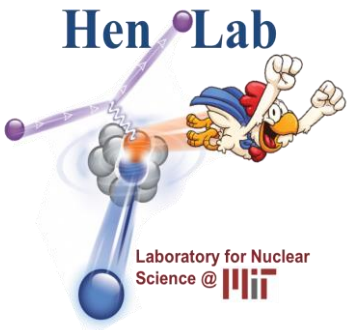
Preparations for the next SRC Experiment

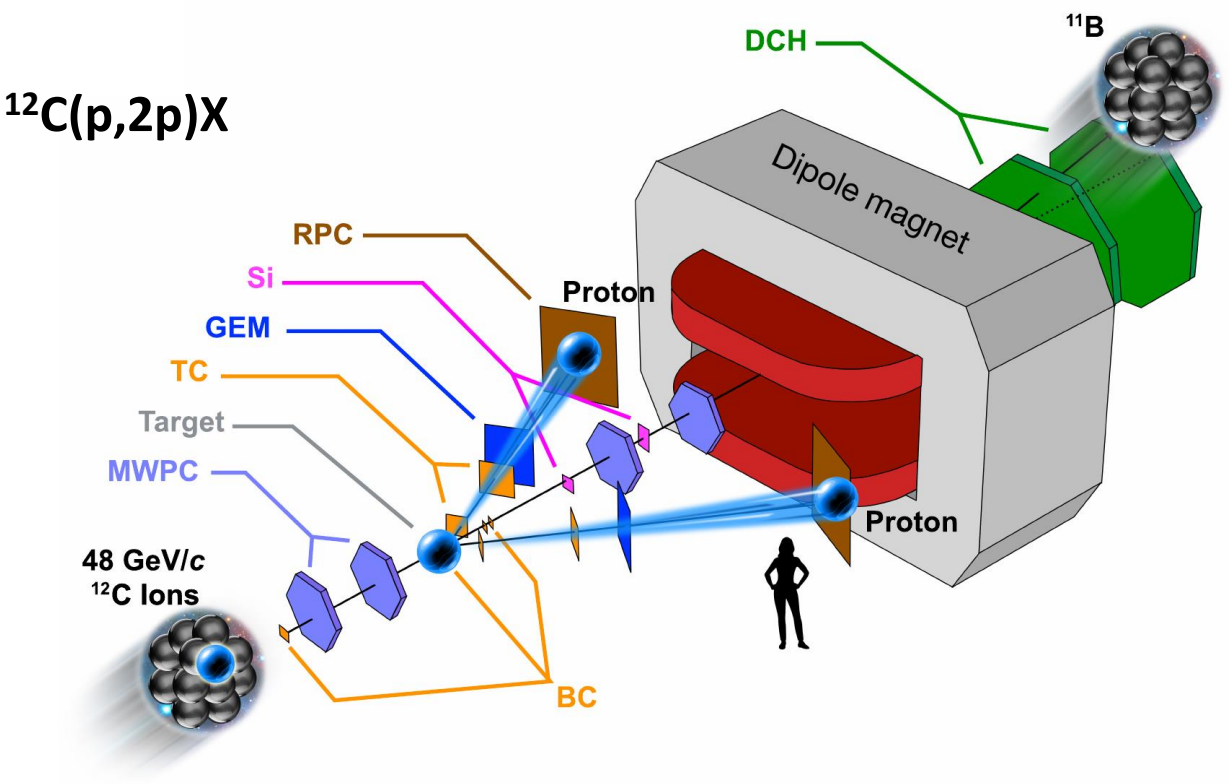
Julian Kahlbow for the SRC team

7th BM@N Collaboration Meeting
April 20th, 2021

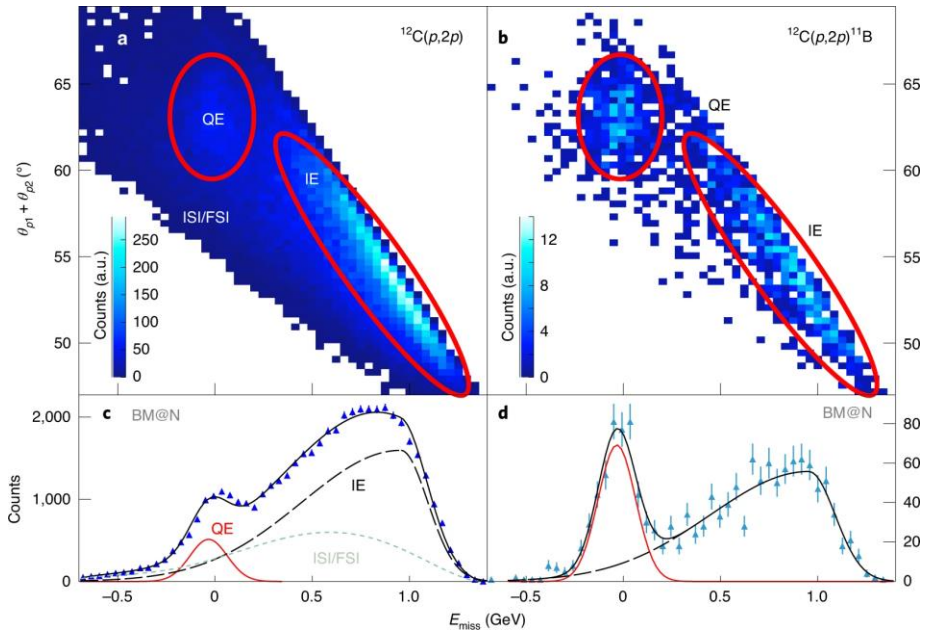


2018 Test Run: Nature Physics (2021)

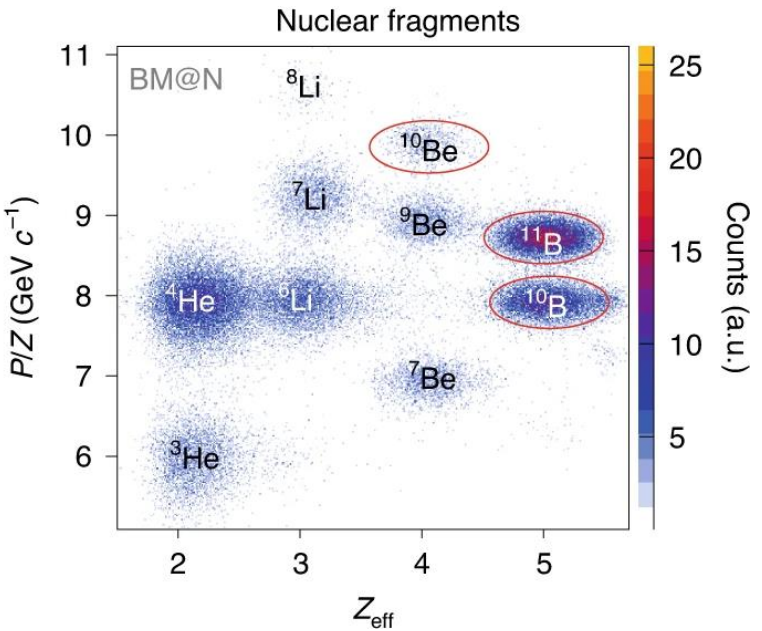
"Unperturbed inverse kinematics nucleon knockout measurements with a carbon beam"



2018 Test Run: Reaction ID

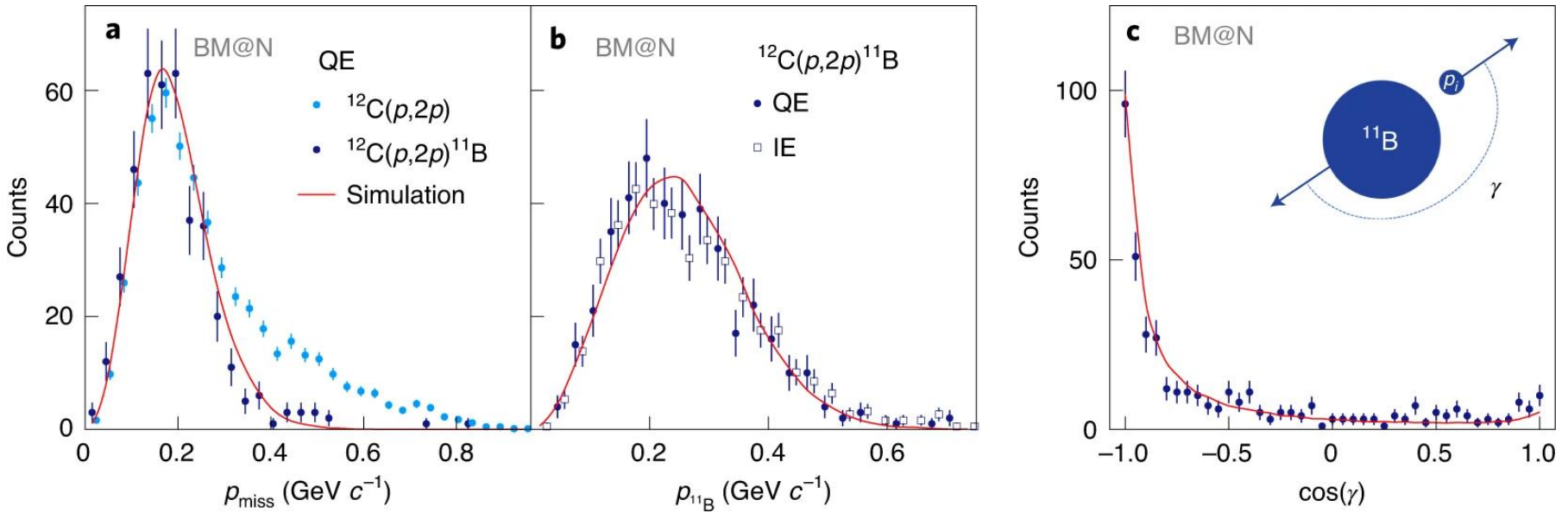


Protons

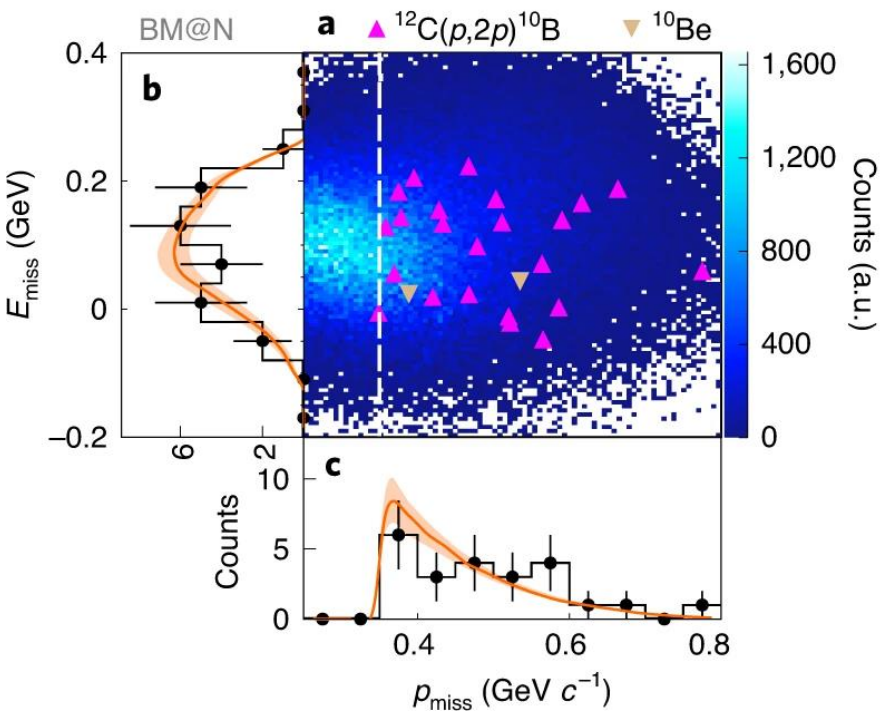


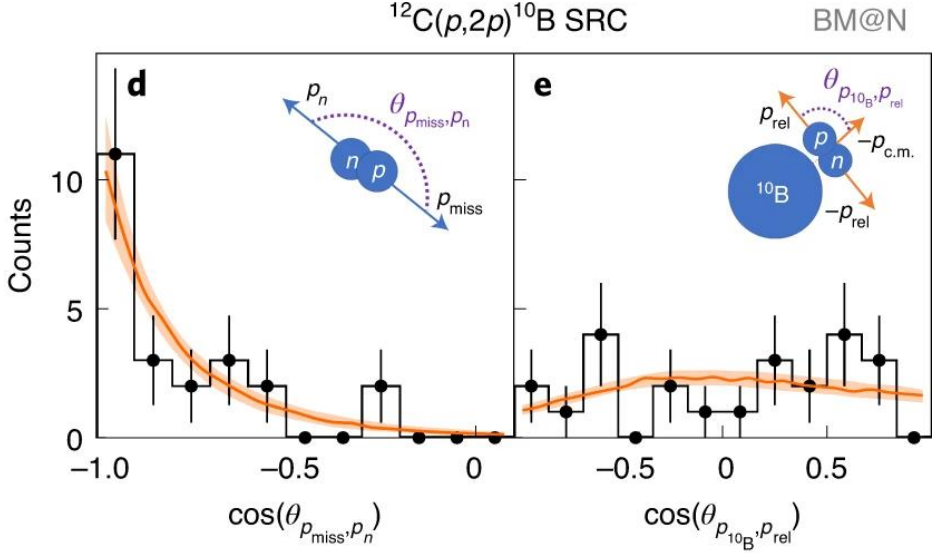
Fragments

2018 Test Run: The “transparent” nucleus



2018 Test Run: 1st SRCs in inverse kinematics





2021 Experiment: Physics Goals

Quasi-elastic Scattering:

- quenching factor
- momentum distribution for deeply bound states

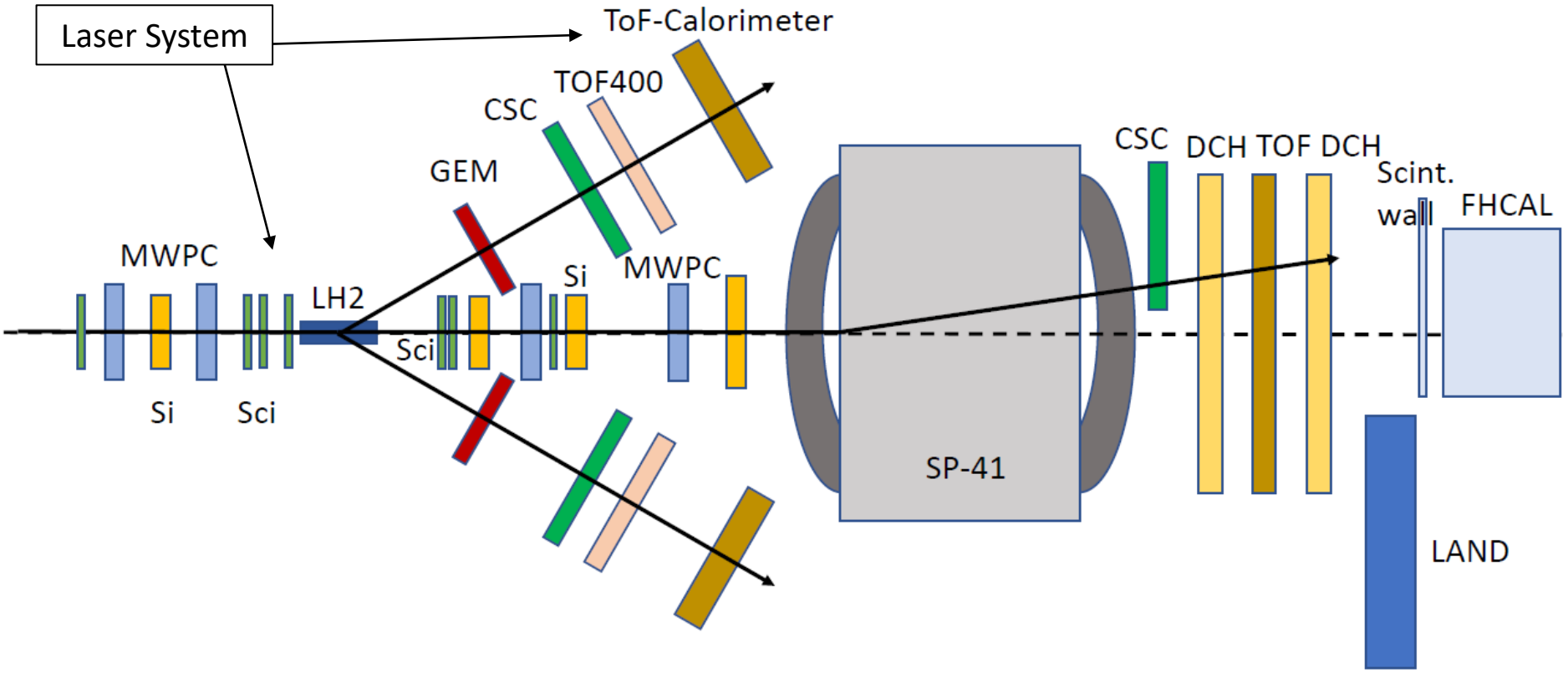
SRC:

- fully exclusive measurement
- incident beam-momentum scan
- search for 3N SRCs

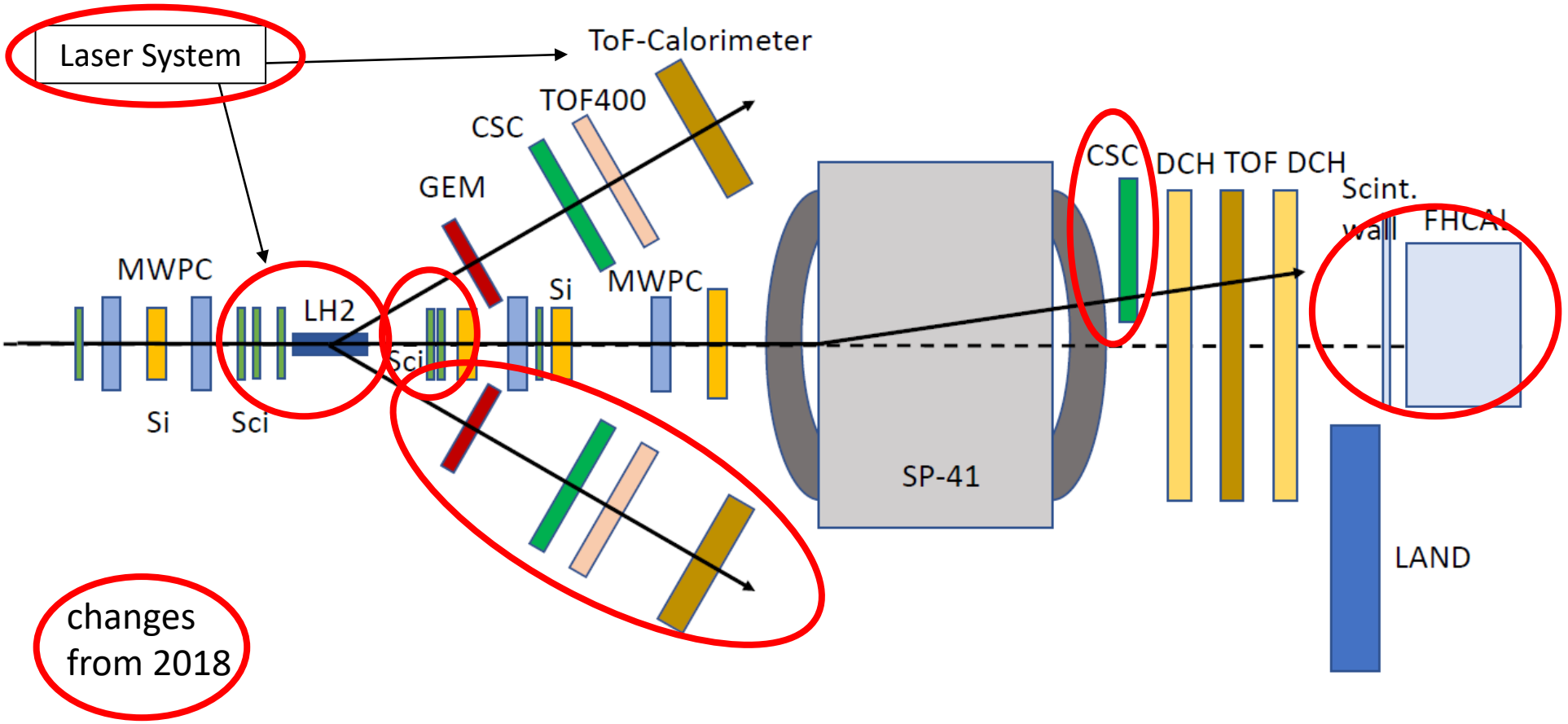
2021 Experiment: Technical Requirements

- absolute cross-section measurement
- improved p/pi ID
- improved missing momentum resolution
- increased fragment detection efficiency
- higher integrated luminosity and acceptance

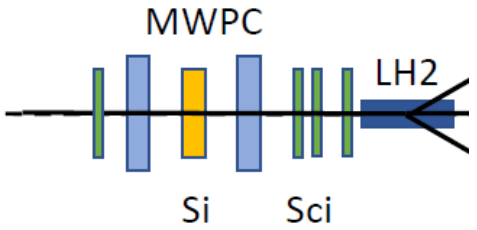
2021 Experiment: Setup



2021 Experiment: Setup



Beam Tracking upstream the target



MWPCs

- 2018: many wires fired (large cluster multipl.)
  -> need to optimize HV & gas-mixture

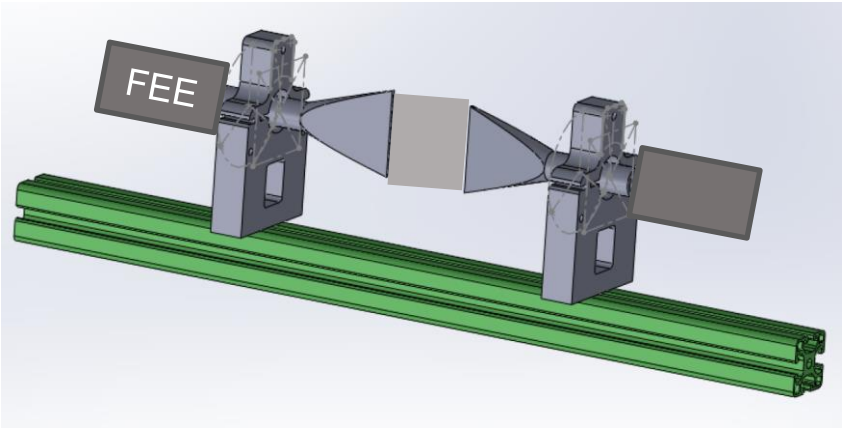
New Si detectors

- for beam tuning, provided by BM@N Collaboration
- removed during data taking

Beam timing: new Start Timers

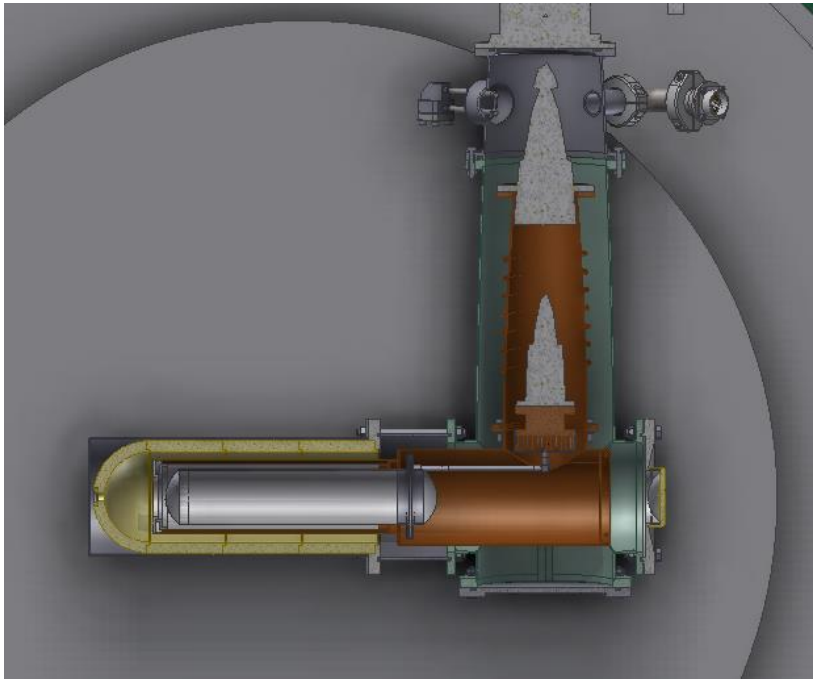
- BC-418 scintillators 6x6 cm², 1mm
- w/ scintillator lightguide
- 2 MCP-PMTs per counter:
  - 2 MCP-PMT XP85012/A1
  - 2 MCP-PMT XPM85112/A1-Q400
- 2 counters, close together

- ready to be shipped to JINR
- assemble at JINR
- front-end electronics: JINR (trigger group)
- tests at JINR



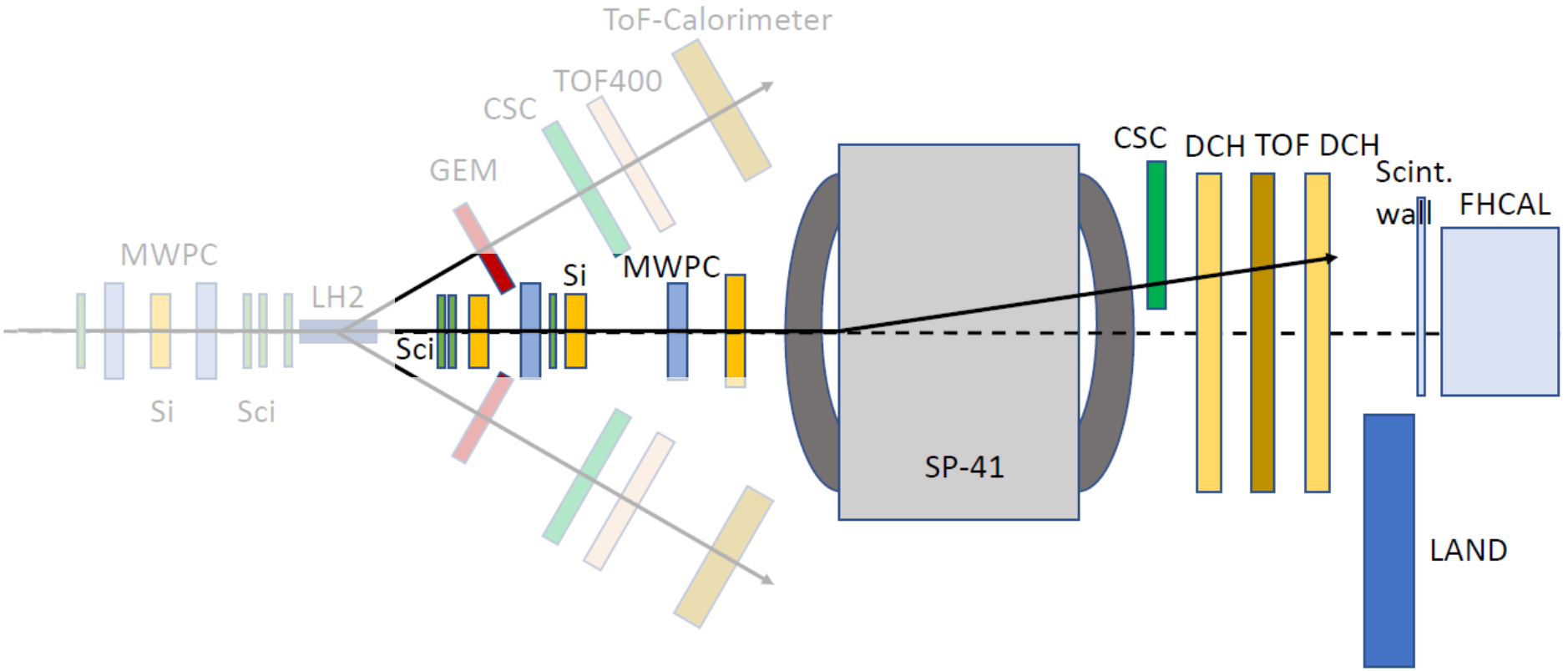
New LH_2 Target

- target at SP-57 center (z-position)
- dimensions: 30cm (length) x 6cm (dia.)
- run also w/ empty target and Pb foil(s)
- veto counter + veto box around target
- target platform being designed



Yu. V. Gusakov, S. Piyadin, I. Kruglova

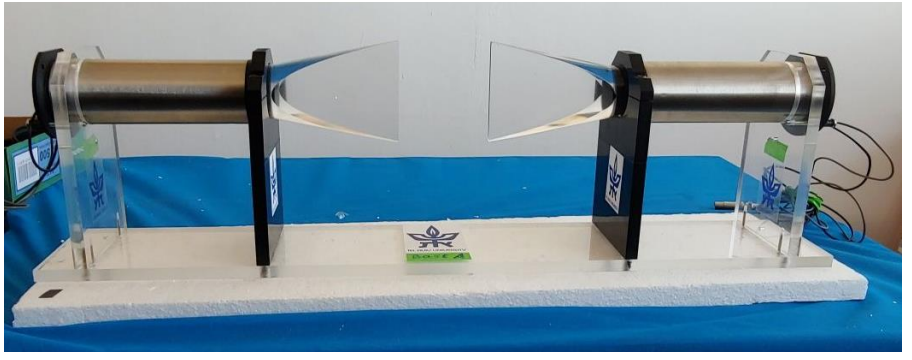
Setup downstream the target



Fragment: Beam Counters

BC3-5

- BC408 scint.: 10x10 cm² (2x3 mm, 1x5 mm)
- lightguide + 2 PMTs (Hamamatsu R7724)
  + shielding
- TQDC readout with 2 amplification stages (JINR)
- ready to be shipped to JINR
- assemble at JINR (electronics from trigger group)
- test at JINR



Fragment Tracking: upstream SP-41

2 x MWPC

develop tuning procedure:

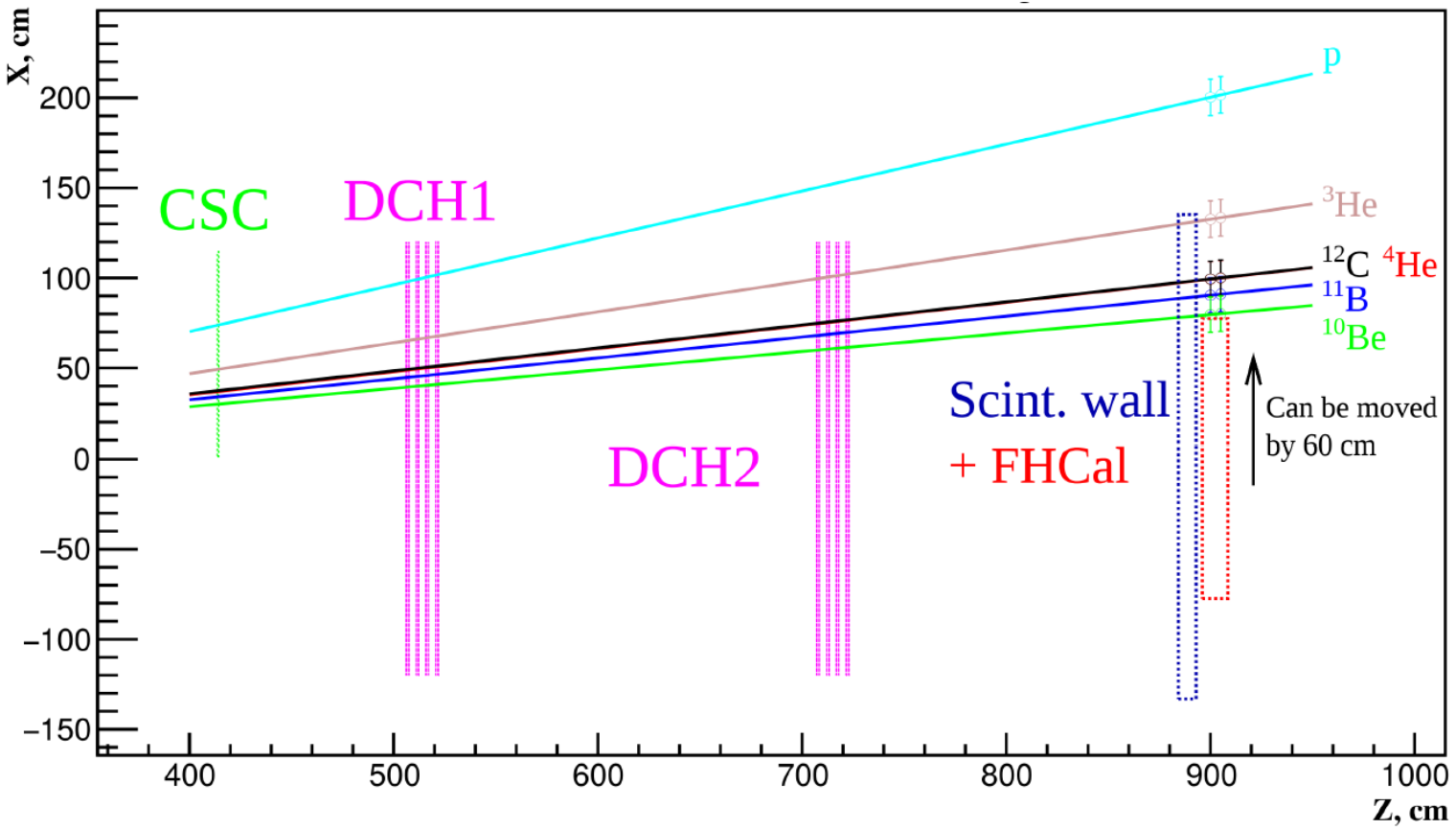
many wires fired (large cluster multipl.) -> tuning HV and gas-mixture for large dynamic range

Si detectors (3 stations)

separate into 3 independent stations

detectors will be checked in summer

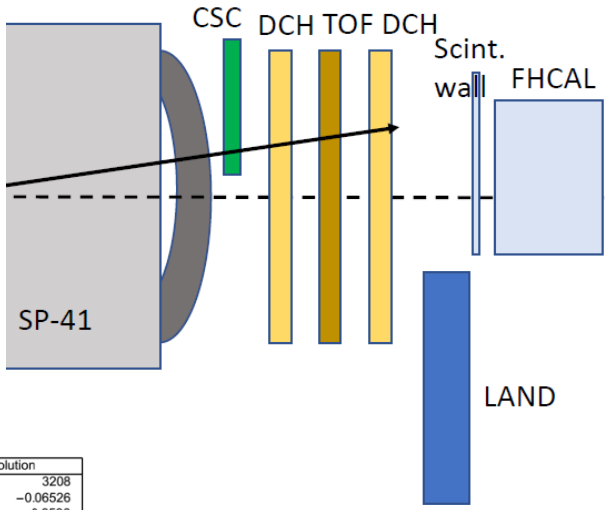
Fragment Tracking

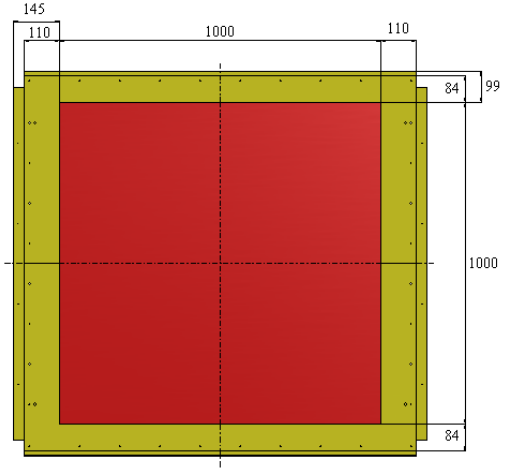


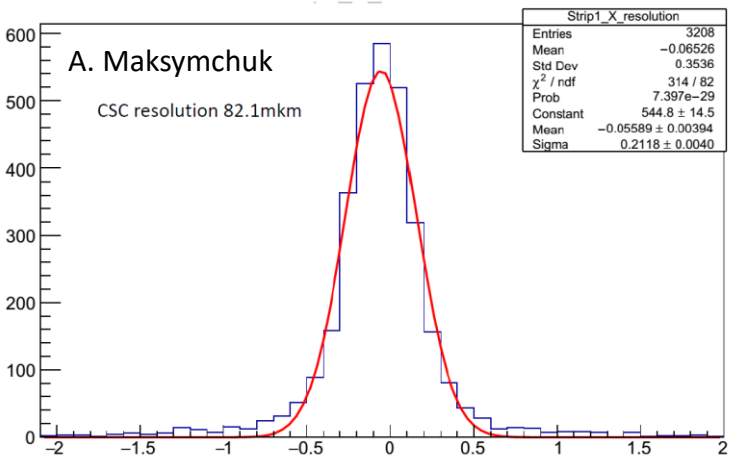
Fragment Tracking: downstream SP-41

CSC

new for SRC run: set up in summer







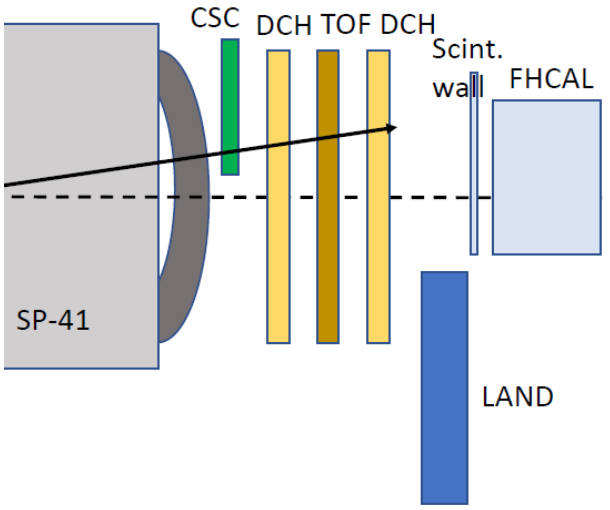
Fragment Tracking: downstream SP-41

DCH 1+2

Need to improve performance

- many ghost tracks
- low tracking efficiency

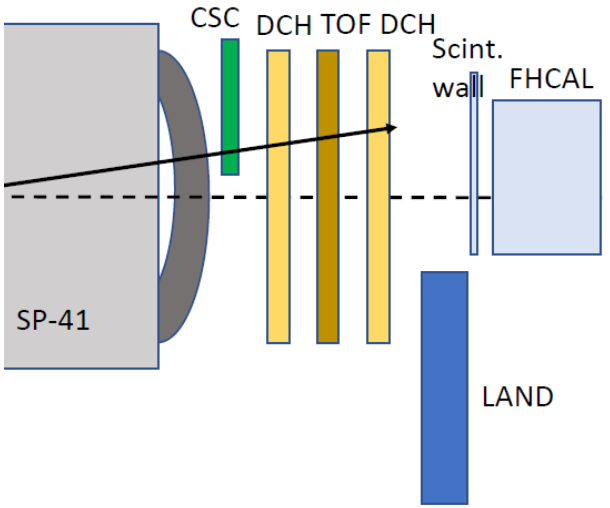
-> HV tuning with beam

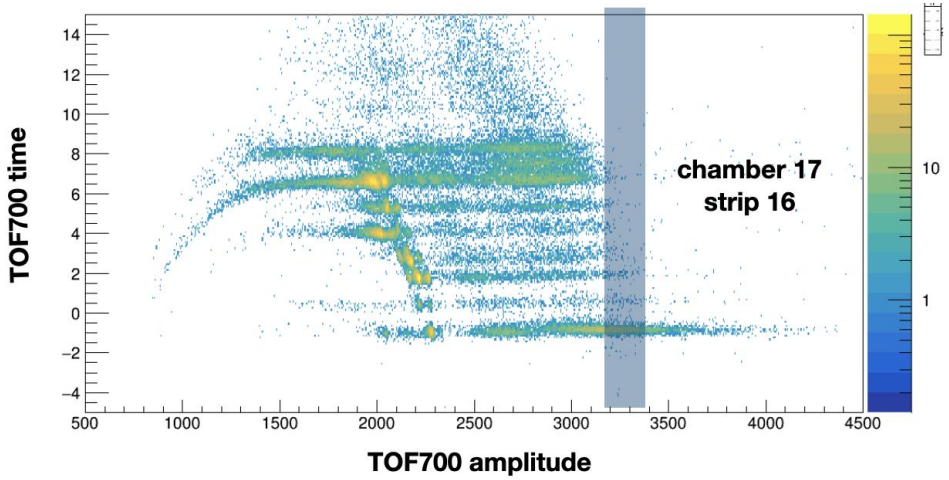


Fragment Tracking: downstream SP-41

TOF700

- need to improve performance:
  multiple time hits
- new calibration method:
  low statistics gamma calibration

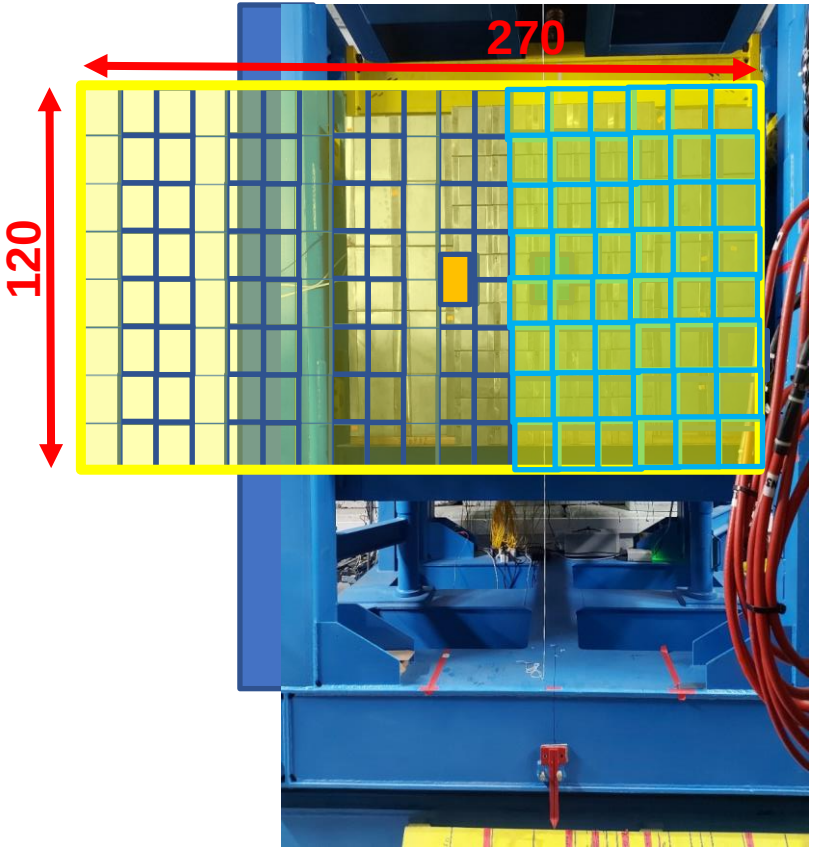




Fragment: Additional ID

FHCAL + Scintillator Wall

optimal position being discussed with FHCal group

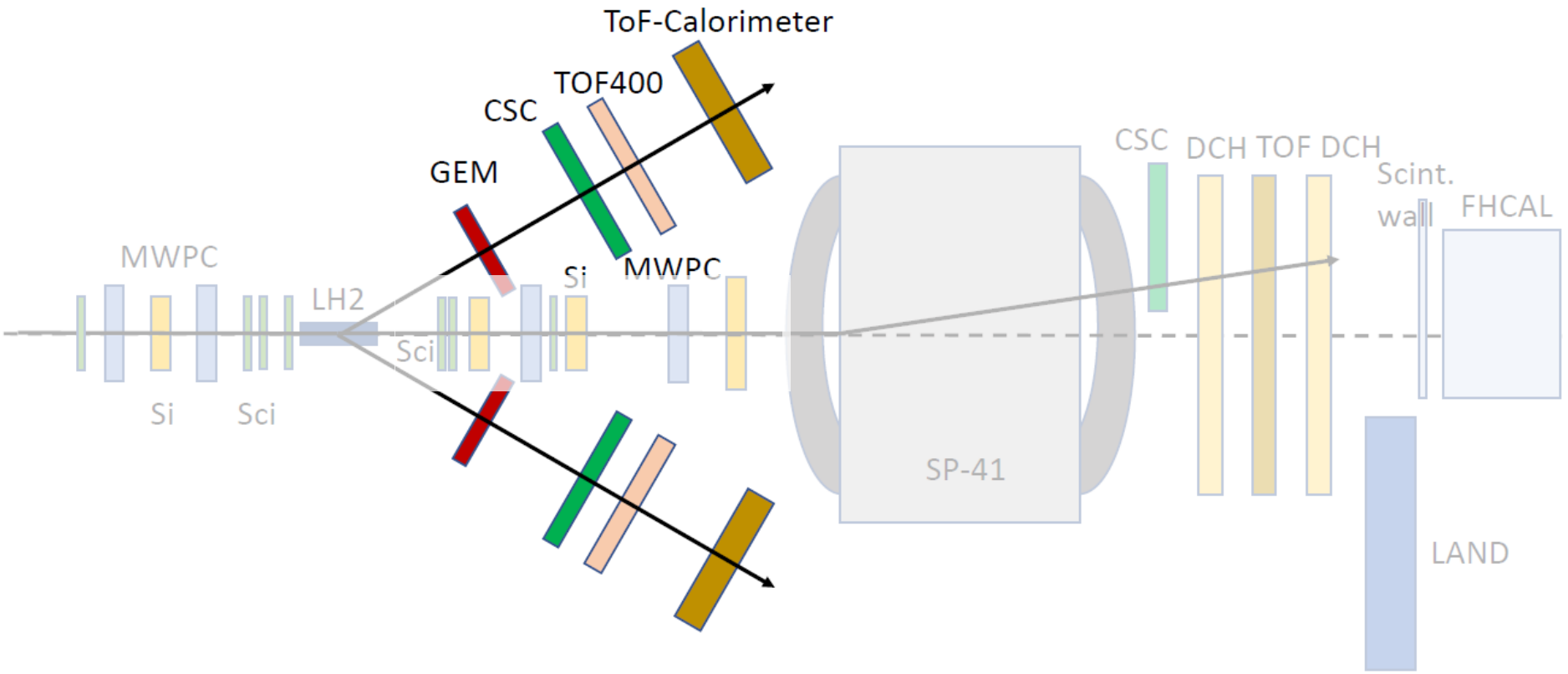


Courtesy: F. Guber

Neutrons: LAND

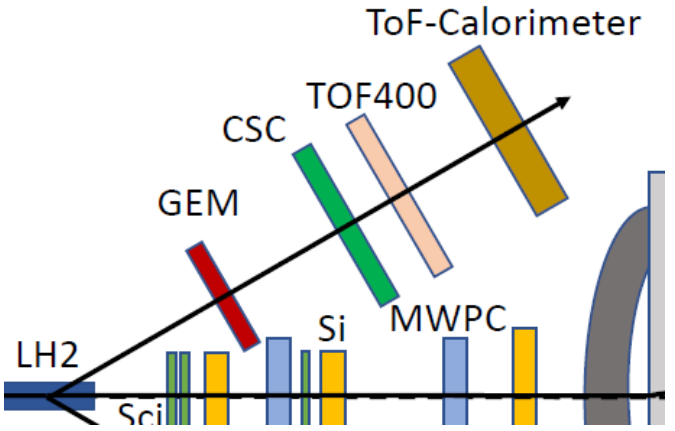
- operated by GSI
- need new HV supply

Proton Arms

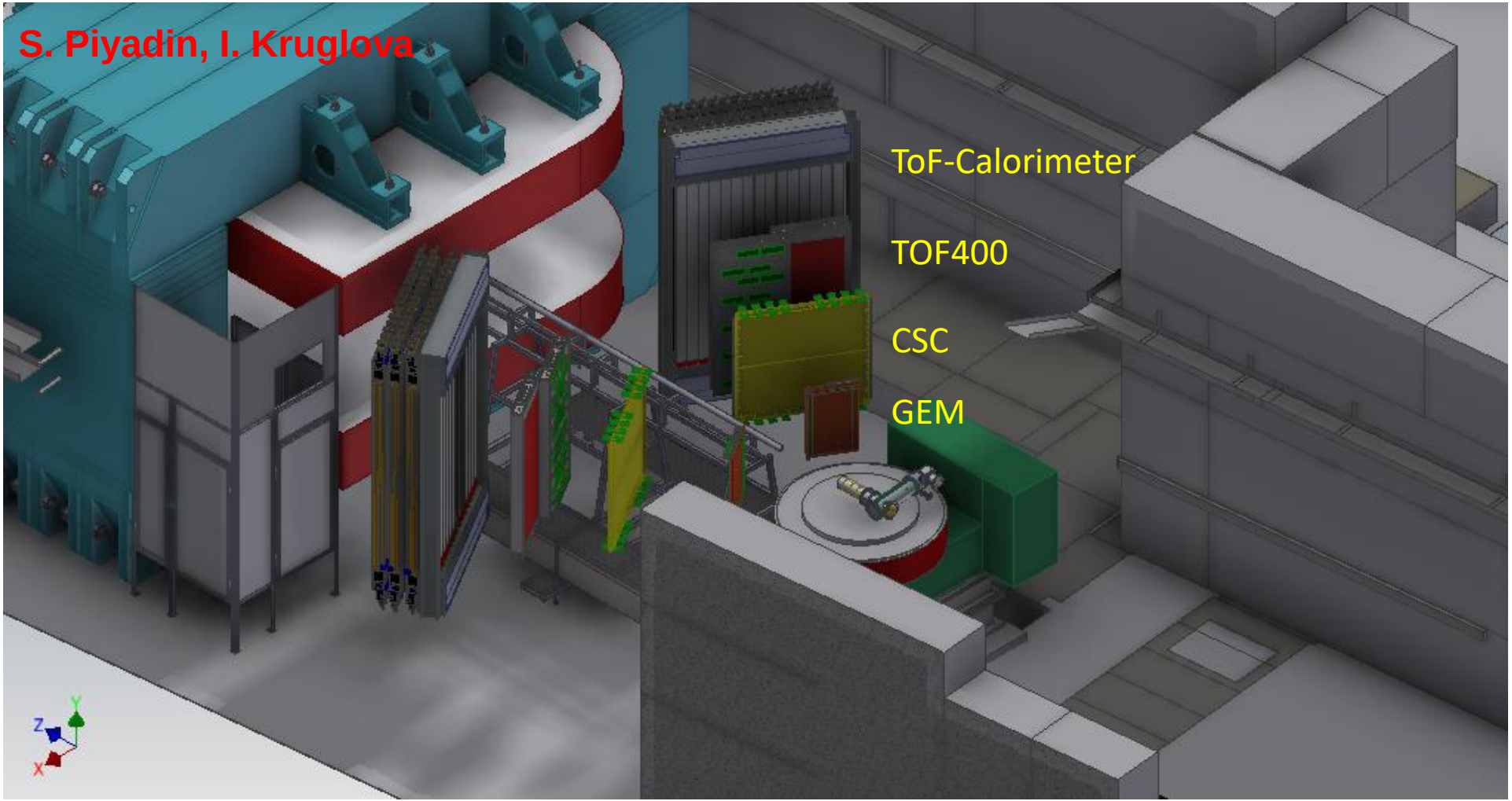

ToF-Calorimeter
TOF400
CSC
GEM
MWPC
LH2
Si
Sci
Si
Sci
MWPC
SP-41
CSC
DCH TOF DCH
Scint.
wall
FHCAL
LAND

Two-Arm Spectrometer

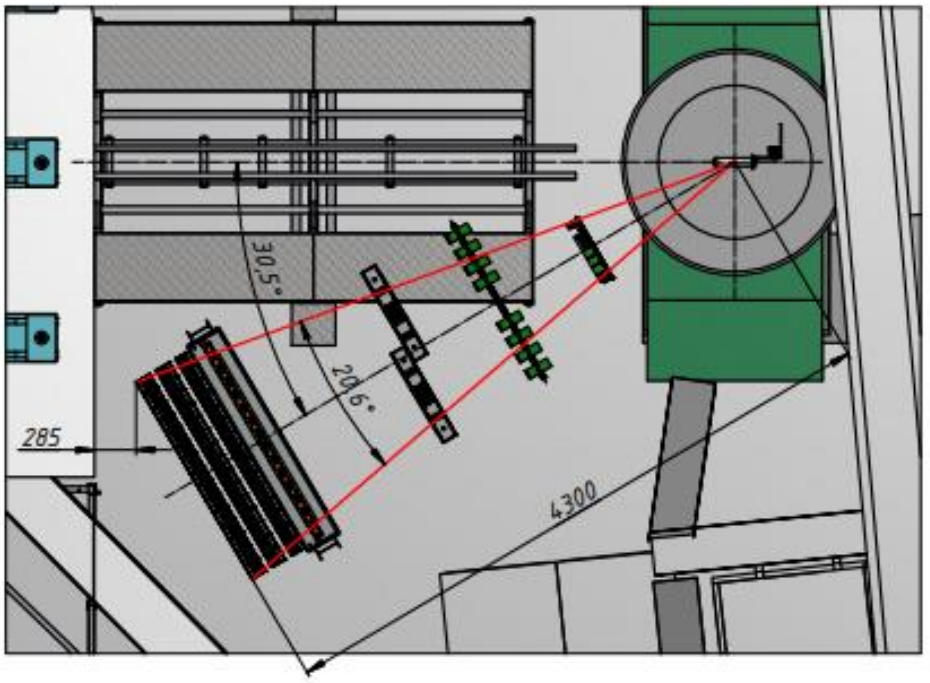
- improved time resolution ~80 ps
- p/pi ID
- increased acceptance
- 3 spatial points for tracking with better resolution

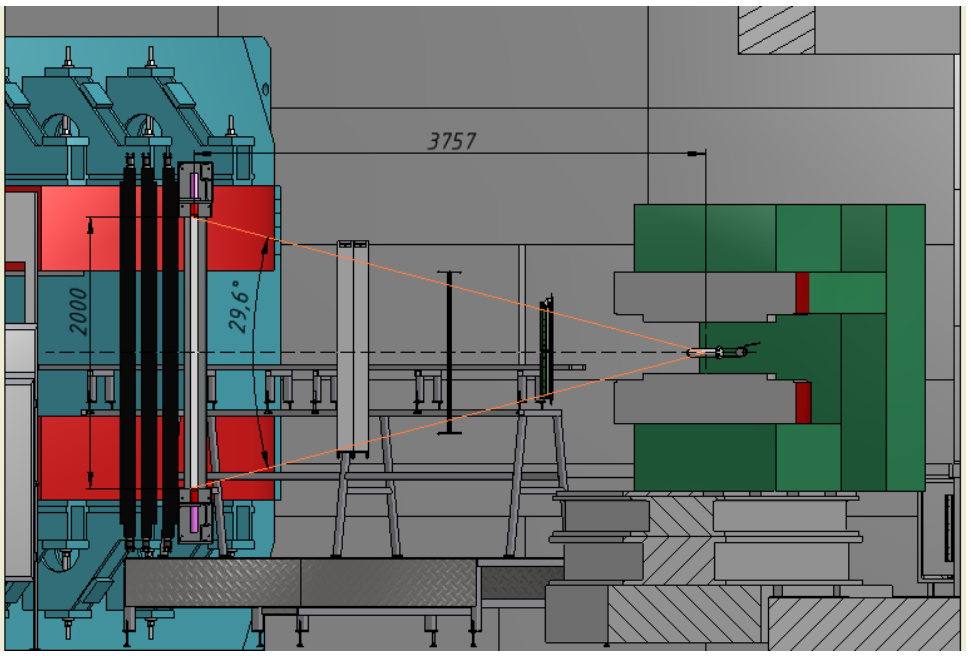


Two-Arm Spectrometer



Two-Arm Spectrometer

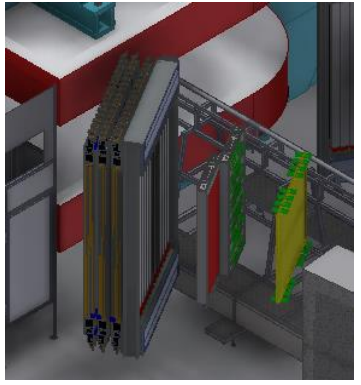


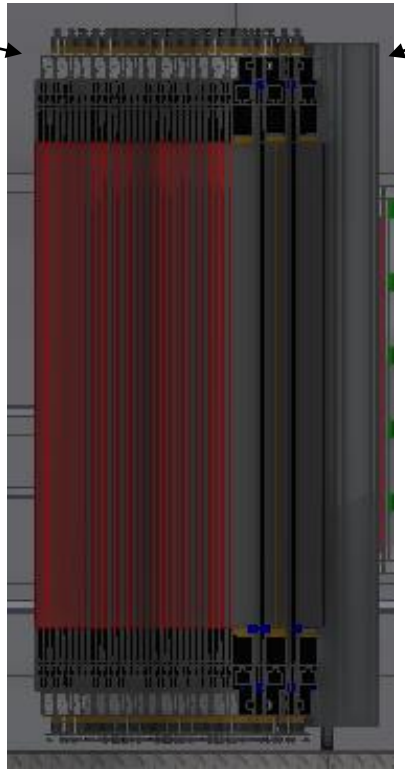


New ToF-Calorimeter

Calorimeter

- 15 LAND paddles x 3 layers
- LAND shipment from GSI
- build frame
- magnetic shielding box
- assemble + test at at JINR





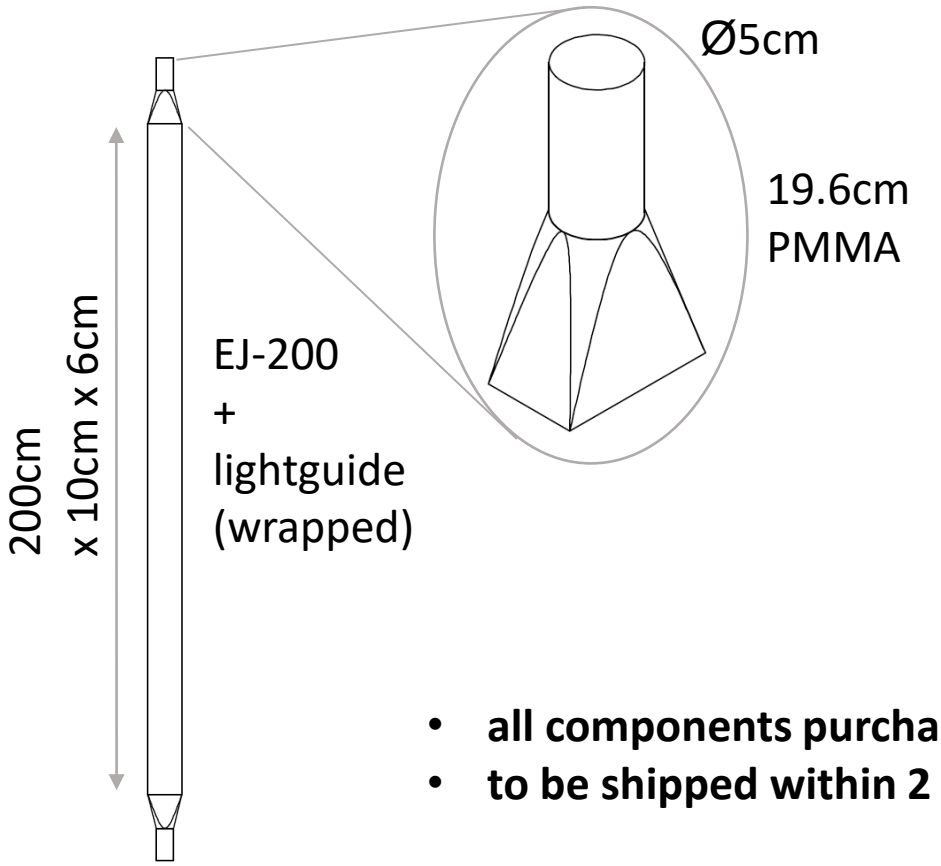
ToF-Array

- 15 Scintillator bars (1 layer)
- PMT readout + mag. shielding
  -> 70ps ToF resolution
- parts to be delivered + assembled at JINR

in total:

- active area: 150cm x 200cm
- 240 signal + HV channels
- using Tacquila electronics (GSI)
- need new HV supplies + cabling

New ToF-Array: Assembly



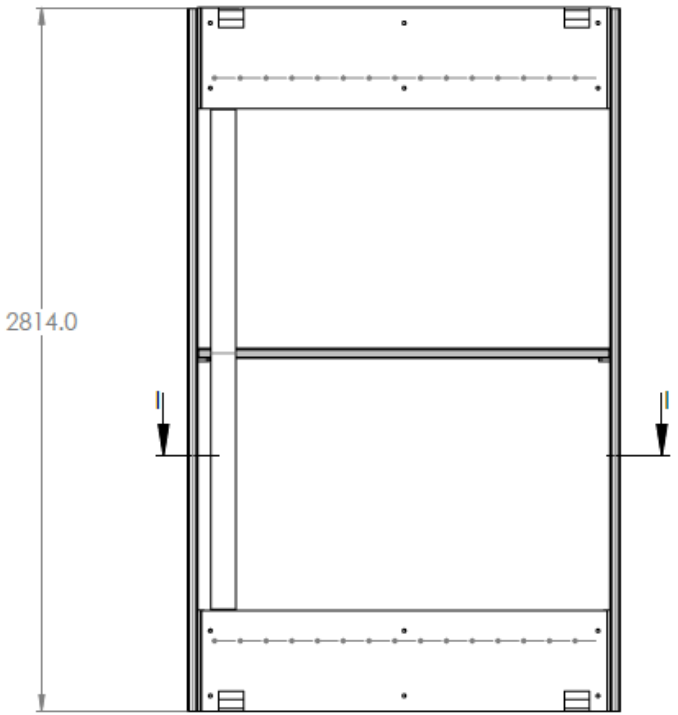
+ Hamamatsu R13435 PMT
+ mu-metal shield

Glueing stand:

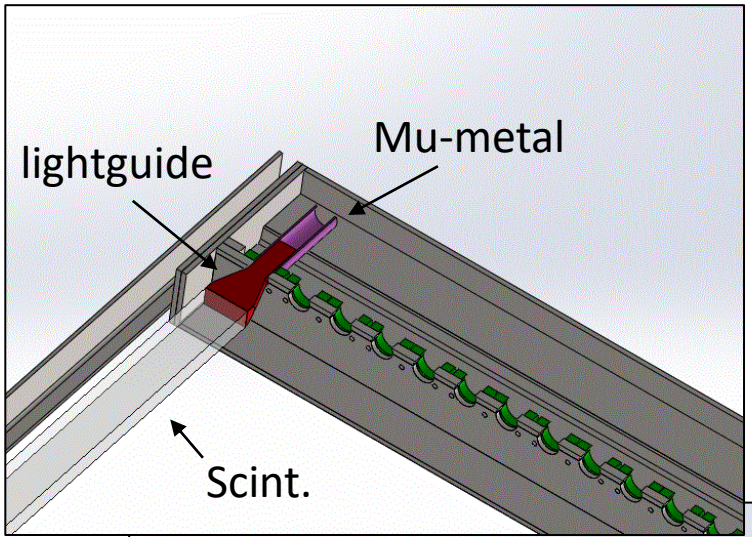
- **all components purchased**
- **to be shipped within 2 months**

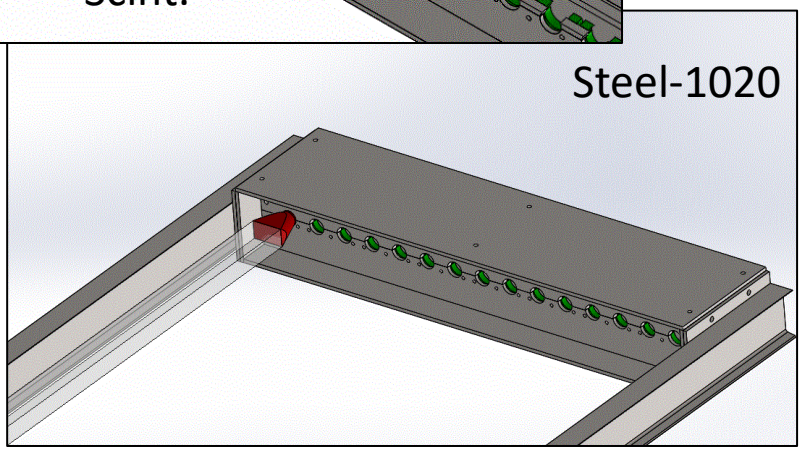
New ToF-Array: Frame

In production at TAU

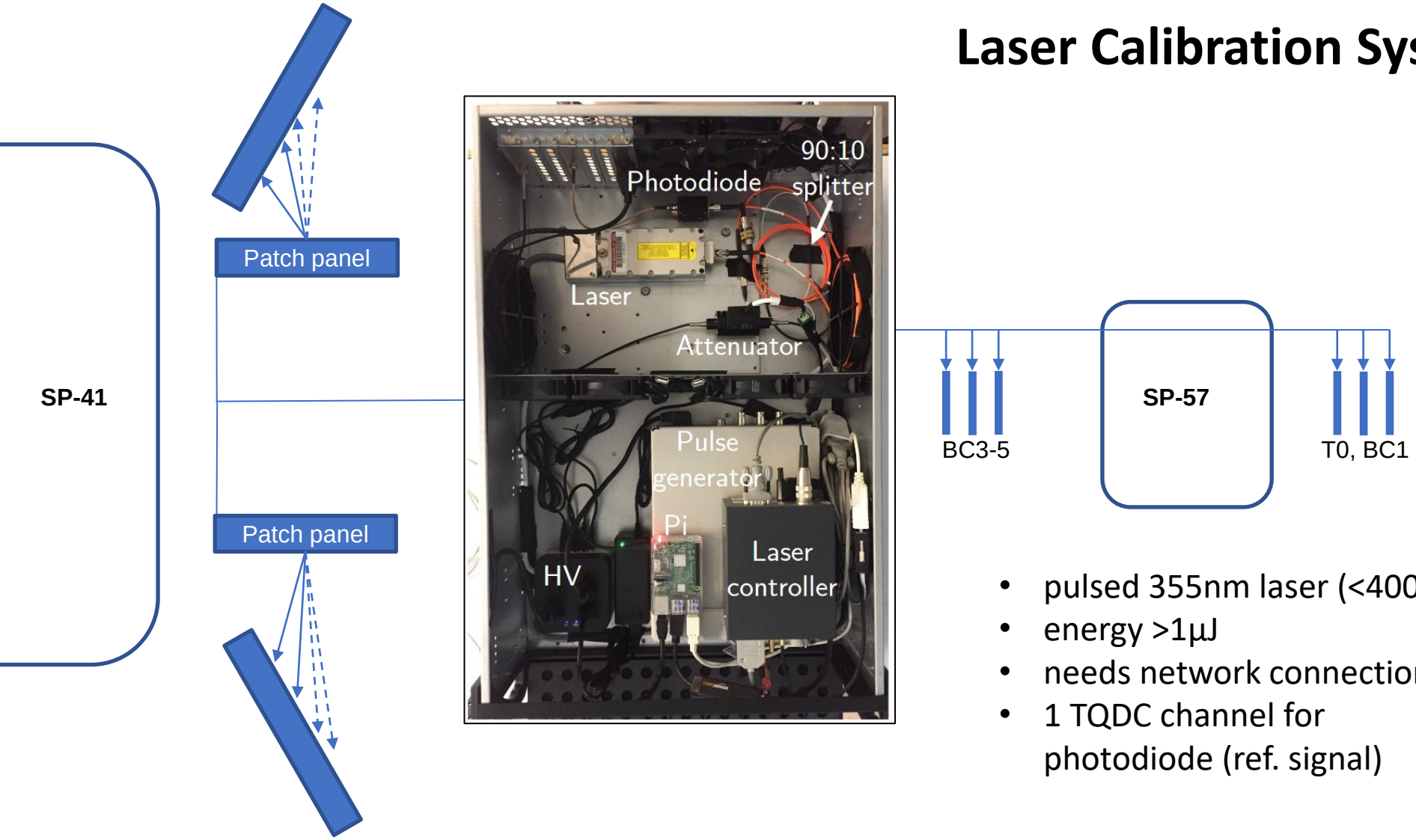


(attached to Calorimeter frame)





Laser Calibration System



- pulsed 355nm laser (<400ps)
- energy >1µJ
- needs network connection
- 1 TQDC channel for photodiode (ref. signal)

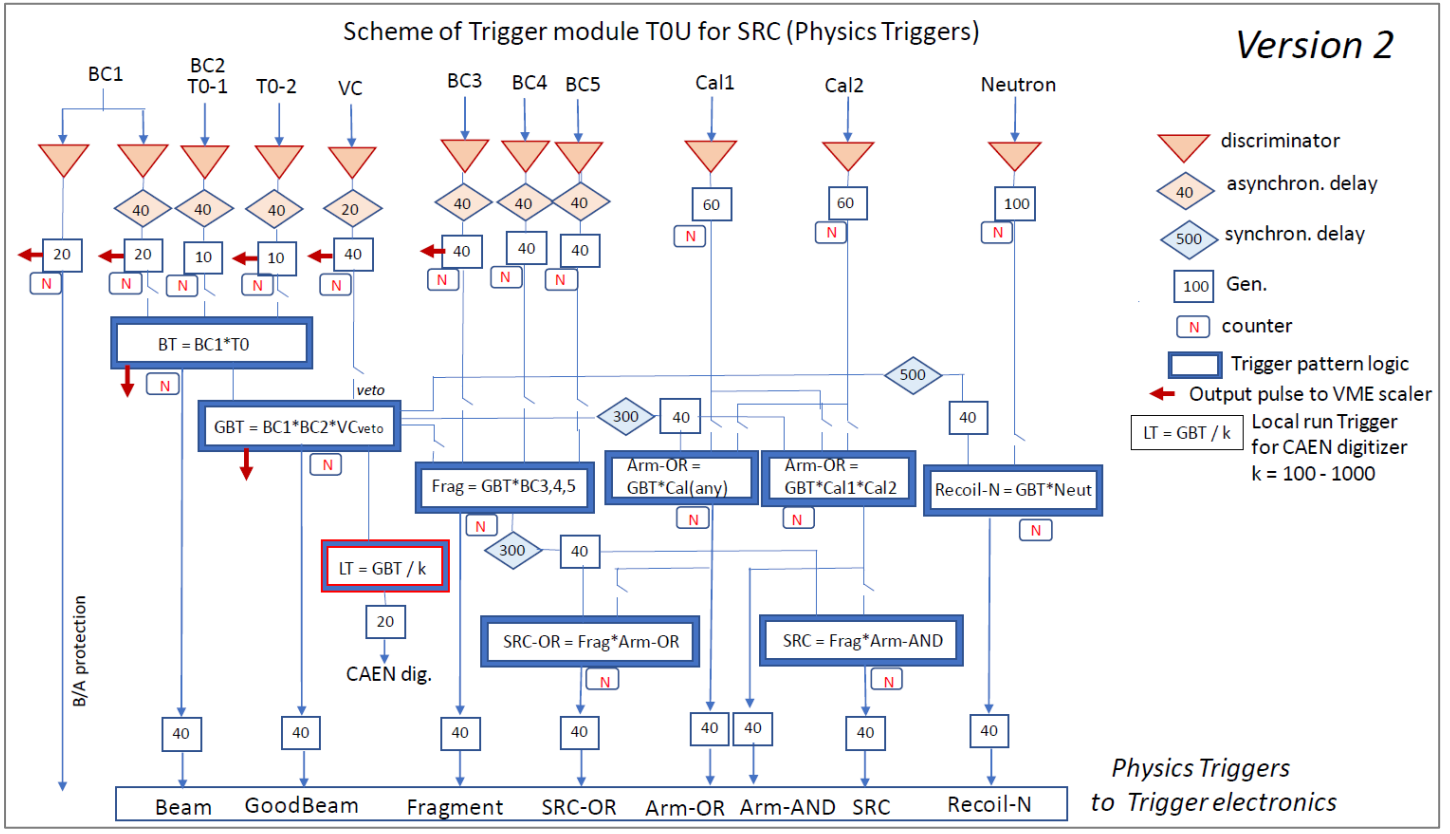
Trigger and DAQ

V. Yurevich

Built for:

- trigger mixing
- downscaling
- scalers readout

- trigger scheme to be finalized
- trigger box to be built



BM@N Working Group Assignments

Working Group	Crucial Tasks
Trigger	T0, trigger module w/ DAQ
Engineering	Calorimeter frame + magn. shielding, detector + target setup in hall
DAQ	Trigger mixing and scalers, detector integration
Si detectors	Refurbish detectors
MWPC	Tuning for large dynamic range
DCH	Noise reduction
TOF700	Improve performance, timing calibration
CSC	Build detectors
GEM	
Target	Build new 6cm (dia.) target
FHCAL	Optimize position
All	**Detector installation, testing, dry-run**

Time plan

	April -- July	Aug -- Sep	Oct -- Dec
BCs+T0s	shipment+assemble test at JINR		
Engineering	design setup + build frames	installation	
Calorimeter	design+build frame shipment to JINR	assemble+test at JINR	
ToF-Layer	produce components shipment	assemble+test at JINR	
HV+cables	purchase + production + shipment		
Readout Electronics	shipment RIKEN – GSI – JINR	installation+test at JINR	
Laser	purchase + production + shipment	installation + test at JINR	
MWPC, Si, GEM, CSC, DCH, TOF400+700, FHCal		installation + test	
DAQ + slow control		tests w/ standalone DAQs	**global dry-run**

* requires external manpower: depending on travel restrictions

2021 Experiment

- absolute cross-section measurement
- improved p/pi ID
- improved missing momentum resolution (60 MeV/c -> 25 MeV/c)
- increased fragment detection efficiency 4 weeks: x30 (2018)
- higher integrated luminosity and acceptance

Run plan:

- set up and calibration: 1 week
- ^{12}C at 3.5 GeV/c/u with 0.5×10^6 cps: 4 weeks
- ^{12}C at 2.5 GeV/c/u with 0.5×10^6 cps: 2 weeks

We`re looking forward to another successful SRC experiment

Thank you.

SRC core team

Eli Piasetzky
Göran Johansson
Julian Kahlbow
Or Hen
Hang Qi
Alex Kiral
Maria Patsyuk
Timur Atovullaev
Sergey Nepochatykh
Vasilisa Lenivenko
Sergey Sedykh
Tom Aumann
Hans Törnqvist
Igor Gasparic
Haik Simon