Au^{31+} in AGS

W. Fischer, L. Ahrens, K. Brown, K. Gardner,
M. Mapes, L. Smart, K. Zeno, S.Y. Zhang
P. Spiller, C. Omet (GSI)

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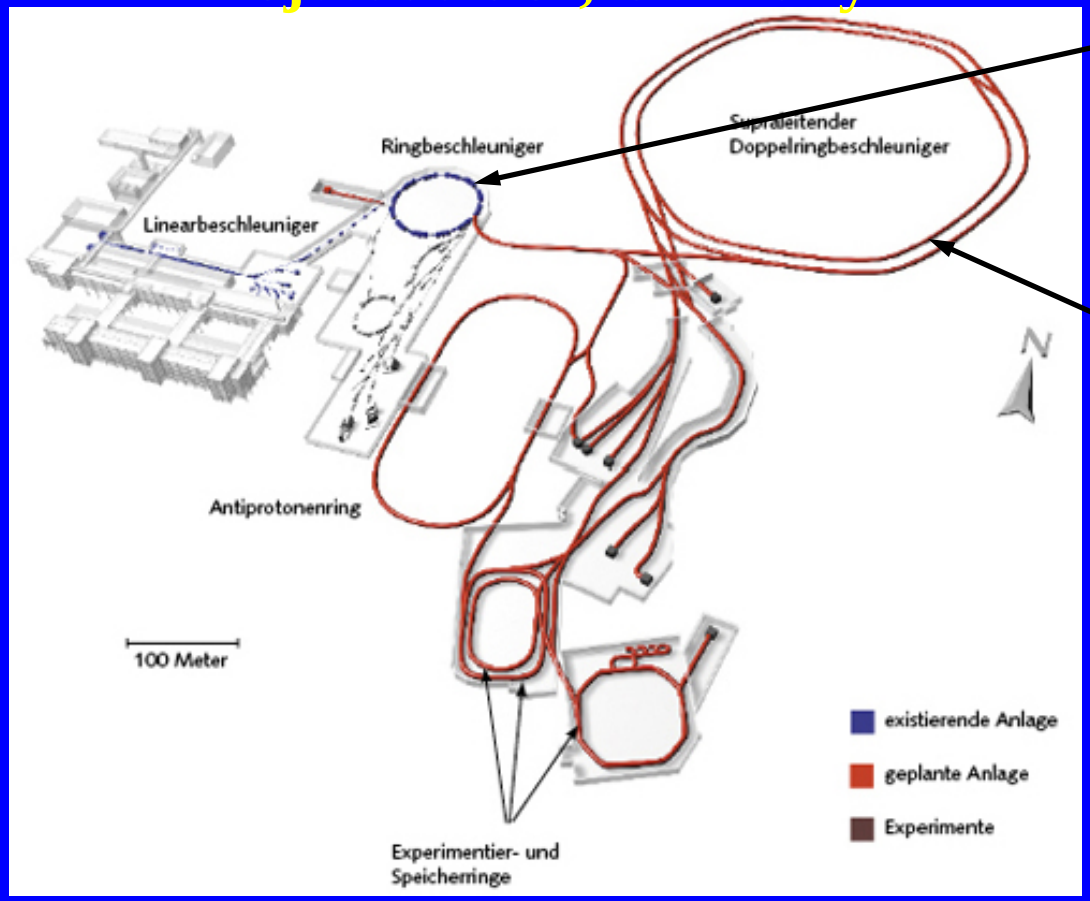
Motivation (GSI)

FAIR Project at GSI, Germany



SIS18 (existing), energy range close to **AGS Booster**

SIS100 (planned) – energy range close to **AGS**

SIS300 (planned)

(SIS-number denotes maximum rigidity in Tm)

Heavy ions to be accelerated: U^{28+}

- low charge state reduces space charge
- increases e-stripping, resulting in dynamic pressure and beam loss (expected to be the main intensity limit)

Motivation (GSI)

FAIR goal:

Up to 10^{12} U ions/pulse from SIS100

$\Rightarrow$ Need low charge state U^{28+} ions to reduce space effects

Experimental goals:

1. Measure ion-impact desorption coefficients for ions with energies in SIS100 (=AGS) range
2. Benchmark calculations of dynamic pressure and beam loss due to charge exchange processes

Motivation (BNL)

- Stripping of Au^{31+} to Au^{77+} in BtA has 30% intensity loss, would be less at higher energy;
  Au^{31+} beam has smaller space charge effects than Au^{77+};
  $\Rightarrow$ could allow acceleration of more intensity in AGS

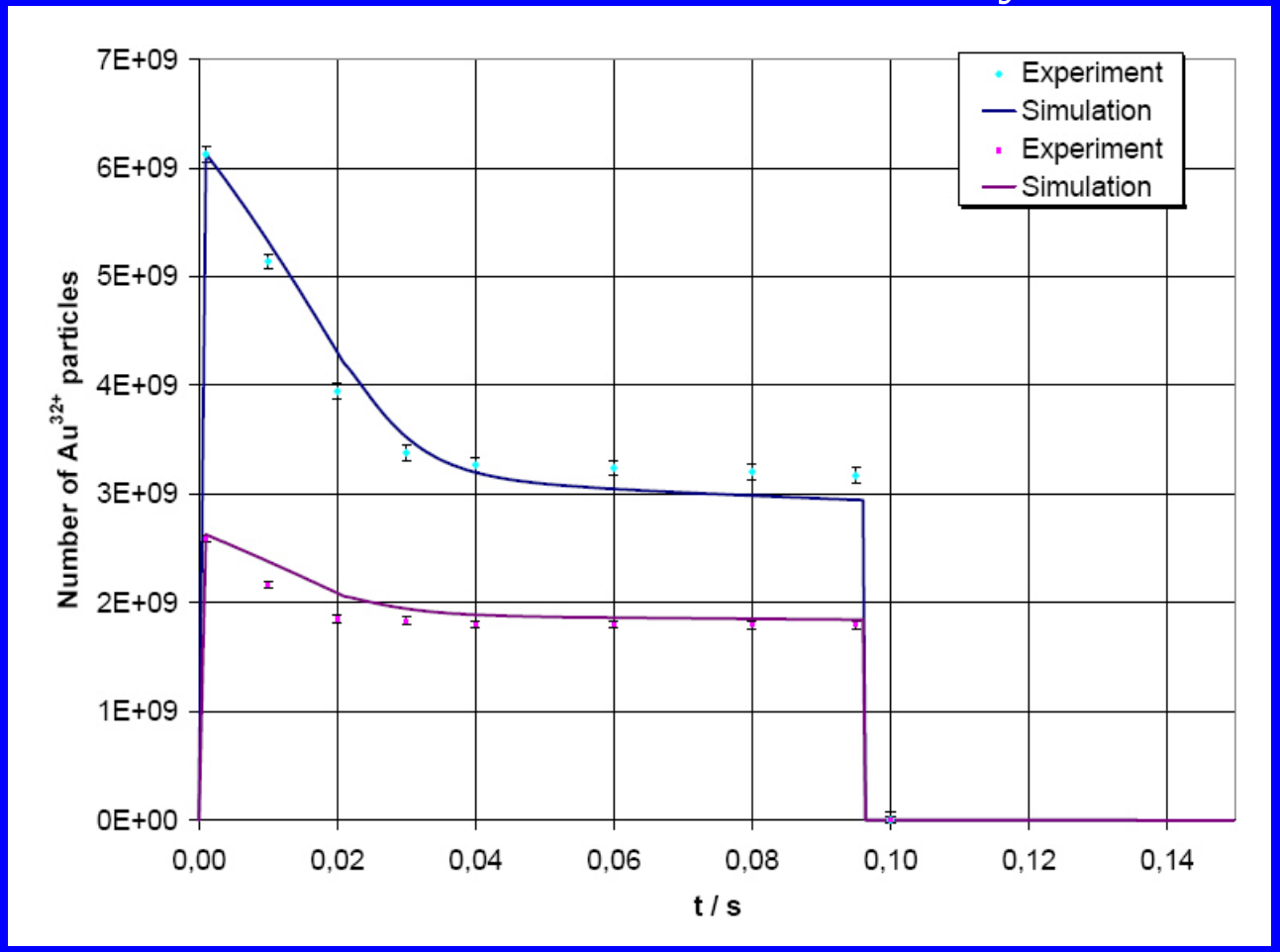
- $(B\rho) = p/q$
  $\Rightarrow$ at same extraction rigidity,
  Au ion momentum reduced by factor 31/77 = 0.4

- Higher intensity at lower momentum can be useful for RHIC low energy operation

- Most restrictive intensity limit probably in Booster
  - also from dynamic pressure, same effect as the one studied here in AGS
  - GSI calculations show a factor 2 increase in Booster output intensity by raising the injection energy from currently 1 MeV/nucleon to 2 MeV/nucleon with EBIS

Effect in AGS Booster

Measured and calculated Au^{32+} intensity in Booster cycle



Calculations:
A. Smolyakov (ITEP)
charge exchange
(mostly e-capture)
and residual gas
ionization
cross sections
C. Omet, P. Spiller (GSI)
pressure and intensity

Experimental data:
L. Ahrens, K. Gardner,
K. Zeno, S.Y. Zhang

[S.Y. Zhang, L.A. Ahrens, PAC'99; A. Smolyakov et al., GSI-Acc-Report-2005-11-001 (2005), BNL C-A/AP/117 (2006)]

Preparation in AGS

- Need average pressure in AGS, on time scale of charge-exchange induced beam loss (≥ 3 Hz)

- AGS vacuum system:
  - 240 ion pumps in AGS (one per dipole), ~100 l/s
  - average pressure about 7×10^{-9} Torr (H_2O – AGS not baked)
  - 7 regions with pressure bumps
    J20 (RF), C20 (polarimeter), D20 (RF), E15 (IPM), C15 (polarimeter), C5 (IPM), I20 (RF) – mid 10^{-7} to high 10^{-8} Torr

- Plan to upgrade for fast read-out:
  - 1 gauge and 3 pumps per vacuum sector (24 sectors)
  - 3 more pumps each in pressure bump region

  [materials cost to be paid for by GSI]

BtA and AGS setup

- Need to change BtA (no stripping)
- Would like to have AGS ramps to about 5 different energies
- Inject Au^{31+} beam of varying intensity, monitor intensity and pressure throughout cycle
- Expect 2-3 days behind RHIC stores

Data to be collected (Booster examples)

← intensities in cycle

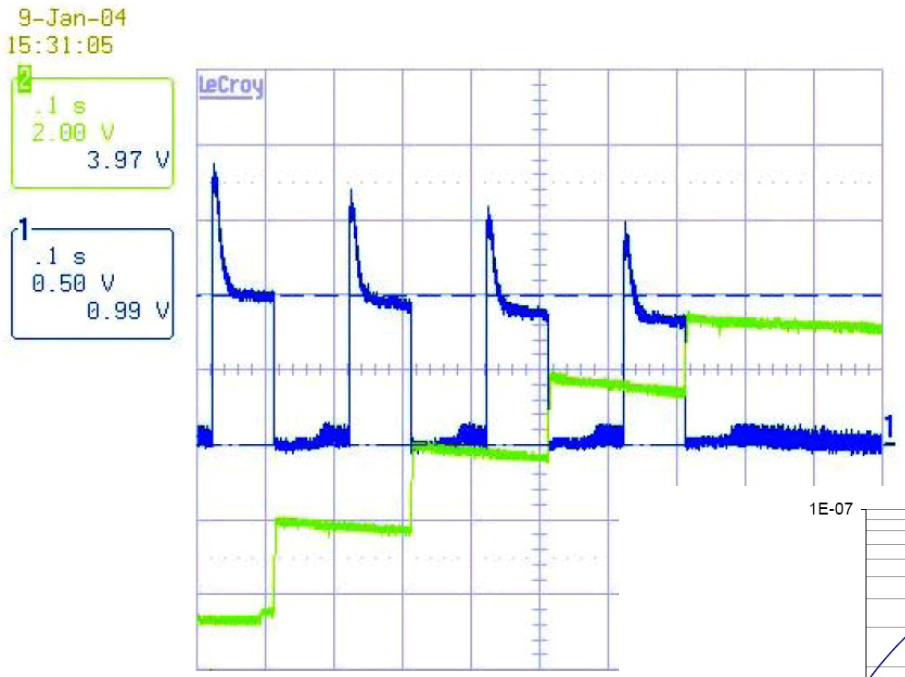


Figure 2: Measured beam intensity profiles in AGS Boos

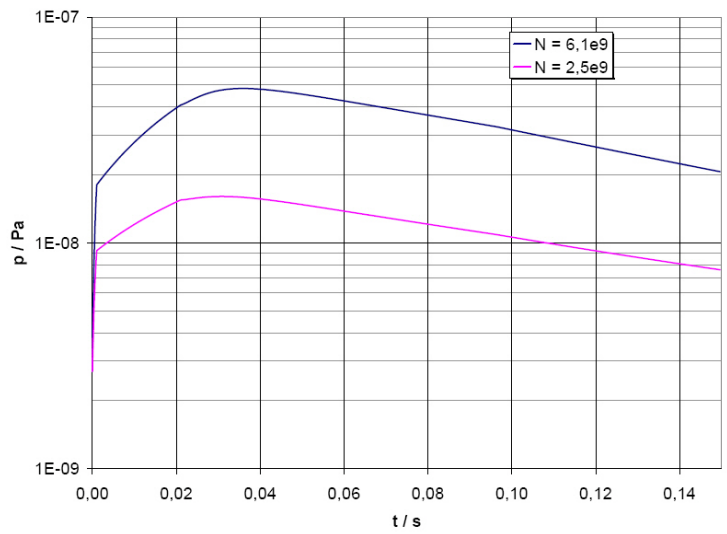


Figure 3: Calculated pressure profile in an AGS Booster cycle for different initial intensities

pressure in cycle →
(calculation in example)

Summary Au^{31+} in AGS

- Preparation started
  - Planned upgrade of AGS vacuum system
  - Dynamic pressure calculation under way at GSI
  - Outlined experimental plan

- Need 2-3 days behind RHIC stores for experiment
  (at reasonable RHIC availability, no p↑ work possible during that time)
  - Setup BtA transfer line
  - Setup AGS cycles to ~5 end energies
  - Inject and accelerate Au^{31+} beam of varying intensity, observe intensity and average pressure
  - Compare intensity and pressure observations to GSI calculations