ILIMA Status

Helmut Weick, GSI
ILIMA Open Meeting, 28th Feb 2017

- Collaboration Structure
- CR Layout
- Detector Types (Schottky, ToF, Silicon)
- Additional Corrector Magnet
- ILIMA in HESR
- Phase 0 at ESR

ILIMA Structure

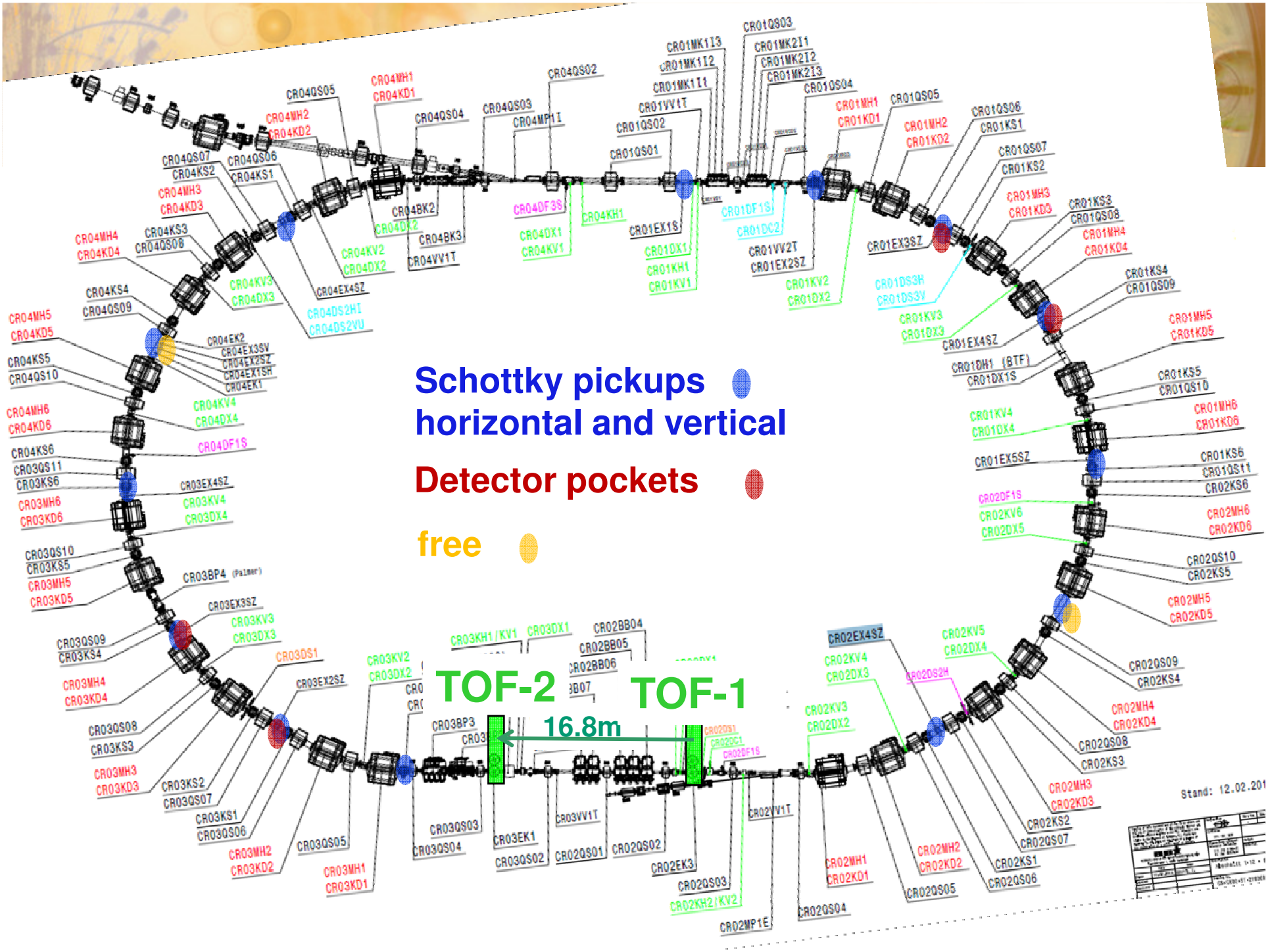
Collaboration board (one appointed from each institute,)

Spokesperson	**T. Yamaguchi**	**Saitama University**	**management**
deputy spokesp.	**Yu. Litvinov**	**GSI Darmstadt**	
project manager	**H. Weick**	**GSI Darmstadt**	

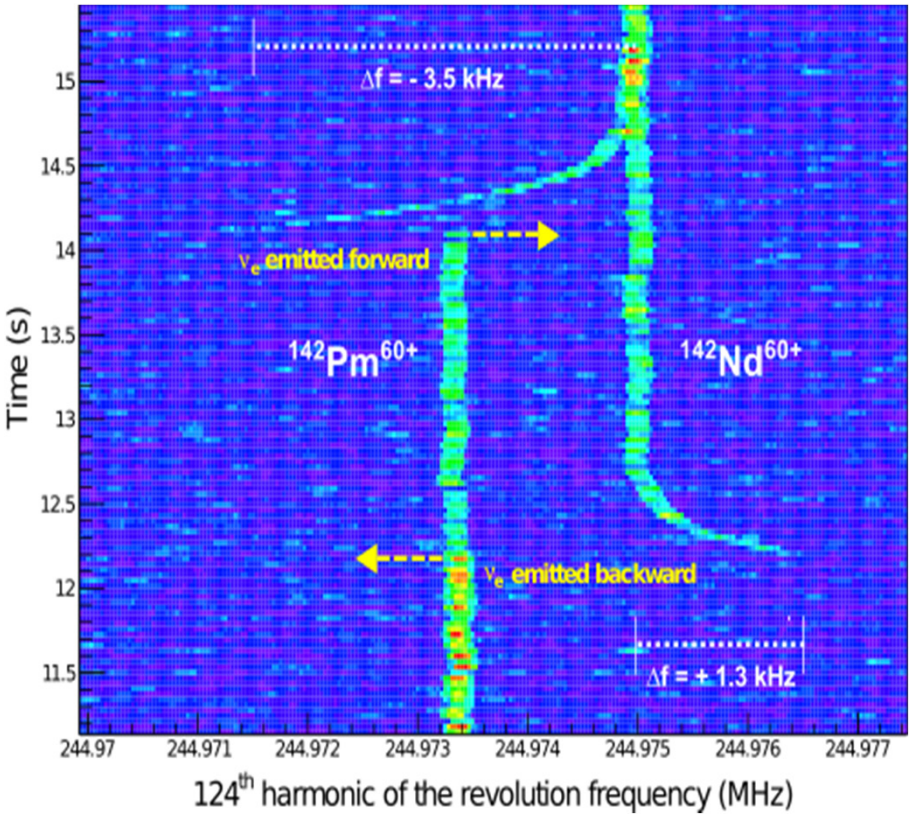
Working groups (WG):

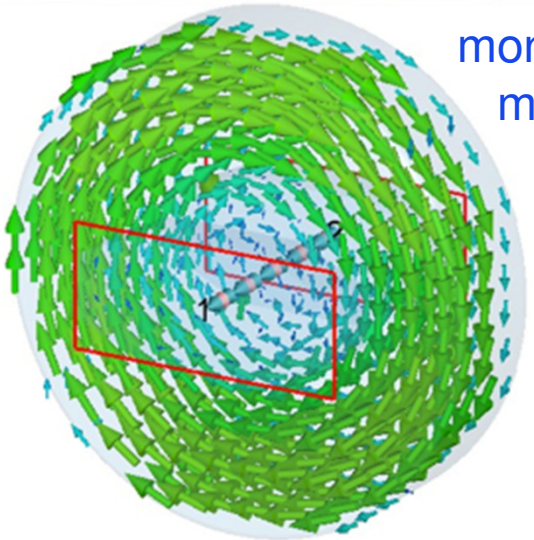
Evaluation software	Yu. Litvinov	GSI Darmstadt	**technical board**
Physics and theory	Z. Patyk	Soltan Inst, Univ. Warsaw	
Simulation+beam handling	H. Weick	GSI Darmstadt	
ToF detectors	W. Plaß	GSI Darmstadt	
Schottky detectors	C. Kozhuharov	GSI Darmstadt	
Particle detectors	R. Gernhäuser	TU Munich	

- **Project manager also represents most WGs in FAIR project structure.**
- **Most important good contact to CR designers (BINP Novosibirsk), contract with FAIR was signed Dec. 2016.**
- **German in-kind contribution foreseen (~970 k€ in 2017 prices)**

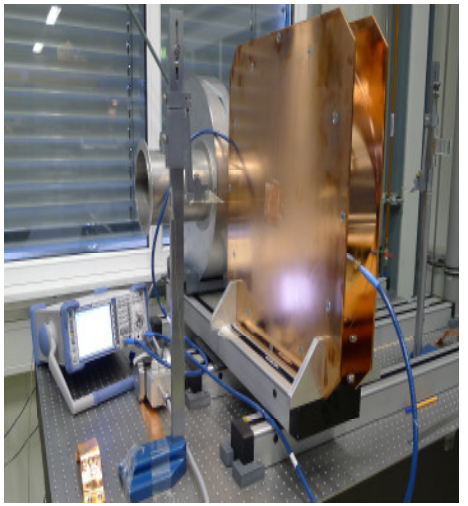

Schottky pickups
horizontal and vertical
Detector pockets
free
TOF-2
TOF-1
16.8m
Stand: 12.02.201

Resonant Schottky Pickups





monopole excitation
magn. component

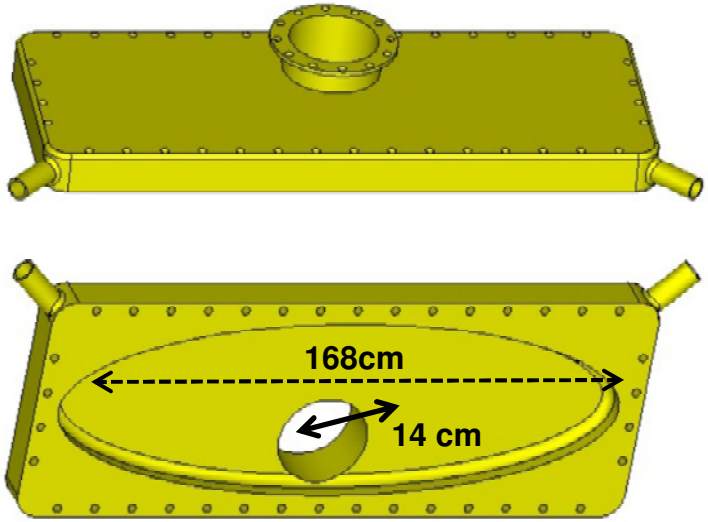


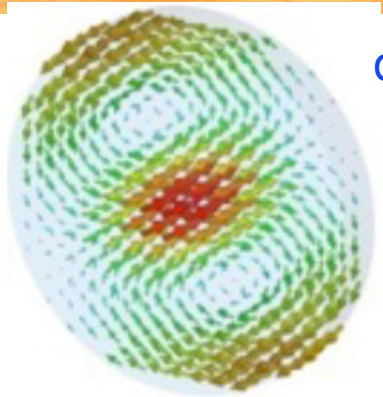
New pick-up in CR size under construction, to be installed in ESR still 2017

f = 680 MHz, Q_u = 12249, tunable

S. Sanjari, X. Chen

Schottky Pickup
with transverse position measurement

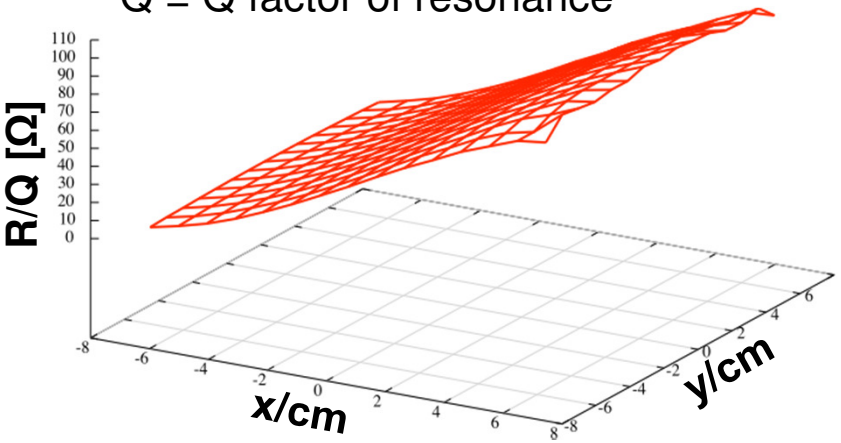


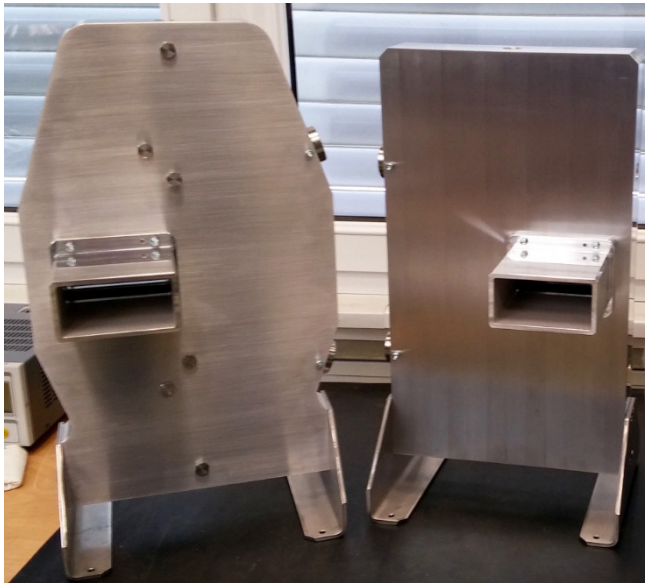


dipole excitation
magn. component

Elliptical cavity, gradient in R/Q
signal strength gives position

R = impedance
Q = Q factor of resonance

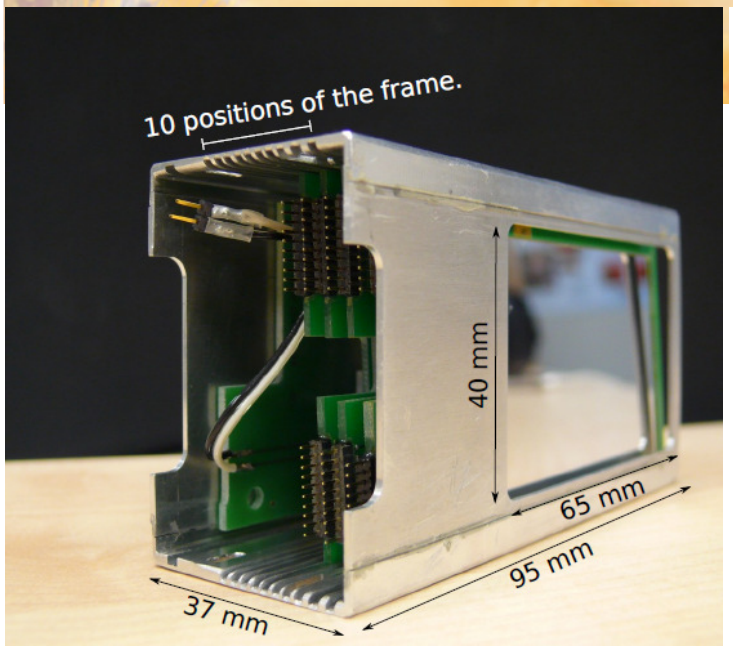


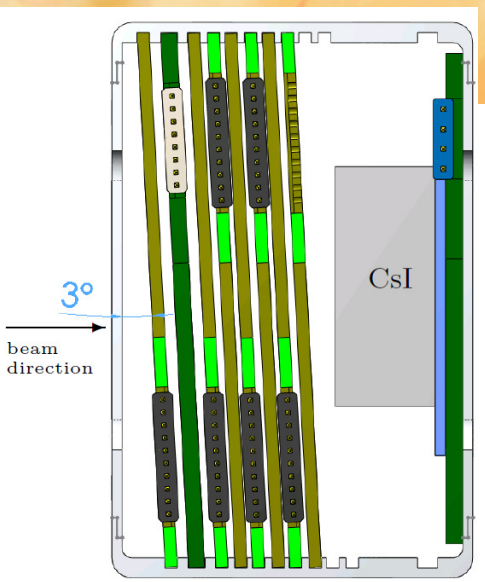


prototypes to be tested at DALINAC

Sanjari, Chen et al.,
Physica Scripta T166 (2015) 014060.
NIM A 826 (2016) 39.

Detector for In-Ring Decay

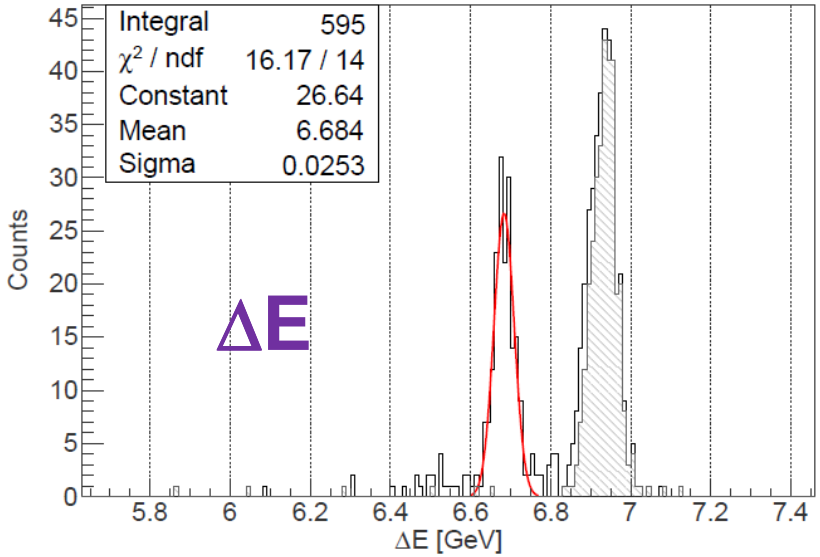


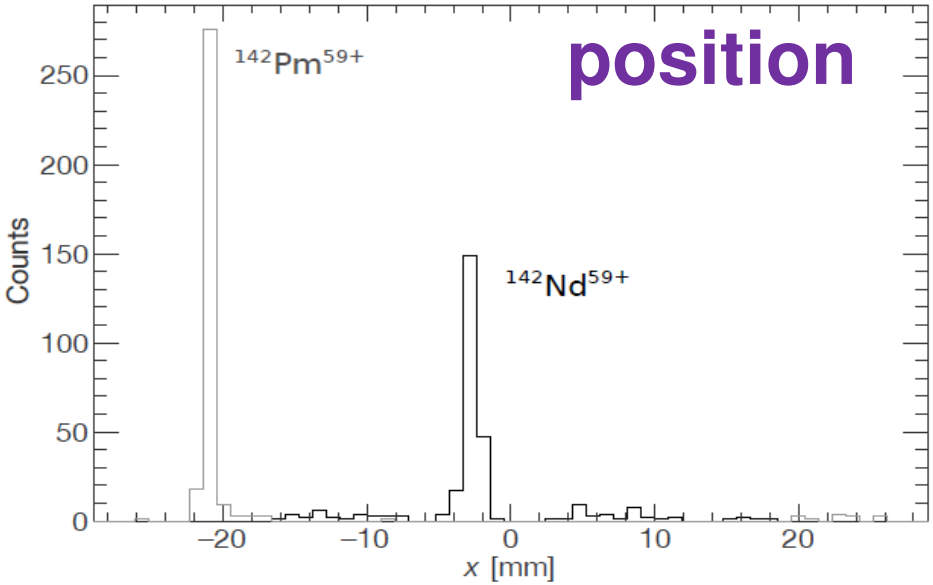


DSSD stack for ΔE-E
active area 40mm x 60mm
also with CsI calorimeter
+ Si photo diode,
to identity Z and A.

Ali Najafi et al.
NIM A836 (2016) 1.

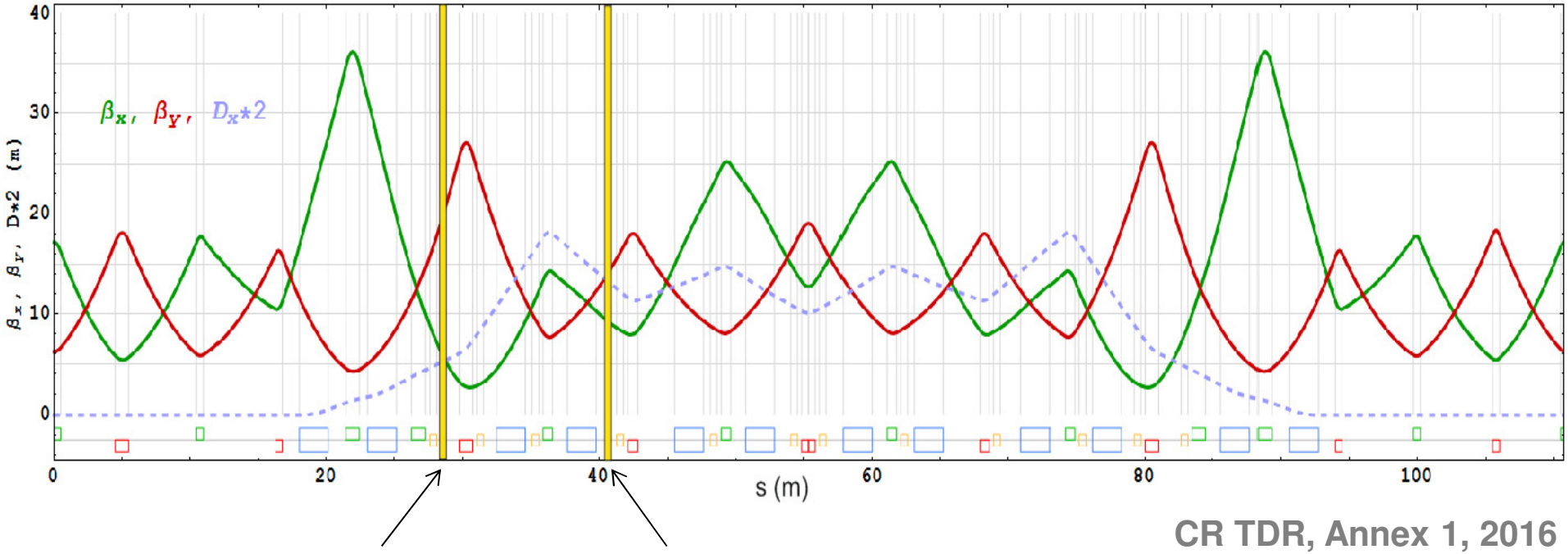
β+ decay: $^{142}Pm^{60+}$ → $^{142}Nd^{59+}$, electron capture $^{142}Pm^{59+}$





Positon of Detector Pockets

half of CR in RIB mode, x-width = sqrt(β_x ε_x)



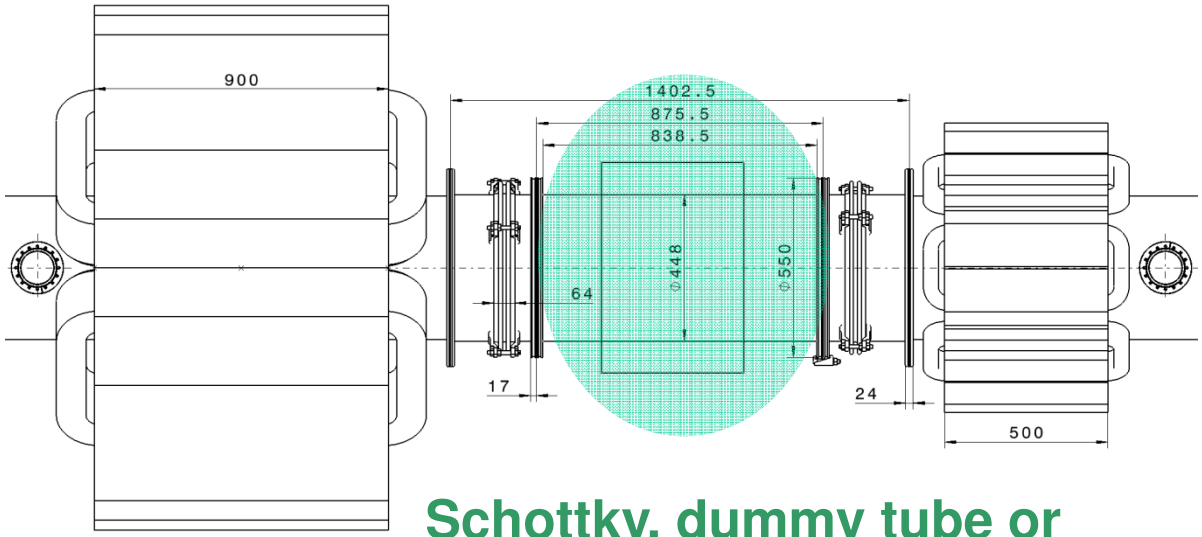
CR TDR, Annex 1, 2016

Δx = -72 mm
for Z=50, m=132

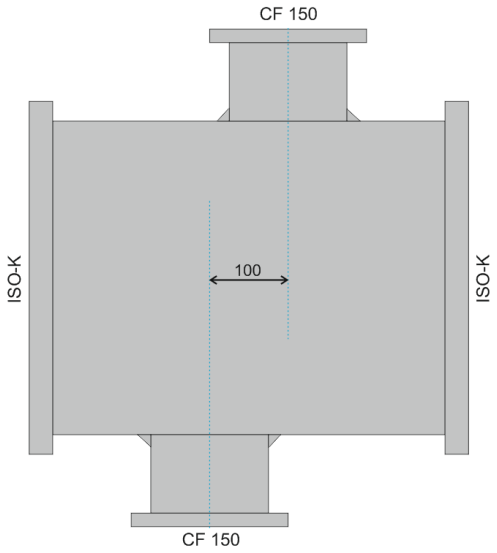
Δx = -130 mm
for Z=82, m=126

cooled beam (ε_x = 1 mm mrad)
➔ x-width = 2.2 – 3.2 mm

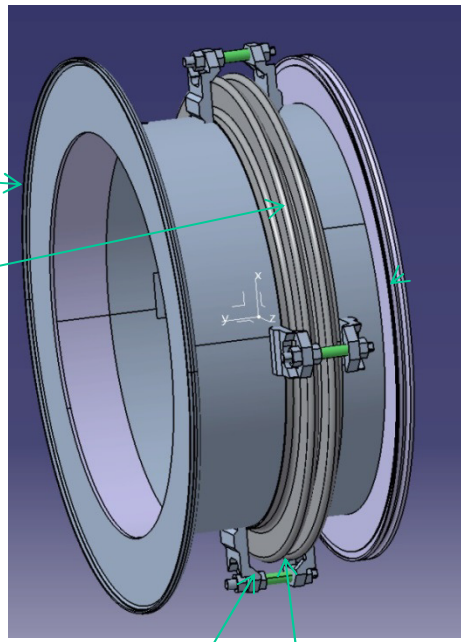
Exchangeable Experiment Sections



Schottky, dummy tube or cross for pockets

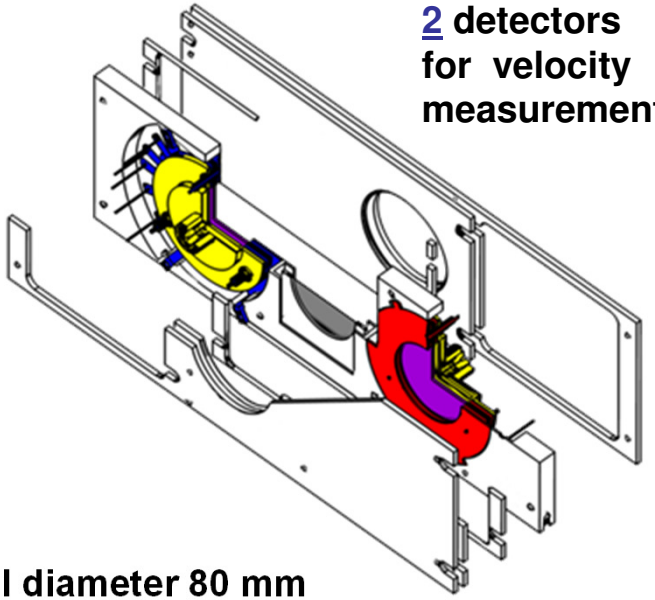


Adapters for welded tubes to ISO-K



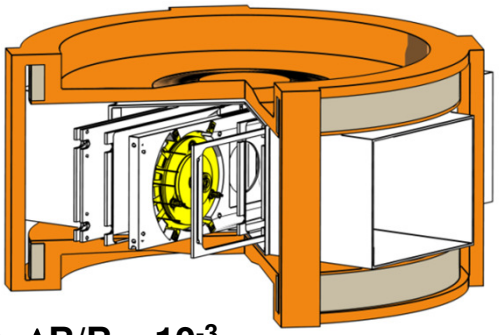
vacuum cross and not tube
⇒ BINP wants some extra money
also support for drive is needed

TOF Detector System for CR



2 detectors for velocity measurement

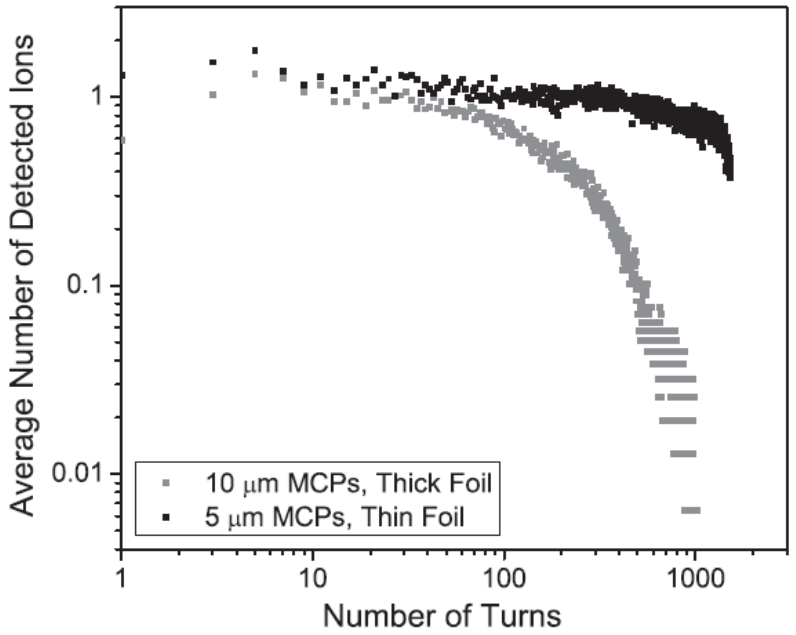
Foil diameter 80 mm
Dimensions: 562 mm x 180 mm x 236 mm
Electron transport efficiency ≈ 98%
Timing accuracy ≈ 35 ps (in simulation)



magnet hom. $\Delta B/B = 10^{-3}$

Main challenges for new detector:

- **Active area x 4 required**
- **Limited space in the ring, no simple scaling**
- **Higher rate and efficiency wanted**

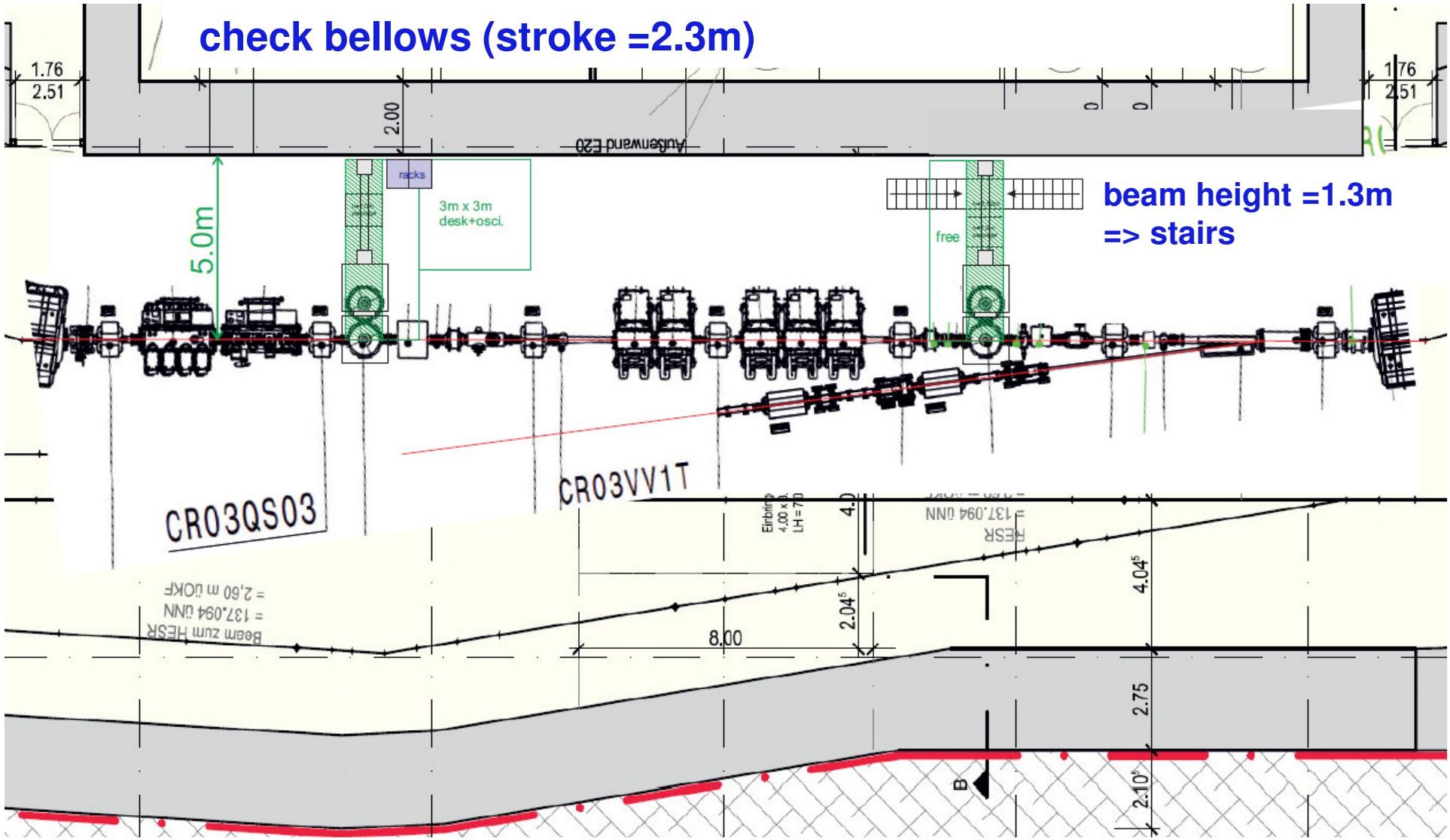


M. Diwisch et al., Phys. Scripta T166, 014058 (2015).
N. Kuzminchuk et al., NIM A821 (2016) 160.

ToF installation in CR

Accepted that we block the path, but try to save 0.8m passage.

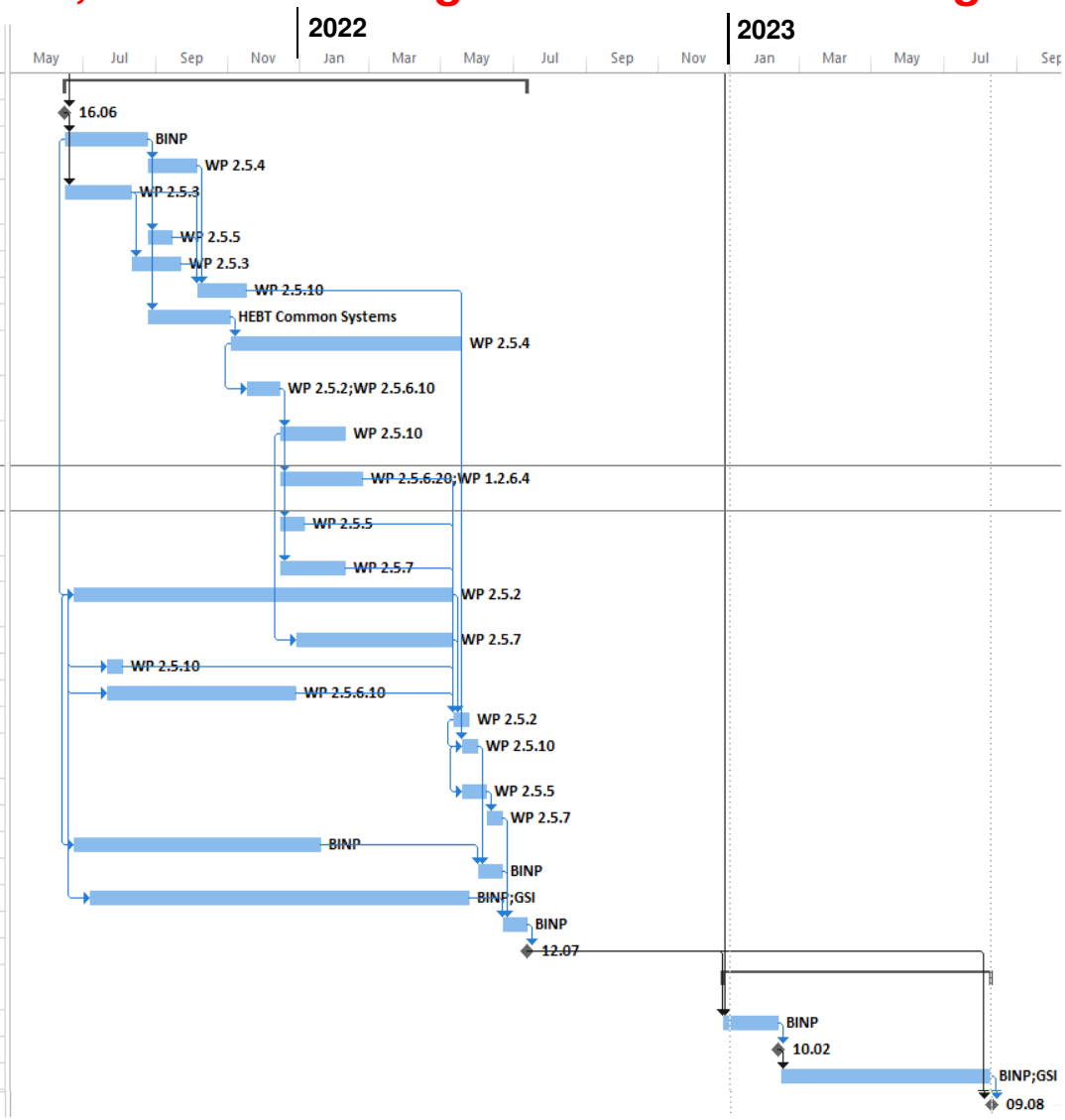
check bellows (stroke =2.3m)



CR Installation Time Plan

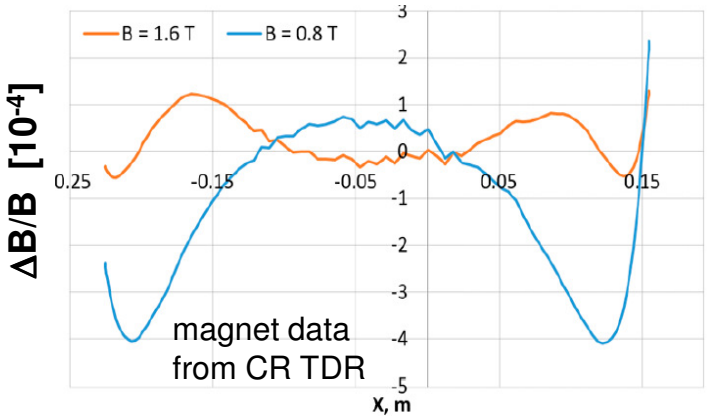
ToF chambers+magnets in first period, rest later during offline commissioning

	Responsible	Task Name	Duration	Start	Finish
10		**CR installation part 1**	**56 wks**	**Wed 16.06.21**	**Tue 12.07.22**
11		Start of 1st installation window	0 wks	Wed 16.06.21	Wed 16.06.21
12	BINP	Pre-alignment – blue line – coordinate syst	10 wks	Wed 16.06.21	Tue 24.08.21
13	WP 2.5.4	Installation power supply for RF-cavity and	6 wks	Wed 25.08.21	Tue 05.10.21
14	WP 2.5.3	Installation power supply for quadrupole, sextupole, octupole, steerers	8 wks	Wed 16.06.21	Tue 10.08.21
15	WP 2.5.5	Installation power supply for kicker magne	3 wks	Wed 25.08.21	Tue 14.09.21
16	WP 2.5.3	Installation power supply for dipole magne	6 wks	Wed 11.08.21	Tue 21.09.21
17	WP 2.5.10	Installation stochastic cooling amplifiers,	6 wks	Wed 06.10.21	Tue 16.11.21
18	HEBT Common	Installation HEBT extraction components	10 wks	Wed 25.08.21	Tue 02.11.21
19	WP 2.5.4	Installation straight section west: RF cavity - integration of RF-system	28 wks	Wed 03.11.21	Tue 17.05.22
20	WP 2.5.2;WP 2.5.6.10	Straight section west: installation quadrupole magnets, beam diagnostics	4 wks	Wed 17.11.21	Tue 14.12.21
21	WP 2.5.10	straight section west: installation stochastic cooling cryogenic PICK-UP	8 wks	Wed 15.12.21	Tue 08.02.22
22	WP 2.5.6.20;WP	straight section west: installation beam diagnostic (CCC) , TOF-detectors	10 wks	Wed 15.12.21	Tue 22.02.22
23	WP 2.5.5	Straight section west: installation extraction septum magnet	3 wks	Wed 15.12.21	Tue 04.01.22
24	WP 2.5.7	Straight section west:installation vacuum c	8 wks	Wed 15.12.21	Tue 08.02.22
25	WP 2.5.2	Arc segments: assembly and installation dipole magnets, quadrupoles, sextupole,	46 wks	Wed 23.06.21	Tue 10.05.22
26	WP 2.5.7	Arc segments: installation vacuum compon	19 wks	Wed 29.12.21	Tue 10.05.22
27	WP 2.5.10	Arc segments: installation stochastic cooli	2 wks	Wed 21.07.21	Tue 03.08.21
28	WP 2.5.6.10	Arc segments: installation diagnostics	23 wks	Wed 21.07.21	Tue 28.12.21
29	WP 2.5.2	Straight section east: installation quadrup	2 wks	Wed 11.05.22	Tue 24.05.22
30	WP 2.5.10	Straight section east: installation stochastic cooling KICKER components	2 wks	Wed 18.05.22	Tue 31.05.22
31	WP 2.5.5	Straight section east: installation kicker ma	3 wks	Wed 18.05.22	Tue 07.06.22
32	WP 2.5.7	Straight section east: installation vacuum c	2 wks	Wed 08.06.22	Tue 21.06.22
33	BINP	TCR1: installation dipole -, quadrupole-, se	30 wks	Wed 23.06.21	Tue 18.01.22
34	BINP	Last part of TCR1 with injection septum ma	3 wks	Wed 01.06.22	Tue 21.06.22
35	BINP;GSI	Last meter installation	46 wks	Wed 07.07.21	Tue 24.05.22
36	BINP	Machine alignment	3 wks	Wed 22.06.22	Tue 12.07.22
37		First installation phase completed	0 dys	Tue 12.07.22	Tue 12.07.22
38		**CR installation part 2 and commissioning without beam**	**32.6 wks**	**Mon 26.12.22**	**Wed 09.08.23**
39		Completation of machine alignment	7 wks	Mon 26.12.22	Fri 10.02.23
40		Machine alignment completed	0 wks	Fri 10.02.23	Fri 10.02.23
41	BINP;GSI	Commissioning without beam (after HBO)	6.4 mons	Mon 13.02.23	Wed 09.08.23
42		CR commissioning without beam finished	0 dys	Wed 09.08.23	Wed 09.08.23

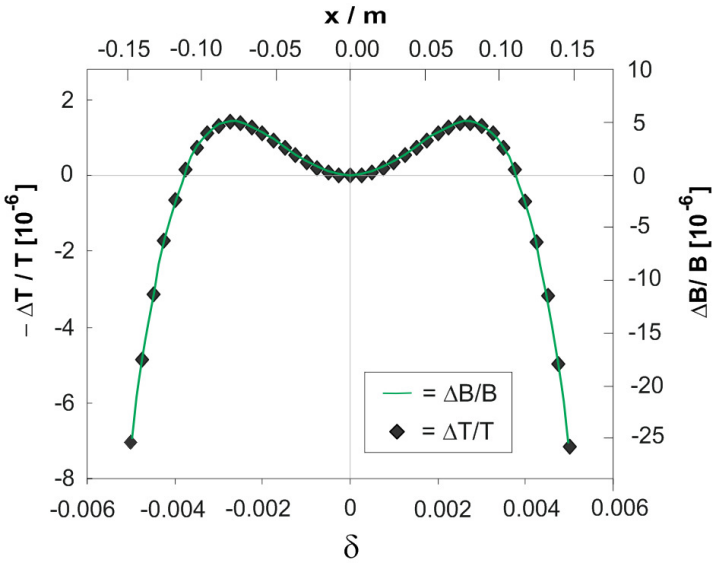


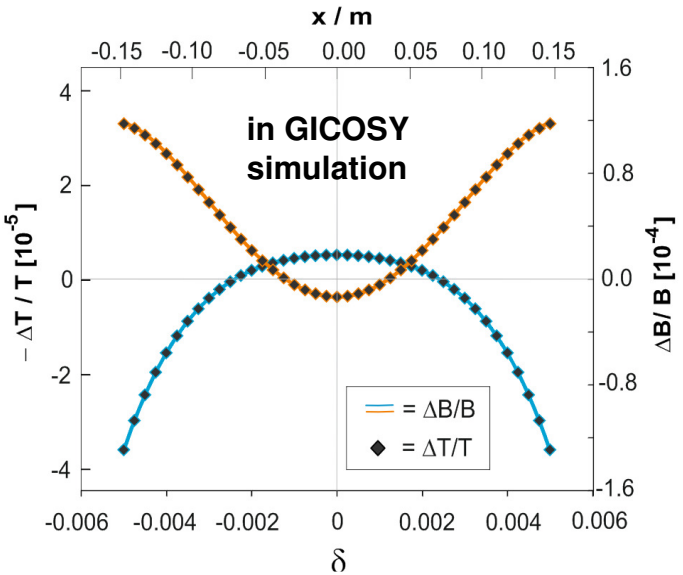
Decapole Corrector

Sextupoles, octupoles are foreseen, but also a 4th order corrector (decapole) is needed.

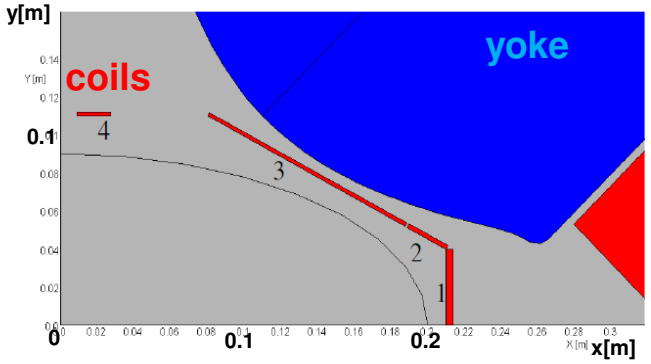


with full correction

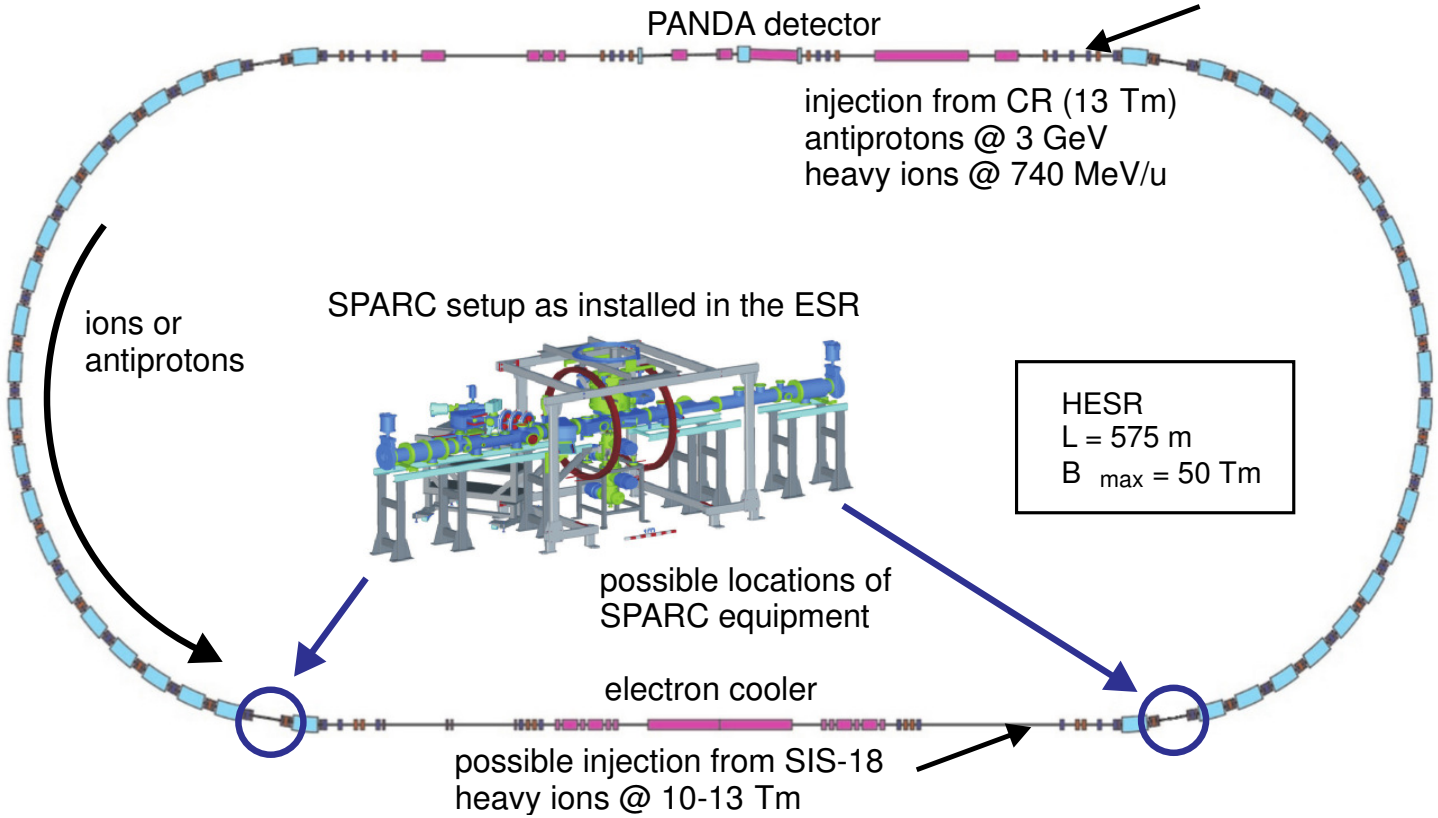




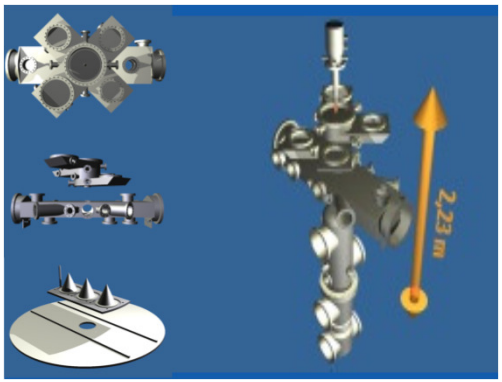
CR large quadrupole with octupole coils, conceptual design, A. Kalimov



SPARC and ILIMA experimental installations in the HESR

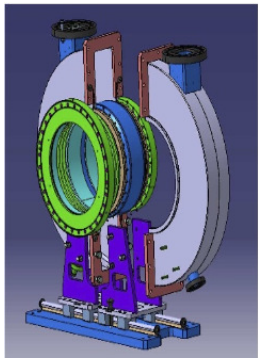


The SPARC Setup includes installations, which can be used also by ILIMA.



Internal gas-jet target

Particle detectors



Schottky diagnostics

Phase 0 (=ESR)

SIS-18 beamtime 2018 - 2023

preliminary plan for 2018

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
IQ	Shutdown				MC	BC MK	MK	BT	MK	TS	MK	Shutdown
UNILAC	Shutdown		HF-Test		MC HC	BC MK	MK	BT	MK		MK	
SIS18	SIS18 upgrade inkl. periodische Dry Runs				MC	BC MK	MK	BT	MK		MK	
HEST	Periodische Dry Runs (3-4Tage am Stück)				MC	BC MK	MK	BT	MK		MK	
ESR	Periodische Dry Runs (3-4Tage am Stück)					MC		BC	MK		MK	
CRYRING	Periodischer Teststrahlbetrieb local (2x4 Wochen am Stück)						MC	BC				

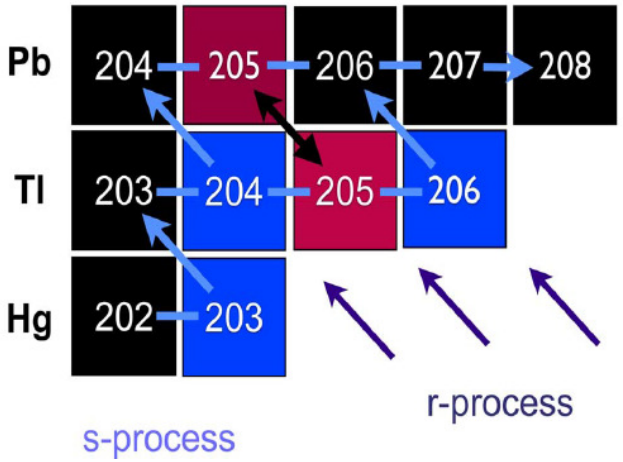
MC	Machine Checkout = Trockeninbetriebnahme incl. Kontrollsystem-/Betriebssoftware Inbetriebnahme
BC	Beam Commissioning = Inbetriebnahme mit Strahl / Inbetriebnahme Strahlwege (Primärstrahl) mit Pilotstrahl, timing System etc
MK	flex. MK-Beamtime (Maschinenexperimente, Maschinenentwicklung, Geräteinbetriebnahmen, Operateursausbildung, FAIR-Detektorentv
BT	Beamtime = Strahlzeit für PAC-Vergabe vorgesehen
TS	Flexible technische Strahlunterbrechung für Reparaturen, Softwareupdates usw. (als Block oder verteilt)
HC	HF-Konditionierung

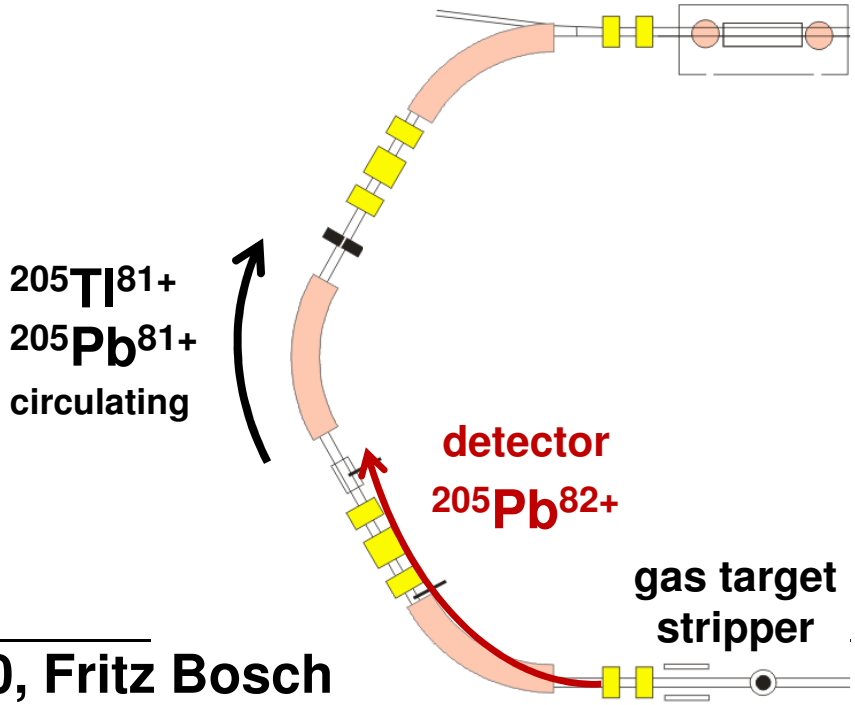
Still waiting for call for proposals and PAC, should be out until June.

Lifetime of ^{205}Tl for bound-state β-decay

Calibrate neutrino capture cross section in Tl for solar neutrino flux,
Influence on cosmic clock for S-process ^{205}Pb ($T_{1/2}$=1.7x10^7 y)

^{205}Pb EC Q-value so small that inverse is possible with highly ionised ions and bound-state β-decay (Q=+31 keV, $T_{1/2}$ ~120d ?).
Intense beam needed, no separation in Schottky possible.
But after gas stripper nicely visible on detector in arc.





Our old-> new Proposals

ToF mass measurements of fission fragments
with much improved conditions (last exp. 2007, last try 2010, E055).

+ Higher repetition rate (improved DAQ, faster ramping) x10
+ Detector efficiency, finding of traces, more turns x10
+ detector timing
+ more stable Uranium beam from SIS x 2
o no two detectors yet, must still use slits/scrapers

Isomers with Schottky and cooled beam or IMS (^{211}Bi, ^{212}Pb, ...).

New proposal should be done in the name of ILIMA.
The spokesperson can be someone for the individual experiment.

Also proposals for proof of principle experiments of accelerator:

- **One ToF detector in standard mode -> measure velocity**
- **Test Schottky pickups in ESR.**

Summary

Detector installation in CR worked out in more detail,

- place for many different pickups
- best positions for pockets
- ToF detectors in tunnel

We have working groups, and promised funds (~970 k€)
let us fix is by TDRs + contracts.

We need to get a higher order correction magnet,
only possible together with BINP Novosibirsk --> extra costs.

HESR can replace NESR with electron cooler,
for observation of isomeres, decays in ring, also with gas jet target.

Phase 0 at ESR is long. Many proposals exist(ed).
Revive proposals, physics ideas are not completely new,
but cases need adjustment. Prepare for call by PAC.

from NUSTAR Technical Board

Money to ask for:

Schottky	330 k€
ToF	320 k€
decay detectors	130 k€
DAQ (= rest)	190 k€

no TDR on DAQ,
include this in other TDRs

submit TDR
-> approval by ECE
-> detailed specifications,
risk assessment (QA),
safety questions (FAIR-SIST)
-> money

Phase 0 (ILIMA in ESR)
needs new proposals, open call expected early 2017
no common funds, requirements like in the past

Phase 1 (CR + HESR in MSV)
common funds for operation costs, more common ?
What services will be needed?
(for installation, computing, ...)