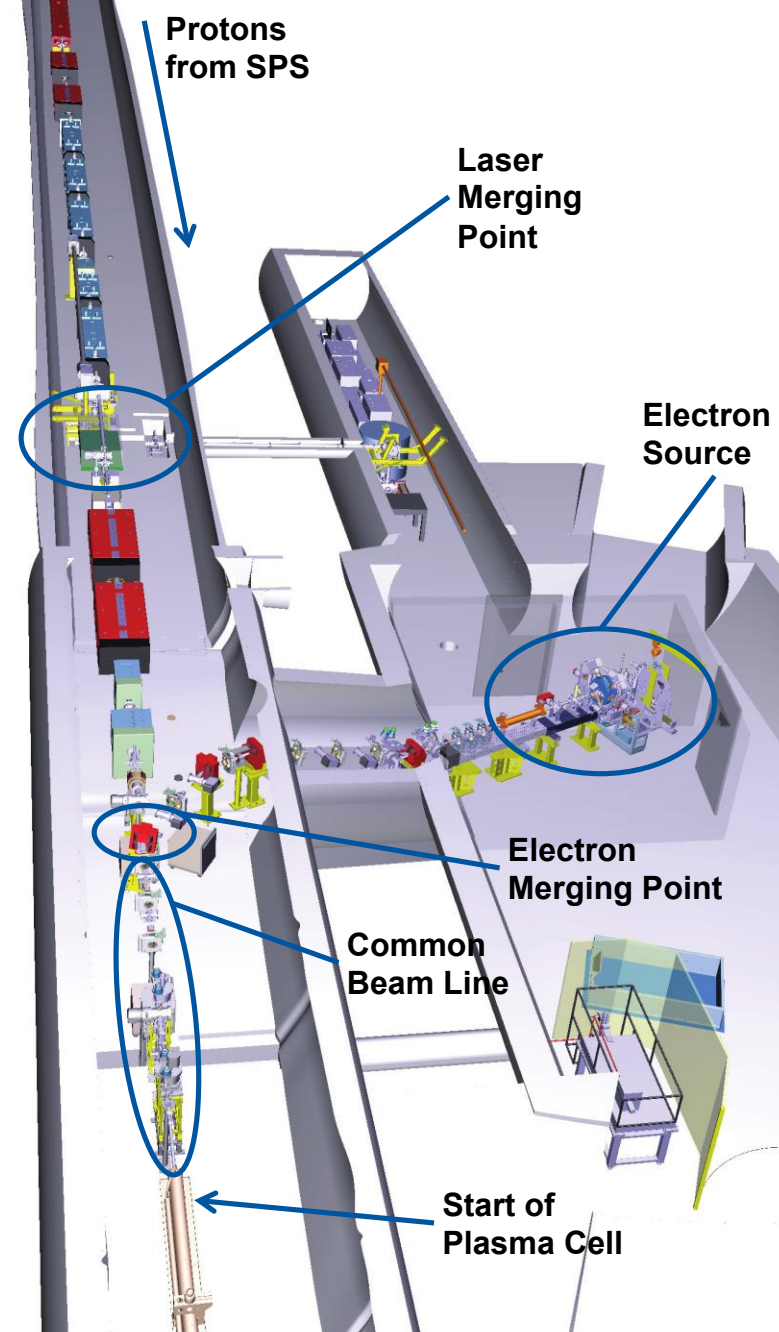


BI activities for AWAKE phase 2

S. Mazzone & AWAKE BI teams

AWAKE

Parameter	Protons	Electrons
Momentum [MeV/c]	400 000	10-20
Momentum spread [%]	± 0.35	± 0.5
Particles per bunch	$3 \cdot 10^{11}$	$1.25 \cdot 10^9$
Charge per bunch [nC]	48	0.2
Bunch length [mm]	120 (0.4 ns)	1.2 (4ps)
Norm. emittance [mm·mrad]	3.5	2
Repetition rate [Hz]	0.033	10
1σ spot size at focal point [μm]	200 ± 20	<250
β -function at focal point [m]	5	0.4
Dispersion at focal point [m]	0	0



AWAKE master schedule

- Phase 1: Self-modulation instability physics
- Phase 2: Accelerating electron physics:
 - Installation during Q1 and Q2 2017
 - Hardware and beam commissioning from Q3 to Q4 2017.
 - Physics from Q1 2018 until start of LS2

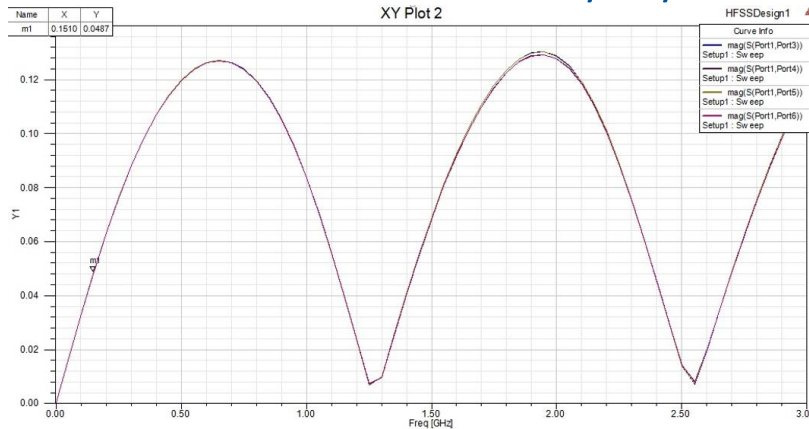
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022ff
Proton and laser beam-line	Study, Design, Procurement, Component preparation		Installation	Commissioning	Data taking	RUN 1	Long Shutdown 2 24 months		RUN 2	Data taking
Experimental area	Modification, Civil Engineering and installation									
e⁻ source and beam-line	Studies, design		Fabrication	Installation	Commissioning	Phase 2				

BI activities overview

- Electron line (TCV4):
 - Installation of 7x TRIUMF BPMs;
 - Refurbishment and installation of 2x BTVs;
 - Electronics/SW for TRIUMF Faraday Cup (to be discussed);
 - (pepper pot?)
- Common line (TT41):
 - Installation of 5x TRIUMF BPMs;
- Experimental hall (TCC4):
 - e- spectrometer optical line
- General:
 - Digital cameras

TRIUMF BPMs

- (7x) 40 / (5x) 60 mm stripline BPMs for electron and common line;
- 600 MHz (standard) / 2 GHz (e- in presence of p+) First test w beam in 2016.
- Expecting all BPMs to be manufactured in October 2016.
- Electronics ready by the end of 2017

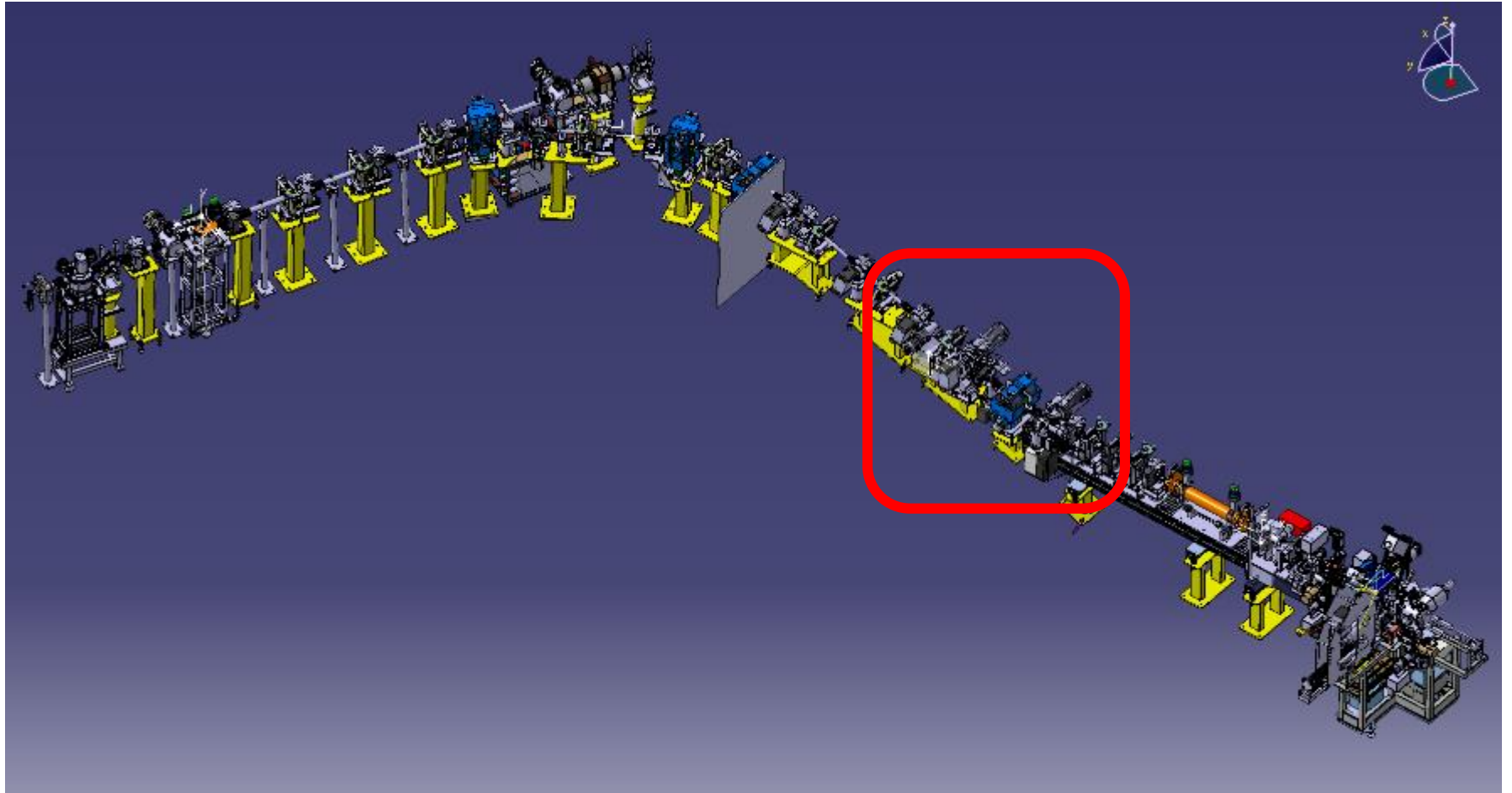


V. Verzilov, March 16

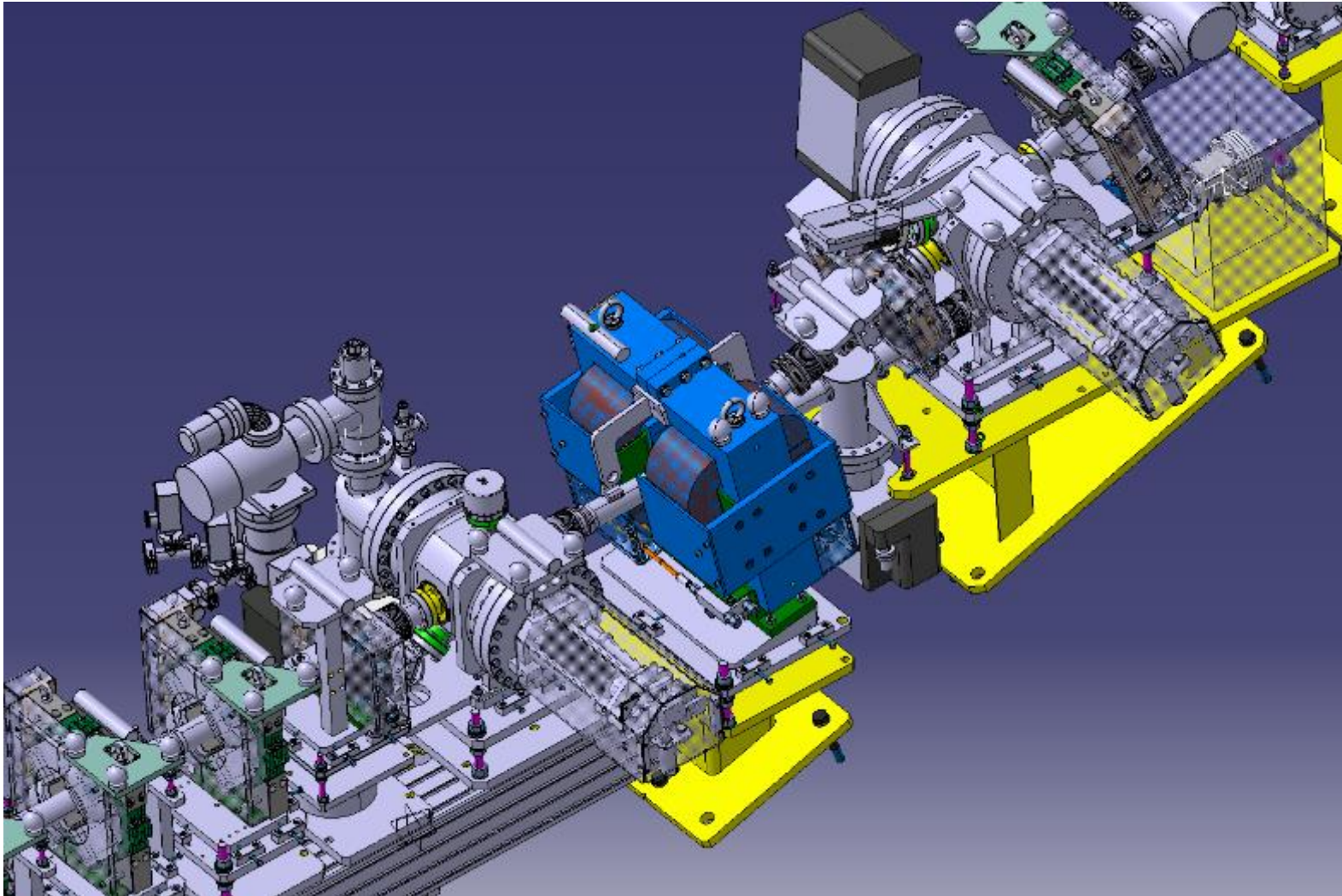
BPMs: BI involvement

- TRIUMF will pay for HW, electronics, supports.
- BI: installation (Q1-Q2 2017), development of FESA class.
- Budget: 0 (installation?)

Electron line BTVs



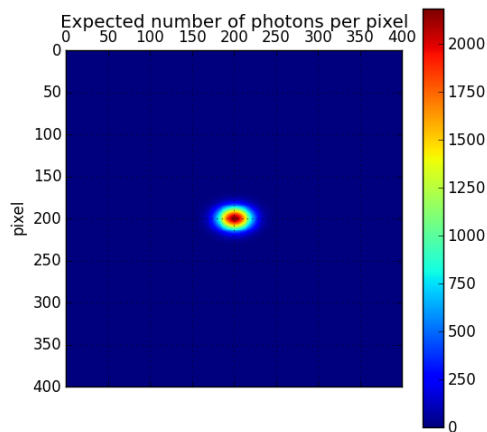
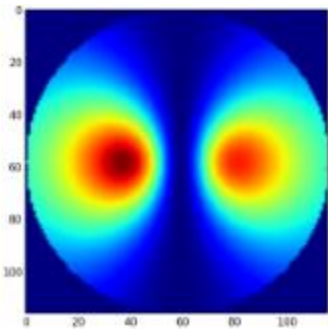
Electron line BTVs



Electron line BTVs

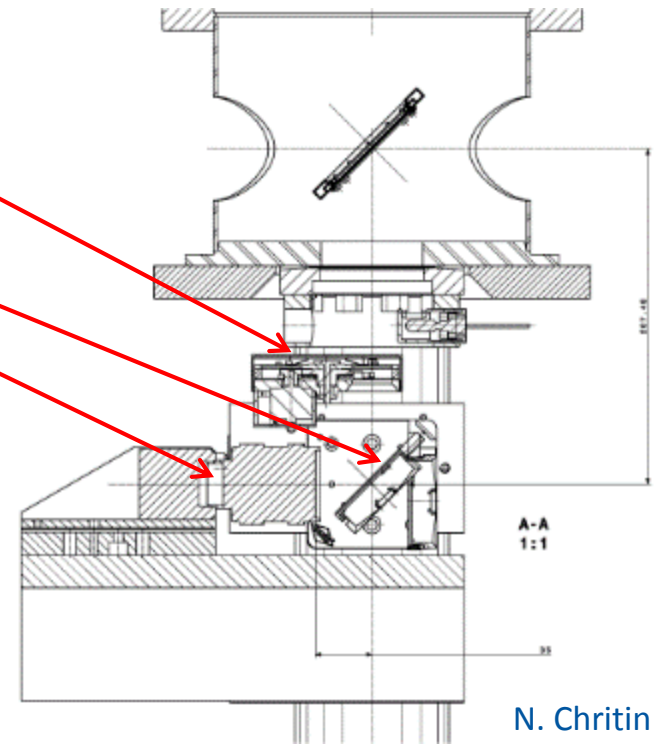
- Two BTVs will be installed : one for emittance measurement (quadrupole scan), one for beam size / energy spread.
- BTVs will be recuperated from CTF3 (CT.MTV.435, CC.MTV.970)
- New: optical line, screens
- **BUDGET: 50 kCHF**
 - 10 design (so far 160 hours = 8kCHF)
 - 10 production
 - 20 cabling
 - 5 screens
 - 5 contingency

BTVs: Light yield calculations



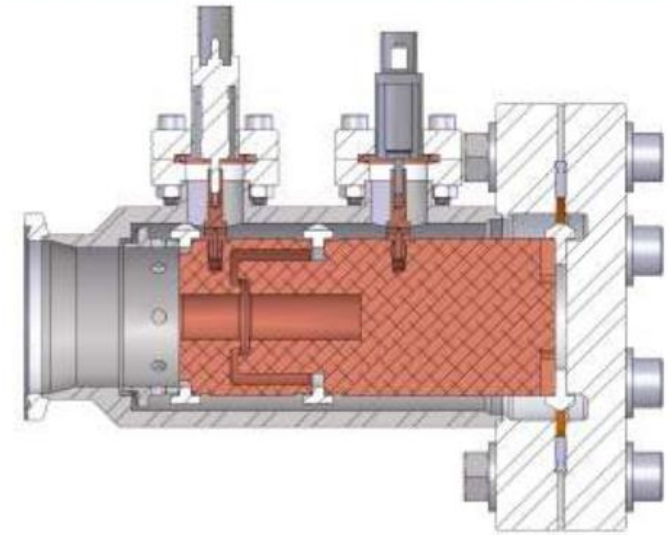
BTV.412350 (the worst case)

- Entrance pupil: 1" filter wheel at 135 mm
- OTR light captured: 23%
- 2" flip mount mirror
- 1:1.8/50 mm camera lens: Resolution of 50 mm achievable. **Light yield for OTR imaging at the limit.**
- At the other BTV positions slightly smaller beam profiles → more photons/pixel.
- Two screens will be used:
 - Silicon with a silver coating (OTR)
 - Chromox (scintillator)



Faraday Cup

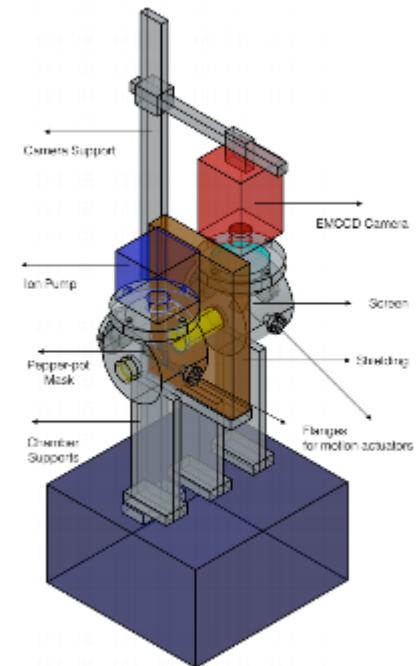
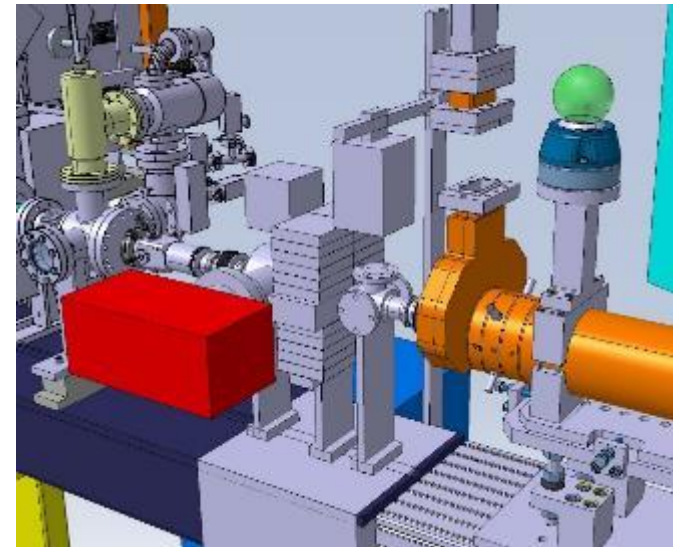
- Development by TRIUMF
- Copper cup, 1.5% of charge lost at 20 MeV
- Design and manufacture completed, assembly in progress
- Electronics and SW?



V. Verzilov, March 16

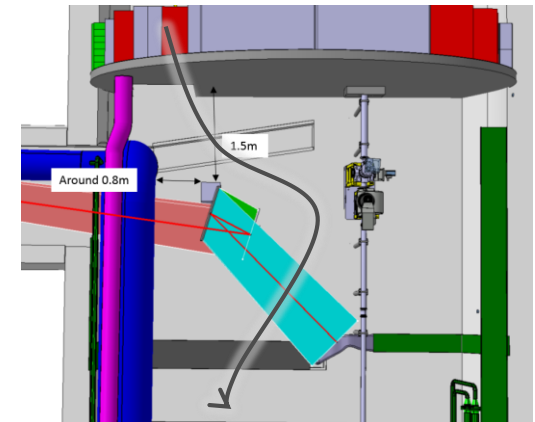
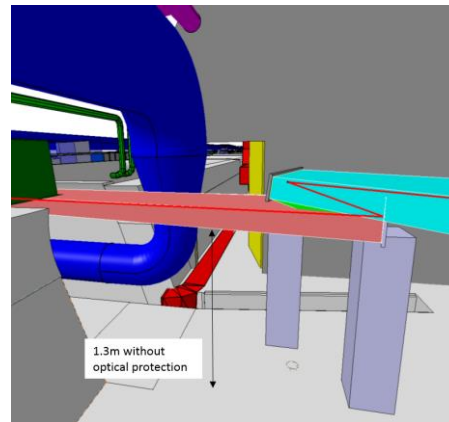
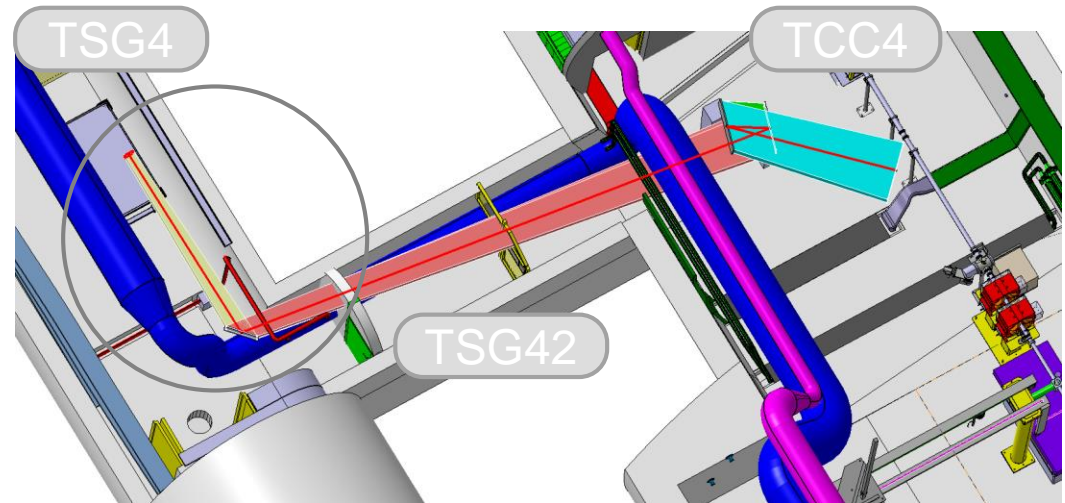
Pepper-pot

- Development by U. Manchester, BI consulting (camera, manufacturing of the mask)
- However, at present issues with STFC budget: no clear way forward.
- BI involvement: none (so far). Edda's proposal: estimate time needed for refurbishment of PHIN pepper-pot as back-up plan.
- Refurbishment: mask(s), actuators.



e- spectrometer optical line

- BI: design and installation of optical line.
- 3x large (1000x200 mm, 700 x 200 mm) mirrors transport light to intensified CCD.
- Light yield and resolution tested in 2015
- For mirror supports and mounts, collaboration with the European Southern Observatory (ESO). Kick off mtg end of June.
- Schedule to be discussed



Special cameras

- A few digital/special cameras present:
 - 2x streak cameras: David working on SW
 - e- spectrometer camera (ANDOR iStar, iCCD)
 - Pepper-pot camera (ANDOR? emCCD)
- “file reader” SW developed by V. Olsen (U. Oslo) for devices including e- spectro camera. Workaround solution for logging images and data.
- Camera control / acquisition missing.

Budget

- BI request: 680 kCHF 2016-2020 + 2 years PJAS:
720 kCHF total
- At present, approx. 720 kCHF spent.
- Phase 2/2016 outstanding activities:
 - BTVs: 50 kCHF
 - TRIUMF BPMs installation: ?
 - TRIUMF FC acquisition system: ?
 - PJAS for BPMs: 58 kCHF

-> min 108 kCHF still needed

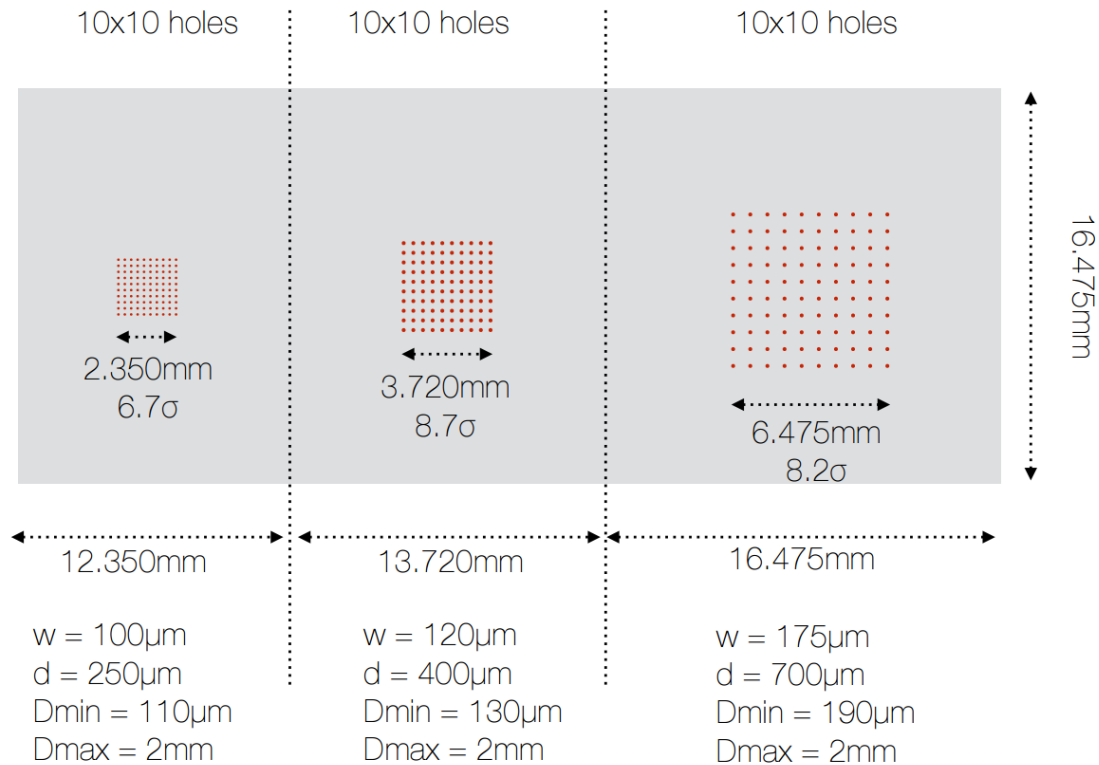


www.cern.ch

Pepper-pot mask design

Mask Geometry optimised for different beams

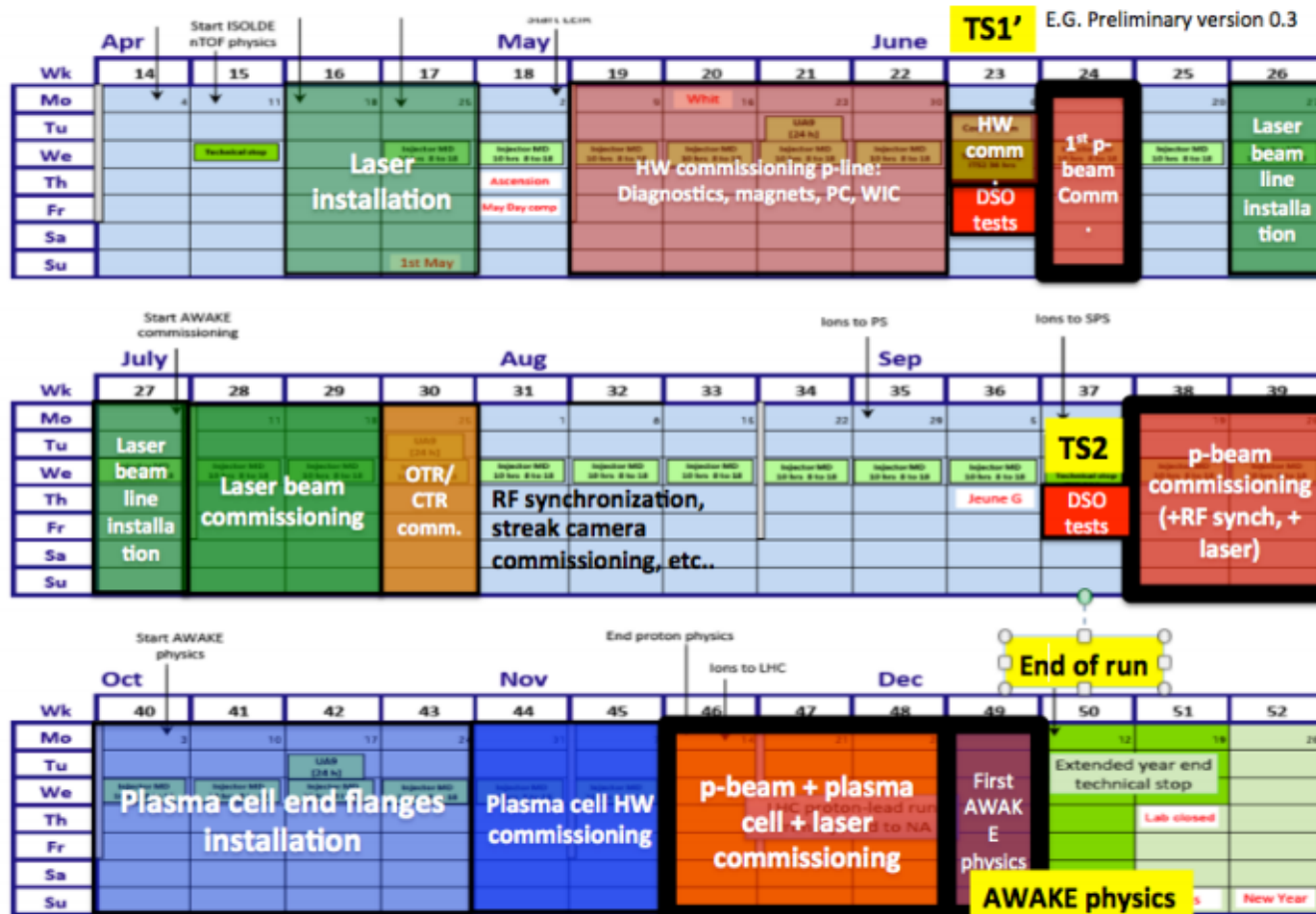
A mask with three regions accommodating geometries for various charge values can be machined.



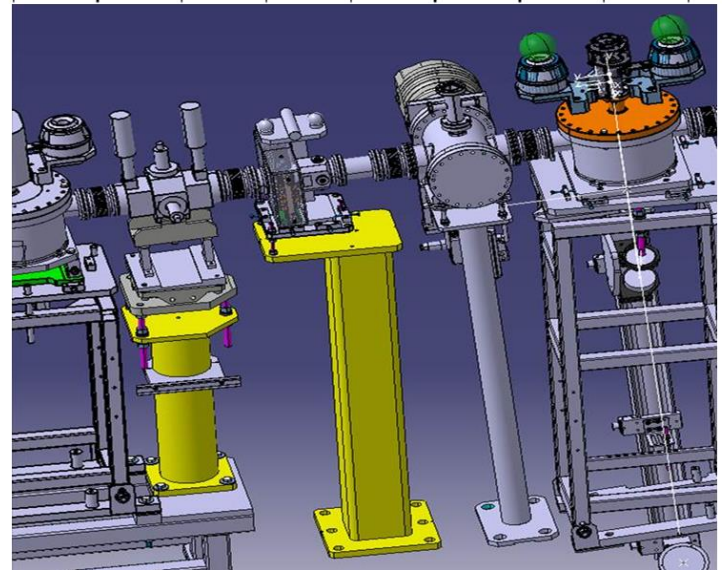
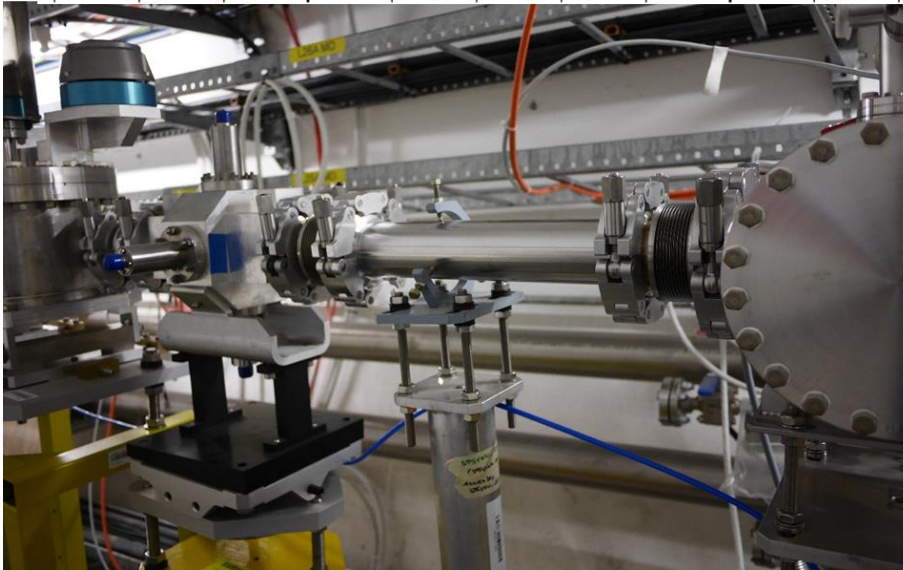
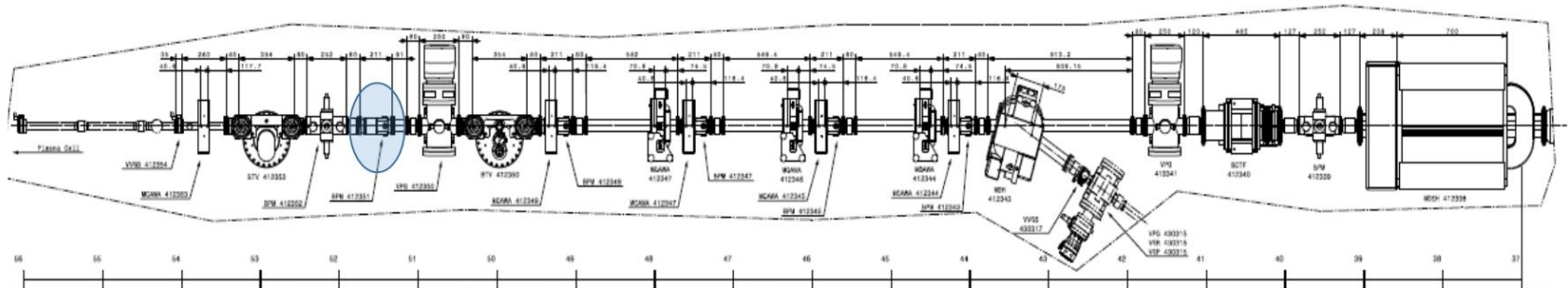
O. Mete

AWAKE Phase 1 planning

→ In case no TS before TS2: Planning shifted by 4 weeks → only 1 week of physics.



Validation of TRIUMF BPM



L. Soby



Validation of TRIUMF BPM

- Test of BPM electronics developed by TRIUMF
 - 400MHz proton beam version, which will already be tested in CALIFES end of June
 - 2GHz electron beam version
 - Frequency separation
 - **Estimate possible resolution on electron beam position in presence of Protons**
 - Measure signal amplitudes coming from proton beam, ideally zero
- Development of FESA class for electron line BPMs

L. Soby

