Midterm Report ECFA-Bulgaria 2020 – for July 2020 plenary meeting

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Content:

1.Research centers:
Bulgarian Academy of Sciences(BAS) - Institut for Nuclear Research and Nuclear Energy (INRNE),
Sofia University "St. Kliment Ohridski" (SU),
Plovdiv University (PU)

2. Human resources in fields relevant to RECFA(2020) Tab.1:
Number of Students and PhD – 9, Supported by BAS,SU, National Science Fund (NSF), Ministry of Education and Science(MES)
Number of physicists permanent staff – 32, Supported by BAS,SU,PU
Number of fixed term physicists – 3, Supported by BAS,SU
Number of Engineers – 7, Supported by BAS,SU
Number of technicians - 1, Supported by BAS,SU
Total for year 2020 – 52, (2017 – 152)

3. Domestic funding Tab. 2
Total per year - (salaries for permanent staff excluded) –
2017/2020 - **407/ 346** (kCHF per year)

Tab.1 Human resources in fields relevant to RECFA - 2017/2020

Bulgaria	Particle physics experiments at CERN	Heavy ion experiments at CERN	Nuclear physics experiments at CERN (other?)	Experiments elsewhere- particle physics exps. at accelerators (incl. nu)	Experiments elsewhere: astro particle exps., GW exps., other, neutrinos	Detector R&D	Computing R&D and operations	Accelerators R&D and operations	Theory	Sum
Physicists Permanent (FRA)	CMS - 16 CMS - 26 NA61 – 3 NA62 – 2		ISOLDE – 3	PADME - 2 INRNE(Nuclear) – 11 Uni.Sofia – 3	MAGIC – 6 MICE,SHIP,ESSvSB – 3				INRNE(Particles) – 28 INRNE(Nuclear) – 3 Other - 4	83/32
Physicists Fixed Term (FRA)	CMS – 0 CMS - 0 NA61 – 1 NA62 - 0		ISOLDE – 0	PADME – 1	MAGIC – 0 MICE -0, SHIP-1, ESSvSB – 1				INRNE(Particles) - 0	3/3
PhD students (FRA)	CMS – 3 CMS - 4 NA61 – 1 NA62 - 1		ISOLDE - 4 ISOLDE – 2	PADME – 1 INRNE(Nuclear) – 9 Uni.Sofia - 2	MAGIC – 1 MICE,SHIP,ESSvSB - 0				INRNE(Particles) – 1	20/9
Engineers (degree) (FRA)	CMS – 9 CMS - 7 NA61 – 0 NA62 - 0		ISOLDE – 0	PADME – 1 INRNE(Nuclear) – 12	MAGIC – 0 MICE,SHIP,ESSvSB - 0				INRNE(Particles) - 0	22/7
Technicians (FRA)	CMS – 1 CMS - 1 NA61 – 0 NA62 - 0		ISOLDE – 0	PADME – 0 INRNE(Nuclear) – 13	MAGIC – 0 MICE,SHIP,ESSvSB - 0				INRNE(Particles) – 0	14/1
Total	**35/43**		**5/4**	**55**	**11/5**				**36**	**142/52**
Total/Population (1/million inhab.)	5/6		0.71/0.66	7.86/0	1.57/0.71				5.14	20.28/7.9
Total/GDP (1/GEuro)	0.8/0.72		0.11/0.07	1.2/0	0.24/0.08				0.8	3.15/0.88

Tab.2 Domestic funding (salaries for permanent staff excluded) – kCHF, 2017/2020

Bulgaria	Particle physics experiments at CERN	Heavy ion experiments at CERN	Nuclear physics experiments at CERN (other?)	Experiments elsewhere: particle physics exps at accelerators (incl. nu)	Experiments elsewhere: astroparticle exps., GW exps, other neutrinos	Detector R&D	Computing R&D and operations	Accelerators RR&D and operations	Theory	SUM Per Year
Travels, stay at CERN/abroad	CMS – 70(1 year) CMS – 133(1 year, SU-73,INRNE-60) NA61 – 22(3 years) NA62 – 5(7 years)		ISOLDE – 20 (10 years)	PADME – 15 (3 years) INRNE(Nuclear) – 8 (1 year) Uni. Sofia – 30(10 years)	MAGIC – 0 MICE -0, SHIP -0, ESSvSB – 5(3years)				INRNE(Particles) – 230 (3 years)	388, **176 (1 year)** **142 (1 year)**
Fixed-term salaries, or PhD grants	CMS – 45(1 year) CMS – 45(1 year, SU-37.7, INRNE-7) NA61 – 8(3 years) NA62 – 10(7 years)		ISOLDE - 0	PADME – 10 (3 years)	MAGIC – 0 MICE-0, SHIP-0, ESSvSB -10 (3 years)				INRNE(Particles) - 0	70, **55(1 year)** **51 (1 year)**
M&O costs	CMS – 96(1 year) CMS – 140 (1 year) NA61 – 27(3 years) NA62 – 5(7 Years)		ISOLDE - 0		MAGIC – 0 MICE,SHIP,ESSvSB - 0				INRNE(Particles) - 0	112 **108(1year)** **149 (1 year)**
Investment for construction/upgrades	CMS – 27(1 year) CMS - 0 NA61 – 0 NA62 – 20(7 years)		ISOLDE - 0	For JINR – 25 (1 year) PADME – 20 (3 years)	MAGIC – 0 MICE,SHIP,ESSvSB - 0				INRNE(Particles) - 0	92 **62(1 year)** **0 (1 year)**
R&D funding	CMS – 0 CMS - 0 NA61 – 0 NA62 – 0		ISOLDE - 0		MAGIC – 0 MICE,SHIP,ESSvSB - 0				INRNE(Particles) - 0	0 0
Computing	CMS – 0 NA61 – 3(3 years) NA62 - 0		ISOLDE - 0	PADME – 5 (3 years)	MAGIC – 0 MICE-0, SHIP-0, ESSvSB – 6(3 years)				INRNE(Particles) - 0	9 **6 (1 year)** **3 (1 year)**
Total	308/338(1 year)		ISOLDE – 20 (10 years)	PADME – 50(3years) INRNE(Nuclear) – 8(1 year) For JINR – 25(1 year) Uni. Sofia – 30 (10 years)	MAGIC – 0 MICE-0, SHIP-0, ESSvSB – 8/(1 year)				INRNE(Particles) - 230 (3 years)	**346 (1 year)**
Total per Year	**275/338(1 year)**		**2**	**53**	**7/8(1 year)**				**77**	**407/ 346(1 year)**

4. Problems from the letter by RECFA (March 2017) which have been recommended to watch closely:

1. The involvement of Bulgarian scientists in the ISOLDE collaboration is longstanding and visible but since Bulgaria is not a member of the collaboration due to lack of funding, this involvement is mostly personal rather than institutional

- **There are no significant changes in this problem for the past 3 years.** The national program which potentially could provide more sustainable funding for participation at ISOLDE and other CERN experiments was not implemented.

2.There is a small astroparticle physics community in Bulgaria, mainly at the INRNE, interested in high-energy gamma sources. It participates in the Major Atmospheric Gamma Imaging Cherenkov (MAGIC) and also in the future Cerenkov Telescope Array (CTA). For the community to grow and acquire more visibility, the Committee would recommend close contacts with the Astroparticle Physics European Consortium, which recently defined its roadmap.

- **In 2018 the consortium (SU, INRNE), became member of CTA collaboration under European Strategy Forum on Research Infrastructures, funded by Horizon 2020.**

3.The theoretical physics community is dominated by mathematical physicists, and its interaction with the experimental physics community appears limited. An increased focus on theoretical aspects relevant to the Bulgarian experimental program could help to revitalize this community.

- **There are no significant changes in this problem for the past 3 years**

4. Problems from the letter by RECFA (March 2017) which have been recommended to watch closely:

4.The Committee was impressed by the excellent technical skills being developed within the INRNE and the University of Sofia which are well-recognized at CMS. The Committee recommends that these valuable technical skills be maintained and possibly even expanded. To attract new personnel, in particular young people, into science, the modernization of the laboratory's equipment is of the utmost importance.

- **There are no significant changes in this problem for the past 3 years**

5. There is no direct accelerator research in Bulgaria. However, a cyclotron facility is under construction at INRNE to produce medical radioisotopes and radiopharmaceuticals. This is providing a good opportunity to build up expertise, establish a community in radiochemistry and bring in revenue. There are further plans to create a Centre for hadron therapy using protons and ions. The Committee would suggest that a prudent approach be taken in the choice of technologies, in order to increase the confidence in obtaining local funding.

- **There are no significant changes in this problem for the past 3 years. The cyclotron was delivered 4 years ago and has not yet been installed**

4. Problems from the letter by RECFA (March 2017) which have been recommended to watch closely:

6. Long-term sustainable funding is a stumbling block in the community's research planning. The Committee was pleased to hear from the Minister that there is a proposal for a National Program for Collaboration with CERN, which, if adopted, would solve the legal issues around the payments associated with Memoranda of Understanding (MoU), typical vehicles for participation in CERN's activities. The same Program would be the natural vehicle to promote the participation of Bulgaria in the Sponsoring Consortium for Open Access Publishing in Particle Physics (SCOAP3). The Committee also hopes that calls by the National Research Agency for the funding of individual projects on a competitive basis can be issued as regularly as possible to ensure the continuity and stability required for basic research.

- There are no significant changes in this problem for the past 3 years. The National Program for Collaboration with CERN is not accomplished.

4. Problems from the letter by RECFA (March 2017) which have been recommended to watch closely:

7. The Committee was made aware of the lack of fixed-term postdoc positions and of a systematic decline in the number of PhD students, in spite of a vigorous outreach program. An effort to provide incentives for students and postdocs to stay in Bulgaria or to return after a period abroad would help invigorate the community and could stop the brain-drain effect. A concentrated effort to encourage young Bulgarian physicists to submit grant proposals to the European Research Commission could also alleviate the funding situation.

- There are no significant changes in this problem for the past 3 years

5. New projects for the period 2017 - 2020

- **In 2018 the consortium (SU, INRNE), became member of CTA collaboration under European Strategy Forum on Research Infrastructures (ESFRI), funded by Horizon 2020.**

- **In 2019 INRNE and consortium from BAS became member of ACTRIS (Aerosol, Clouds and Trace Gases Research Infrastructure) in the frame of ESFRI**

- **In 2018 consortium BAS-SU won a project "Construction and development of centers of competence - Quantum Communication, Intelligent Security Systems and Risk Management "(Quasar)", funded by MES - operational program "Science and Education for Smart Growth" 2014-2020**

- **In 2018 SU became member of the project "The Investigation on the Dark Sector at the PADME Experiment" - BG funding by Bulgarian National Science Fund**

- **Neutrino related activity**
  MICE - Analysis and publishing papers; No BG funding;External funding:
  EUCARD-2: Transnational Access
  SHiP - Very limited activity; No BG funding; No external funding.
  ESSvSB - Coordination and work on Near and Far Neutrino detectors working package; Design Study Project funded by EU and COST; BG co-funding by Bulgarian National Science Fund

Summary

Contributions to CERN membership and M&O expenses were paid regularly, regardless of the relative increase in amounts.

The internal support for the particle physics activity, was regularly implemented by NSF for CMS contracts with SU and INRNE without change of the funding for the last 10 years.

The total funding for particle physics community in Bulgaria is decreasing as compared between 2017(407 kCHF/year) and 2020(346 kCHF/year).

The number of physicists and PHD students has decreased for the period 2017/2020 except for those, working for CMS.

There are no significant changes for the past 3 years for most of the conclusions from the letter by RECFA (March 2017), recommended to watch closely. The recommendations concerning the National Program for Collaboration with CERN, the involvement of Bulgarian scientists in the ISOLDE, modernization of the laboratory's equipment, construction of the cyclotron facility are unachieved.

There is activity in the new projects for the period 2017 – 2020
- Under European Strategy Forum on Research Infrastructures (ESFRI) - CTA, ACTRIS, Quasar
- PADME, MICE, SHiP, ESSvSB