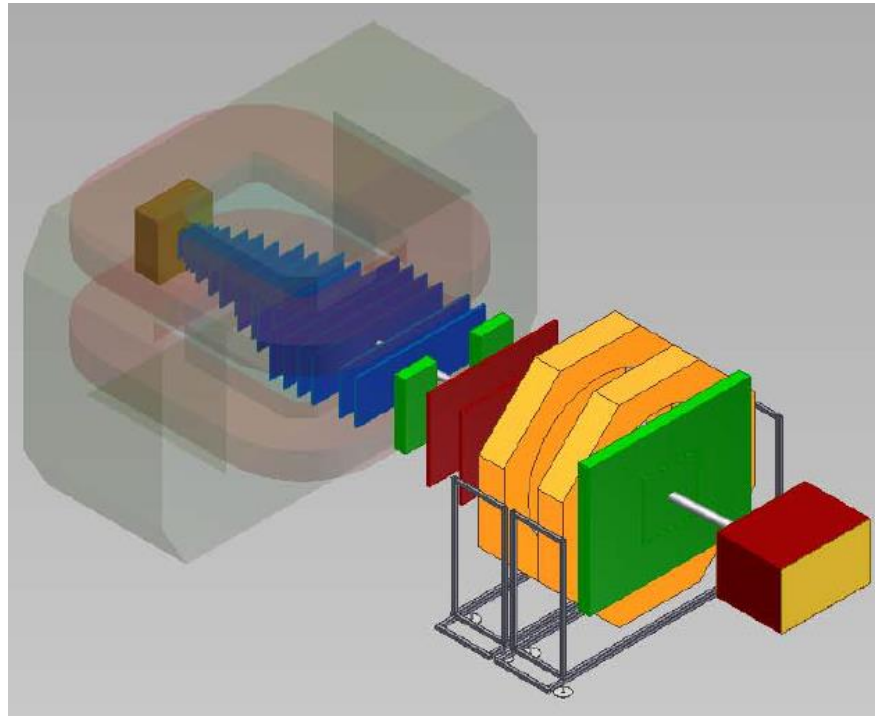




Status of the BM@N experiment



M.Kapishin

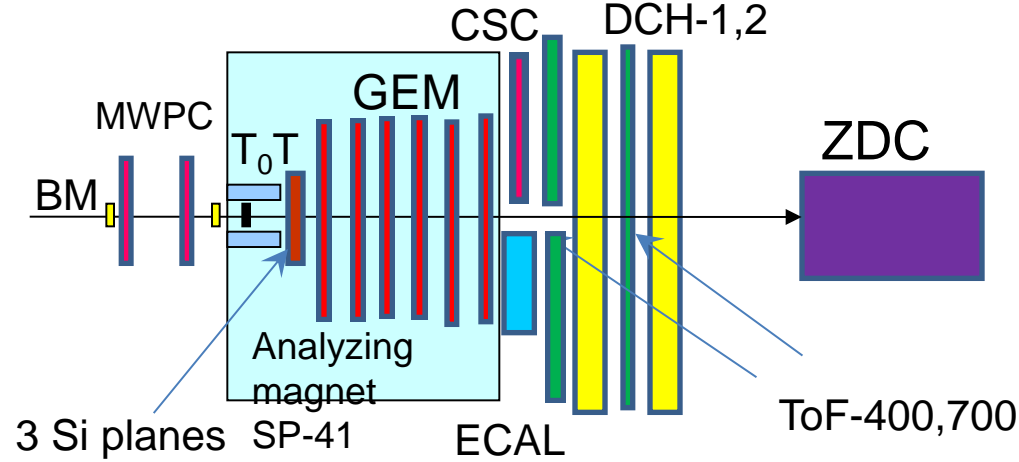
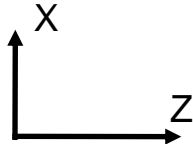




BM@N run with Ar and Kr beams in March 2018



Ar beam, $T_0 = 3.2$ GeV/n



Kr beam, $T_0 = 2.4$ (2.9) GeV/n

- Central tracker inside analyzing magnet → 6 GEM detectors 163×45 cm² and forward Si strip detectors for tracking
- ToF system, trigger detectors, hadron and EM calorimeters, outer tracker

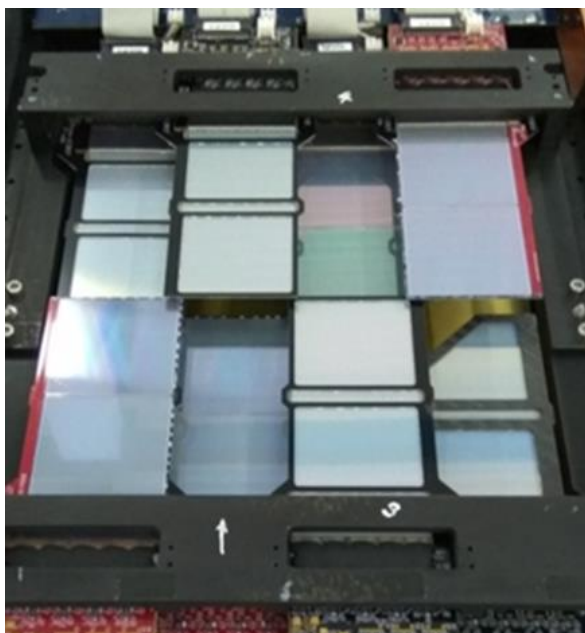
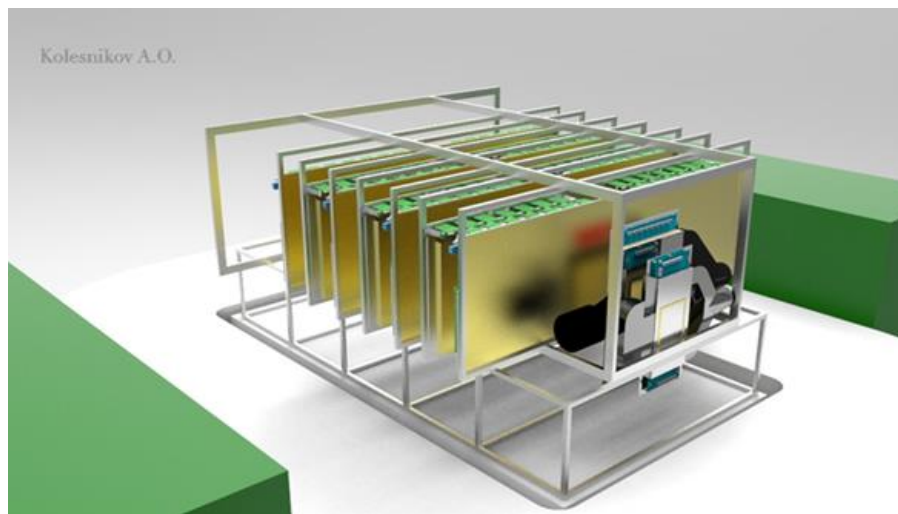
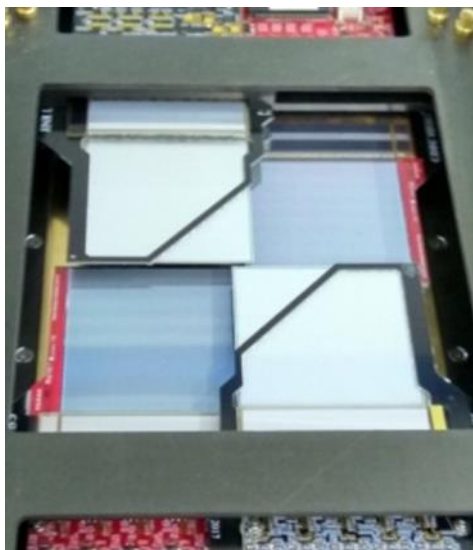
Program:

- Measure inelastic reactions Ar (Kr) + target → X on targets C, Al, Cu, Sn, Pb
- Hyperon production measured in central tracker (Si + GEM)
- Charged particles and nuclear fragments identified with ToF
- Gamma and multi-gamma states identified in ECAL

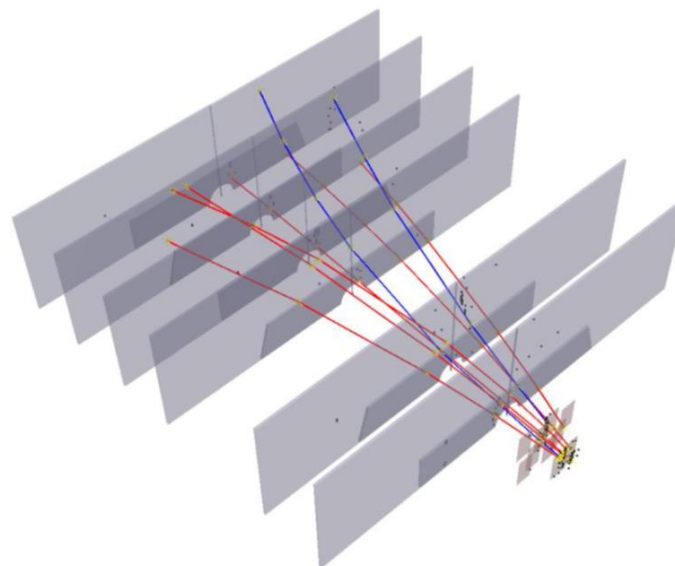
+ analyze data from previous technical run with Carbon beam of 3.5 - 4.5 GeV/n

Central tracker in Ar / Kr runs

3 forward silicon strip planes and 6 GEM detectors



Ar-target interaction reconstructed in central tracker



Λ hyperon production in carbon beam

C beam , 4 AGeV
C + C,Al,Cu \rightarrow X

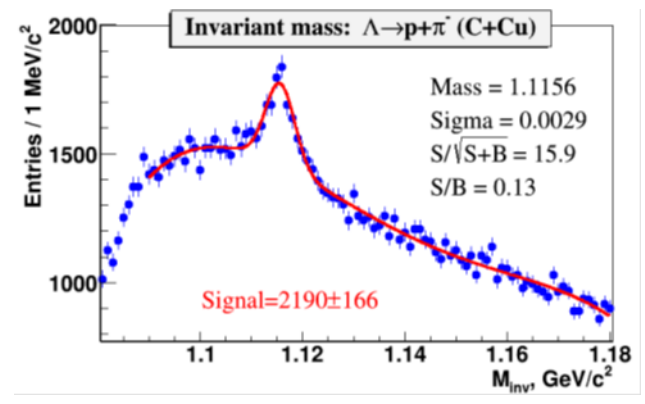
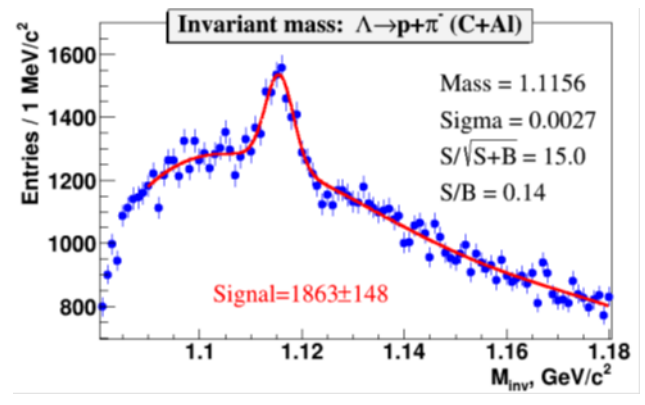
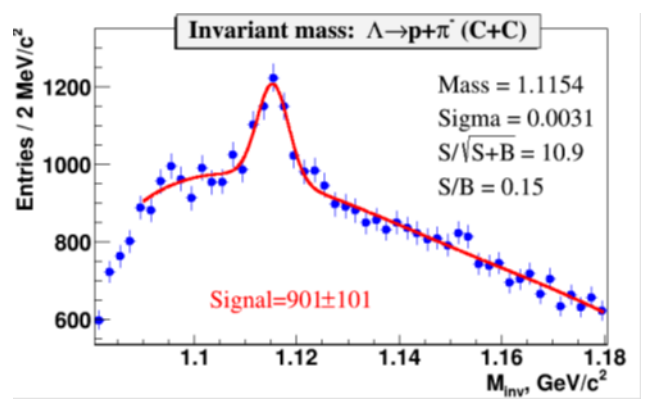
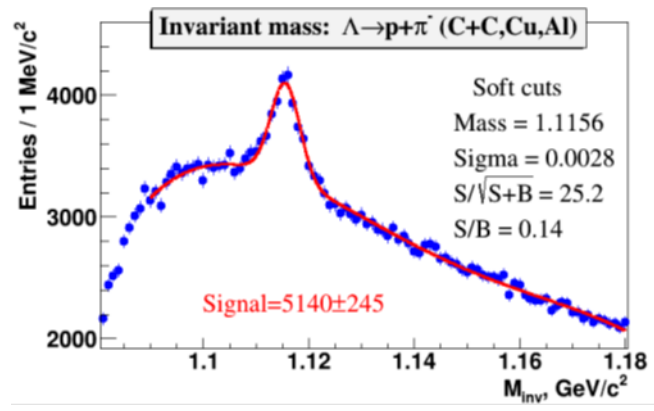
Λ signal width
2.5 - 3 MeV

Analysis team: Gleb Pokatashkin +
Alexander Zinchenko, Yulia Gornaya
Veronika Vasendina, Igor Roufanov

First expected physics results:

- Yields of Λ hyperon in C – nucleus (C,Al,Cu) interactions at beam kinetic energy of 4 AGeV

\rightarrow Status report of Gleb Pokatashkin



Status of TOF-400 identification and analysis

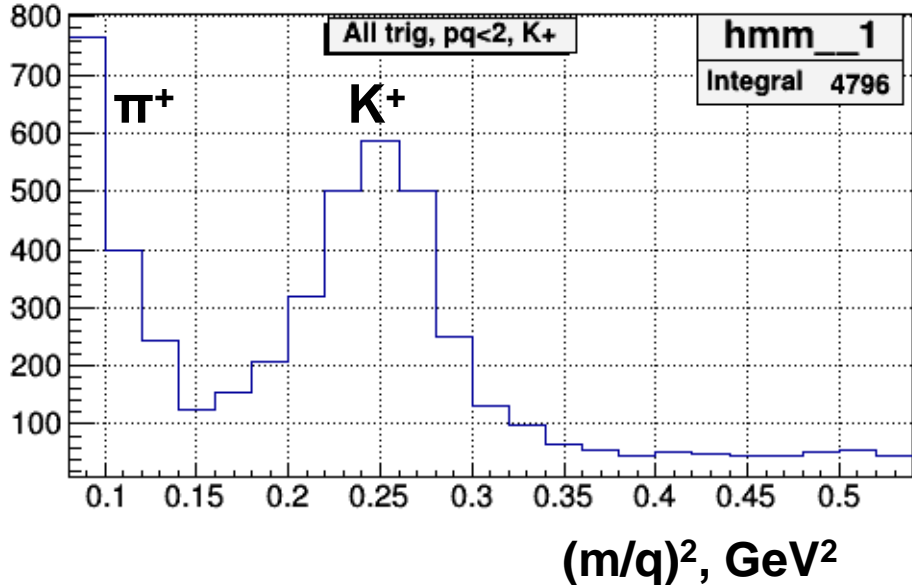
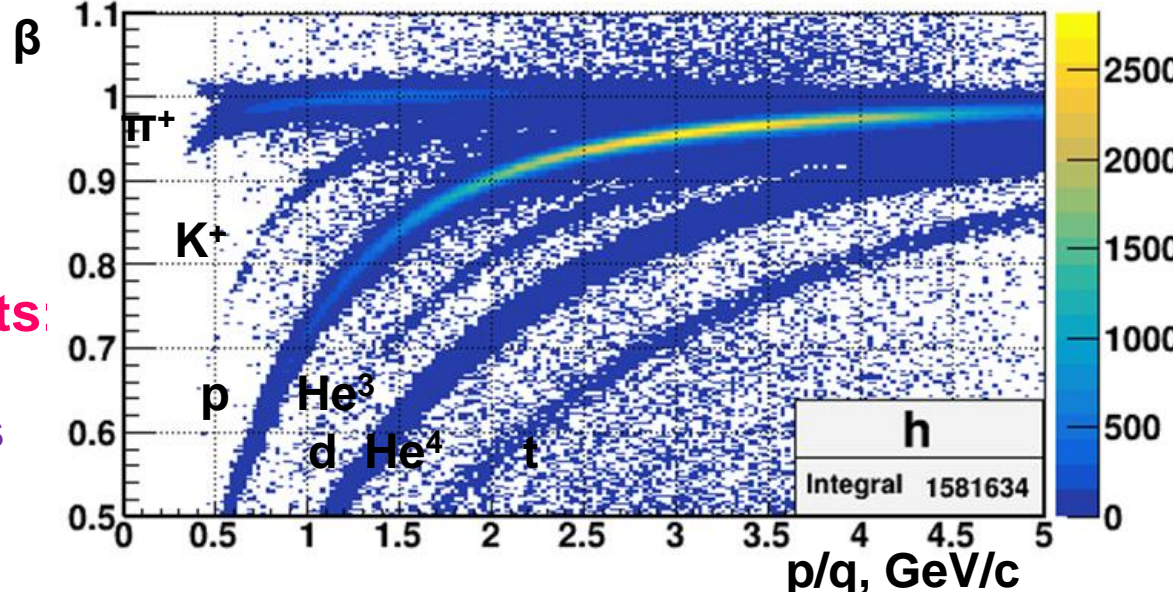
Ar beam , 3.2 AGeV , Ar + C,Al,Sn,Cu → X

Analysis team:
Vasily Plotnikov
Mikhail Rumyantsev

First expected physics results:

- Ratio of K^+/π^+ in Ar - nucleus interactions at beam kinetic energy of 3.2 AGeV
- Ratio of K^+/π^+ in Kr - nucleus interactions at beam kinetic energy of 2.4 AGeV

→ Status report of Vasily Plotnikov



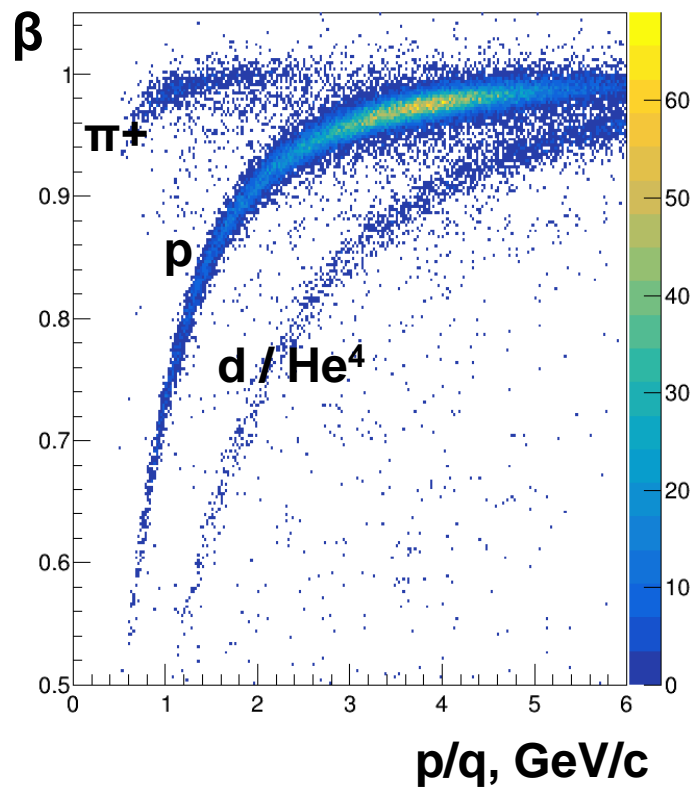


Status of TOF-700 identification



Ar beam , 3.2 AGeV , Ar + Al,Cu \rightarrow X

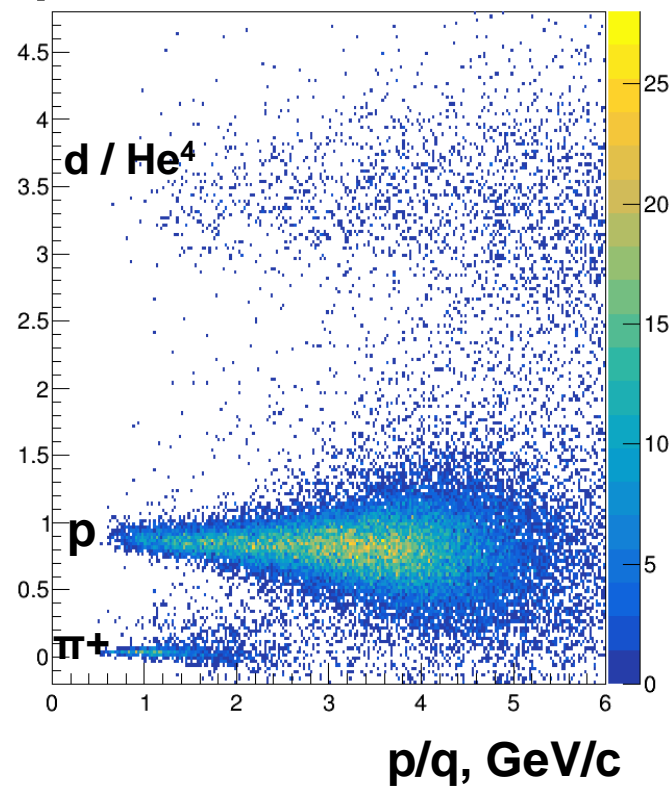
Betacor vs momentum



Analysis team:
Yuri Petukhov, Layo Kovachev
DCH reconstruction:
Vladimir Palichik, Nikolay Voitishin

M^2/q^2

Masscor2 vs momentum





Towards centrality measurement with ZDC in Carbon / Argon runs

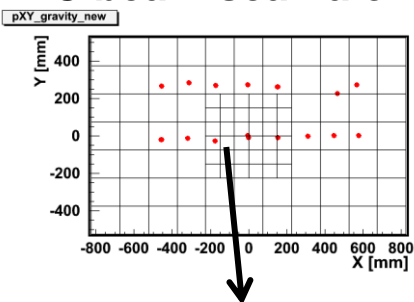


Team: F.Guber, A.Ivashkin,
S.Morozov, M.Golubeva,
A.Taranenko
C beam , 4.5 AGeV, March 2017

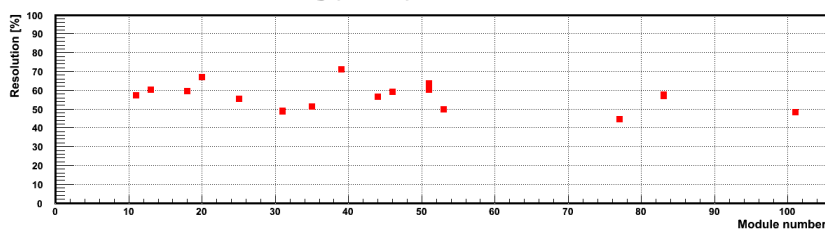
Team: A.Stavinskiy,
P.Alexeev, N.Zhigareva

SRC run, C beam, 3.14 AGeV, March 2018
→ ZDC calibration for Ar run

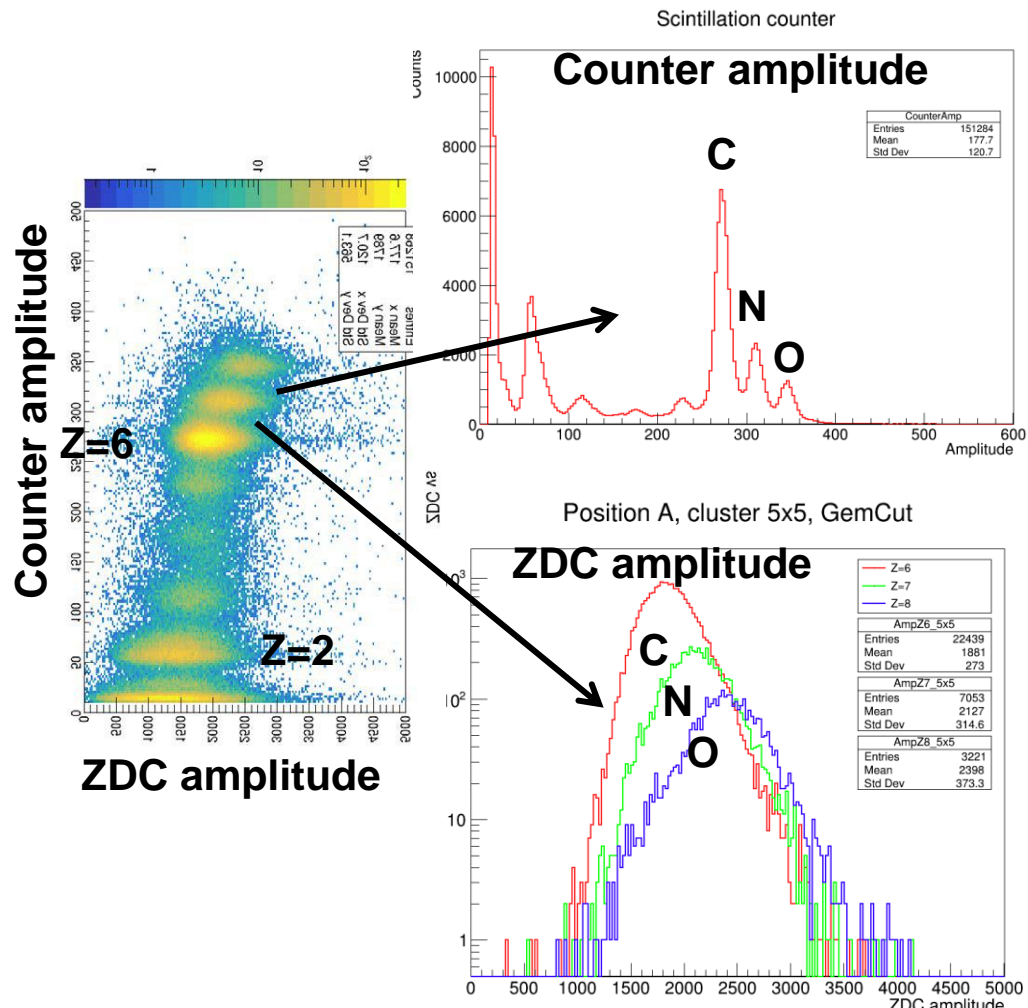
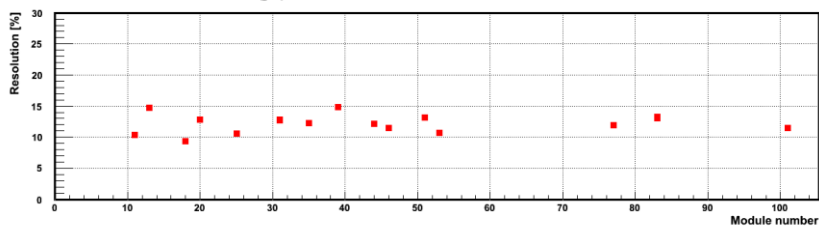
ZDC beam scan along X, Y



Mean energy, systematics ~12%



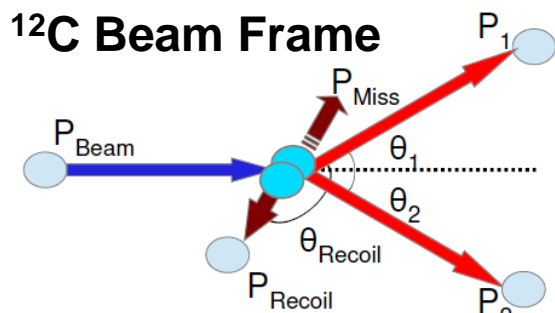
Energy resolution ~12%



ZDC resolution ~2.5 spectators

→ talks of Sergey Morozov and Alexey Stavinskiy

to study SRC with hard inverse kinematic reactions



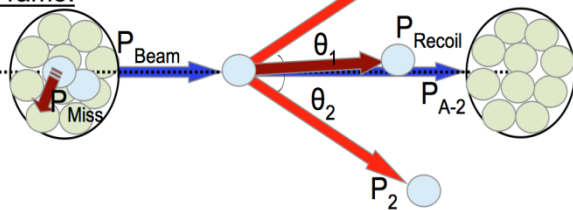
JINR (Dubna): BM@N
Israel: Tel Aviv University
Germany: TUD and GSI
USA: MIT
FRANCE: CEA

Objectives:

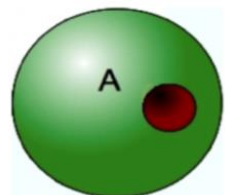
- identify 2N-SRC events with inverse kinematics
- study isospin decomposition of 2N-SRC
- study A-2 spectator nuclear system

Lab frame

Lab Frame:



^{12}C



Projectile

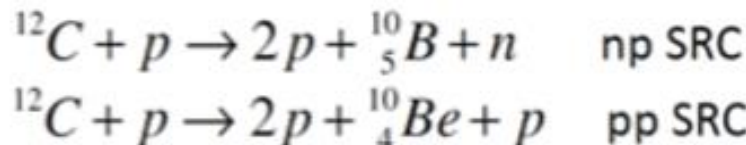
Free target proton

$^{10}\text{B} / ^{10}\text{Be}$



p/n

p



→ SRC status report of Valerii Panin

Cuts

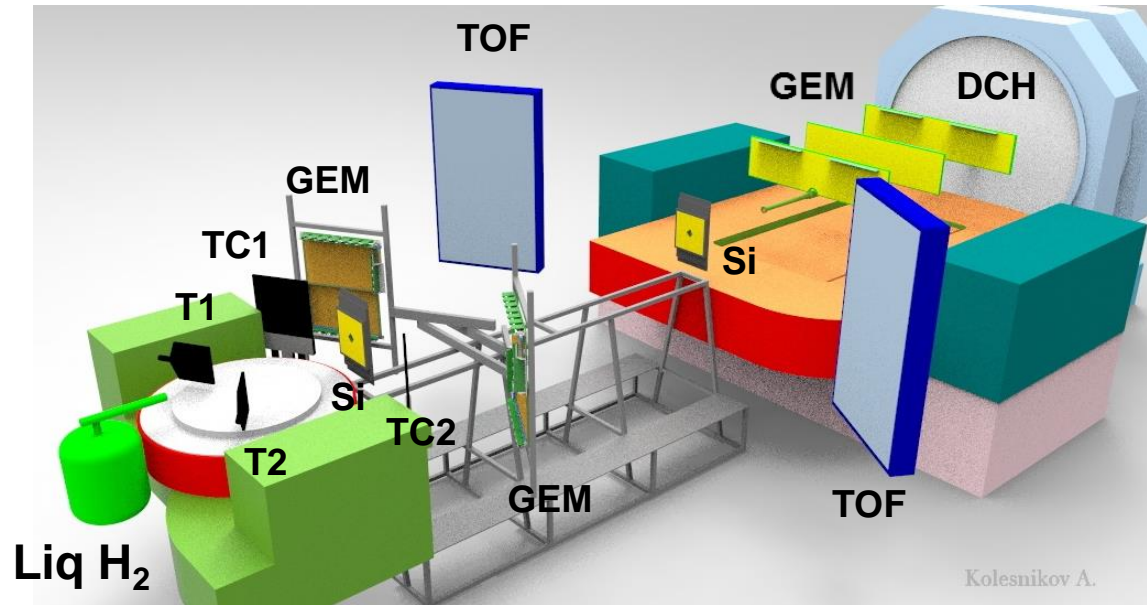
$$|\theta_{1,2}-30^\circ| < 6.5^\circ$$

$$|\Delta\phi_{1,2}| < 7.5^\circ$$

$$|s,t,u| > 2 \text{ (GeV/c)}^2$$

$$P_{\text{miss}} > 0.275 \text{ GeV/c}$$

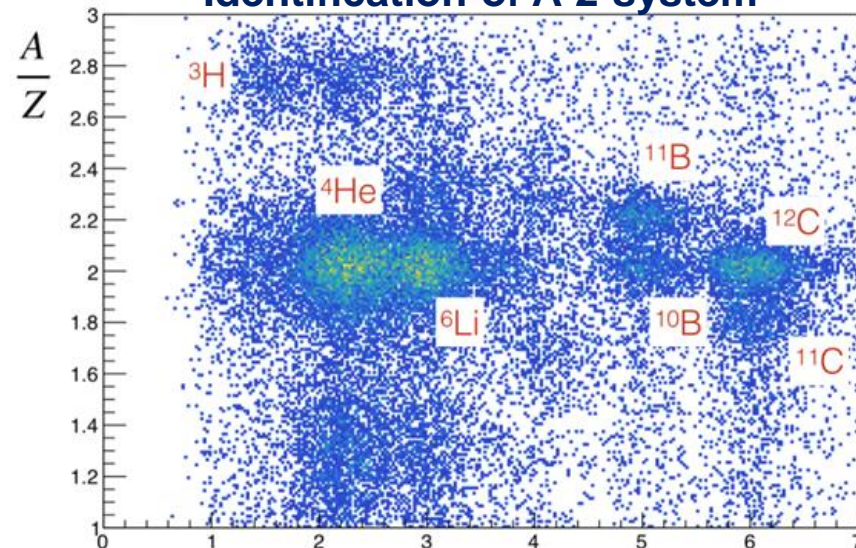
First SRC @ BMN run in
March 2018



First expected results:

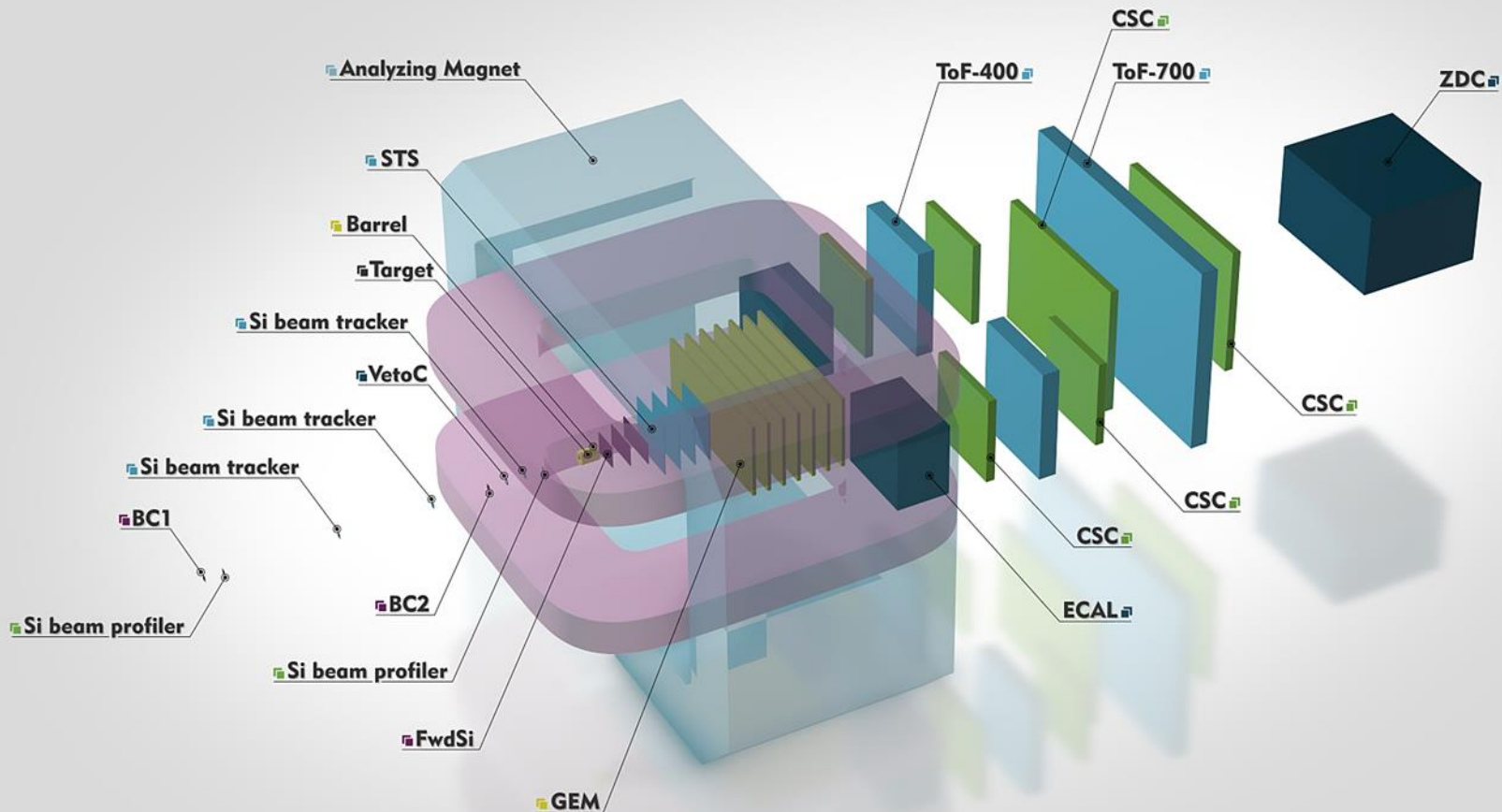
- Study A-2 residual system after SRC knockout
- Study quasi-elastic (p,2p) with 4 GeV/c/nucleon beam

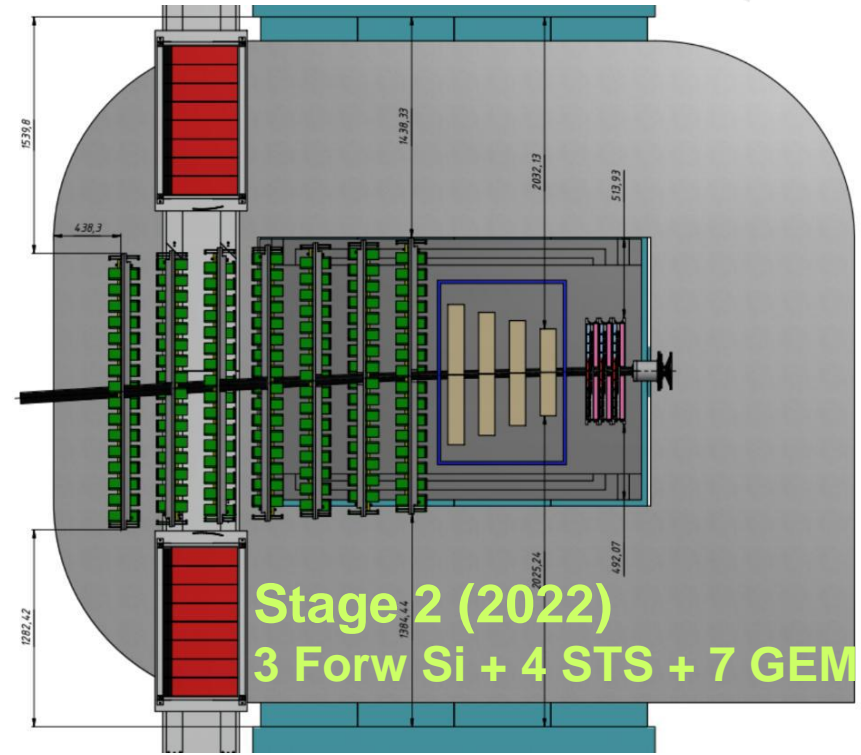
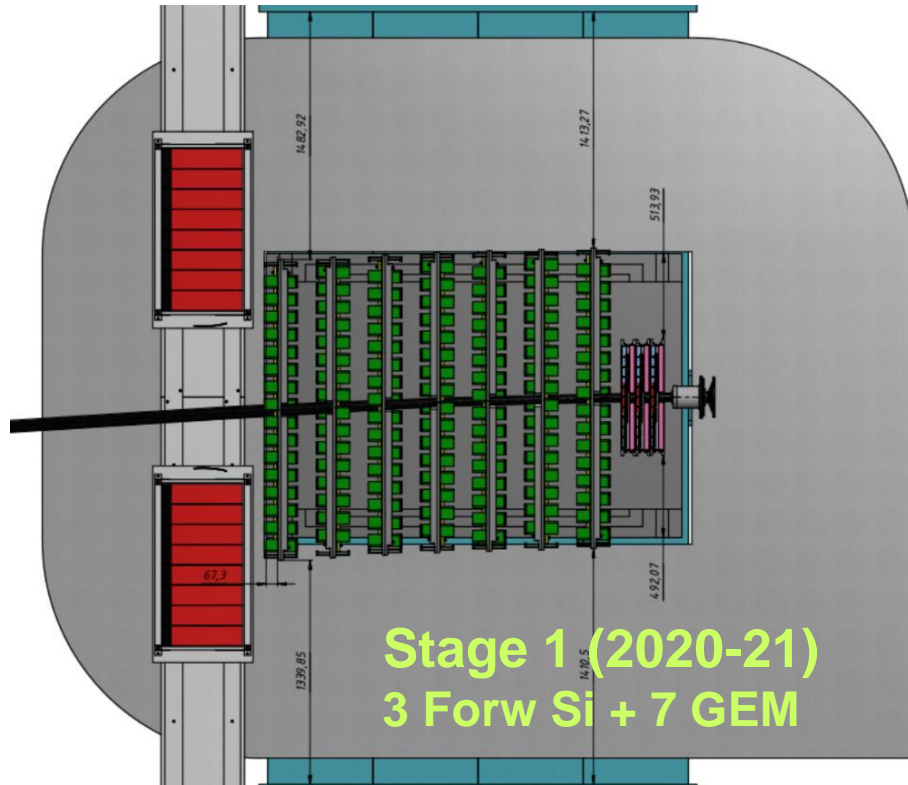
Identification of A-2 system





Configuration of BM@N detector for heavy ion program (without beampipe)





For heavy ion beam intensities
few 10^6 Hz

→ 4 STS + 7 GEM

→ fast FEE and readout electronics

→ Talk of Anna Maksymchuk



Nuclotron - BM@N beam line



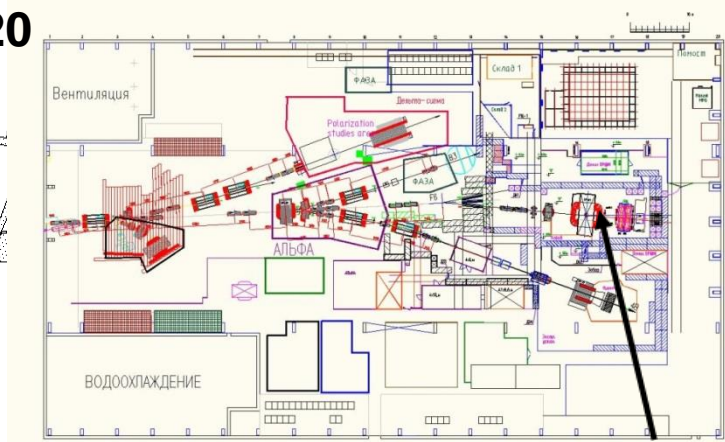
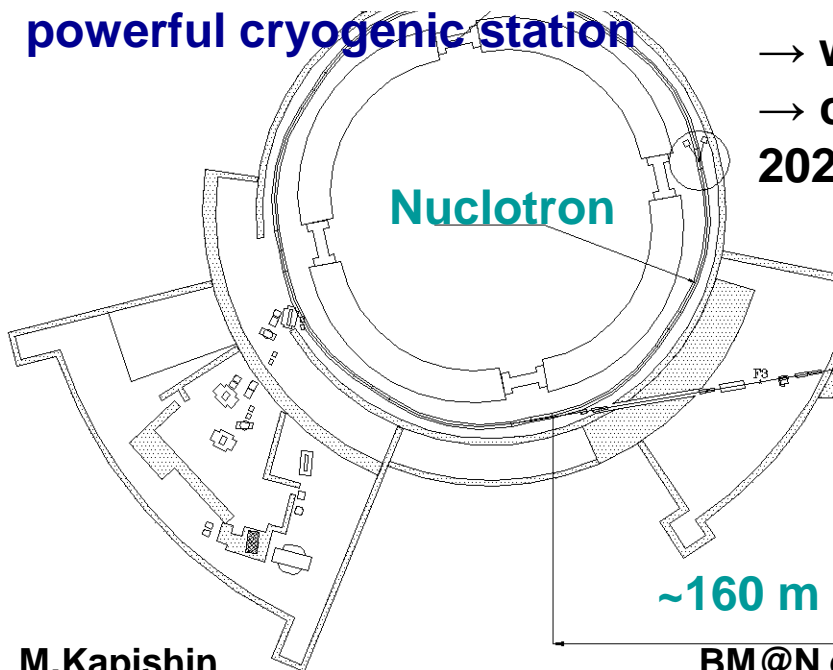
► Upgrade of Nuclotron - BM@N transport channel for heavy ion program:

- replace air intervals / foils with vacuum beam pipe along 160 m of BM@N transport line to get minimum dead material
- implement non-destructive beam position monitoring on movable vacuum inserts
- implement vacuum beam pipe inside BM@N from target to end

► Replacement of transformers, power supplies and cables to power magnetic elements of the transport channel (need a new building to place transformers)

► To use heavy ion beams from Booster-Nuclotron need construction of a new powerful cryogenic station

- we do not expect heavy ion beams before 2021
- carbon beam from laser source could be in fall 2020



Building 205

BM@N

BM@N experiment



Beam parameters and setup at different stages of BM@N experiment



Year	2016	2017 spring	2018 spring	2021	2022 and later
Beam	d(↑)	C	Ar,Kr, C(SRC)	Kr,Xe	up to Au
Max.inten sity, Hz	0.5M	0.5M	0.5M	0.5M	2-5M
Trigger rate, Hz	5k	5k	10k	10k	20k→50k
Central tracker status	6 GEM half planes	6 GEM half planes	6 GEM half planes + 3 forward Si planes	7 GEM full planes + forward Si planes	7 GEM full planes + forward Si + large STS planes
Experiment al status	technical run	technical run	technical run+physics	stage1 physics	stage2 physics

Physics and Analysis working groups (PAWG) and Technical working groups (TWG)



Hyperon reconstruction, simulation and analysis (PAWG)

Convener: Alexander Zinchenko

Particle identification and analysis (TWG+PAWG)

Convener: Mikhail Rummyantsev

Event reconstruction and simulation (TWG)

Convener: Sergey Merts

Software development and data quality analysis (TWG)

Conveners: Konstantin Gertsenberger, Pavel Batyuk

SRC data analysis and simulation (PAWG)

Conveners: Or Hen, Maria Patsyuk

ZDC centrality and ECAL data analysis and simulation (TWG)

Conveners: Sergey Morozov, Sergei Afanasiev, Alexey Stavinskiy

Executive Committee



Mikhail Kapishin, Spokesperson

Peter Senger, Deputy Spokesperson, elected by IB

Anna Maksymchuk, Project Manager

Elected by IB

Konstantin Gertsenberger , Software Coordinator (JINR)

Or Hen (MIT)

Vyacheslav Slepnev (JINR)

Arkadiy Taranenko (MEPhI)

Yi Wang (Tsinghua U.)

Alexander Zinchenko (JINR)

Proposed by Spokesperson, to be approved by IB

Dmitry Dementev (JINR)

Nikolay Zamiatin (JINR)

Speakers Buro formed by EC

**Hans Rudolf Schmidt (Chair), Mikhail Kapishin, Peter Senger,
Or Hen, Arkadij Taranenko, Yi Wang + conveners of PAWG**

Upload your talks for cross check and revision:

<http://indico.jinr.ru/categoryDisplay.py?categId=337>

Procedure to get “BM@N Preliminary” to present results at Conferences



- **Steps of analysis are regularly presented at Analysis plenary meetings or at Collaboration meetings**
- **Analysis is approved in the PAWG, analysis note is prepared in PAWG and distributed to the Collaboration at least a week before the final presentation**
- **At least two internal referees are assigned by the Spokesperson to check the quality of the analysis, physics message, if crucial comments from the Collaboration members are addressed. As a rule, the selected referees serve also at next steps for publication of the final results**
- **The Spokesperson, referees and conveners of the corresponding PAWG discuss performance of the analysis and give green light for the final presentation**
- **The BM@N Preliminary is stamped upon results of the final presentation at the Collaboration meeting or at the Analysis plenary meeting**

**Thank you
for attention!**



BM@N beam profile



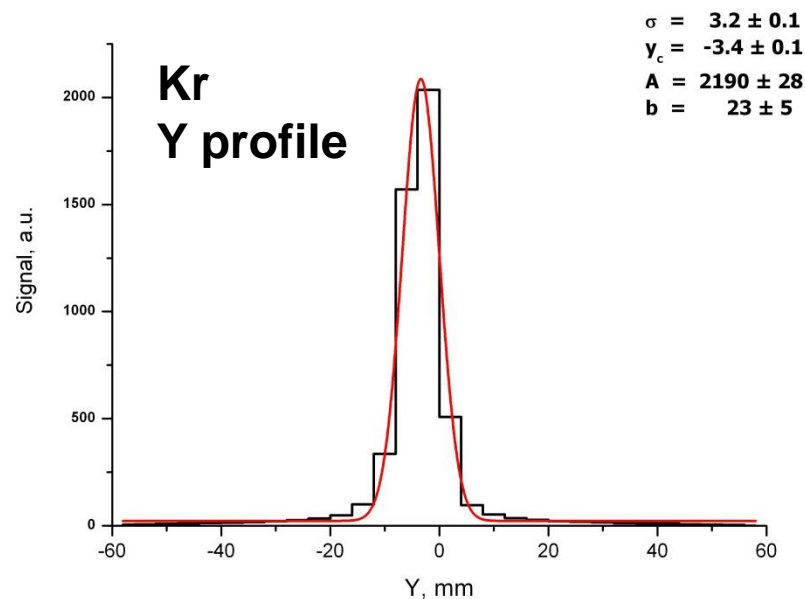
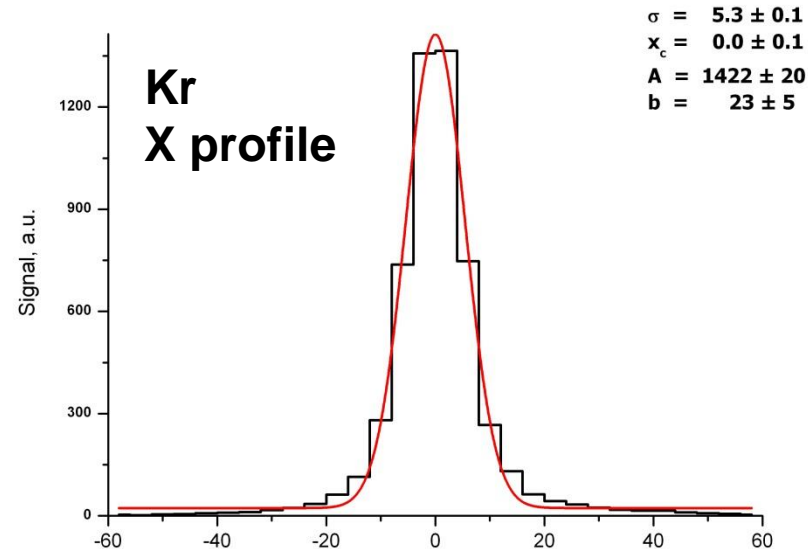
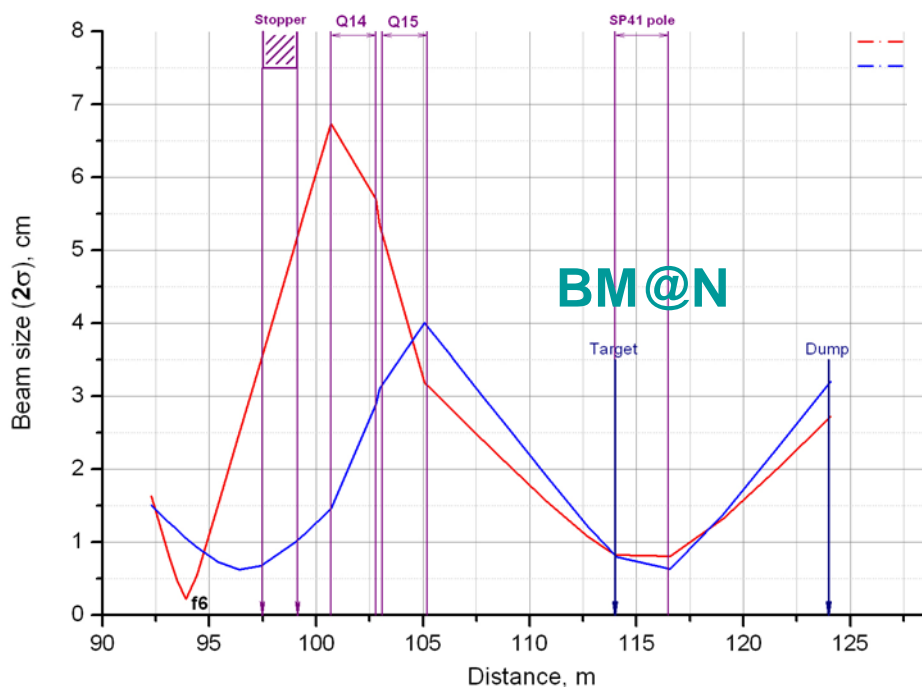
C¹², Ar, Kr beam profiles measured by Nuclotron beam group

C¹² 2017 Ar 2018 Kr 2018

$\sigma_x = 6$ mm 5 mm 5.3 mm

$\sigma_y = 4.9$ mm 5 mm 3.2 mm

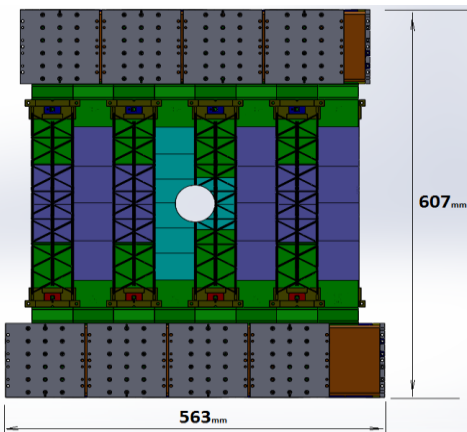
Beam envelopes at the BM@N area





Upgrade of central tracker with CBM STS

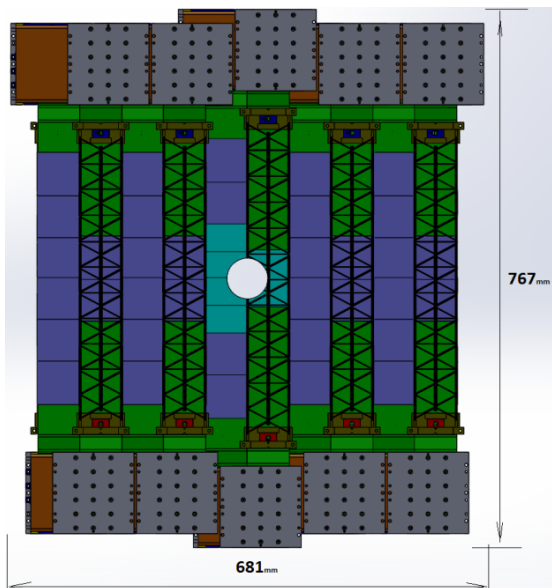
STS-1



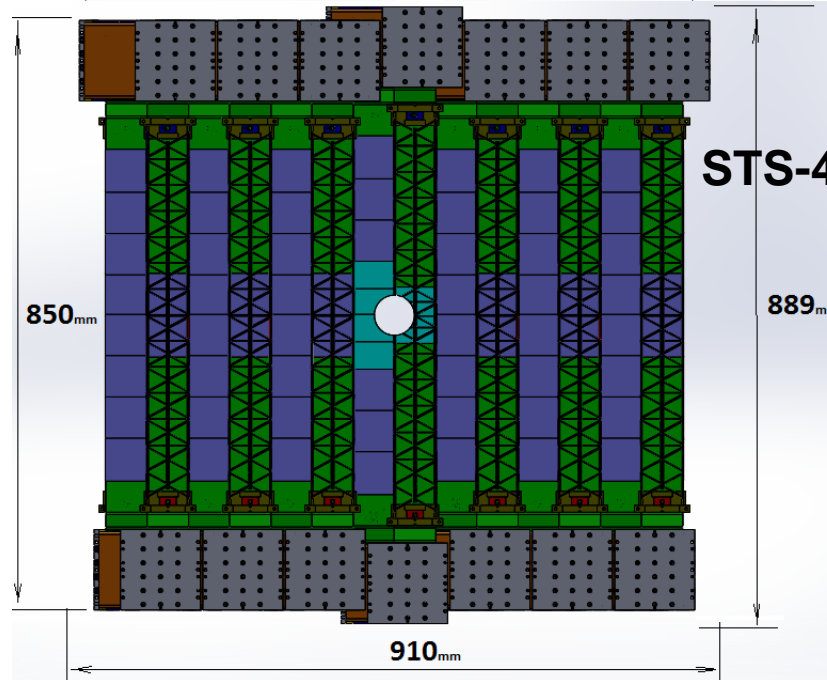
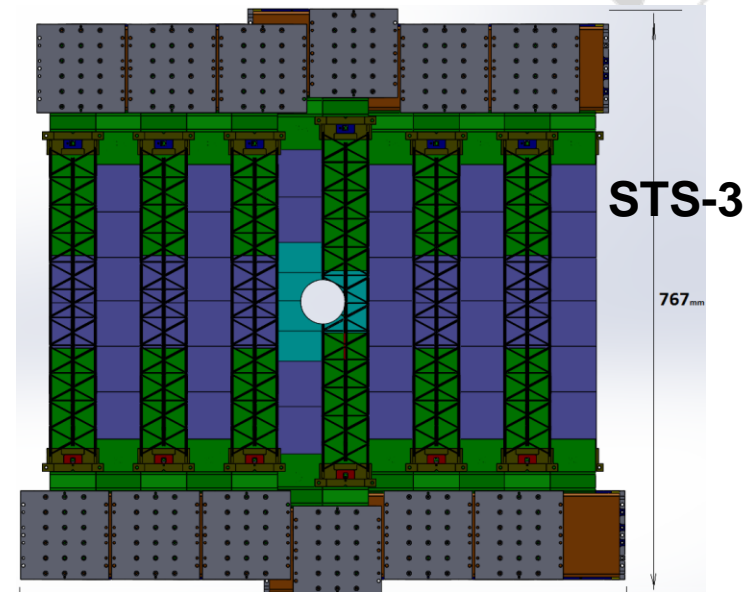
Team: LHEP JINR,
MSU, GSI, Tübingen
University

→ Talks on detector
status and simulation

STS-2



Total: 292 modules,
~600k channels



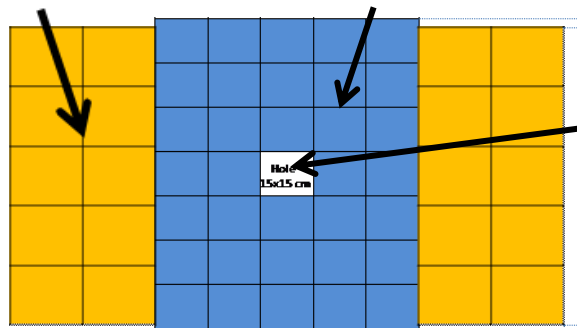


MPD / CBM hadron ZDC calorimeter

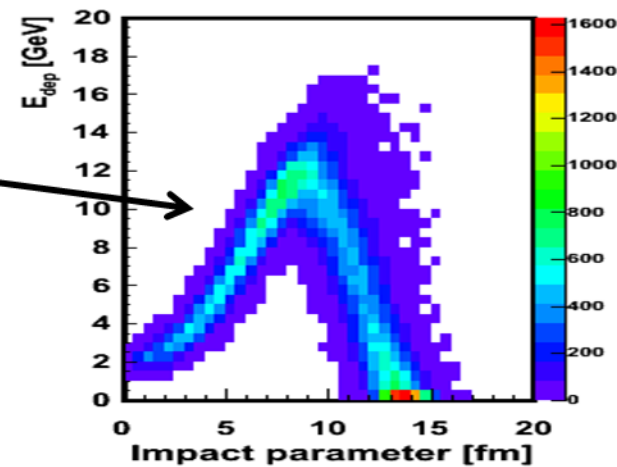


INR RAS Moscow

CBM modules MPD modules



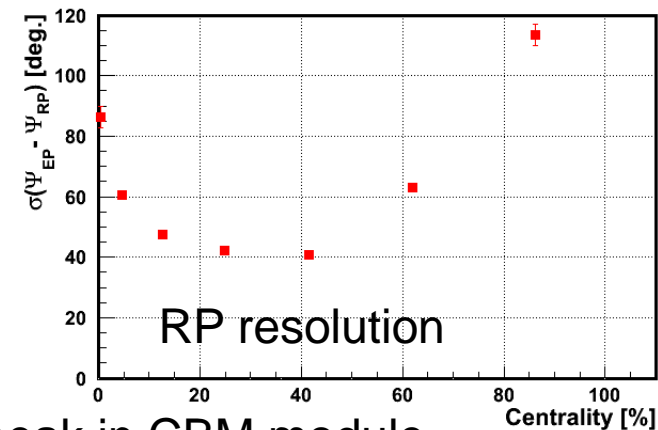
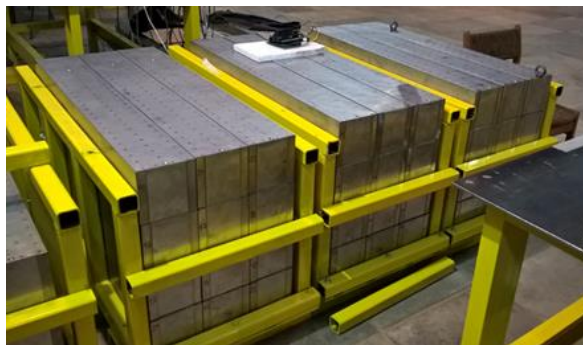
dE/dx scintillator to resolve central / peripheral interactions



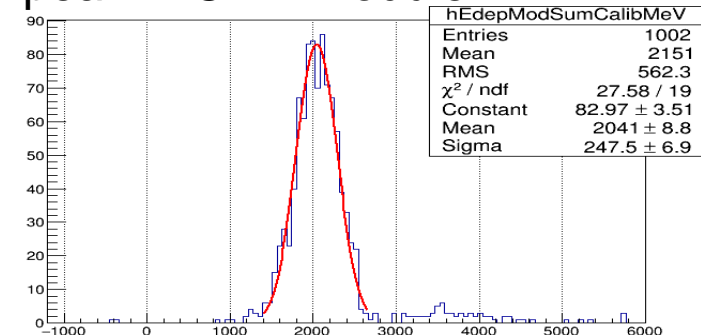
- Modern technics;
- Light yield $\sim x10$ higher;
- Detection of low energies;
- Stable operation at high count rates;
- Experience in operation for later MPD/CBM experiments
- Motivated team

CBM module in BM@N

MPD FHCAL modules



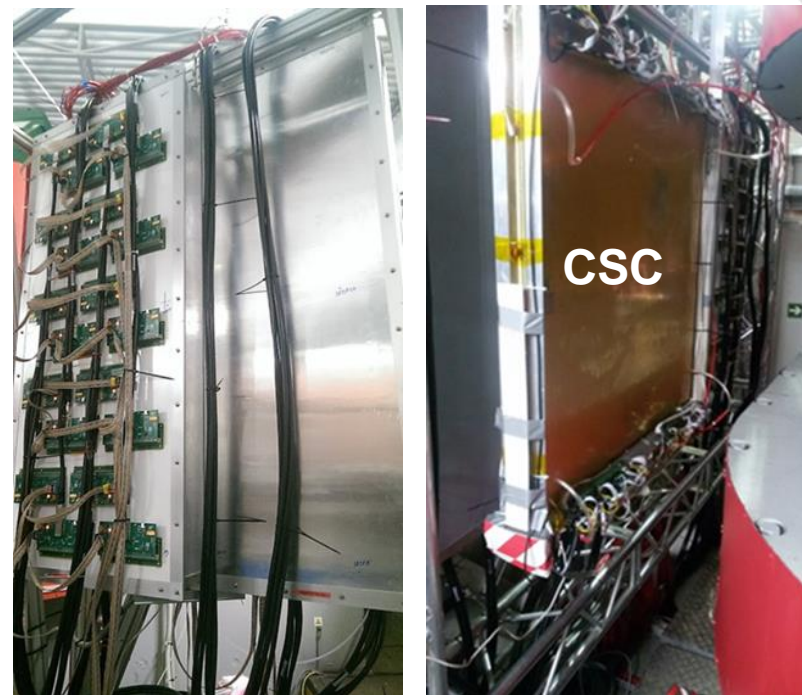
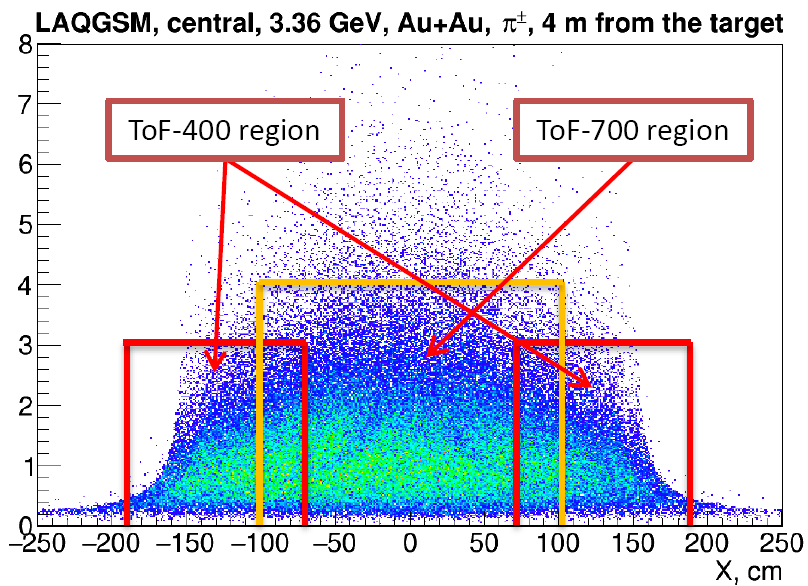
Ar peak in CBM module



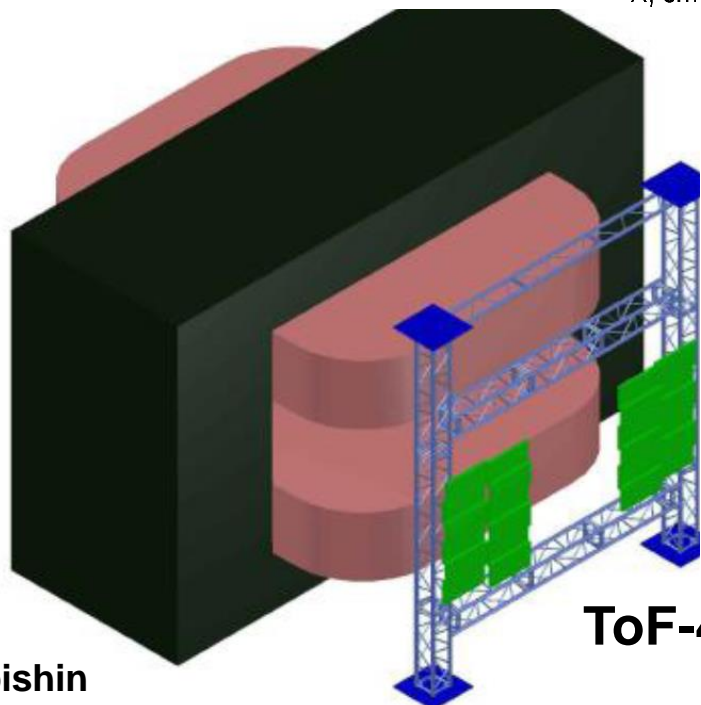
hEdepModSumCalibMeV	
Entries	1002
Mean	2151
RMS	562.3
χ^2 / ndf	27.58 / 19
Constant	82.97 ± 3.51
Mean	2041 ± 8.8
Sigma	247.5 ± 6.9



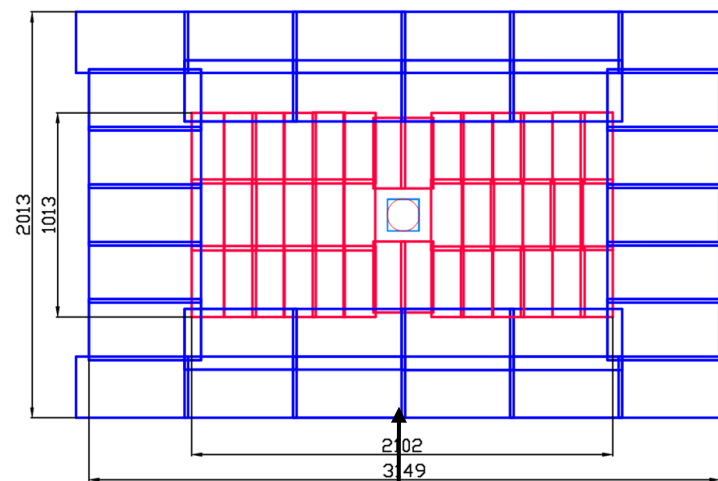
ToF-400 and ToF-700 based on mRPC



ToF-700 wall



ToF-400 wall



BM@N beam axis