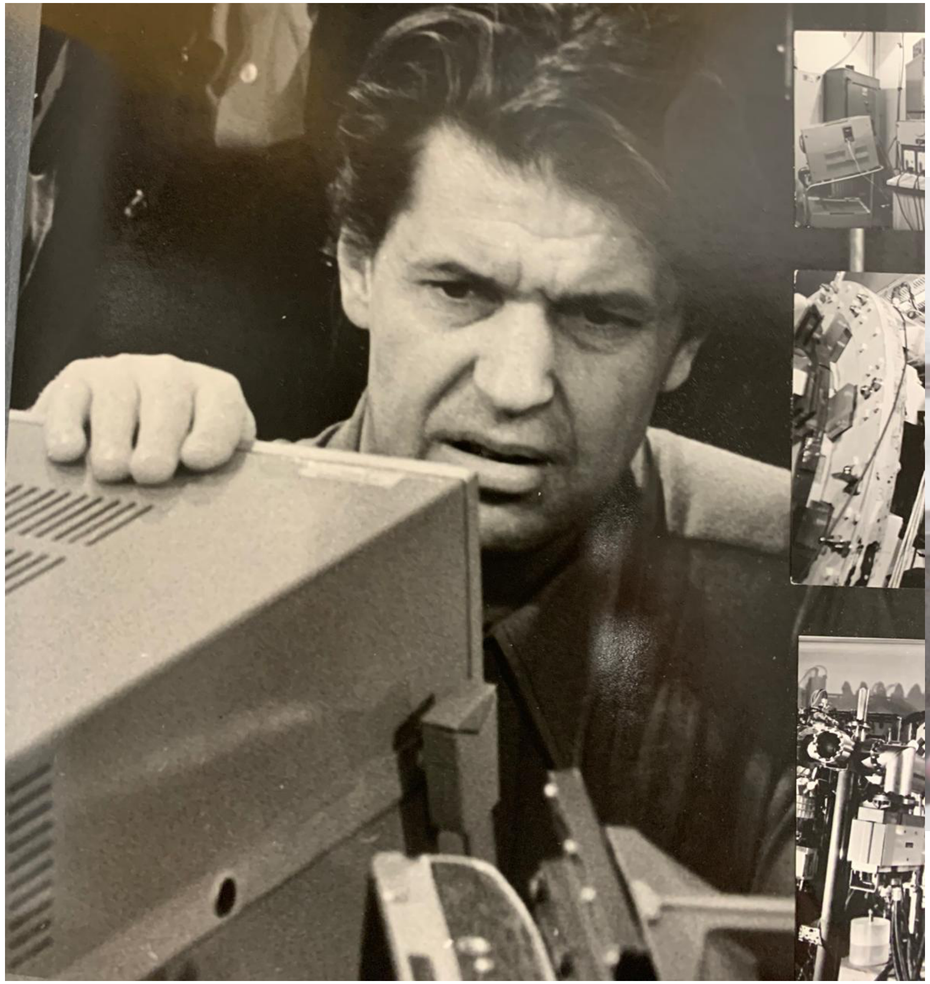
Andrey Golutvin
son of Igor

A quick recap of memories *(related to physics)* about Igor

Selected Highlights on the Impact from Papa in 1974-2024

(very biased selection since it is about an impact on me)



Igor was the physicist fully dedicated to CERN

Papa

I

Lessons from Igor

NA4

CMS

Moscow State University / Department of physics

Tritium beta-decay experiment at ITEP

ARGUS at DESY

GEM at SSC, Texas

HERA-B at DESY

LHCb at CERN

SHiP at NA / CERN

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First flashes of inspiration by the construction of large detectors for large experiments

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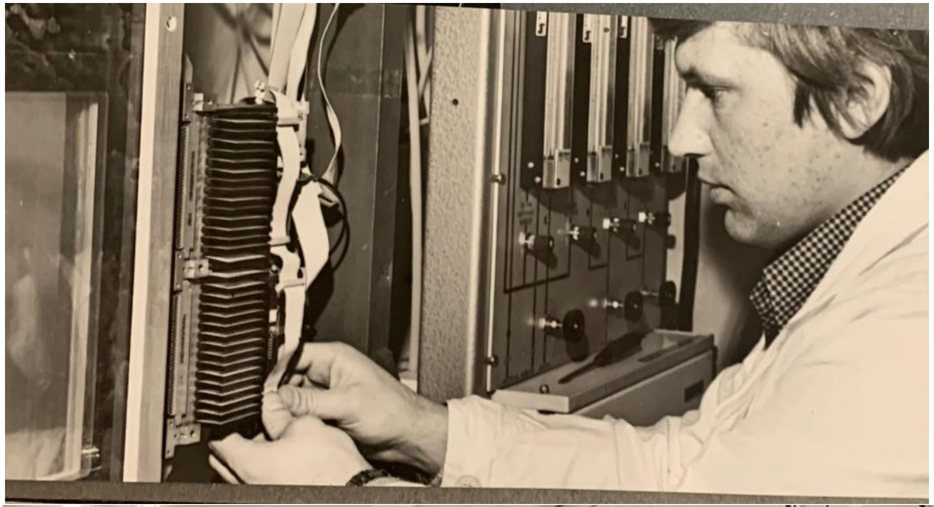
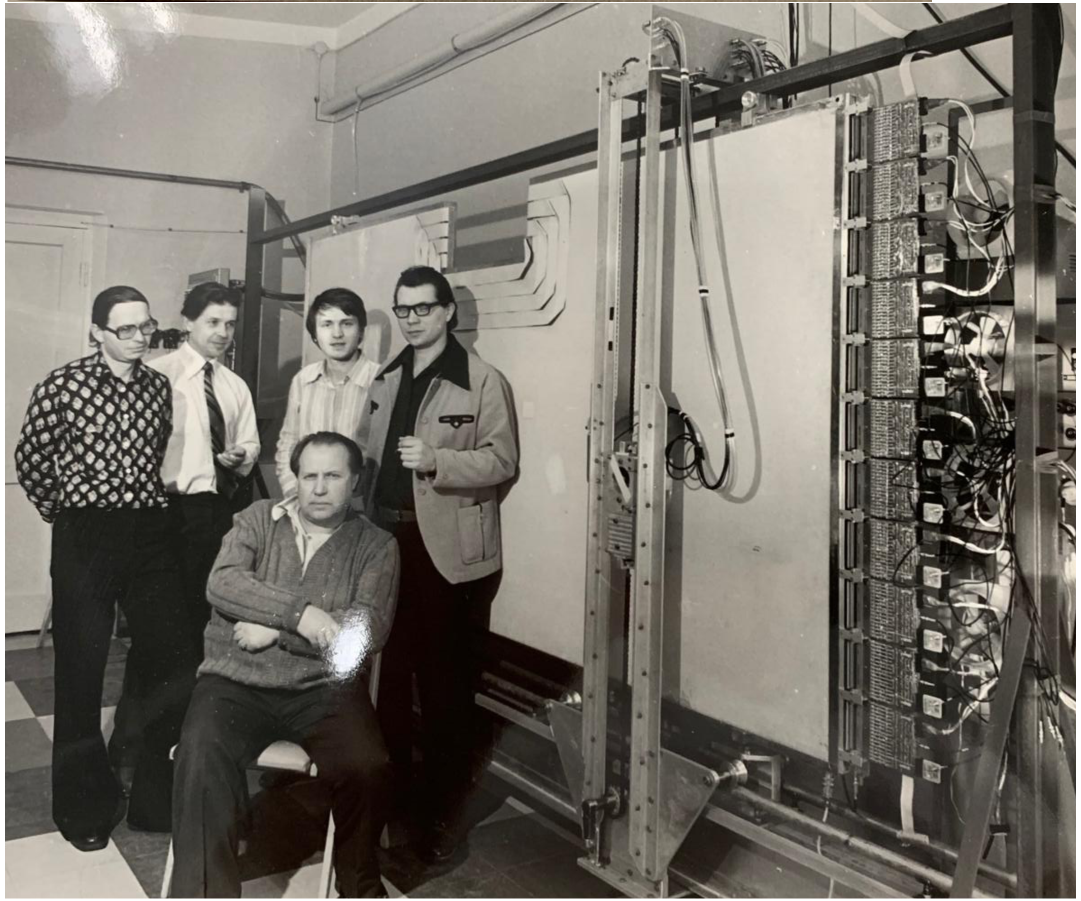
Large MWPC for the NA4 experiment





Very creative atmosphere in Igor’s group
+ volleyball in the evening and picnics on some weekends

Igor was the physicist fully dedicated to CERN

Papa	I	Lessons from Igor
	Moscow State University / Department of physics	Inspiration by the construction of large experiments
NA4	**Tritium beta-decay experiment at ITEP:** online readout; study of electron energy losses in valine → effects on the resolution function	M_ν~30 eV cannot be true → Check the spectrometer resolution function
	ARGUS at DESY	
	GEM at SSC, Texas	
CMS		
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	LHCb at CERN	
	SHiP at NA / CERN	

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Papa

NA4

CMS

I

Moscow State University / Department of physics

Tritium beta-decay experiment at ITEP

ARGUS at DESY: τ- lepton physics,
B$\bar{B}$ oscillations

GEM at SSC, Texas

HERA-B at DESY

LHCb at CERN

SHiP at NA / CERN

Lessons from Igor

Inspiration by the construction of large experiments

M_ν ~ 30 eV cannot be true → Check the spectrometer resolution function

- Reconstruction of τ-leptons is interesting for Higgs physics
- Top is heavy → Need pp-collider to discover top
- **Awards have to be given to Walter SP who lead ARGUS during construction and initial data taking**

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Papa

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Lessons from Igor

Moscow State University / Department of physics

Inspiration by the construction of large experiments

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GEM at SSC, Texas: analysis of cosmic data for various chamber technologies

- ✓ Chambers constructed in my lab are the best
- ✓ SSC vs LHC: Luminosity is more efficient than $\sqrt{s}$

HERA-B at DESY

LHCb at CERN

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- ✓ Why do we need ECAL for HERA-B
- ✓ If you want to make it, just copy the technology (SHASHLIK) developed in Protvino

LHCb at CERN

SHiP at NA / CERN

HERA-B at DESY

Appreciations of Victor's (Sviridov) ideas about Beauty physics at the colliders using internal target

Victor was one of the best friends of Igor for many years !

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LHCb at CERN: Construction of ECAL
Convener of the Rare Decays
Spokesperson 2007-2011

We have constructed fantastic detectors
→ Will be no problem to reconstruct data during the first LHC collision

SHiP at NA / CERN

So far, all lessons from Igor had 100% predictive power

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SHiP at NA / CERN: Spokesperson from the Expression of Interest in 2013 until now

SHiP: The experiment to Search for Hidden Particles

Igor (after the Higgs discovery and no SUSY...):

- ✓ Igor somehow started loosing his enthusiasm about physics at HL-LHC, and looked beyond HL-LHC
  → "Need to increase energy"
- ✓ "Andrey, you should try proposing an experiment to search for BSM not at the LHC"
- ✓ "You cannot be doing flavour physics for all of your life"
- ✓ **"SHiP is a very good idea. You may be lucky to discover new particles if the experiment has been approved"**
- ✓ "Be prepared that the approval of SHiP may take long time"

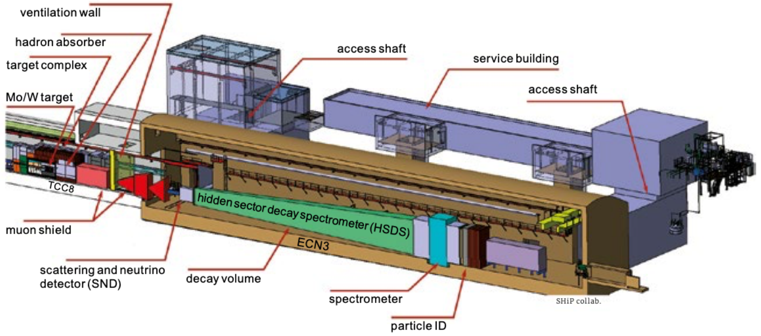
NEWS ANALYSIS
CERN COURIER
May/June 2024 cerncourier.com
Reporting on international high-energy physics

North Area

SHiP to chart hidden sector

In March, CERN selected a new experiment called SHiP to search for hidden particles using high-intensity proton beams from the SPS. First proposed in 2013, SHiP is scheduled to operate in the North Area's ECN3 hall from 2031, where it will enable searches for new physics at the "coupling frontier" complementary to those at high-energy and precision-flavour experiments.

Interest in hidden sectors has grown in recent years, given the absence of evidence for non-Standard Model particles at the LHC, yet the existence of several phenomena (such as dark matter, neutrino masses and the cosmic baryon asymmetry) that require new particles or interactions. It is possible that the reason why such particles have not been seen is not that they are too heavy but that they are light and extremely feebly interacting. With such small couplings and mixings, and thus long lifetimes, hidden particles are extremely difficult to constrain. Operating in a beam-dump configuration that will produce copious quantities of photons and charm and beauty hadrons, SHiP will generically explore hidden-sector particles in the MeV to multiple-GeV mass range.



Full speed ahead *Layout of the SHiP experiment, with the target on the left and the experiment in the ECN3 hall.*

Optimised searching

SHiP is designed to search for signatures of models with hidden-sector particles, which include heavy neutral leptons, dark photons and dark scalars, by full reconstruction and particle identification of Standard Model final states. It will also search for light-dark-matter scattering signatures via the direct detection of atomic-electron or nuclear recoils in a high-density medium, and is optimised to make measurements of tau neutrinos and of neutrino-induced charm production by all three neutrinos species.

The experiment will be built in the existing TCC8/ECN3 experimental facility in the North Area. The beam-dump setup consists of a high-density proton target located in the target bunker, followed by a hadron stopper and a muon shield. Sharing the SPS beam time with other fixed-target experiments and the LHC should allow around 6×10^{20} protons on target to be produced during 15 years of nominal operation. The detector itself consists of two parts that are designed to be sensitive to as many physics models and final states as possible. The scattering and neutrino detector will search for light dark matter and perform neutrino measurements. Further downstream is the much larger hidden-sector decay spectrometer, which is designed to reconstruct the decay vertex of a hidden-sector particle, measure its mass and provide particle identification of the decay products in an extremely low-background environment.

One of the most critical and challenging components of the facility is the proton target

One of the most critical and challenging components of the facility is the proton target, which has to sustain an energy of 2.6 MJ impinging on it every 7.2 s. Another is the muon shield. To control the beam-induced background from muons, the flux in the detector acceptance must be reduced by some six orders of magnitude over the shortest possible distance, for which an active muon shield entirely based on magnetic deflection has been developed.

The focus of the SHiP collaboration now is to produce technical design reports. "Given adequate funding, we believe that the TDR phase for BDF/SHiP will take us about three years, followed by production and construction, with the aim to commission the facility towards the end of 2030 and the detector in 2031," says SHiP spokesperson Andrey Golutvin of Imperial College London. "This will allow up to two years of data-taking during Run 4, before the start of Long Shutdown 4, which would be the obvious opportunity to improve or consolidate, if necessary, following the experience of the first years of data taking."

The decision to proceed with SHiP concluded a process that took more than a year, involving the Physics Beyond Colliders study group and the SPS and PS experiments committee. Two other experiments, HIKE and SHADOWS, were proposed to exploit the high-intensity beam from the SPS. Continuing the successful tradition of kaon experiments in the ECN3 hall, which currently hosts the NA62 experiment, HIKE (high-intensity kaon experiment) proposed to search for new physics in rare charged and neutral kaon decays while also allowing on-axis searches for hidden particles. For SHADOWS (search for hidden and dark objects with the SPS), which would have taken data concurrently with HIKE when the beamline is operated in beam-dump mode, the focus was low-background searches for off-axis hidden-sector particles in the MeV-GeV region.

"In terms of their science, SHiP and HIKE/SHADOWS were ranked equally by the relevant scientific committees," explains CERN director for research and computing Joachim Mnich. "But a decision had to be made, and SHiP was a strategic choice for CERN."

Igor Golutvin 1934–2023

A pioneer of the CMS experiment

Igor Anatolievich Golutvin, an outstanding scientist who founded new directions and research techniques in particle physics, died on 13 September 2023.

Born on 8 August 1934 in Moscow, Golutvin graduated from MIPT in 1957 and started his work at JINR in 1958. Several generations of detectors for large-scale physics facilities were developed under his supervision at the JINR Synchrophasotron, the IHEP accelerator in Serpukhov, and at the Proton Synchrotron and the LHC at CERN.

Golutvin became one of the pioneers of the CMS experiment, driving the cooperation of Russia and other JINR member states via the Russia and Dubna Member States (RDMS) CMS collaboration. Over the past 30 years, under his supervision, RDMS physicists have completed the development of unique detectors for CMS. Igor was also instrumental in initiating Grid computing for CMS in Russia. He was awarded the 2014 Cherenkov Prize of the Russian Academy of Sciences for his outstanding contribution to the development of CMS. In recent years, he played an important role in the preparation of upgrades for CMS, in particular concerning the calorimeters.

During his work at JINR, Golutvin established a scientific school and trained a team of active, qualified physicists and engineers. Within the framework of cooperation between CMS Russia and other JINR member states, he brought together like-minded people with the aim of preserving Russian scientific schools, built unique teams of engineers and physicists, and developed favourable conditions for attracting gifted young physicists, which he saw as extremely important for the implementation of long-term scientific projects.

Igor Golutvin drove the cooperation of JINR member states with CMS.

Igor was a member of the equipment committee of the International Committee for Future Accelerators, an editorial board member of the journal *Nuclear Instruments and Methods*, a directorate member of the CMS collaboration at CERN, head of the collaboration of the institutes of Russia and JINR in CMS, and the organiser and head of numerous international and Russian scientific conferences and symposia.

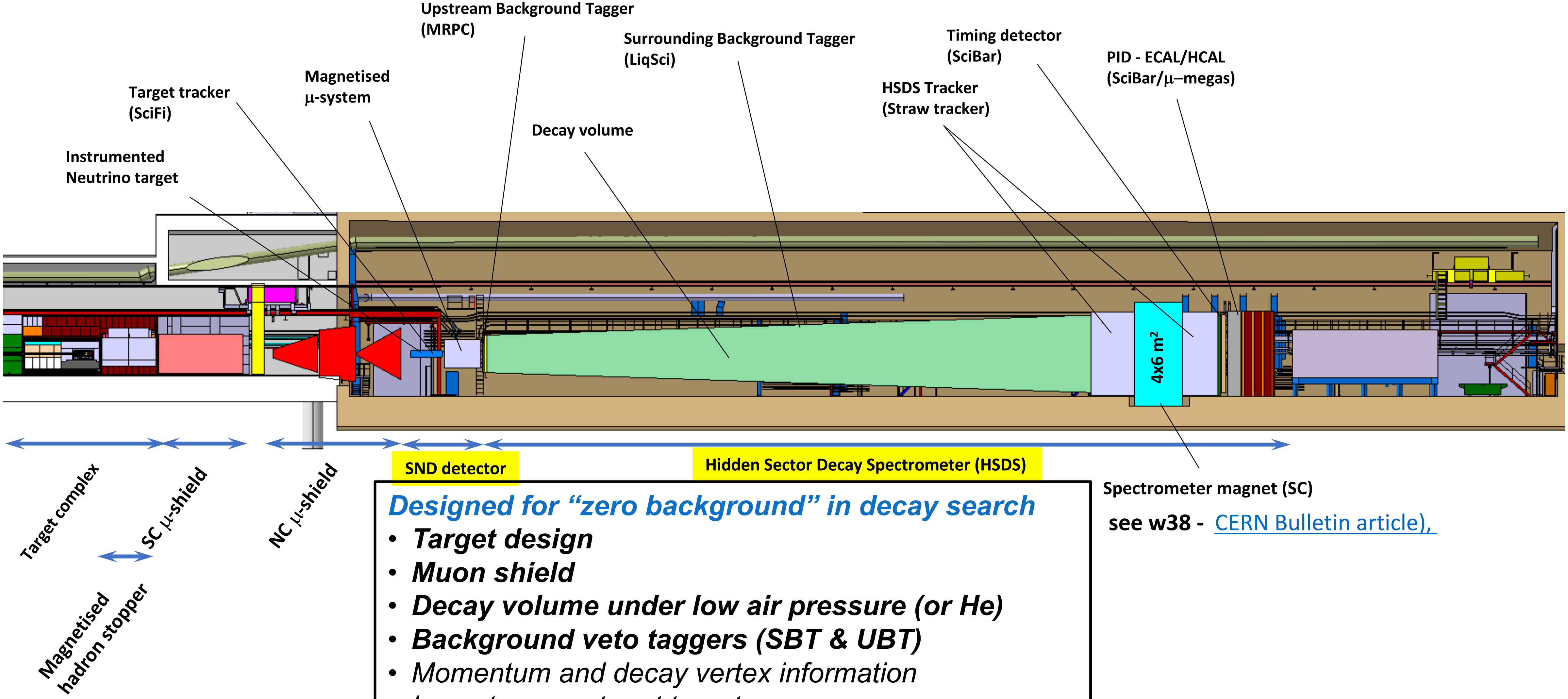
He was also a professor/full member of the Russian Academy of Engineering Sciences, Russian Academy of Natural Sciences, International Academy of Sciences, Honoured Scientist of the Russian Federation and chief researcher for CMS at VBLHEP. For many years of fruitful work, Golutvin was awarded numerous state and scientific awards and prizes.

His friends and colleagues *at JINR.*

Igor liked SHiPs

Watching and piloting

SHiP detector, as approved in March 2024

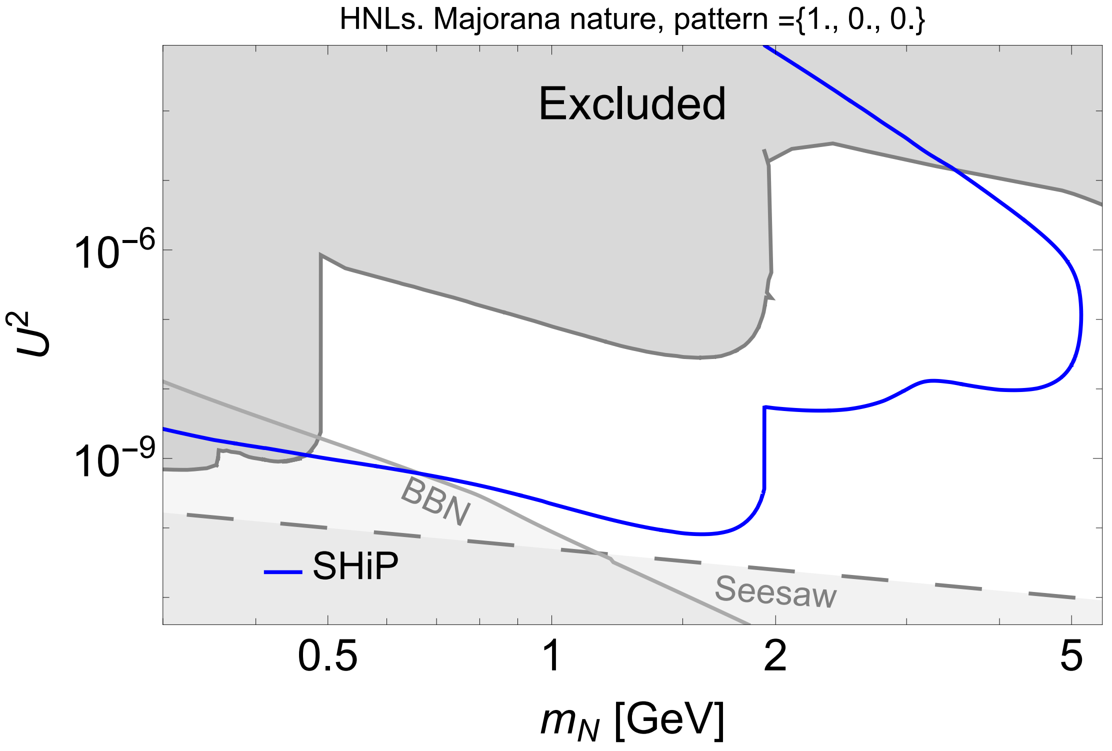


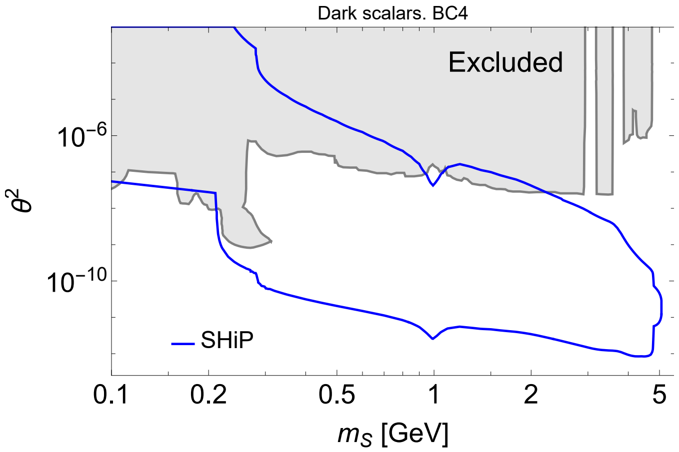
Designed for "zero background" in decay search

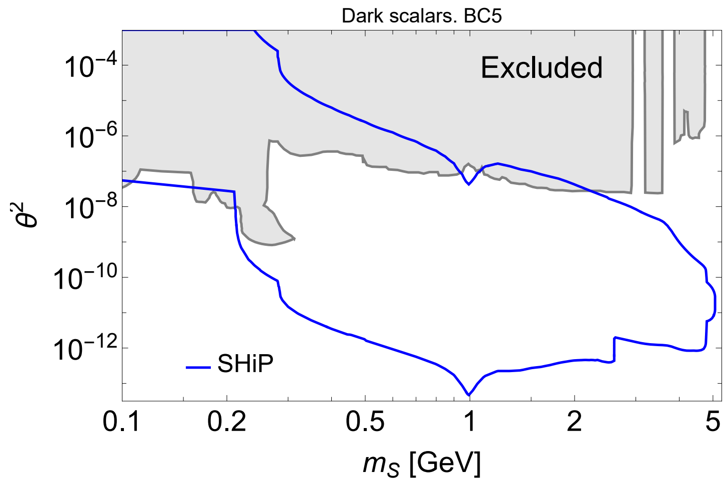
- ***Target design***
- ***Muon shield***
- ***Decay volume under low air pressure (or He)***
- ***Background veto taggers (SBT & UBT)***
- *Momentum and decay vertex information*
- *Impact parameter at target*
- *Time coincidence*
- *Particle identification* — Not currently used in background suppression

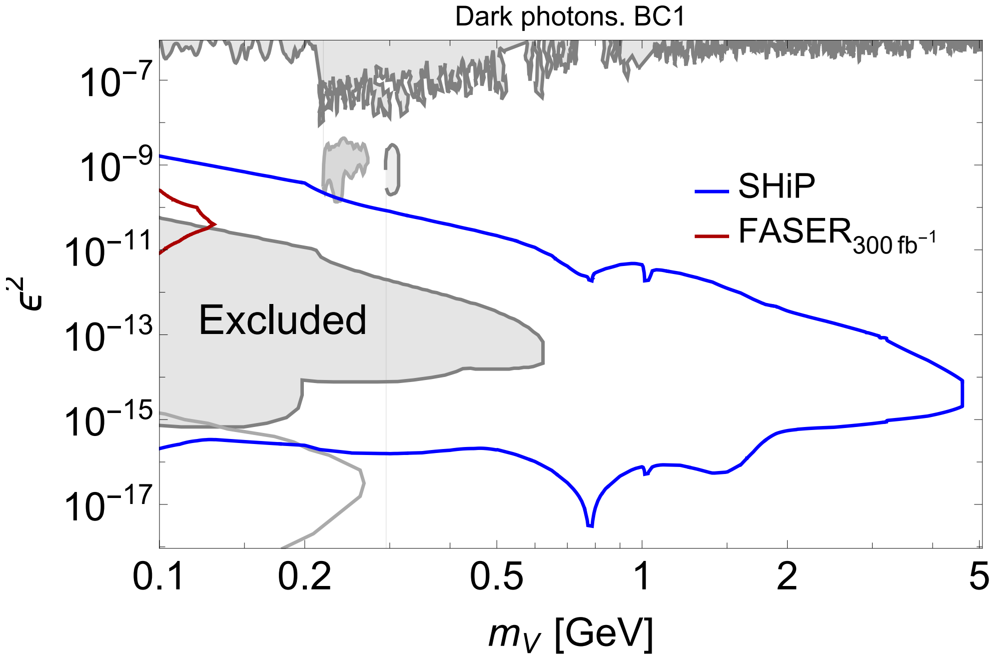
see w38 - [CERN Bulletin article),](#)

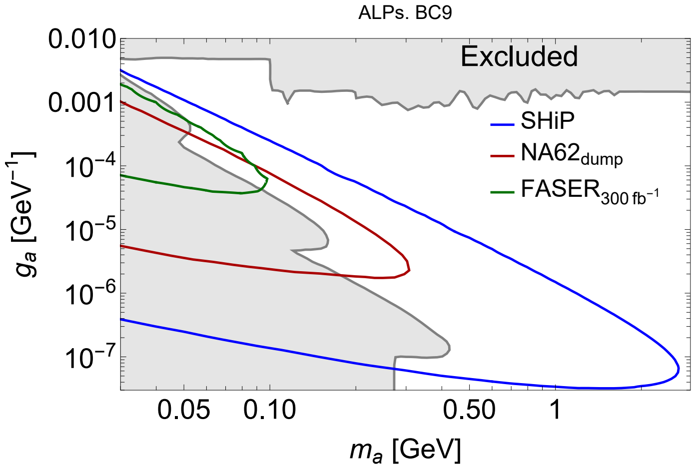
SHiP sensitivities

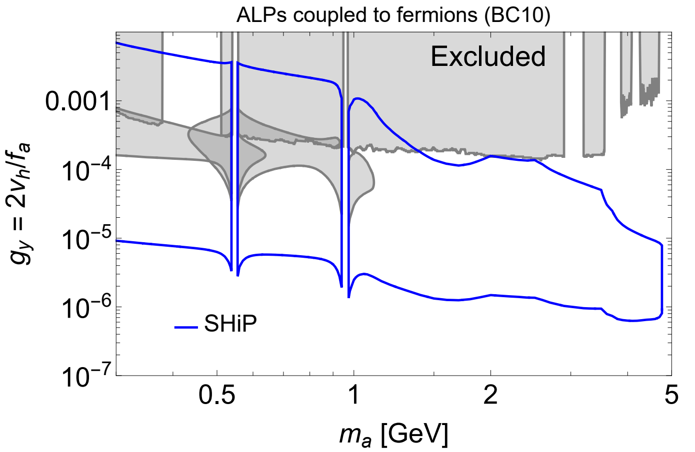






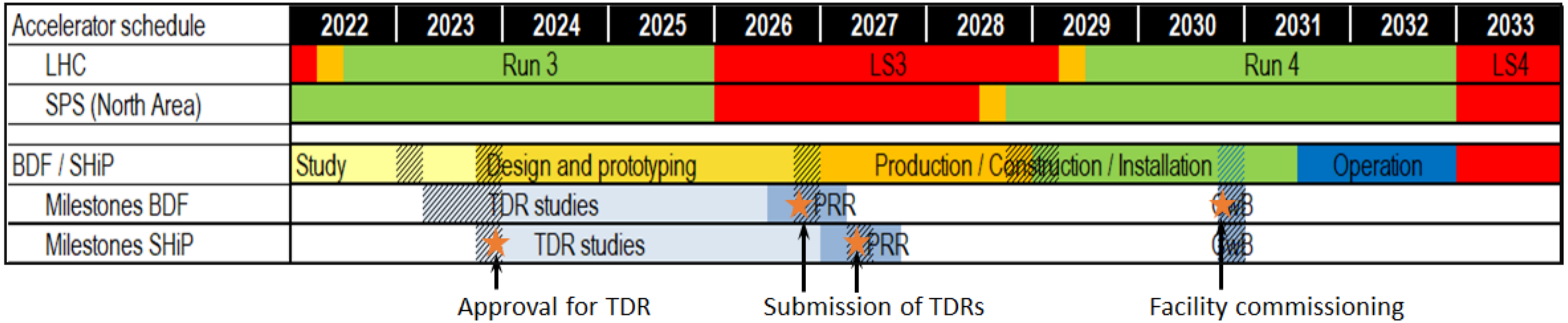




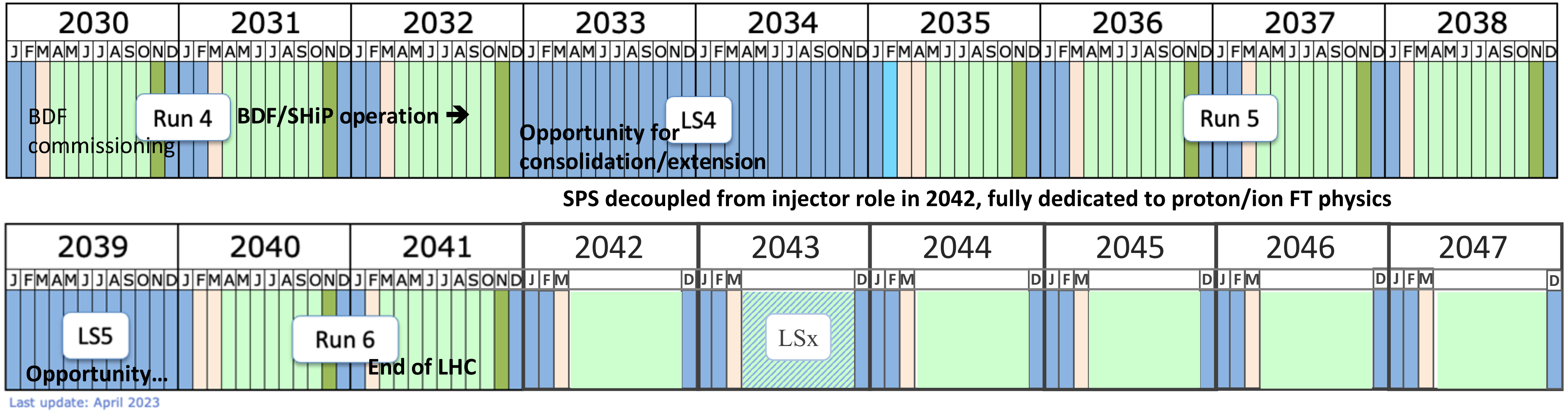


- ✓ *SHiP sensitivities to FIPs are orders of magnitude better than existing limits*
- ✓ *Sensitivity is not limited by backgrounds in 6 x 10^{20} PoT*

SHiP preliminary schedule



- *~2.5 years for detector TDRs*
- *Construction / installation of facility and detector is decoupled from NA operation*
- *Important to start data taking >1 year before LS4*
- *Several upgrades/extensions of the BDF/SHiP in consideration over the operational life*



Big hope to present interesting results in 10 years at the Igor’s 100th anniversary

Salutations to Hidden Papa

Three of us have a birthday today → could be 90 + 90 = 180 altogether