



Spin Physics Detector project

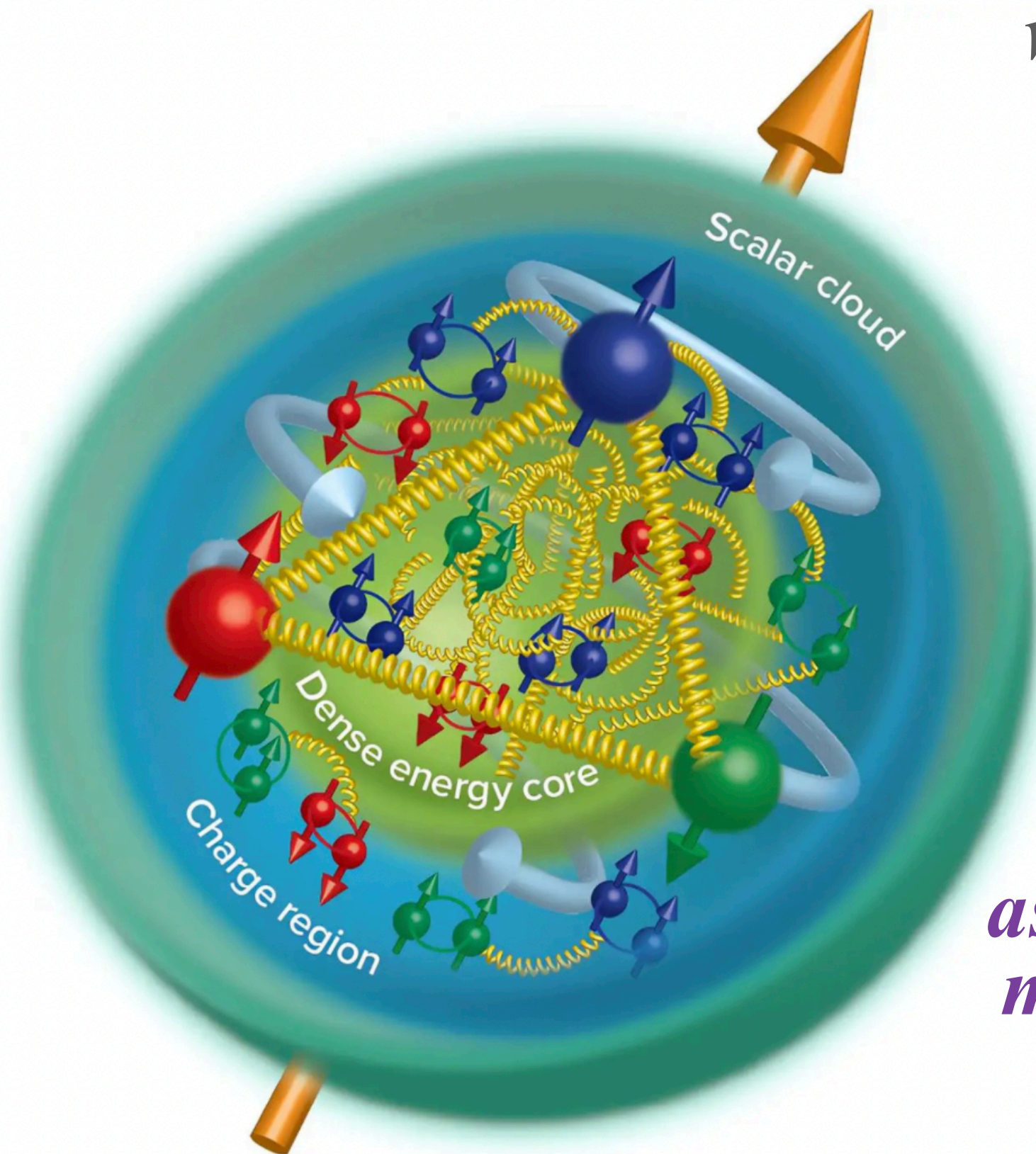
Project leader A. Guskov
Deputy project leader V. Ladygin

Goal of the project

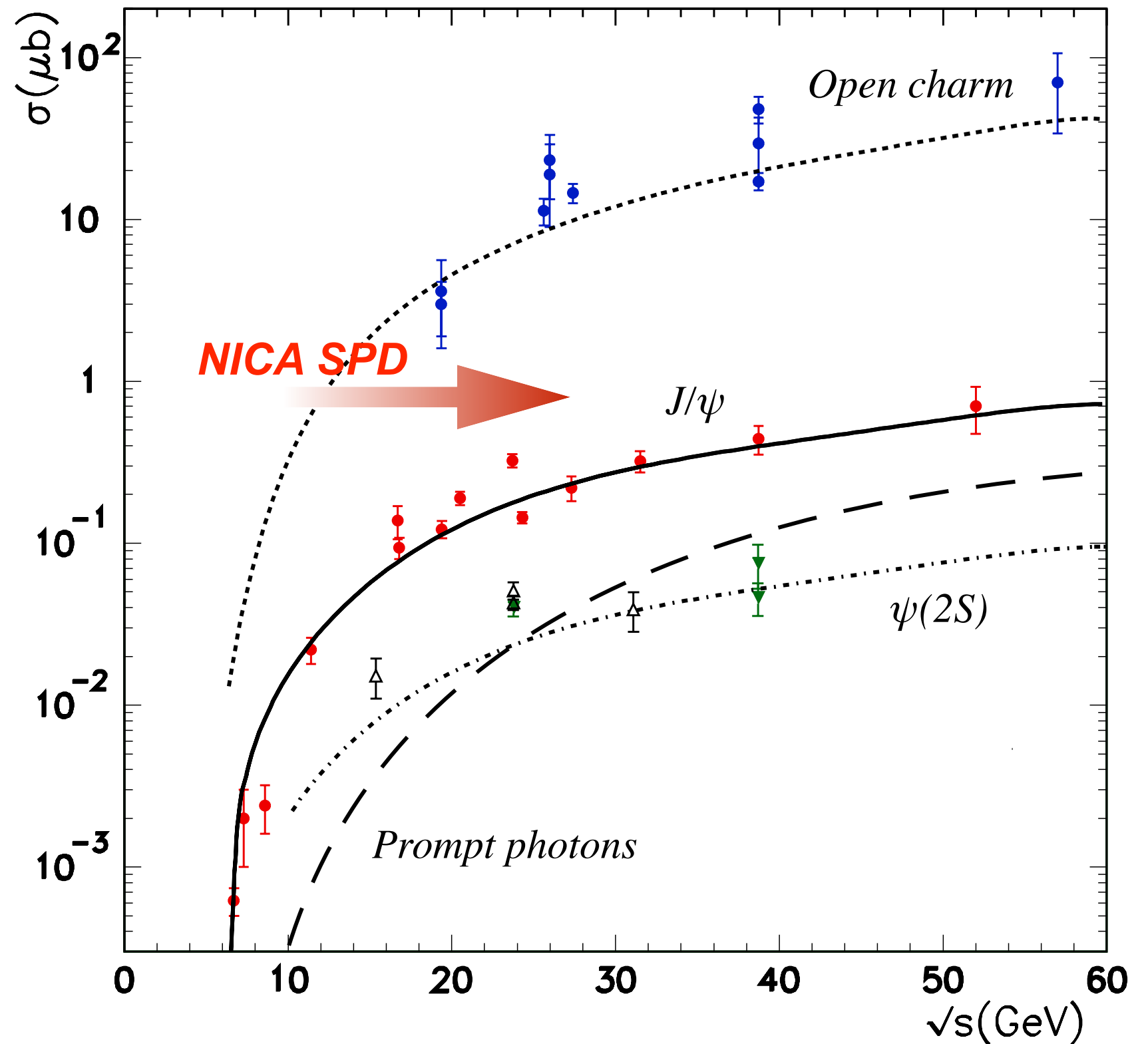
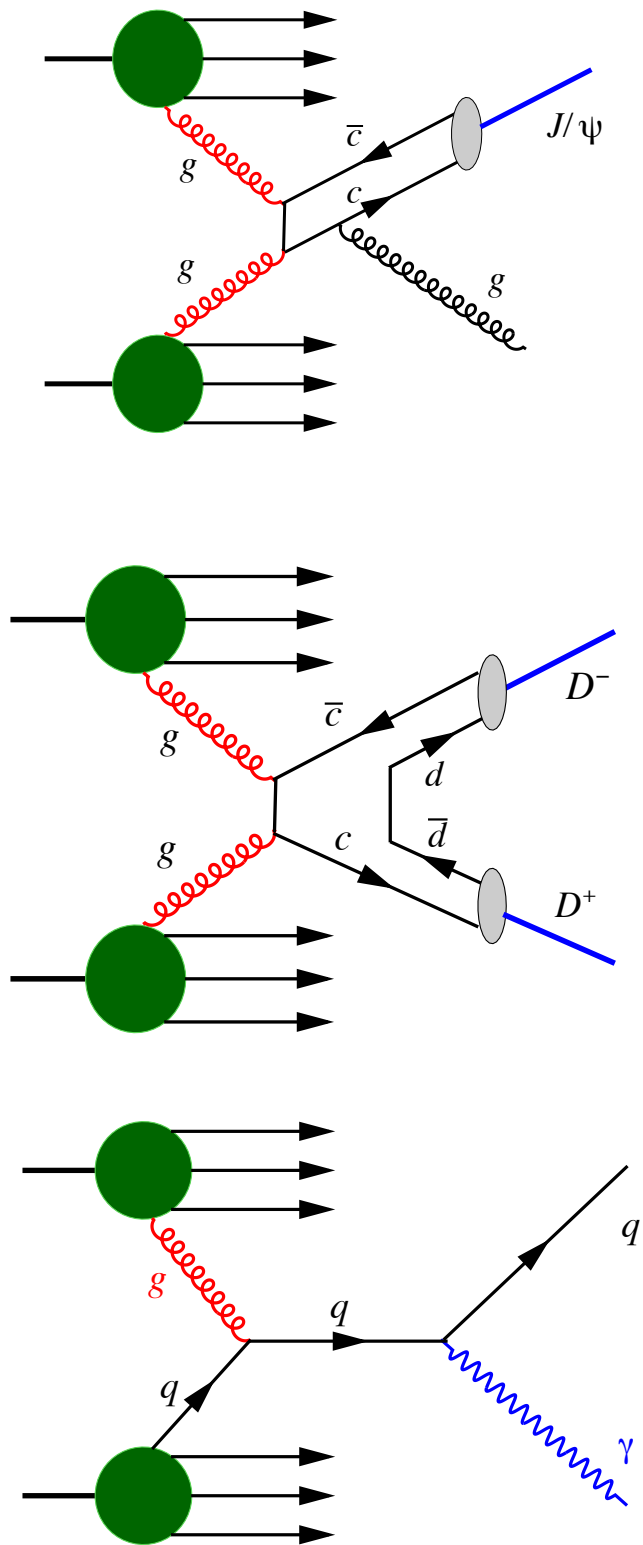
*we plan to study how the
proton and deuteron
spin!*

*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

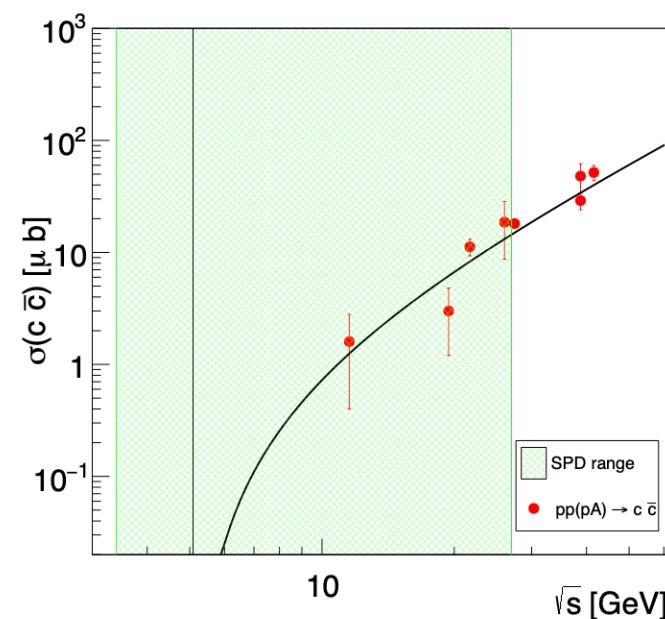
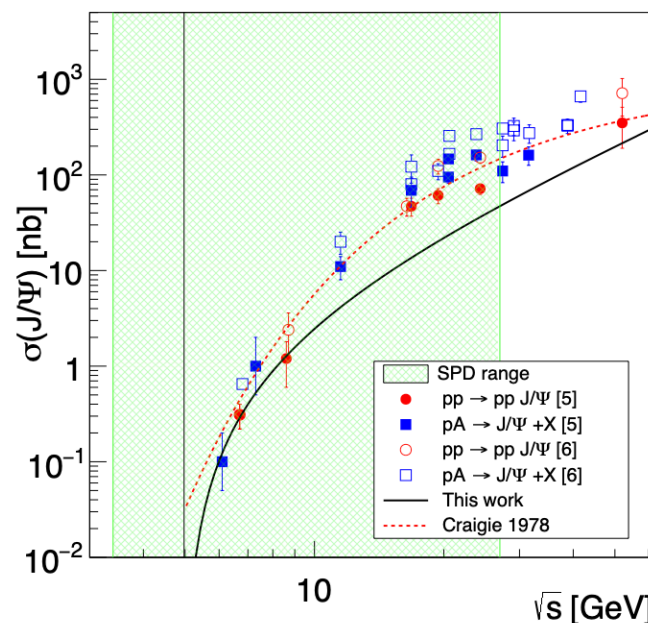
- Spin effects in p-p, p-d and d-d elastic scattering
- Spin effects in hyperons production
- Multiquark correlations
- Dibaryon resonances
- Physics of light and intermediate nuclei collision
- Exclusive reactions
- Hypernuclei
- Open charm and charmonia near threshold

$$pp \rightarrow (6q)^* \rightarrow NN \text{ Mesons,}$$

$$dd \rightarrow K^+ K^+ \Lambda\Lambda^4 n,$$

 \sqrt{s}

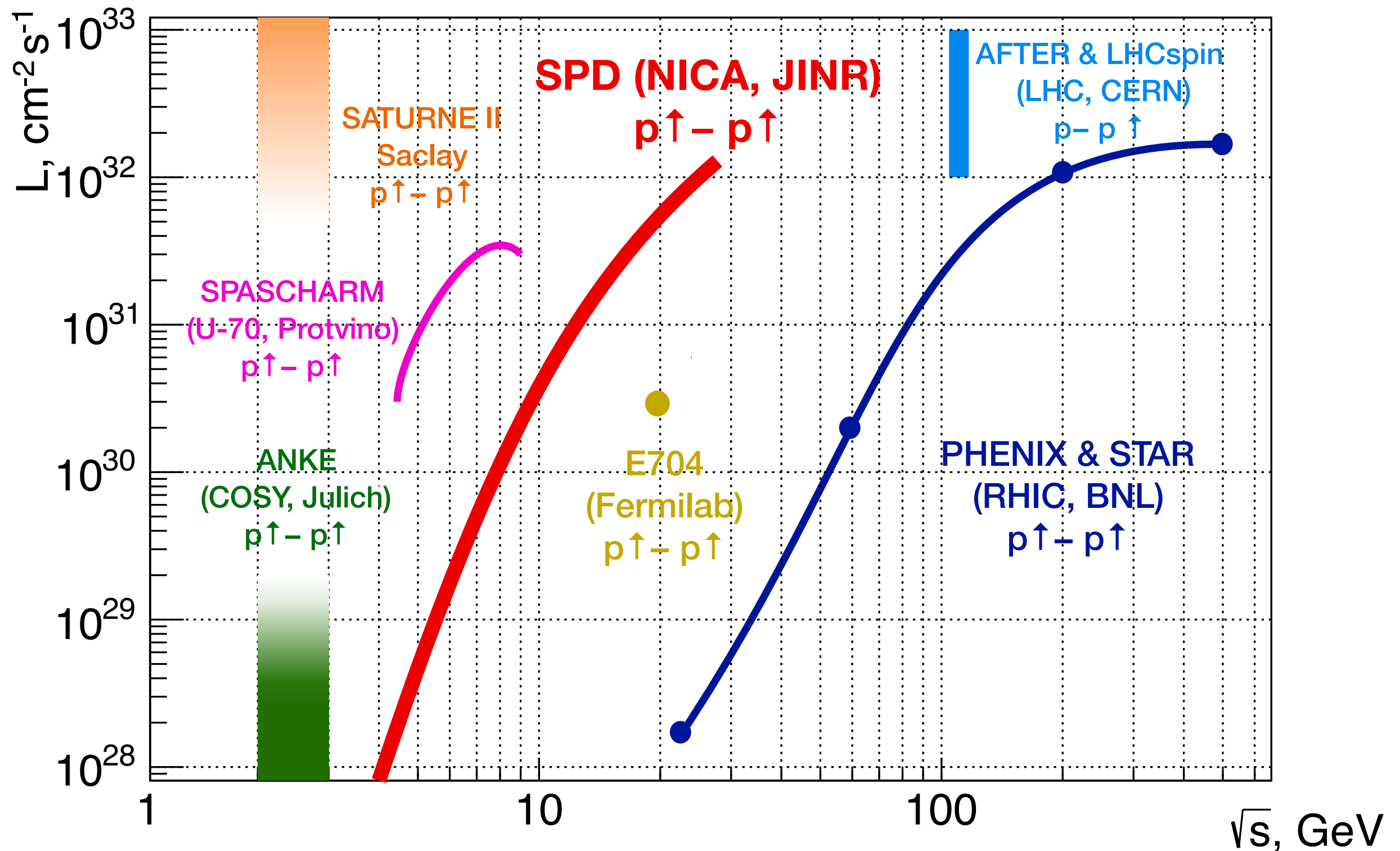
arXiv:2102.08477



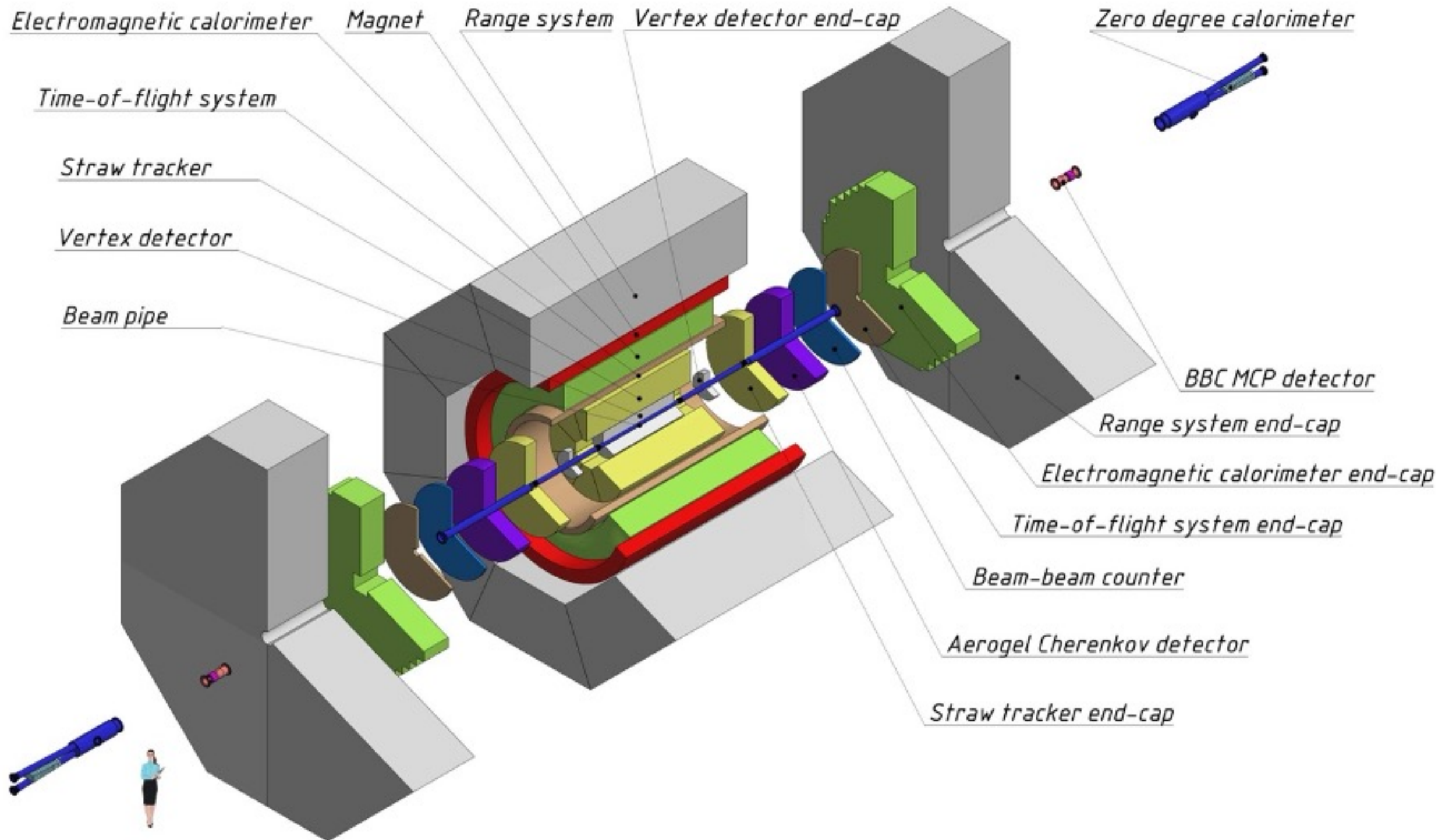
- Auxiliary measurements for astrophysics

➤ ...

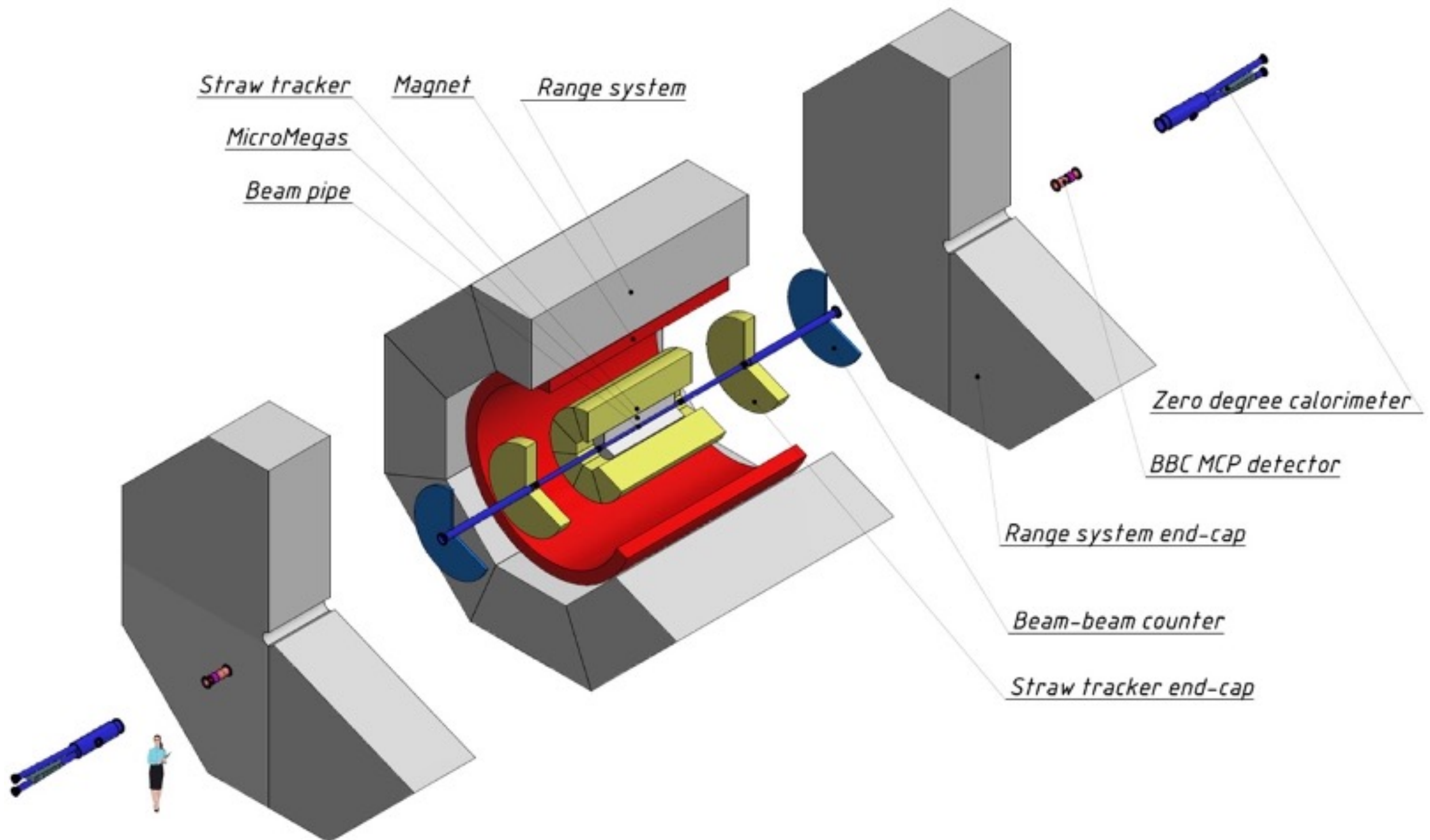
SPD and others



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

NRC “Kurchatov Institute”, Moscow (NRC KI)

iThemba LABS, SA

> 30 institutes

~ 400 participants

<http://spd.jinr.ru/>

MoU signed

MoU under discussion

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

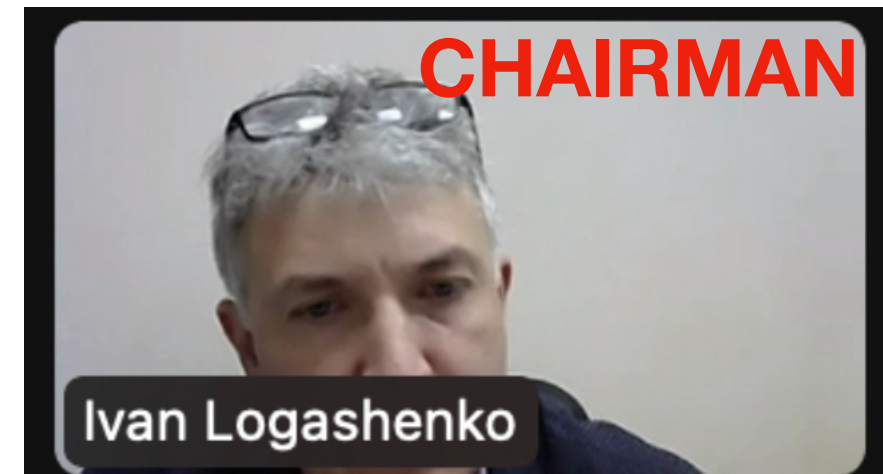
**Expert in HEP Computing and
Software**

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

No.	Category of personnel	JINR staff, amount of FTE	JINR Associated Personnel, amount of FTE
1.	research scientists	60	10
2.	engineers	40	
3.	specialists	1	
4.	office workers		
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				
	1 st year	2 nd year	3 rd year	4 th year	5 th 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

Наименования затрат, ресурсов, источников финансирования		Стоимость (млн. долл.) потребности в ресурсах	Стоимость, распределение по годам					
			1 год	2 год	3 год	4 год	5 год	
	Международное сотрудничество (МНТС)	0.5	0.1	0.1	0.1	0.1	0.1	
	Материалы	51.5	5.0	13.5	15.5	9	8.5	
	Оборудование и услуги сторонних организаций (пуско-наладочные работы)	12.0	1.3	4.1	2.1	2.2	2.3	
	Пуско-наладочные работы							
	Услуги научно-исследовательских организаций	1.5	0.5	0.4	0.3	0.2	0.1	
	Приобретение программного обеспечения	0.2	0.1	0.1				
	Проектирование/строительство	0.6	0.2	0.3	0.1			
	Сервисные расходы (планируются в случае прямой принадлежности к проекту)							
Необходимые ресурсы	Нормо-час	Ресурсы						
		– сумма FTE,		116	140	140	140	140
		– ускорителя/установки,	2000		500	500	500	500
		– <u>реактора</u> .						
Источники финансирования	Бюджетные средства	Бюджет ОИЯИ (статьи бюджета)	53	7.0	15.5	14.5	8.4	7.6
		Вклады соисполнителей	2.4	0.1	0.5	0.5	0.6	0.7
	Внебюджет (доп. смета)	Средства по договорам с заказчиками						
	Другие источники финансирования	10.9	0.1	2.5	3.1	2.5	2.7	