Preparations for the next SRC Experiment

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BM@N Detector Meeting
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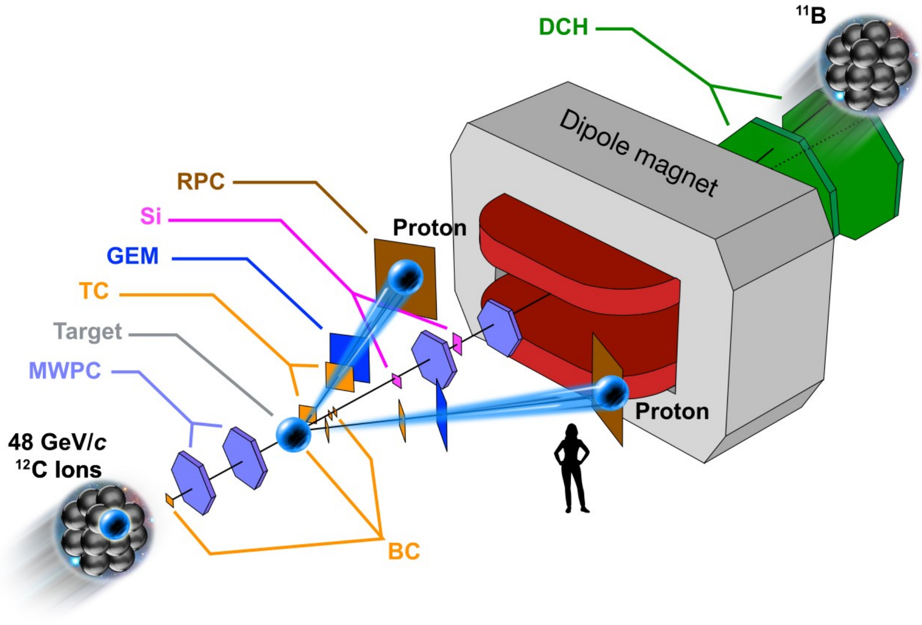
Next Experiment

Following the successful pilot experiment
(publication under review):

- increase statistics
- improve detector resolutions
- employ multi-particle tracking
- event selection: p/pion sampling
- "learn from lessons from previous experiment"

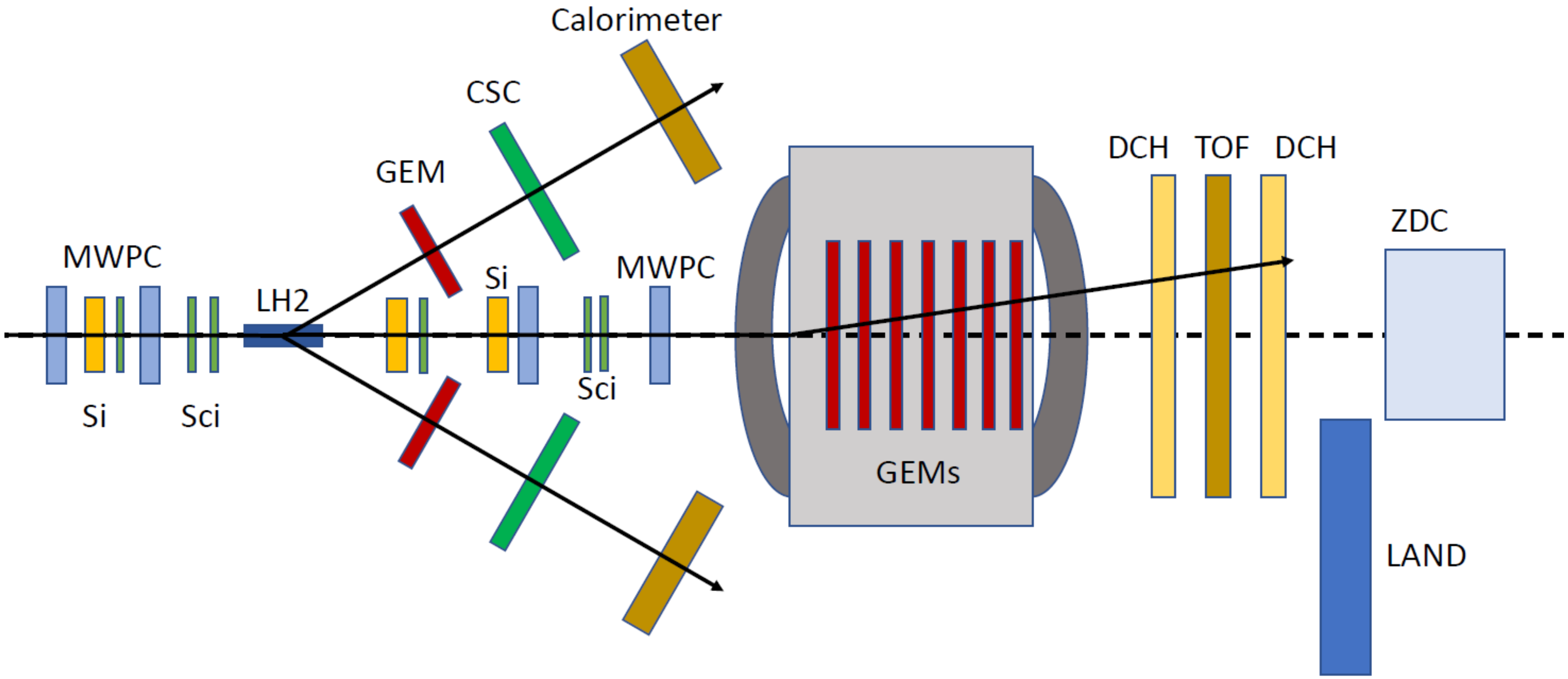


Next Experiment

- ^{12}C and deuteron beam
- several beam energies: ~2 – 3 GeV/u
- max. beam intensity ~ 10^6 ions/s

  (compatible with detector limitations)

Similar Setup as in Run 7

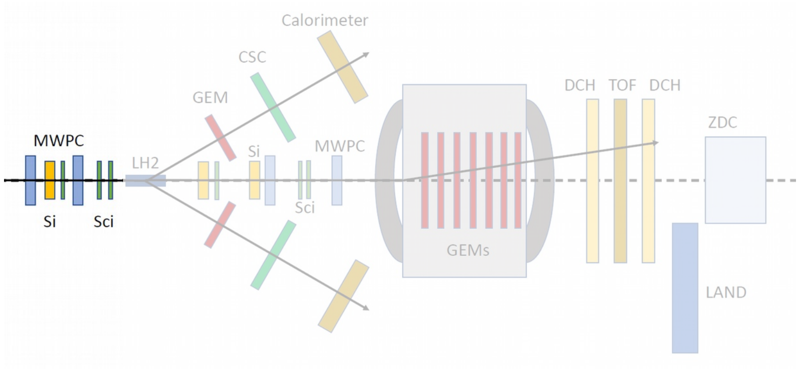


Incoming Beam Monitoring

- Tracking:
  2 x MWPC
  Si detectors for beam tuning

- Energy loss:
  2 x 3 mm Scintillator (60x60 mm²)

- T0:
  2 x Scintillators with XPM 85112 PMT



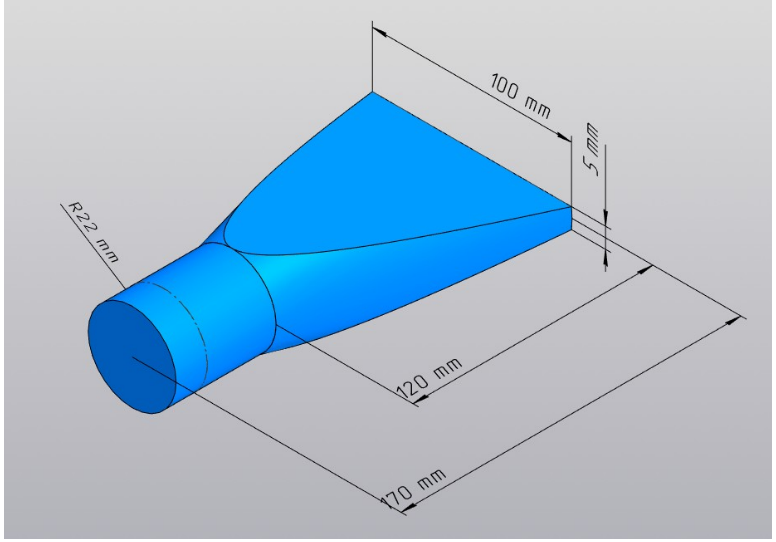
In-beam Scintillator Detectors

General Configuration

- scintillator sheet coupled to light guides and 2 PMTs
  (design for detectors and mechanical support being finalized)

- to be assembled and tested at JINR

- In total: 5 detectors (+ veto)



New LH_2 Target

- The target group is developing a new LH2 target with
  the same parameters (D = 6 cm, length = 30 cm)

- Target will be inside the SP-57 magnet gap
  to gain acceptance for the arms

- Veto box around target: thin scintillator detectors

Fragment Tracking

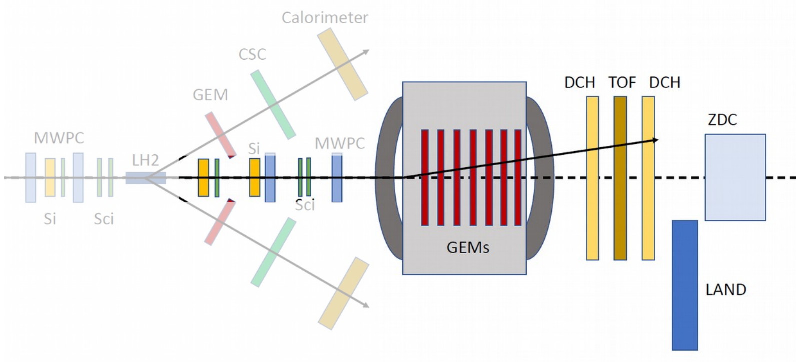
Detect protons up to carbon and multiple particles

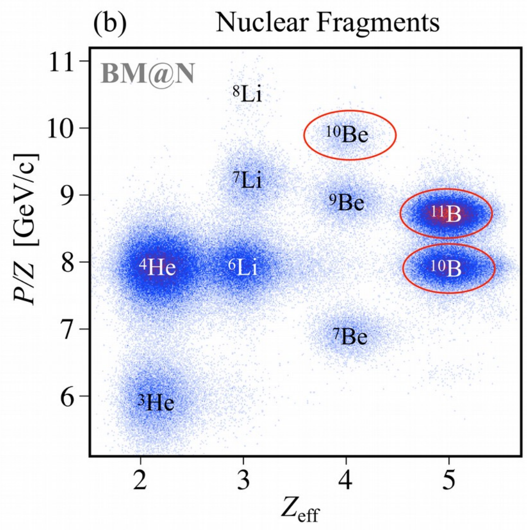
- Tracking:
  - 2 x MWPC
  - Same Si detectors as previously?

- Si detectors:
  2 Si stations that can
  - stay rate
  - large enough
  - dynamic range to cover p and C (?)

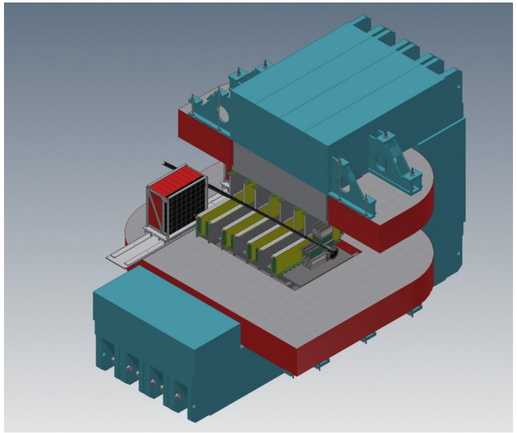
- Energy loss:
  - 3 x 3 mm (or 5 mm) Scintillator (100x100 mm²)
  - with XP2020 PMT

- no beam pipe





Fragment Tracking

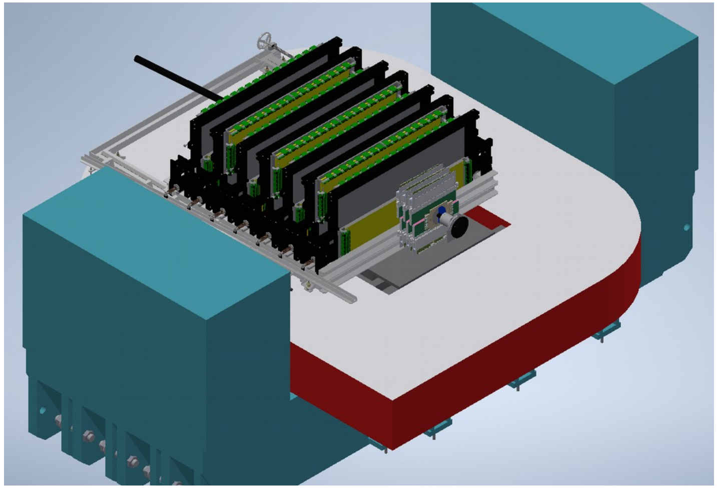


- SP-41 Configuration:
  Compromising between SRC and BMN experiment

- SRC cannot afford any additional material
  than GEMs (active area)

- We cannot have
  trigger Si,
  forward Si, 3 planes

- Planned ECal configuration ↔ p acceptance ?



Fragment Tracking

Option: install lower half of GEMs and lift system by max. 7 cm:

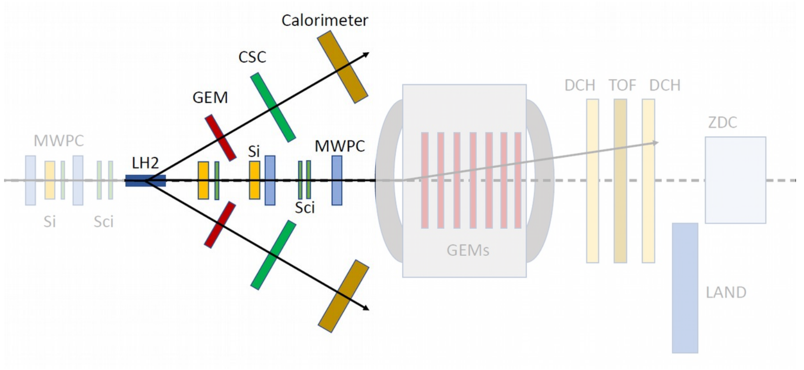
simulations show that this is not (???) sufficient to keep fragments undistorted

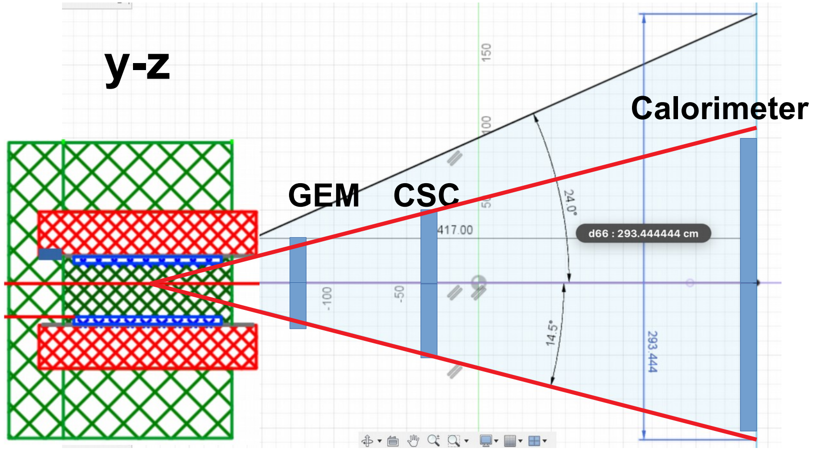
FIGURES SIMULATION

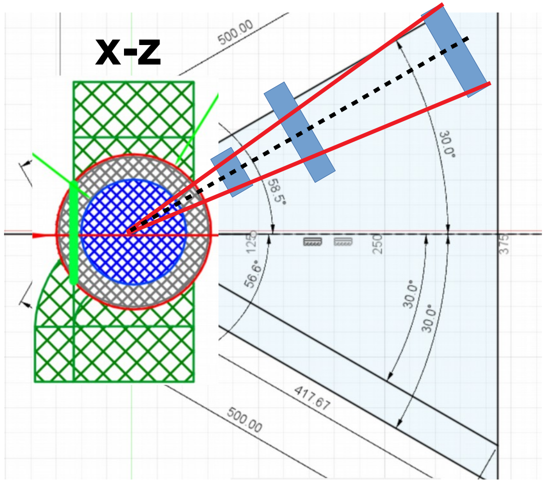
Two Arm Spectrometer

TAS configuration:
- GEM – CSC – Calorimeter

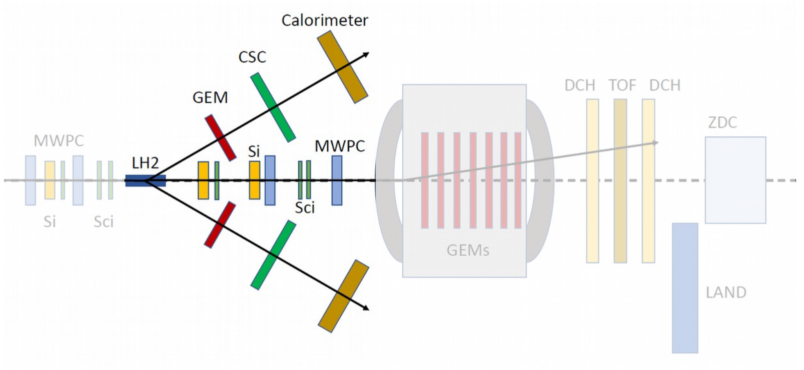
- 2 small GEMs (66 x 41 cm²)
- (min.) 2 CSC (100 x 100 cm²)







New Calorimeter



(non-magnetic) Calorimeter:
Sandwich like structure of Sci – Fe – Sci
(~ 150 x 230 x 25 cm^3)

1. Sci layer:
High-performance Sci. bars (~25 each arm)
Sci + PMT Tests to reach <70ps Tof resolution

2. Fe layer:
to be optimized to achieve strong p-pion separation

3. Sci layer for dE

→ allows to determine number of initial p and pions
→ show in statistical approach that pion contribution is small
and can be subtracted in p_{miss} distribution

DAQ and Trigger

Trigger Module:

- add coincidence signal from each arm
- off-beam trigger: laser calibration

DAQ:

- sdd <~200 TDC and ADC channels for Calorimeter

Backup

New laser calibration system

A new laser calibration system will be brought to calibrate all scintillator counters and the calorimeter without the beam

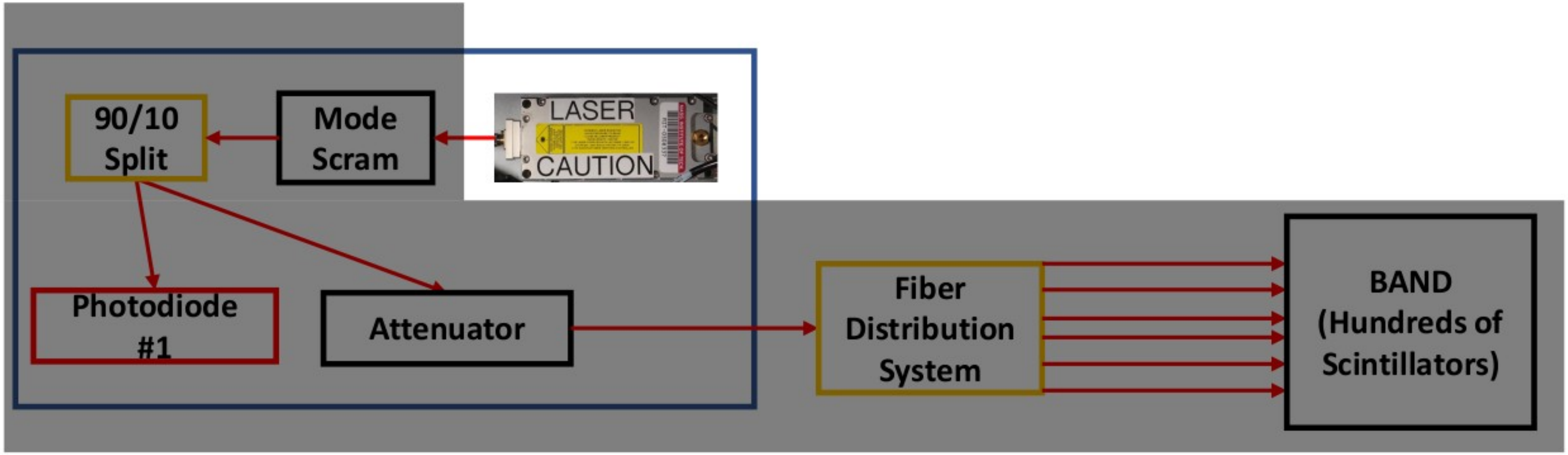
The laser system will give absolute TOF measurements with all relevant detectors with no need to calibrate with beam and gammas!

Wavelength is 335 nm or 405 nm, and the fibers are 200 um core diameter

Fiber length will be adjusted to fit the setup

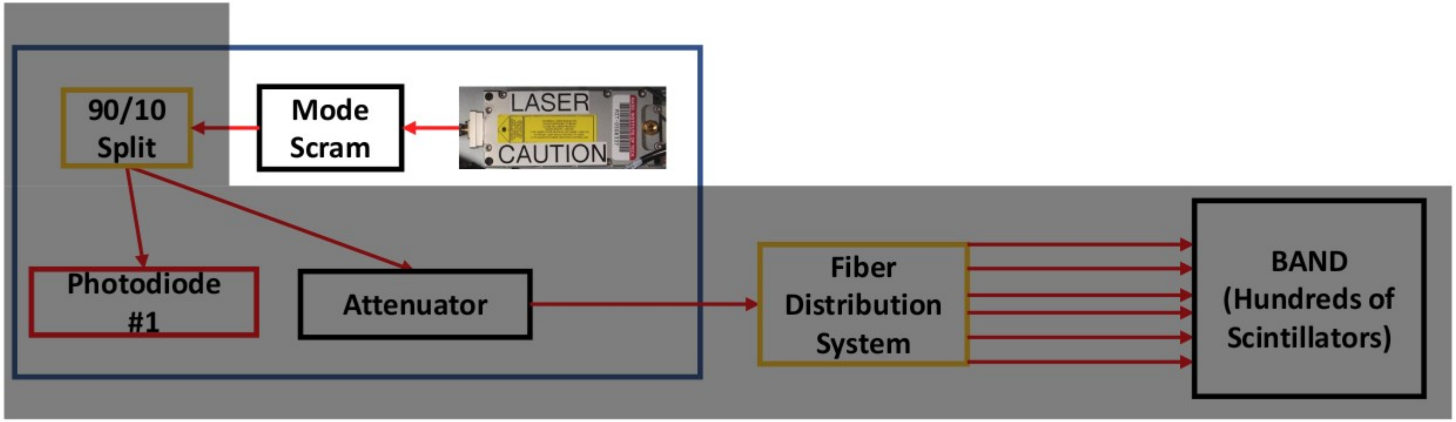
Around 50 fibers

BAND Setup

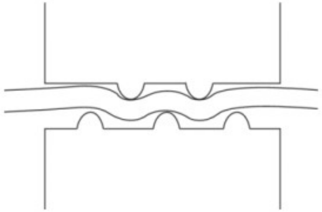


- Laser
  - 355 nm
  - ~0.3ns pulse width
  - 1kHz pulse frequency
  - Controlled by Raspberry PI

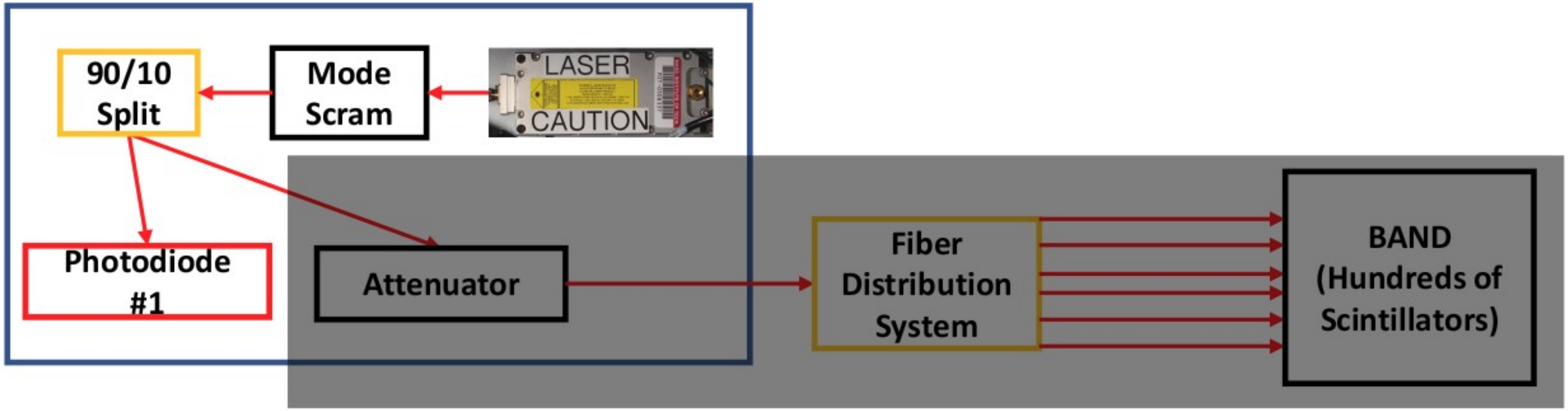
BAND Setup



- Mode Scrambler
    - Single mode laser
    - Multimode splitter

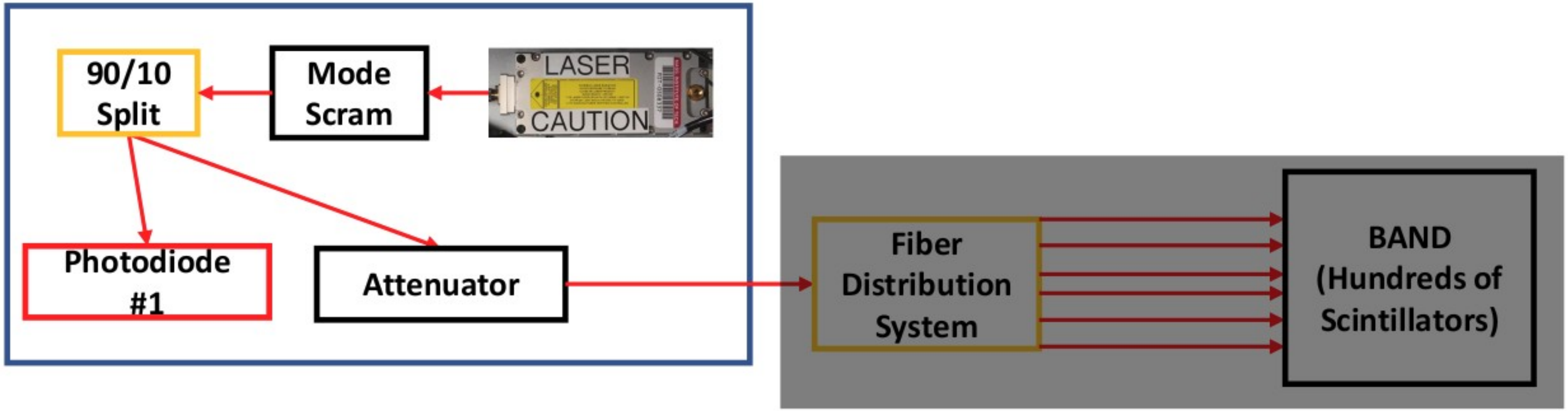


BAND Setup



- Photodiode #1
  - Fast Photodiode
  - Si Biased Detector

BAND Setup



- Attenuator
  - Variable optic attenuator
  - Range of 5 orders of magnitude

Fiber Distribution System

New BC counters + new trigger module

BC1, VC – same as last time

X1, X2, Y1, Y2 – trigger counters same as last time

BC2 – two new detectors, each read out by two PMTs (last time it was one detector read out by 1 PMT)

BC3, BC4 – new detectors, each read out by 2 PMTs

Additional BC5 – read out by 2 PMTs

T0Module – same module with additional channels and corresponding logic modifications

More BC channels than last time

BC1 – 1 channel + 1 spare channel
VC – 1 channel

T01 (MCP-PMT-based) – 2 channels
T02 – 10 channels

BC3 – 2 channels
BC4 – 2 channels
BC5 – 2 channels

X1, X2 – 4 channels
Y1, Y2 – 4 channels

29 TQDC channels

29 TDC channels

+ include the new calorimeter into the trigger?

Power supplies will be provided by the group of V. Yurevich

New electronics for LAND based on TRB3

IPC 21694

TRIXOR1

KINPEX1A

EXPLODER

TAMEX3_IN2

FEBEX_POW1A

TAMEX3_BKP2

TAMEX3_PWR3

TAMEX3_OUT2

TAMEX3A

NEULANDFQT1 – QDC

FQTINT1

CLK-TRG-DISTR2

This is a new electronics (not the one used last time).

Next run improvements

Measure the beam momentum in the hall to evaluate the actual energy loss

T0 did not provide design timing resolution → two T0 devices next time read out by 2 PMTs each

BC counters provided poor charge separation and low efficiency → new design of BC counters

TDC counts were not written out properly to the file → high discriminator threshold?

Gas mixture in the MWPC was not adjusted properly

X’ readout for the Si was poor

DCHs were not sensitive to protons (single charge particles)