detector

B2 over B1 improvements:

- Introduction of the highly segmented homogeneous calorimeter with CsI cubes ⇒ improved energy resolution, extended GF with lateral particle impingement, nuclei capability
- Increase of the planar dimensions of the calorimeter (from 80 cm x 80 cm to 100 cm x 100 cm) ⇒ larger A_{eff}
- Si strip detector pitch of the 2 CC1 layers decreased from 0.5 mm to 0.1 mm

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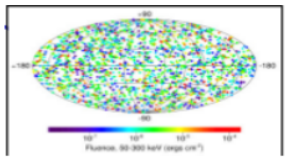
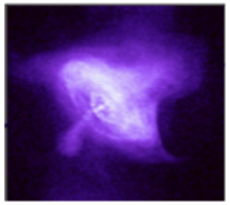
Physics with GAMMA-400

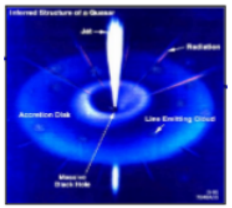
Galactic/ Extragalactic gamma-ray sources



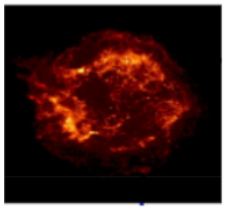
GRBs



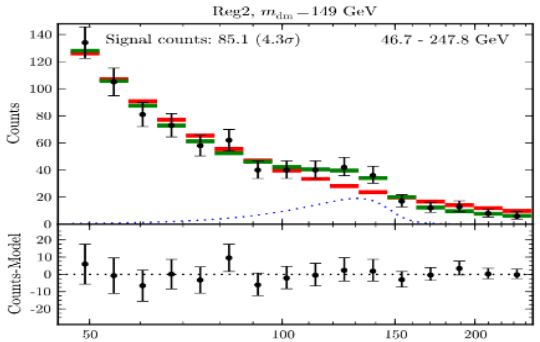
Pulsars



AGNs

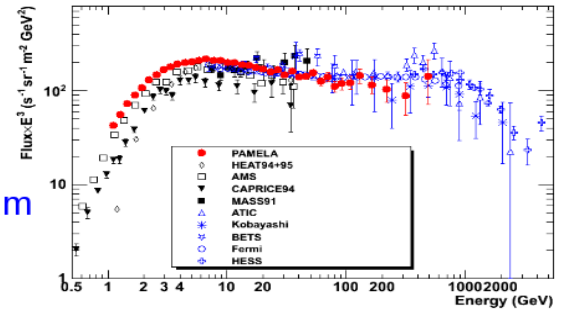


SNRs



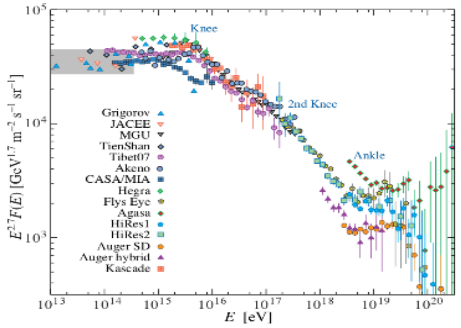
Dark Matter

CR propagation



Electron spectrum

Knee origin



CR origin and acceleration mechanisms

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Skolcovo 2012 Abstract

Skolkovo Tech

Skolkovo Institute of Science and Technology

Abstract

Skolcovo CRIE on Space science & technology
using as a pulling and motivatin project the GAMMA400 project, a
Collaboration between (at present) Infn, Inaf (Italy) and FIAN, MEPHI, ...

The best way to give birth to an effective centre is to forge it through an effective competitive project. This is what this proposal concerns. Having as a backbone an approved project whose scientific task is of certain scientific pertinence and unicity in an international scenario, the Centre to be realized will profit of all the, other way floating and diffused experiences which comes together when constructing a space launch ready instrument, to stabilize into the Centre the know how efficiently developed for the space project GAMMA400. Having a precise and tough time schedule and quality standards milestones to be reached, the work of realization of the spacecraft observational instrument, of its on-ground characterization and space qualification, of exploitation of the produced flight data has an extremely high formative value for student and young researchers it has a very strong pulling force for industrial collaborations of every sort from advanced electronics to sensors to information technology data transmission, treatment, enabling technologies for safe certified space projects and missions.
The proponent groups have, both, form Russian and Italian side an over 20 years joint experience on design, construction, test qualification and operation of scientific space instrument and the related space technologies. This is certified by the most cited publications in astrophysics and astroparticle physics

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questions addressed

questions :

- What is the long term vision for TT and what are the metrics for progress towards the long range vision?
- What incentives exist for researchers to collaborate with firms and business R&D departments?
- What kind of support is being built within research systems to sustain TT activities?

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broaden the perspective of researchers to enter into relationships with industrial R&D departments

- Research personnel is motivated mostly by research, and the ***technology transfer activity may be felt as a diversion*** from the attainment of the main goal.
- *Several actions can help :*
  - ***help broaden the perspective of researchers to enter into relationships with industrial R&D departments,***
  - ***encourage them to consider other motivations for their work than pure research***
  - **Support also is needed for researchers who wish to develop relationships with industrial R&D departments**

- ***Institutional incentive and promotion plans for researchers have to be modified to give weight to the activities of technology transfer, like patenting, collaborations with firms and spin offs, in addition to more traditional metrics such as publications.***

- Support also is needed for researchers who wish to develop relationships with industrial R&D departments

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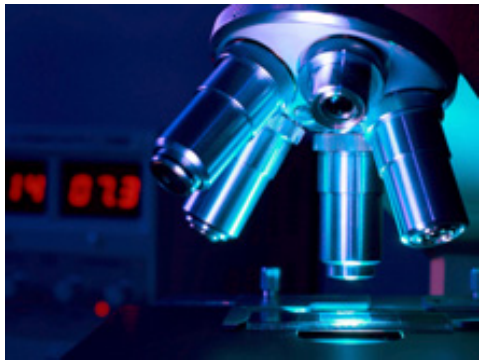
require researchers who are motivated and capable of looking at technology also from business point of view



- The transformation of technological assets into business opportunities has its roots in technological advances but it will also ***require people within research who are motivated and capable of looking at technology from a business point of view.***

- This will also be needed ***to foster productive communication between research and industrial researchers***.

- Encourage to look at opportunities for ***joint participation in European projects with industrial R&S departments.***

- Creation of local network = CLUSTERS.

- INTERNAL AND EXTERNAL out-reach actions mapping facilityes develop joint projects and technology transfer opportunities.

PhD students

- PhD students shall be exposed to a broader set of motivations for research.
- In the Italian tradition, PhDs candidates are encouraged to think of research as a goal in itself.
- Students would benefit by being encouraged to look at research experience as a way to attain a broader set of goals, including business development and technological deployment.
- Such a strategy might actually broaden the number of PhD candidates associated with the Institutes as well as giving room in the INFN to young people motivated by different perspectives, ***keen to search for industrial collaboration and looking for it as a way to attain their goals***.
- This action can be supported by industrial fellowships have been activated in collaboration with the industrial enterprises.
- A final suggestion is create an Alumni association, aimed at keeping alive long term relationships with researchers trained in INFN and making their careers in business or industry.

Industrial lieson

- ***help connect the researchers with technological solutions to the societal and industrial problems that need solving.***

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R&D^2

- Industrial innovation starts from the end of research processes R&D more D than R !!!
- One starts from the results of available technologies and develops the application
- Product innovation - collaborative research
- Needs a local supporting structure can not be left on the shoulders of researcher alone

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