CBM detector and electronics tests at COSY

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for the CBM Collaboration

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Outline

Update on the application for beamtime at COSY in 2016 and 2017:

1) Detector tests: September 2016 *(1 week)*
2) Detector tests: February/March 2017 *(2 weeks)*
3) Electronics tests: April 2017 *(1 week)*

CBM detector tests

Original proposal:

- Test final-prototype microstrip sensors for the CBM Silicon Tracking System towards their tracking efficiency:
  - *using a new reference telescope and a cooled station comprising the sensors under test;*
- Test full-size prototype GEM detectors for the CBM muon detection system for efficiency, gain uniformity and cluster sizes as a function of beam rate and varying high voltage.

calendar week 35 (August 2016)

The set-up will comprise a completely new data acquisition chain:

- *n-XYTER ASICs on updated front-end boards type F,*
- *new AFCK read-out boards,*
- *prototype interface boards FLIB to computing farm FLES,*
- *new software for data transport and analysis.*

→ **challenging concerning timely delivery of hardware**

1) CBM detector test – September 2016

Updated proposal:

- Use alternative set-up to study charge collection performance of STS prototype sensors:
  - *ALIBAVA based read-out system*
  - *STS reference telescope under construction will be commissioned in laboratory at GSI*
- The GEM test with two full-size chambers at COSY will be cancelled:
  - *will take place during ion-beamtime at CERN in December 2016*
- Instead, diamond detectors for CBM-TOF will be investigated:
  - *time resolution of single crystalline CVD plates, demonstrate < 100 ps.*
  - *Read out with an independent acquisition system based on TRB-3.*

- Test of microcontroller TMS-570 for the CBM detector control system
  - *against SEU requirements*

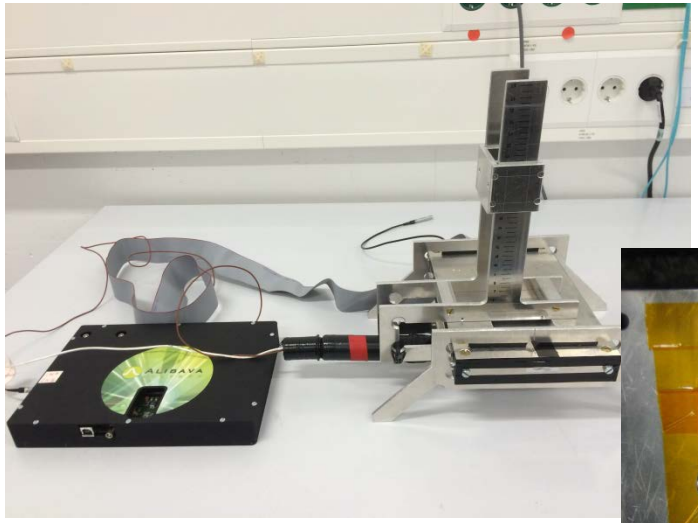
shift from calendar week 35 (August 2016) to middle of September 2016

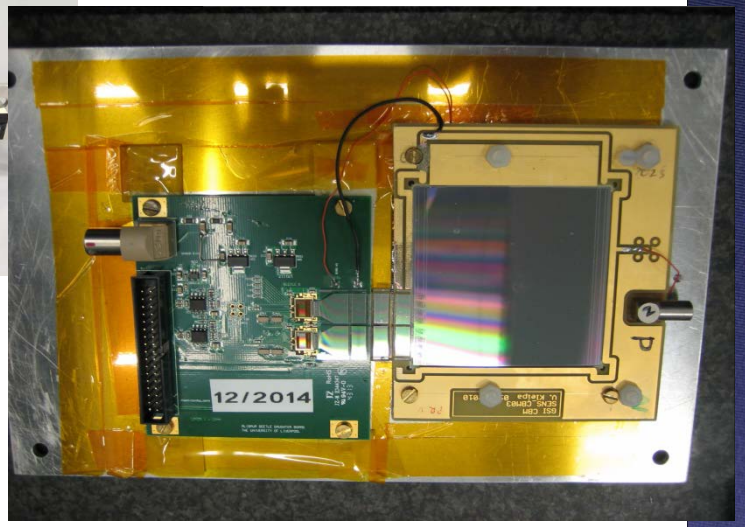
STS set-up:

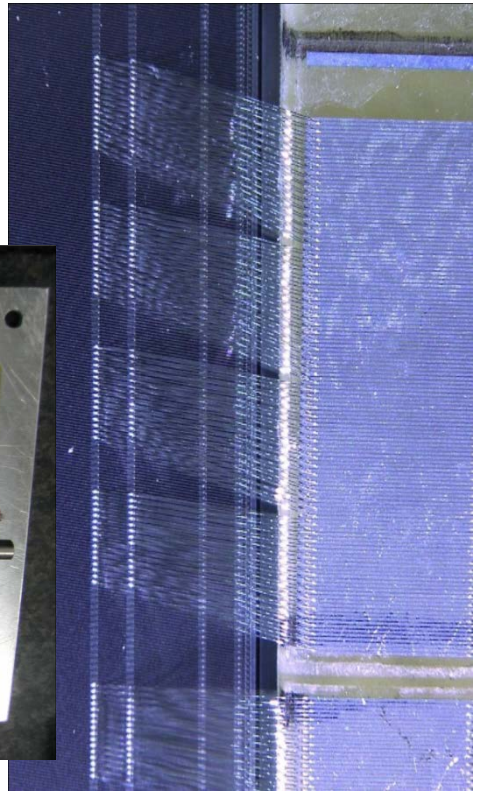
Alibava read-out system, daughter read-out board with connected sensors

Experimental goal:

- *charge collection performance of prototype micro-strip sensors*
- *as function of read-out pattern and particle impact angle*





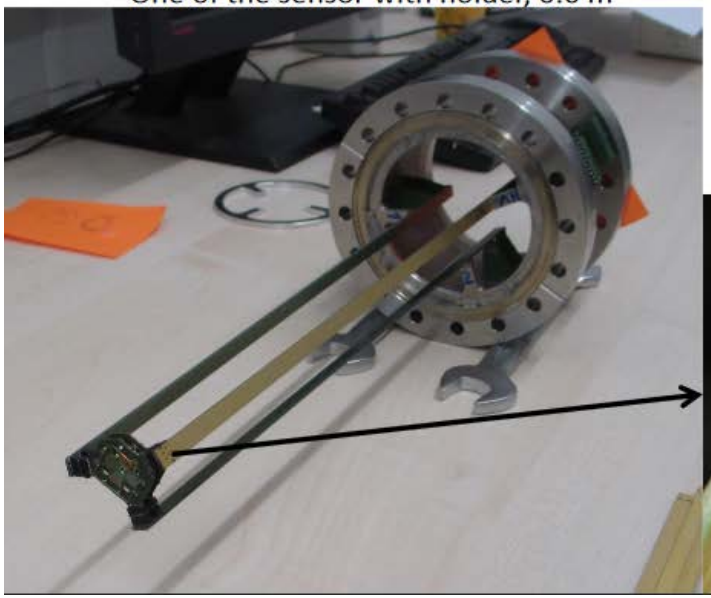


Diamond detector set-up:

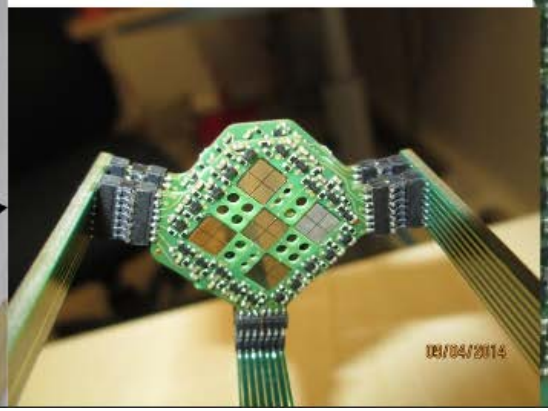
Experimental goal:

- *time resolution for single crystalline diamond → below 100 ps*
- *prototyping a polycrystalline diamond for MIPs → signal stability, variation, time resolution*

One of the sensor with holder, 0.6 m



9 scCVD diamonds mounted
1.2 cm x 1.2 cm, 36 channels



pcCVD diamonds mounted on PCB
128 readout chennels, 2cm x 2cm

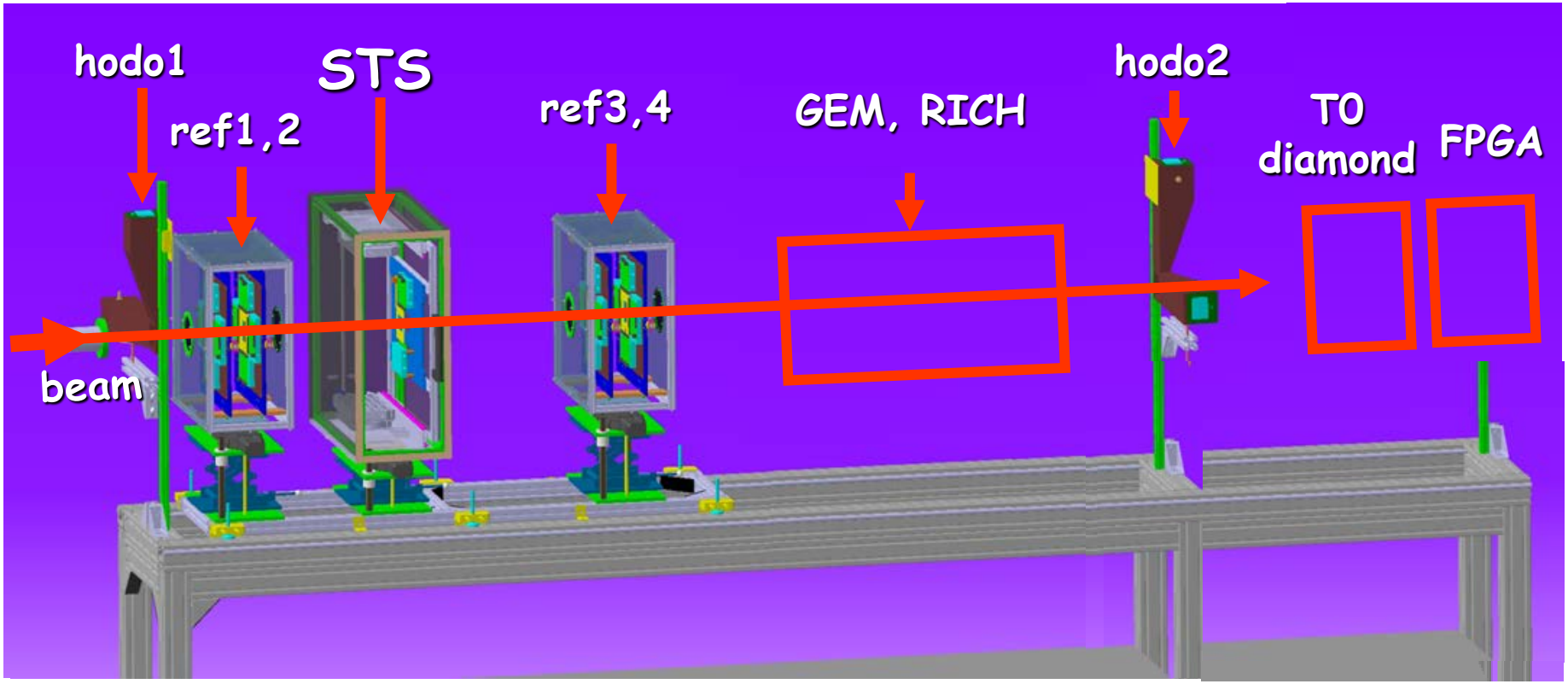
2) CBM detector test – Feb./March 2017

Proposal:

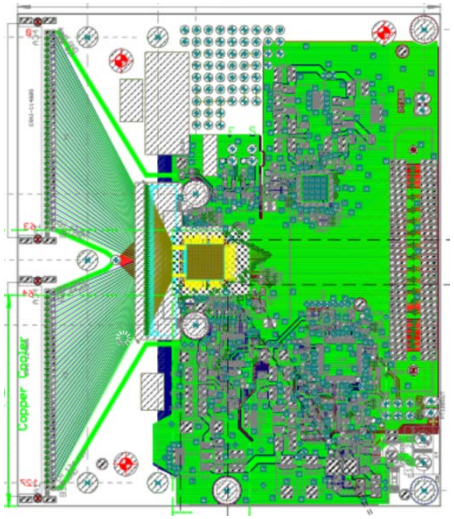
- Carry out the full test of final-prototype microstrip sensors towards their tracking efficiency:
  - *using the new reference telescope, cooled station, DAQ and software;*
- Test a small-prototype triple-GEM detector with final gap sizes and matching CERN-standard resistive chains
  - *tracking efficiency as function of gap size. Read-out with the acquisition system as for the STS.*
- Study poly-crystalline CVD diamond strip detectors
  - *rate capability, time precision, stability.*
- A first in-beam test of the new (standalone) TRB3 based FPGA-TDC DiRICH read-out chain:
  - *small detector prototype with glass radiator and focusing element.*
  - *Cherenkov ring projected onto Multi-Anode Photo Multipliers read out with DiRICH chain.*
- Tests of FPGA and microcontroller electronics for single-event effects

shift from calendar week 49 (December 2016) to a two-week block in February/March 2017

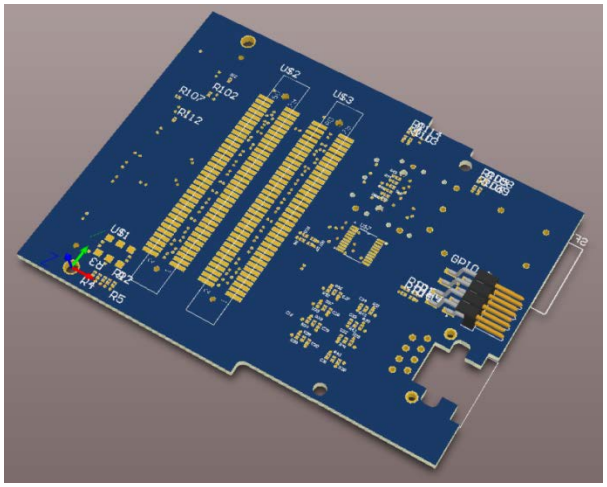
Set-up for detector tests – Feb./March 2017



DAQ for detector tests – Feb./March 2017



nXYTER FEB-F rev2



nDPB FMC

AFCK

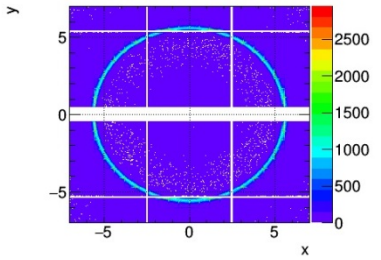
2x mFLES node

4x FLIB

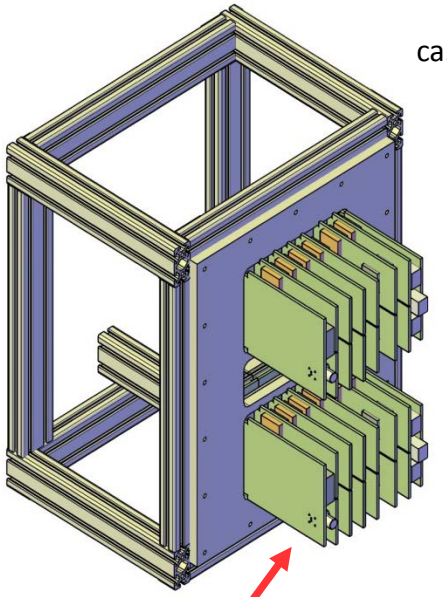
new on-line and offline software

Test of DiRICH prototype with glass lens

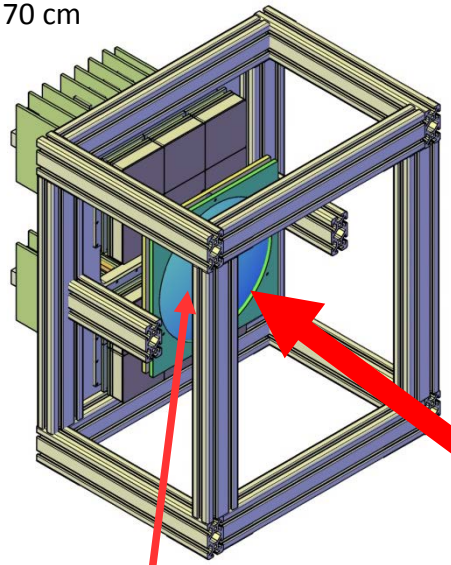
- Evaluation of new CBM/HADES RICH readout chain (TRB3)
- High-rate tests of photon detector and readout chain
- Test integration into CBM GPTX/FLIB readout scheme

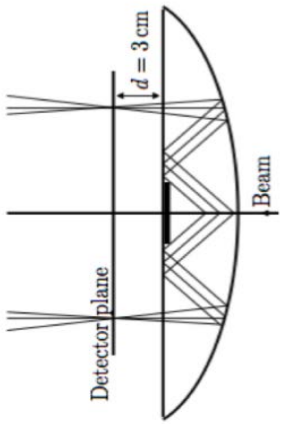


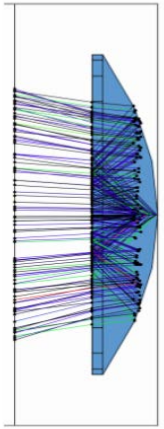
Ring radius ~ 5.5 cm
5-50 photons/ring



ca. 50 × 50 × 70 cm







COSY proton beam
few GeV/c

2x MAPMT readout modules:
up to 12 MAPMTs
up to 24 DiRICH modules,
2x Combiner, 2x Power module

Spherical Borosilicate glass lense:
Serves as Cherenkov radiator and focusing mirror
Reflective Al+MgF coating on curved side
Diameter ~15 cm

3) CBM electronics test – April 2017

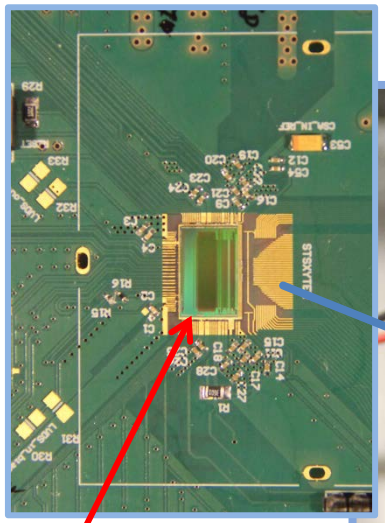
Proposal:

- Qualification of the improved DICE cell architecture with respect to Single Event Effects (SEE) in the STS-XYTER rev. 2 ASIC;
  - *comparison with the cross section determined in the electronics test in September 2015 using a similar setup.*
- Different FPGA electronics will be tested for single-event upsets and the effectiveness of data correction methods.
- *Optional:* New custom-designed LDOs will be tested for effects of total ionizing dose and fast transients.

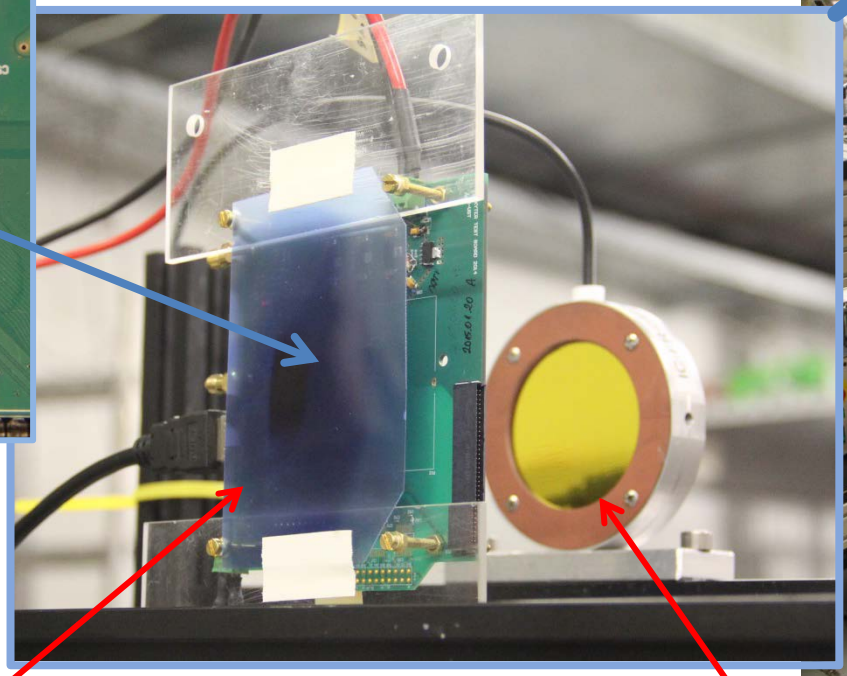
last week in April 2017

Setup similar to the one used in Fall 2015

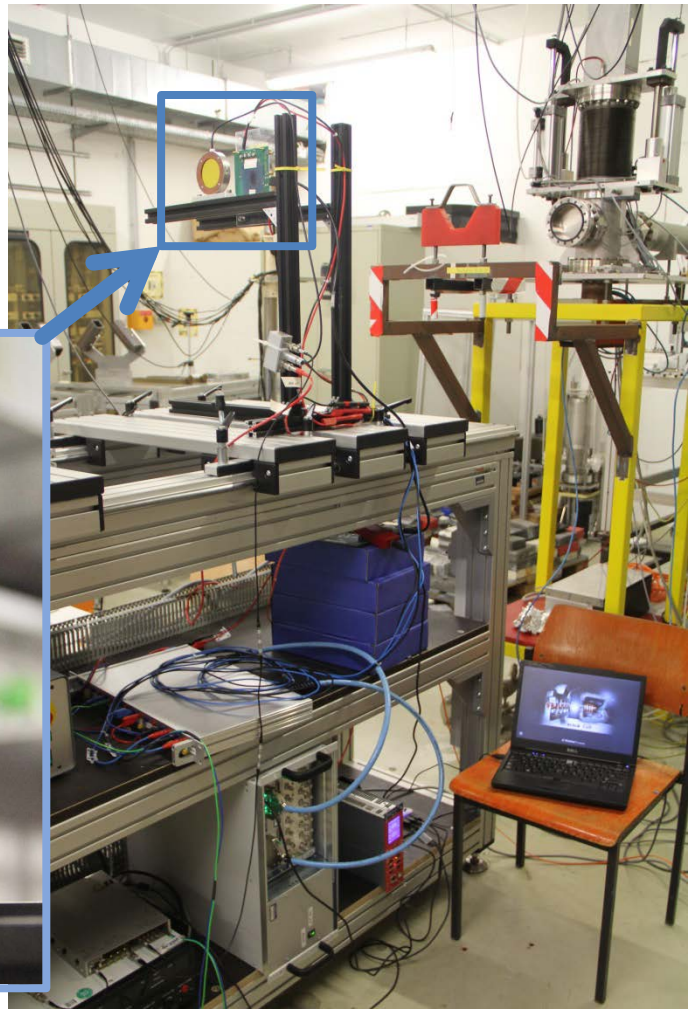
08.-12.09.2015
FZ Jülich, COSY, JESSICA cave
~3×10^9 p/spill on setup



STS-XYTER ASIC
bonded to FEB



FEB with STS-XYTER v1



Ionization Chamber with QFW based readout

Beamtime application: 9/16, 3/17, 4/17

Total number of particles and type of beam (p,d,polarization)	Momentum range (MeV/c)	Intensity or internal reaction rate (particles per second)	
		minimum needed	maximum useful
p, not polarized	p ~ 2700 MeV/c	10^4	up to 10^6 (det.), 10^8 (electr.)

Experimental area	Safety aspects (if any)	Earliest date of Installation	Total beam time (No.of shifts)
1) JESSICA	None	middle of September 2016 detector system tests: STS, Diamond, DCS	one week, 24/7

Experimental area	Safety aspects (if any)	Earliest date of Installation	Total beam time (No.of shifts)
2) JESSICA	None	February/first half of March 2017 detector system tests: STS, GEM, Diamond, RICH, DCS	two weeks, 24/7

Experimental area	Safety aspects (if any)	Earliest date of Installation	Total beam time (No.of shifts)
3) JESSICA	None	last week of April 2017 electronics tests: front-end ASIC, FPGA, power regulators	one week, 24/7 highest possible intensity

Proton momentum 1.8 GeV/c

- Silicon detector:
  - p with 1.8 GeV/c: close to minimum-ionizing
  - 6% more signal than with mip;
    can be taken into account in data analysis
    → OK
- Diamond detector → OK
- RICH detector → OK
- GEM detector → OK

What is the uncertainty on the beam momentum?