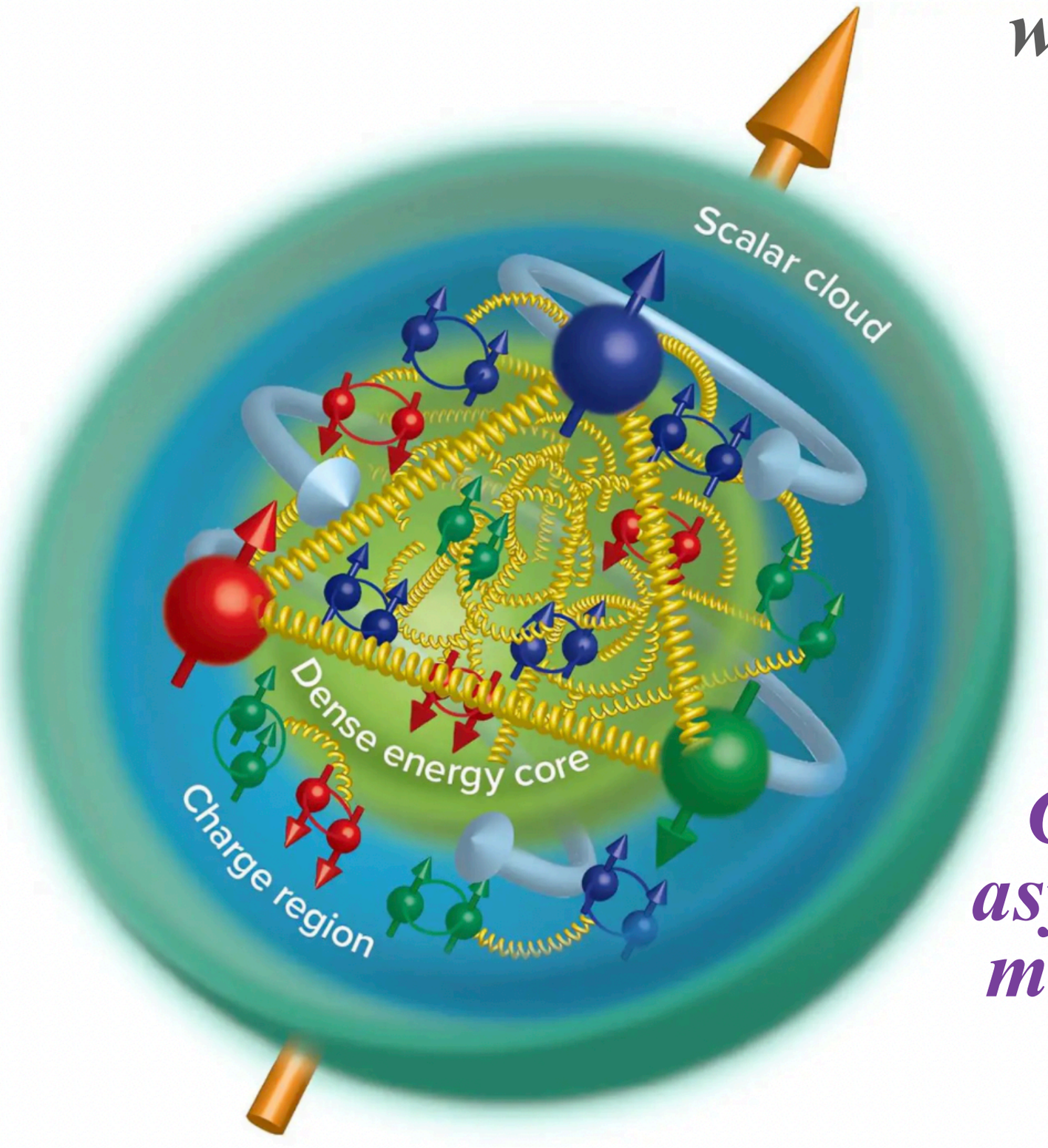
17.6.24

Spin Physics Detector project

Project leader A. Guskov
Deputy project leader V. Ladygin

Goal of the project

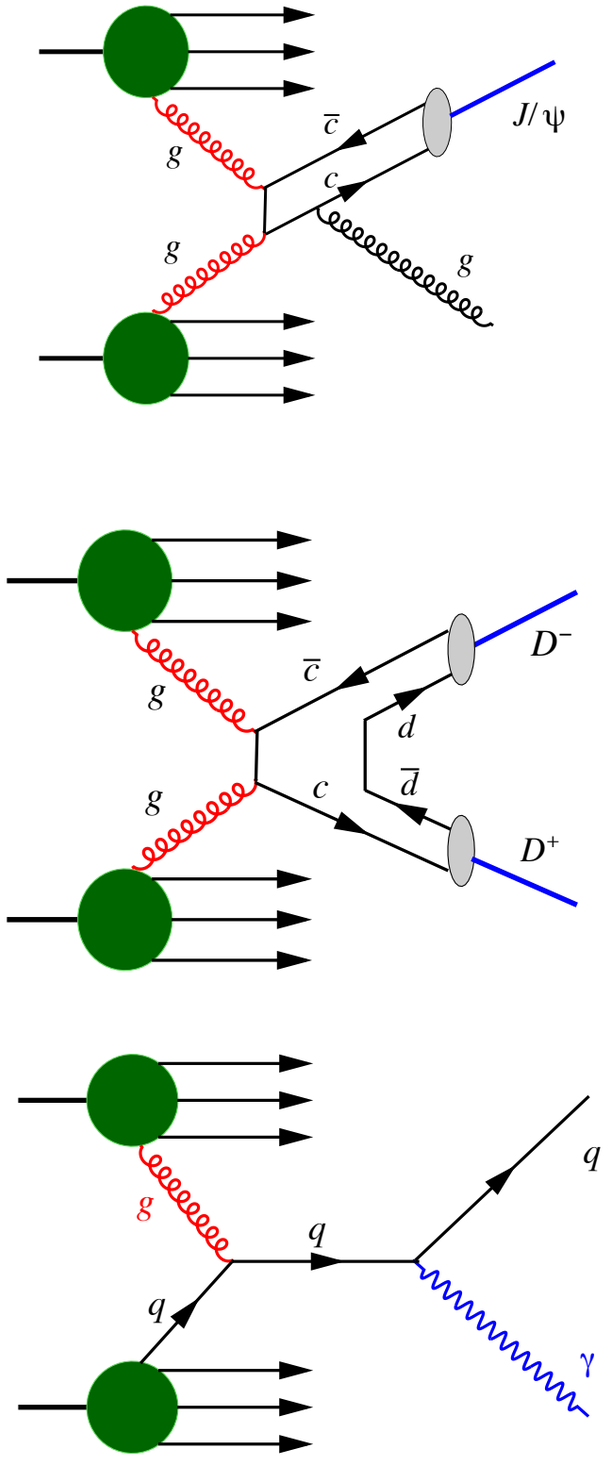


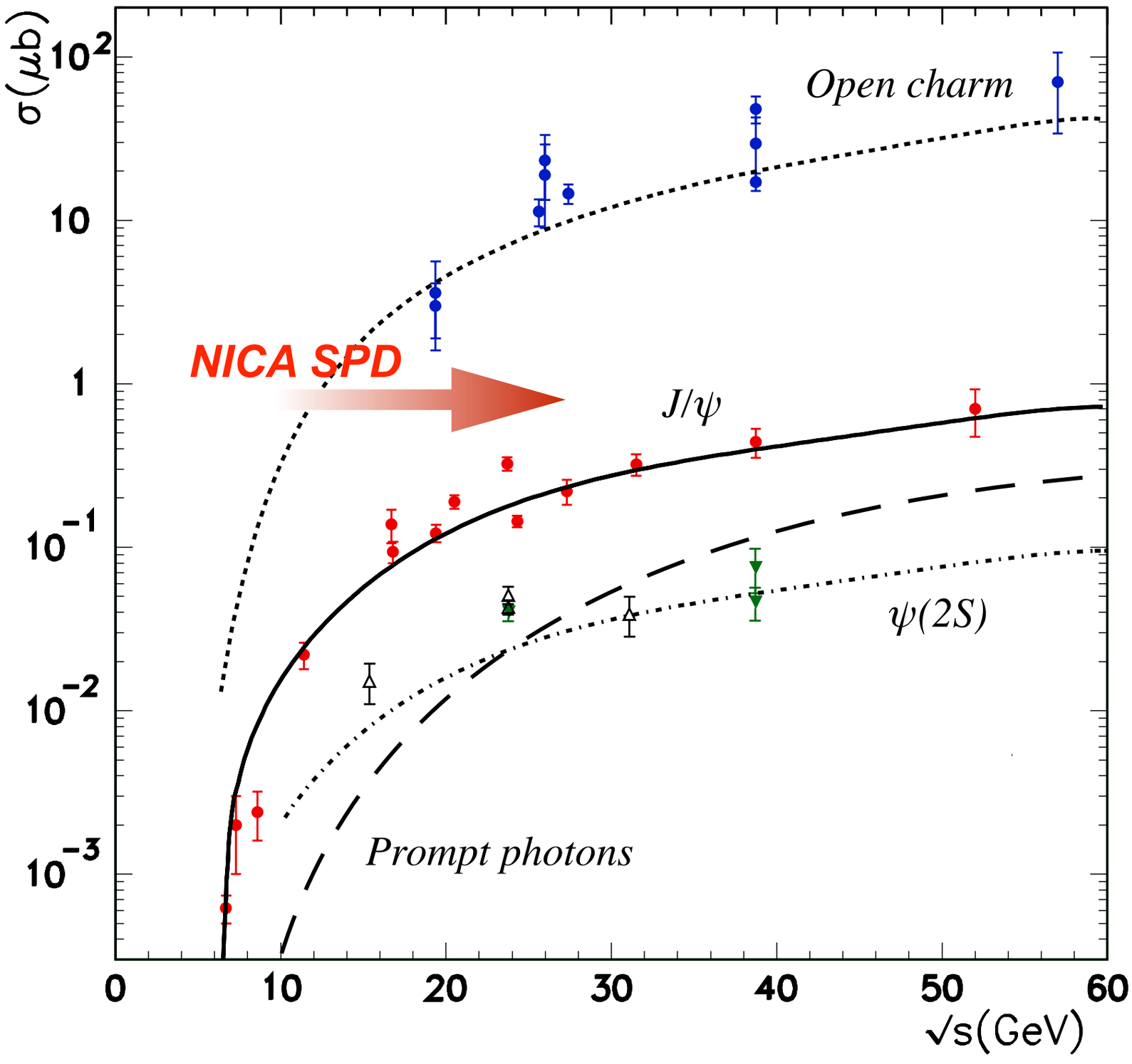
we plan to study how the proton and deuteron spin!

especially their gluon component!

Gluon TMD PDFs via asymmetries and angular modulations in the cross sections

Goal of the project





Goal of the project

Non-perturbative QCD — *Perturbative QCD*

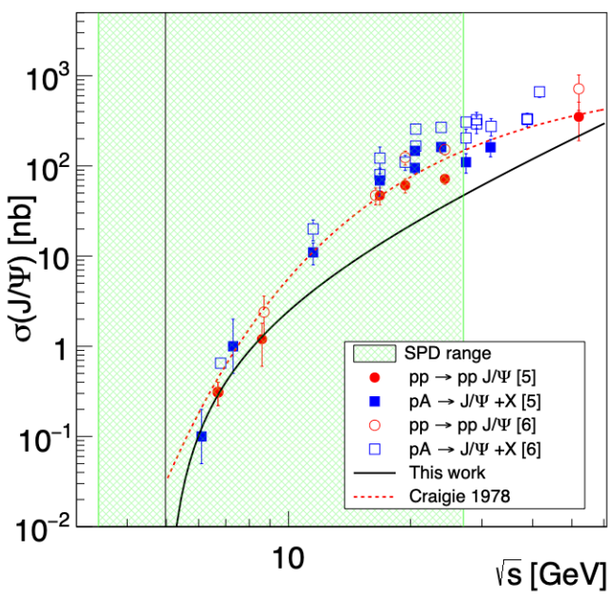
$\sqrt{s}$

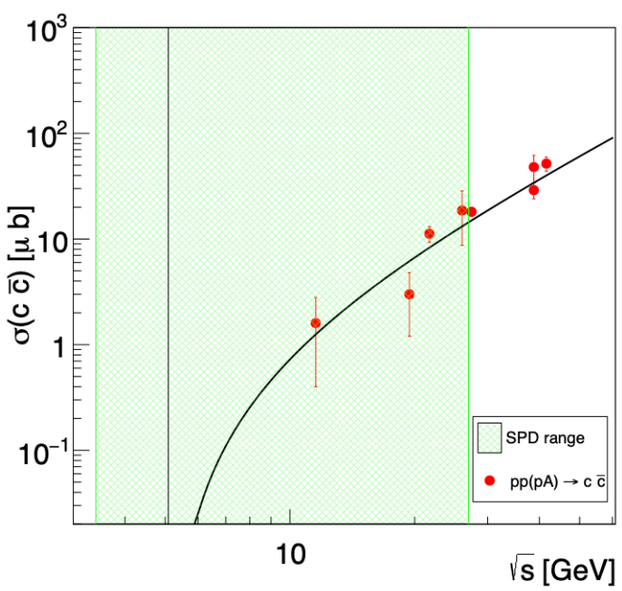
- Spin effects in p-p, p-d and d-d elastic scattering
- Spin effects in hyperons production
- Multiquark correlations
- Dibaryon resonances
- Physics of light and intermediate nuclei collision
- Exclusive reactions
- Hypernucei
- Open charm and charmonia near threshold
- Auxiliary measurements for astrophysics
- …

$$pp \to (6q)^* \to N\,N\,Mesons,$$

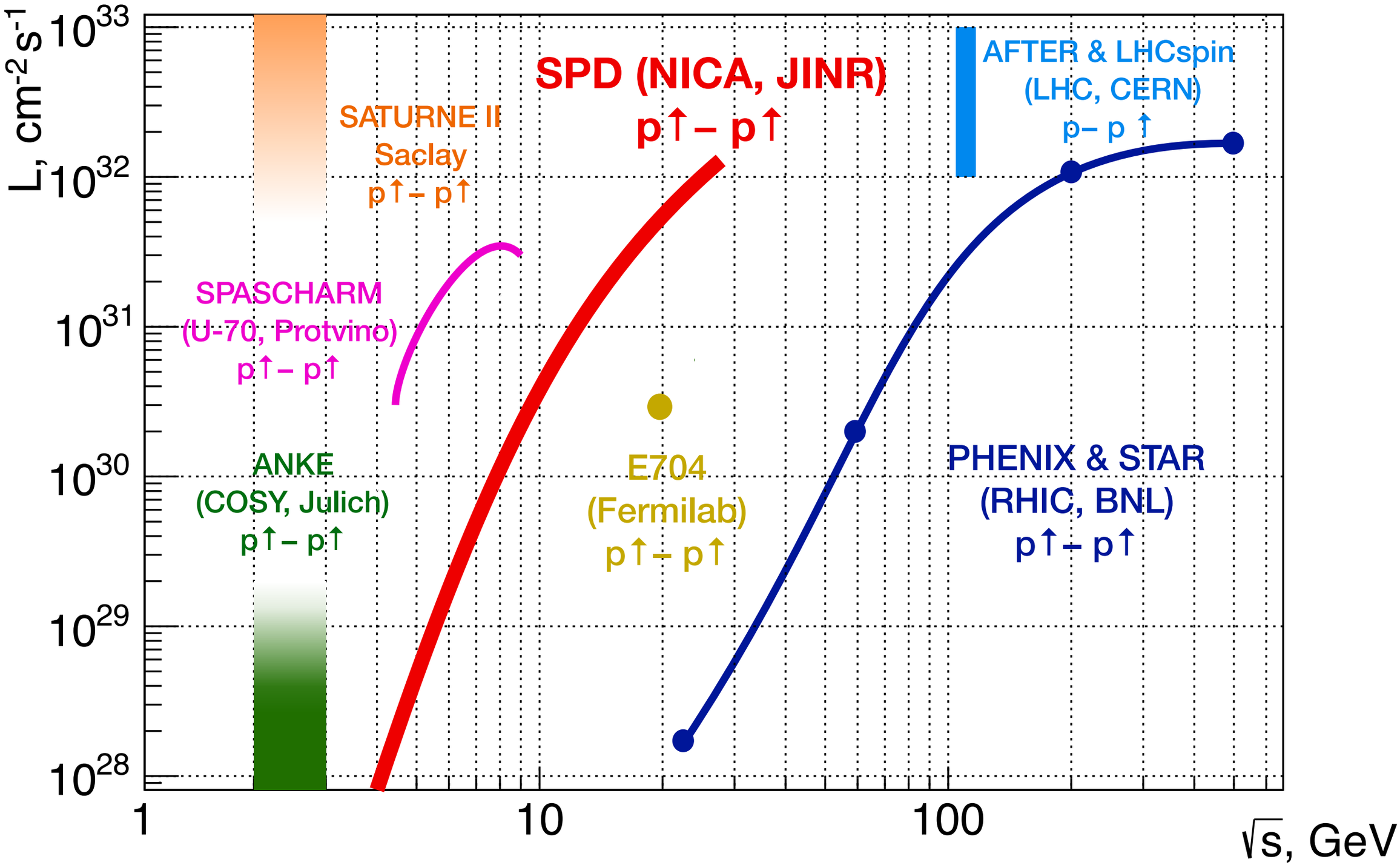
$$dd \to K^+\,K^+\,{}^{4}_{\Lambda\Lambda}\mathrm{n},$$

arXiv:2102.08477

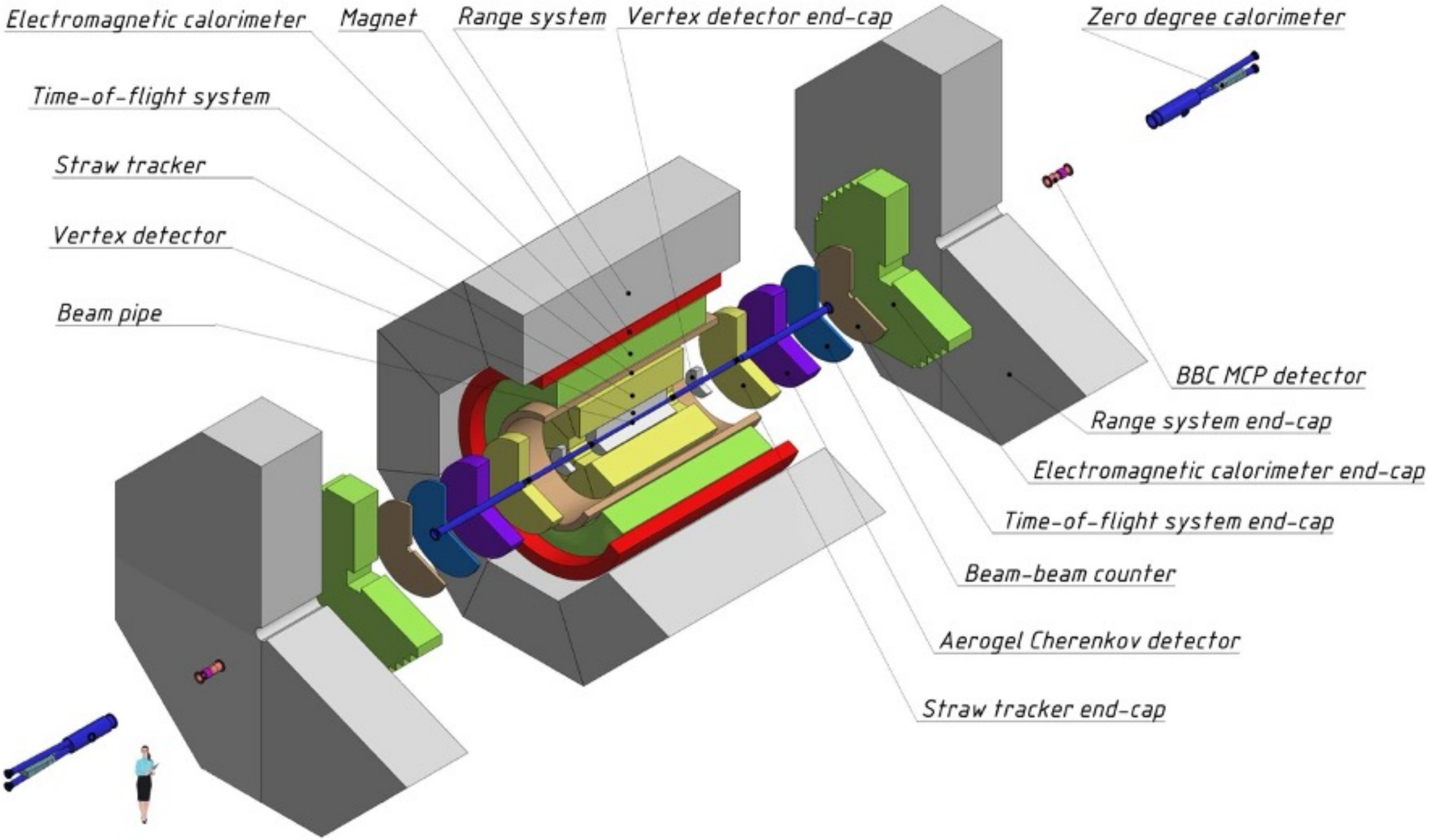




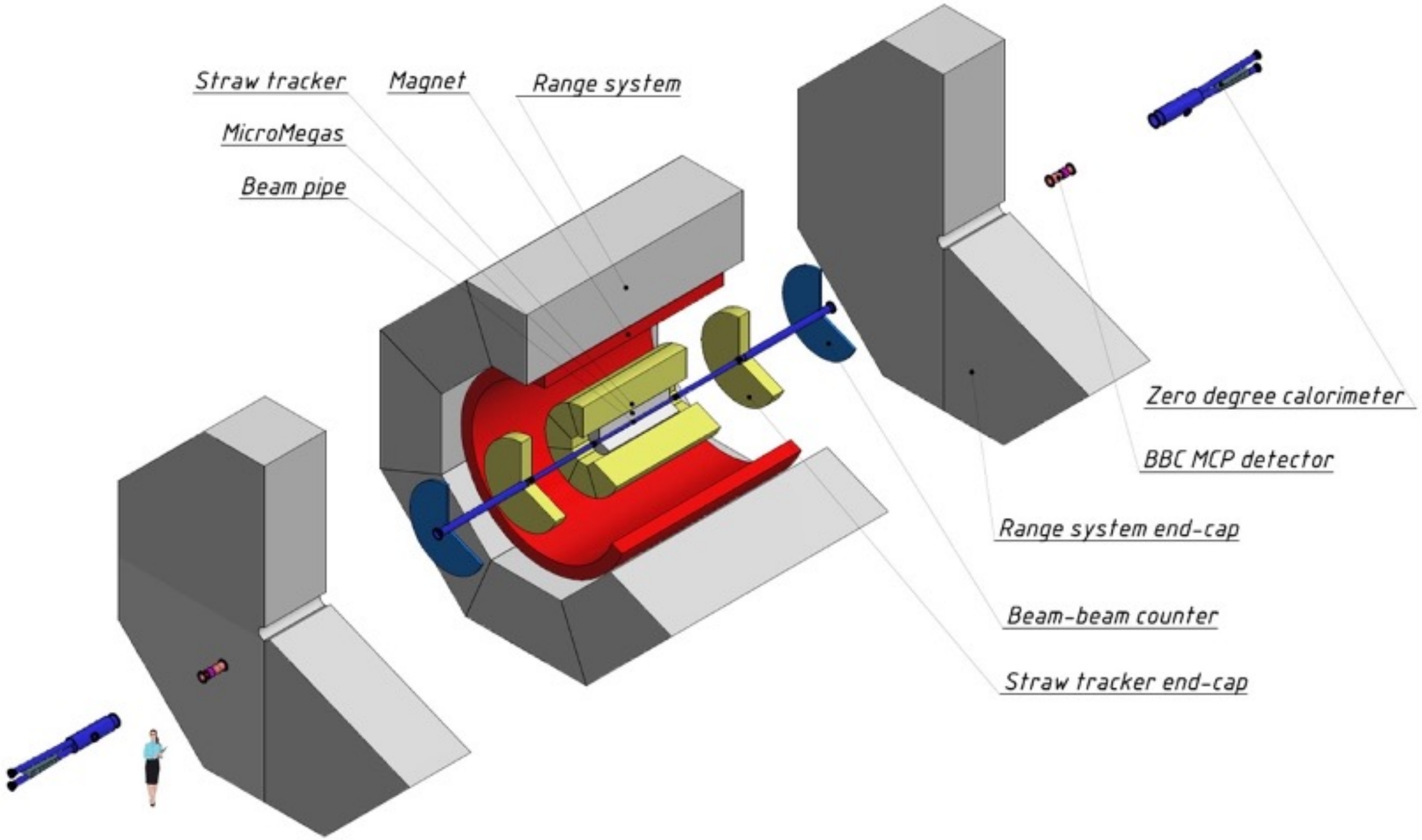
SPD and others



Experimental setup



Experimental setup, stage 1



SPD collaboration

A.I. Alikhanyan National Science Laboratory (Yerevan Physics Institute), Yerevan
NRC “Kurchatov Institute” - PNPI, Gatchina
Samara National Research University (Samara University), Samara
Saint Petersburg Polytechnic University St. Petersburg
Saint Petersburg State University, St. Petersburg
Skobeltsyn Institute of Nuclear Physics, Moscow State University, Moscow
Tomsk State University, Tomsk
Belgorod State University, Belgorod
Lebedev Physical Institute of RAS, Moscow
Institute for Nuclear Research of the RAS, Moscow
National Research Nuclear University MEPhI, Moscow
Institute of Nuclear Physics (INP RK), Almaty
Institute for Nuclear Problems of BSU, Minsk
Budker Institute for Nuclear Physics, Novosibirsk
Higher Institute of Technologies and Applied Sciences, Havana
HSE University, Moscow

MoU signed

NRC “Kurchatov Institute”, Moscow (NRC KI)
iThemba LABS, SA

MoU under discussion

>30 institutes

~400 participants

http://spd.jinr.ru/

Project results 2020-2024

- In the course of the SPD project, the physical program of the experiment was substantially reconsidered. For this purpose, a series of workshops were held with the invitation of leading experts in the field of spin physics. The updated physical program was published as two review papers.

- In 2020, an international SPD collaboration was formed, which currently includes more than 400 scientists from more than 30 Russian and foreign research centers. Currently, memorandums of understanding have been signed with 15 institutions (11 Russian and 4 foreign).

- In 2021, a conceptual design of the SPD setup was prepared and presented, which successfully passed an independent international expert review. Based on the conceptual design, the technical design of the plant was prepared and presented (2023), as well as an updated design (2024). The design is currently undergoing an independent international expert review.

- As part of the preparation of the conceptual and technical designs, R&D on the main subsystems of the experimental setup was performed and prototypes of the main elements of the detector were produced. Contacts with potential manufacturers and suppliers have been established, and preparations are underway to start the construction of the first stage detectors.

- During the project implementation, the JINR staff made 35 reports at international conferences and published more than 20 papers in refereed scientific journals.

Budker Institute of Nuclear Physics (Novosibirsk)

Expert in detectors, DAQ, data analysis

Shandong University

Expert in HEP Computing and Software

IHEP CAS

Manager of BESIII TOF system, central detector of Daya Bay and JUNO, an expert of scintillators and other detector systems

BNL (retired in 2023)

Experience with physics & hardware in PHENIX and sPHENIX Collaborations

Plans for 2025-2029

1) Development of design documentation, construction and testing of prototypes, production of detectors and subsystems of the First Phase of the project: muon system, superconducting solenoid and associated cryogenic system, straw-tube-based track detector, beam-beam collisions counter (BBC), MCP-based beam collision detector, Micromegas-based central tracker, zero-degree calorimeter (ZDC), end-cap part of the electromagnetic calorimeter, data acquisition system, slow control system, gas distribution system, and supporting structures.

2) Preparation, construction, and test the computer infrastructure for Monte Carlo simulations for the benefit of the SPD project, and prepare data acquisition and storage systems.

3) Continuation of R&D for the Phase II detectors: silicon vertex detector, time-of-flight system, electromagnetic calorimeter, and aerogel-based detector.

4) Interaction with the VBLHEP Accelerator Department on the issues of building, testing and optimization of infrastructure for operation with polarized proton and deuteron beams at the NICA collider.

Risks

1) Significant increase in the project cost due to changes in the geopolitical situation and availability of foreign components, materials and technologies.

2) Delay in the creation and development of the accelerator infrastructure of the NICA complex for work with polarized beams.

3) Uncertainty with the parameters of polarized and unpolarized beams available for the first phase of the experiment.

Manpower

№№ n/a	Categoryofpersonnel	JINR staff, amount of FTE	JINR Associated Personnel, amount of FTE
1.	researchscientists	60	10
2.	engineers	40	
3.	specialists	1	
4.	officeworkers		
5.	technicians	5	
	Total:	**106**	**10**

	FTE	people
LHEP	43.6	104
LNP	41	70
LIT	7	14
LTP	1	**3**
TOTAL	93.1	191

Requested computing resources

Computing resources	**Distribution by year**				
	1st year	2nd year	3rd year	4th year	5th year
Data storage (TB) - EOS - Tapes	1500 0	2000 2000	5000 10000	7000 14000	10000 20000
Tier 1 (CPU corehours)	17 520 000	43 800 000	87 600 000	131 140 000	175 200 000
Tier 2 (CPU corehours)	1 752 000	4 380 000	8 760 000	13 114 000	17 520 000
SC Govorun (CPU core hours)	1 752 000	4 380 000	8 760 000	8 760 000	8 760 000

Requested resources

Names of costs, resources, funding sources			Cost (millions of US dollars) / Resource request	Proposal from the laboratory for allocation of funding and resources				
				1 year	2 year	3 year	4 year	5 year
		International cooperation	0.5	0.1	0.1	0.1	0.1	0.1
		Materials	51.5	5.0	13.5	15.5	9	8.5
		Equipment, Third-party company services	12.0	1.3	4.1	2.1	2.2	2.3
		Commissioning						
		R&D contracts with other research organizations	1.5	0.5	0.4	0.3	0.2	0.1
		Software purchasing	0.2	0.1	0.1	0	0	0
		Design/construction	0.6	0.2	0.3	0.1	0	0
		Service costs (*planned in case of direct project affiliation)*						
Resourcesrequired	**Standardhours**	Resources						
		– theamountofFTE,	-	116	140	140	140	140
		– accelerator/installation,	2000	0	500	500	500	500
		– reactor,…						
Sourcesoffunding	**JINR Budget**	JINR budget*(budgetitems)*	53	7.0	15.5	14.5	8.4	7.6
	Extrafudning (supplementarye stimates)	Contributions by partners	2.4	0.1	0.5	0.5	0.6	0.7
		Funds under contracts with customers	10.9	0.1	2.5	3.1	2.5	2.7
		Other sources of funding						