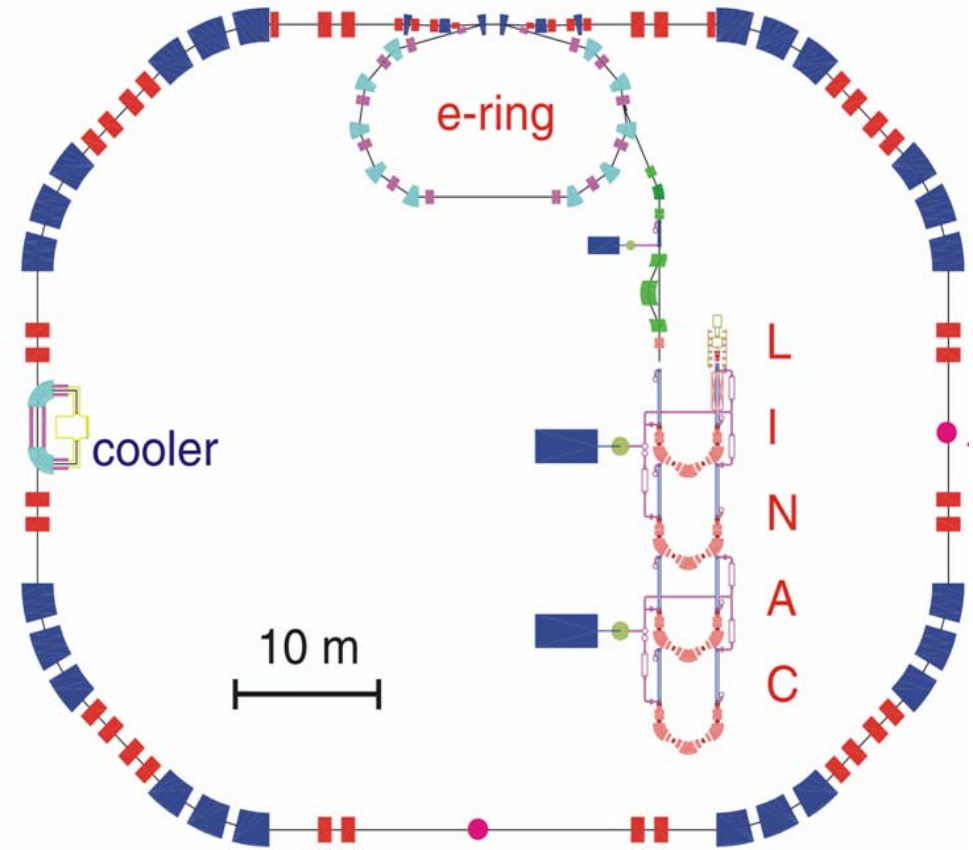
The ELISe experiment at FAIR

Haik Simon • Gesellschaft für Schwerionenforschung / Darmstadt



- 125-500 MeV electrons
- 200-740 MeV/u RIBs

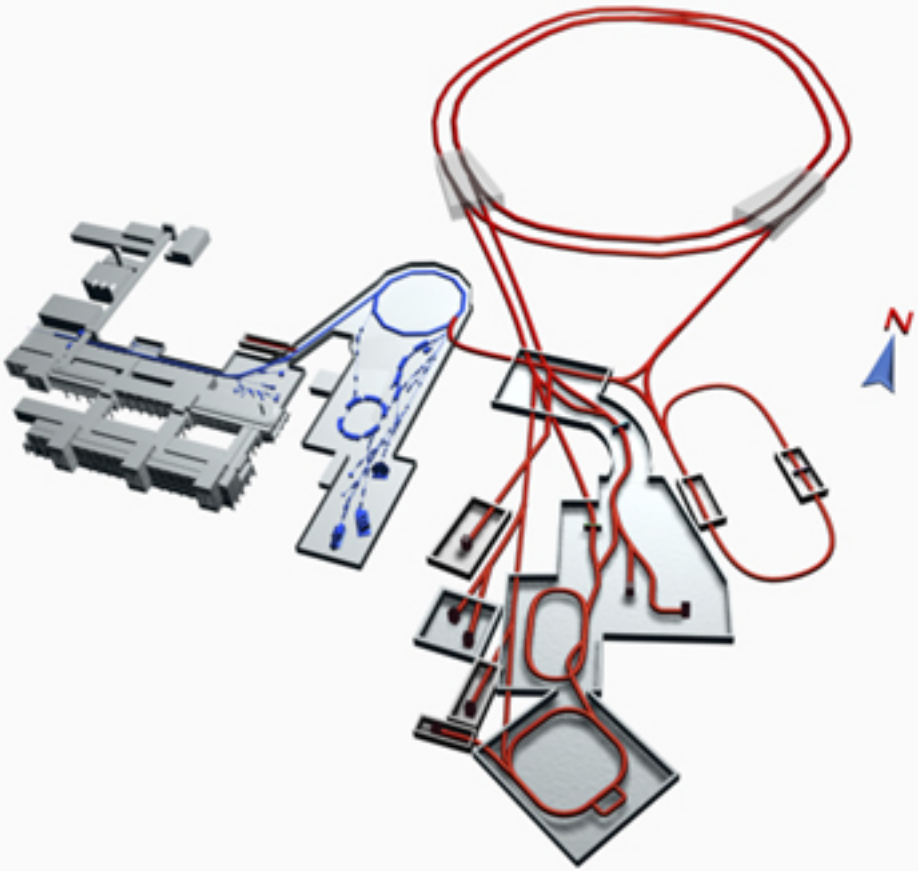
→ up to 1.5 GeV CM energy

- spectrometer setup at the interaction zone & detector system in ring arcs

- Part of the core facility

- Baseline technical report July
http://www.gsi.de/fair/reports/btr.html

The FAIR facility



Primary Beams

- 5 $\times 10^{11}$/s; 1.5 GeV/u; $^{238}U^{28+}$
- 2(4)x10^{13}/s 30 GeV protons
- 10^{10}/s $^{238}U^{73+}$ up to 25 (- 35) GeV/u

Secondary Beams

- Broad range of radioactive beams up to 1.5 - 2 GeV/u; up to factor 10 000 in intensity over present
- Antiprotons 3 - 30 GeV

Storage and Cooler Rings

- Radioactive beams
- e – A collider
- 10^{11} stored and cooled 0.8 - 14.5 GeV antiprotons

Why electron scattering ?

Pointlike, pure e.m. probe ➔

- Formfactors F(q)
  ⇒ elastic scattering

- $F_\ell(q)$ transition formfactors
  ⇒ excitation energy E*
  ⇒ high selectivity to certain multipolarities
  ⇒ access to interior
  ⇒ inelastic scattering

Large recoil velocities
➔ full identification (Z,A)
complete kinematics

Physics goals

- Charge distribution of exotic nuclei
  (radius, diffuseness, higher moments...)
  req. luminosity: about 10^{24} cm^{-2} s^{-1}

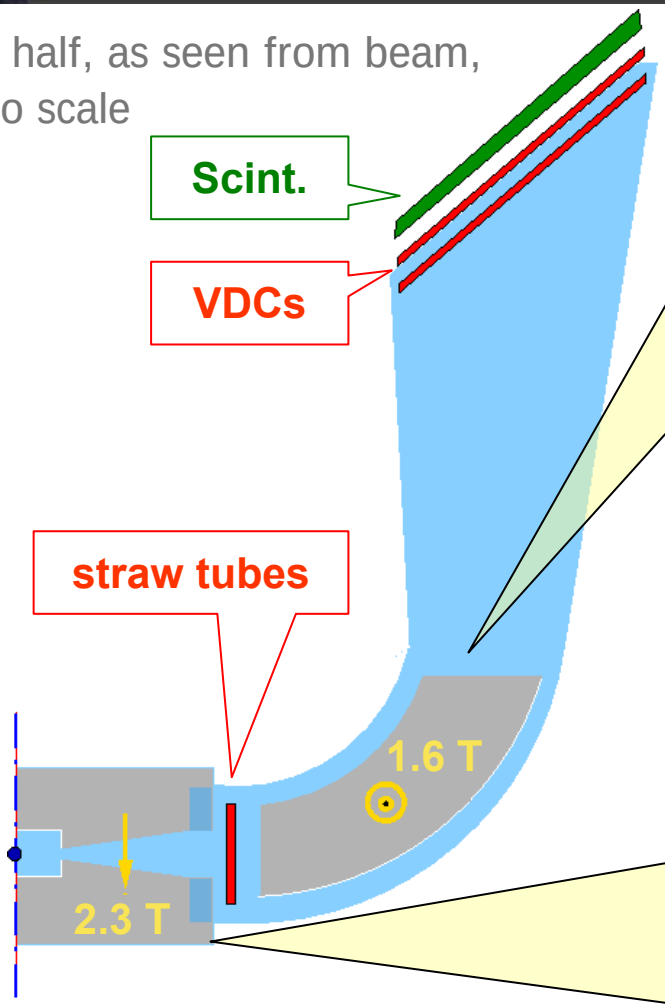
- Selective electromagnetic excitation
  Full identification of electric & magnetic multipolarities and of the final state
  (*new* collective *soft* modes)
  req. luminosity: about 10^{28} cm^{-2} s^{-1}

- Quasi-free scattering
  (single-particle structure)
  req. luminosity: about 10^{29} cm^{-2} s^{-1}

Spectrometer design

→ proof of concept

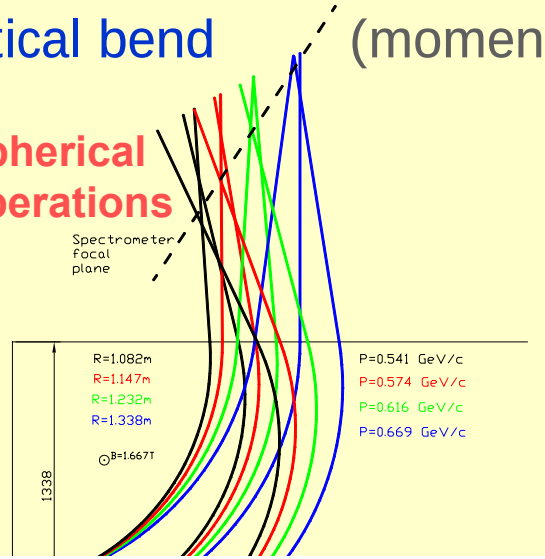
right half, as seen from beam,
not to scale



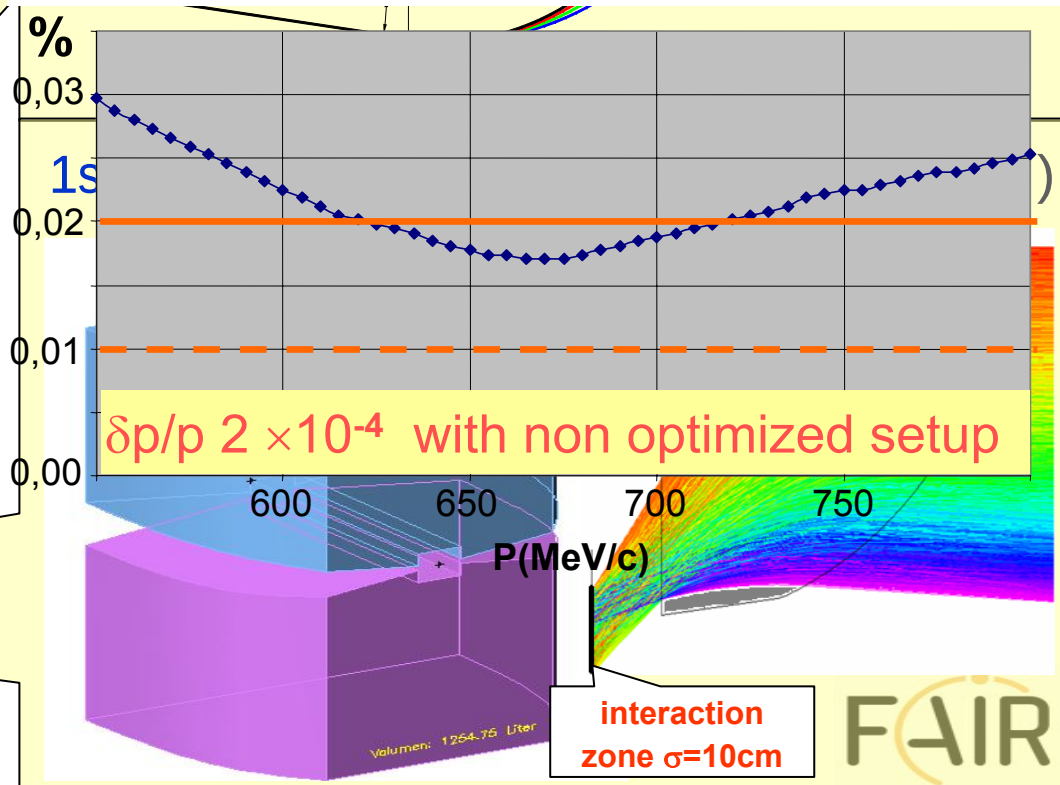
2nd stage: vertical bend (momentum)

spherical abberations

10% of full (azimuthal) angle coverage



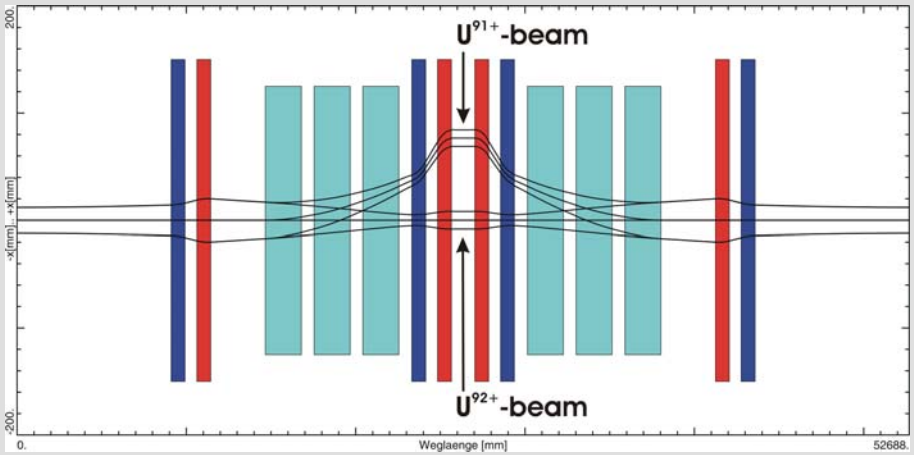
Full tracking simulation including detectors



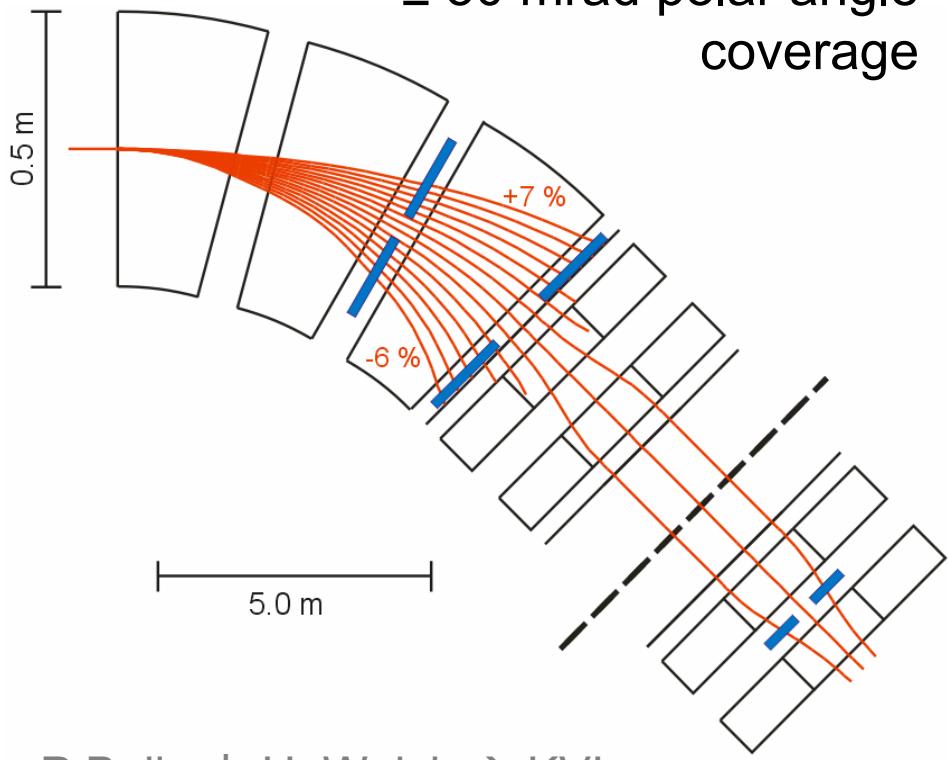
GSI

FAIR

In-ring instrumentation



± 50 mrad polar angle coverage



Tracking: e.g. (e,e‘n) → (e,e‘A‘)
ΔE/E, material budget
Si-strip, CVD, MWC, CsI/Si(Li)
Rate limited: several 10-100 kHz
Correlation via Timestamps.

P.Beller†, H. Weick → KVI

Separation of U^{92+}/ U^{91+} (ε = .1 mm mrad):	**79 mm**
Separation of U^{92+}/ U^{91+} (ε = 10 mm mrad):	**63 mm**

In ring detector setup as for the EXL, SPARC … collaborations

N/CBM-XYTER:
DETNI Neutron Detector/CBM Readout ASIC

Architecture: 128 channel data driven charge sensitive front end

Front end for either polarity input signals:

Charge sensitive pre-amp

Fast analogue shaper as timing channel: init peak detector, timestamp

Slow analogue shaper as energy channel with peak detection

Readout:

- de-randomizing analogue energy and digital time stamp (2ns resolution) FIFO
- 2D-spatial information through X-Y-coincidence
- possible background suppression through spectroscopic window
- resolution enhancement through center of gravity determination
- de-randomizing robust and self sparsifiing readout strategy (token ring)
- test facilities

AMS 0.35 microns

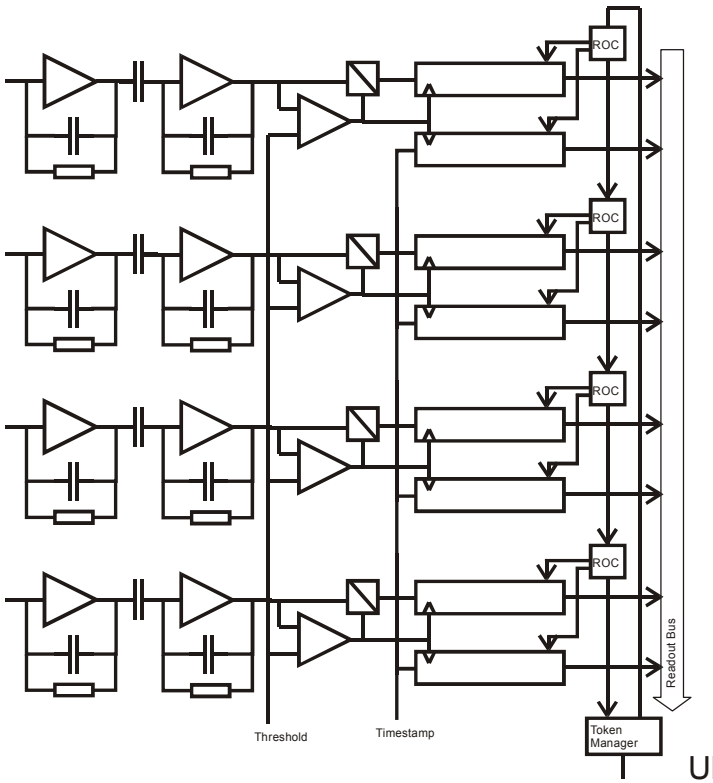
Specifications for DETNI-ASIC as of 19.06.04

Property	Spec agreed upon	Gd/Si-MSD	Gd/CsI-MSGC	B-CASCADE GEM
channel pitch	**50 µm**	50 µm	Arbitrary	arbitrary
input capacitance C_{in}	**30 pF**	10....15 pF or rather 25pF ?	23 pF X 40 (33)pF Y	10....30pF
T_p timing channel	**30 ns**			
T energy channel	**$T_{5\%}$ = 650 ns**	**Def:** Peak is above 5% no longer than $T_{5\%}$		
Max ENC at C_{in} and T_p for timing channel	**optimize**	550 e	2000 e	660 e
Dynamic range & gain two versions, low gain later	(8 – 120)*10^3 e (2 –30)*10^5 e	(8 – 69)*10^3 e	(2 - 30)*10^5 e	(2 – 400)*10^3 e
no. of chan. per chip	**128**	128	64, 128	64, 128
timing resolution	**4 ns (opt. res.)**	8 ns	4 ns	10 ns
Max. % dead-time	**10 % -> fifo depth: 10**	10 %	10 %	10 %
average rate per chan.	**160 kHz**	160 kHz	960 kHz	160 kHz

Token Ring Schema as proposed by Ulrich Trunk 2003

ASIC Labor Heidelberg

Sparsified, de-randomized readout



- Periodic readout at 20MHz
- Token asynchronously passes from channel to channel in search of data
- Within one readout cycle token could pass through all channels
- If token encounters occupied channels, data readout is initiated.
- After readout the token passes to the next channel.

→20 MHz/128 Ch ≈ 160 kHz

ENOB 10.4

Ulrich Trunk
Physikalisches Institut der Universität Heidelberg

DETNI Collaboration

S.S. Alimov[a], A. Brogna[b], S. Buzzetti[b,c], W. Dabrowski[d], T. Fiutowski[d], B. Gebauer[a], G. Kemmerling[e], M. Klein[b], C. Petrillo[f], F. Sacchetti[f], **Ch.J. Schmidt[g]**, K.H. Soltveit[b], R. Szczygiel[d,h], Ch. Schulz[a], C. Thielmann[e], U. Trunk[b], P. Wiacek[d], Th. Wilpert[a]

[a]*Hahn-Meitner-Institut Berlin, Glienicker Str. 100, D-14109 Germany*

[b]*Physikalisches Institut der Universität Heidelberg, Philosophenweg 12, D-69120 Heidelberg, Germany*

[c]*INFM & Dipartimento di Elettronica et Informazione, Politecnico di Milano, Piazza Leonardo da Vinci 32, Milano I-20133, Italy*

[d]*Faculty of Physics and Applied Computer Science, AGH University of Science and Technology, al. Mickiewicza 30, 30-059 Krakow, Poland*

[e]Central Institute for Electronics, Research Centre Jülich, 52425 Jülich, Germany

[f]*INFN & Dipartimento di Fisica, Universita di Perugia, Via A. Pascoli, Perugia I-06123, Italy*

[g]*Gesellschaft für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt, Germany*

[h]*Institute of Nuclear Physics, Polish Academy of Sciences, ul. Radzikowskiego 152, 31-342 Krakow, Poland*

Summary: Tracking devices

- Rate capability → single wire/strip/pixel readout
  required e.g.: AIC, EXL, ELISe, SPARC, SuperFRS, …
  ➔ synergies …
- external trigger delayed → ‚slow detectors'/long distances/several systems (~ 100 m)
  several µs buffering
  (absolute) time stamp interface
- noisy environment/detector → fair share bandwidth (e.g. N-XYTER Token)

Rate requirement: few 100 kHz
Low resolution (10Bit/160kHz version) is available
Spectroscopy version (few 10 channels, ΔE is missing)