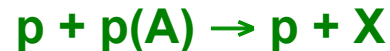


# Measuring Forward Protons at RHIC

pp, pA and future ep, eA

*Włodek Guryn BNL*

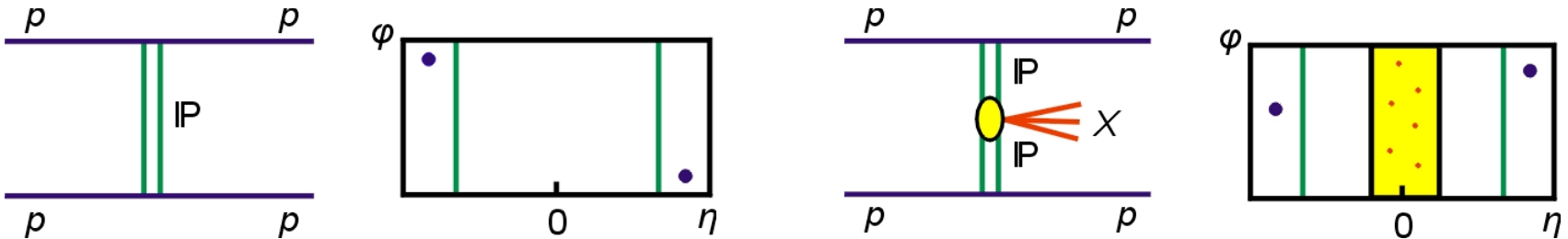
- Physics in pp and beyond
- Implementation for running without special optics
- Implementation - fast track solution at STAR
- Summary



**Common feature – forward proton(s) measured currently at STAR**

**PHENIX and RHICf possibly in the future**

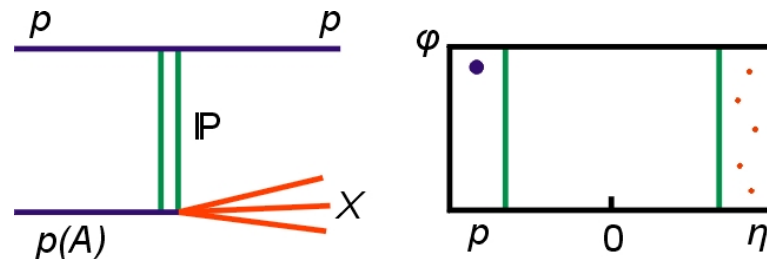
# Physics with Tagged Forward Protons



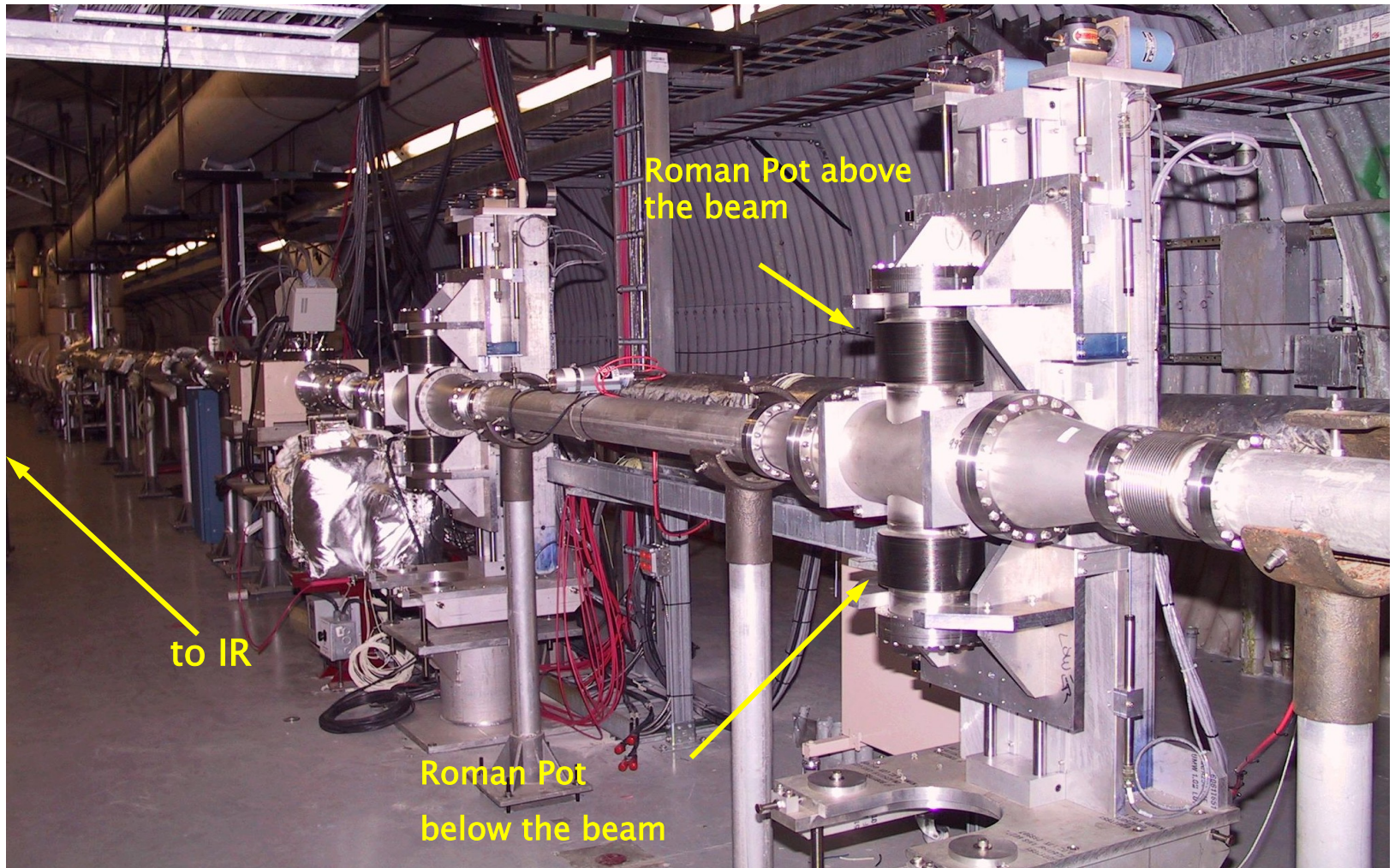
## Physics with tagged forward protons

$p + p \rightarrow p + p$   
elastic

$p + p \rightarrow p + X + p$   
diffractive  $X =$  particles, jets,  $W$ ,  $J/\Psi$ , Higgs, glueballs....

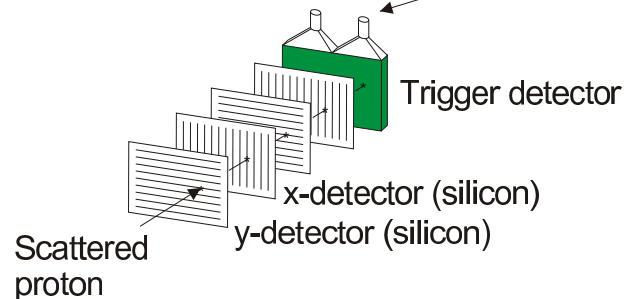
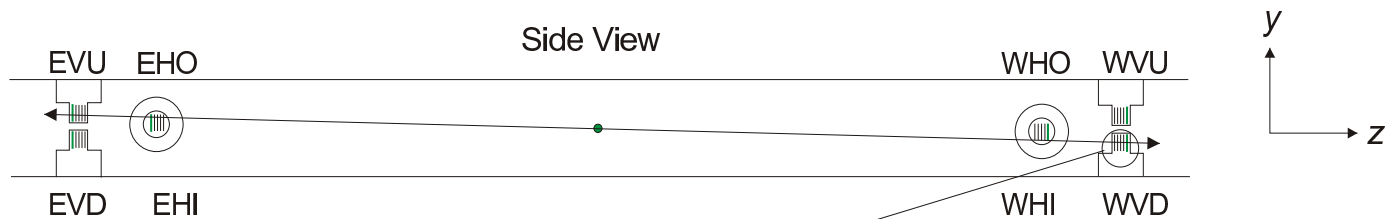
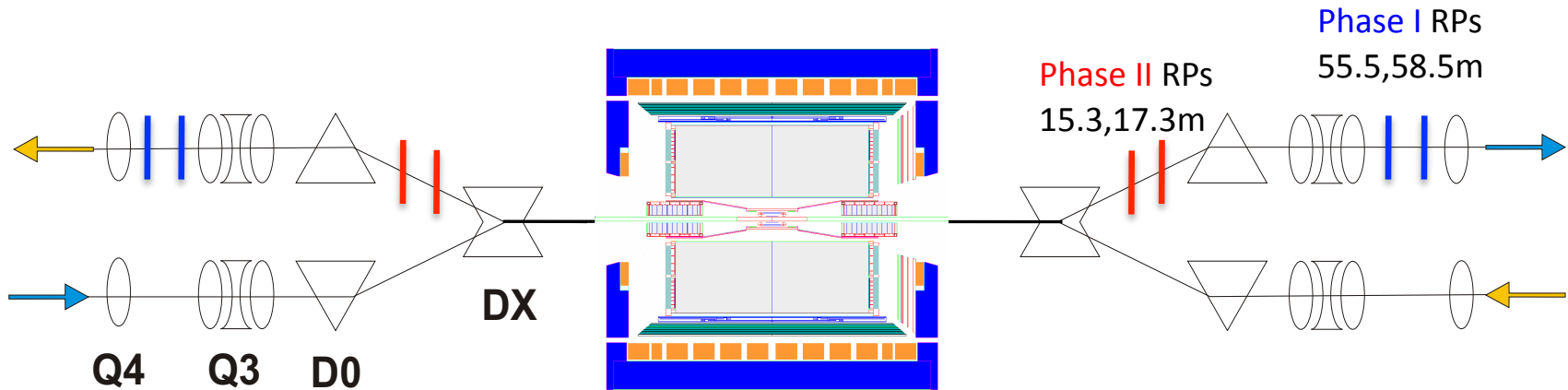


# Roman Pot Stations at RHIC (pp2pp 2 o'clock)

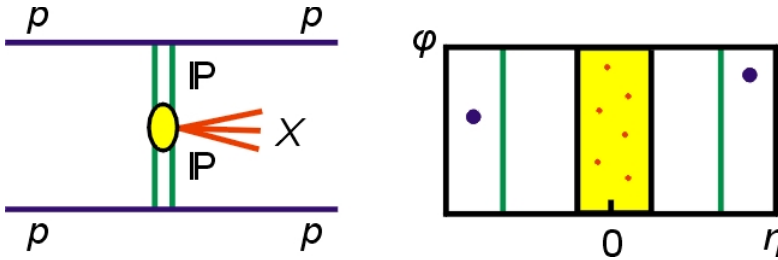


# RP location (Phase I and II at STAR)

RPs for Phase II are located between DX – D0  
Modification to the vacuum chamber is required



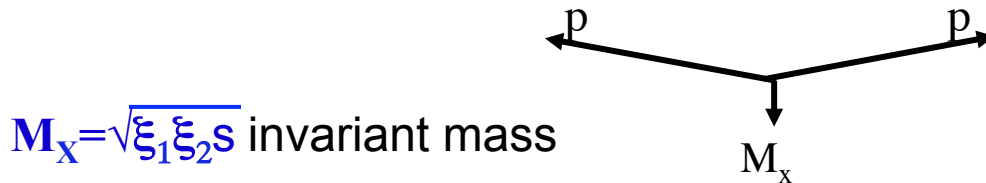
# Central Production in DPE



Method is complementary to:

- GLUOX experiment (2015)
- PANDA experiment (>2015)
- COMPASS experiment (taking data)

In the double Pomeron exchange process each proton “emits” a Pomeron and the two Pomerons interact producing a massive system  $M_X$



$$M_X = \sqrt{\xi_1 \xi_2 s} \text{ invariant mass}$$

For each proton vertex one has  
 $t$  four-momentum transfer  
 $\xi = \Delta p/p$

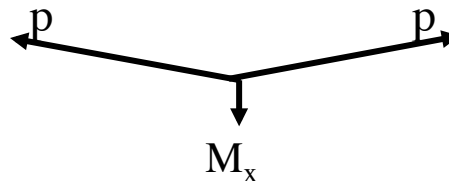
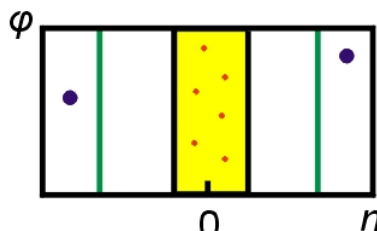
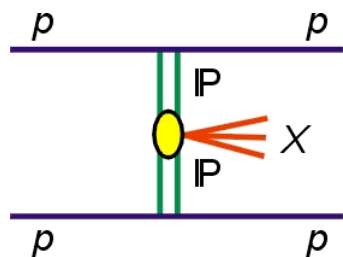
where  $M_X = \pi^+ \pi^-, \chi_c(\chi_b), qq(\text{jets}), H(\text{Higgs boson}), gg(\text{glueballs})$

The massive system could form resonances. We expect that because of the constraints provided by the double Pomeron interaction, glueballs, hybrids, and other states coupling preferentially to gluons, will be produced with much reduced backgrounds compared to standard hadronic production processes.



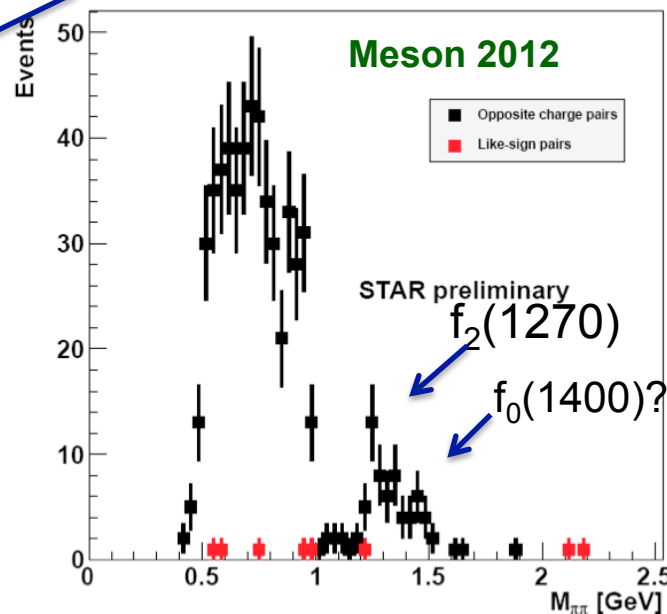
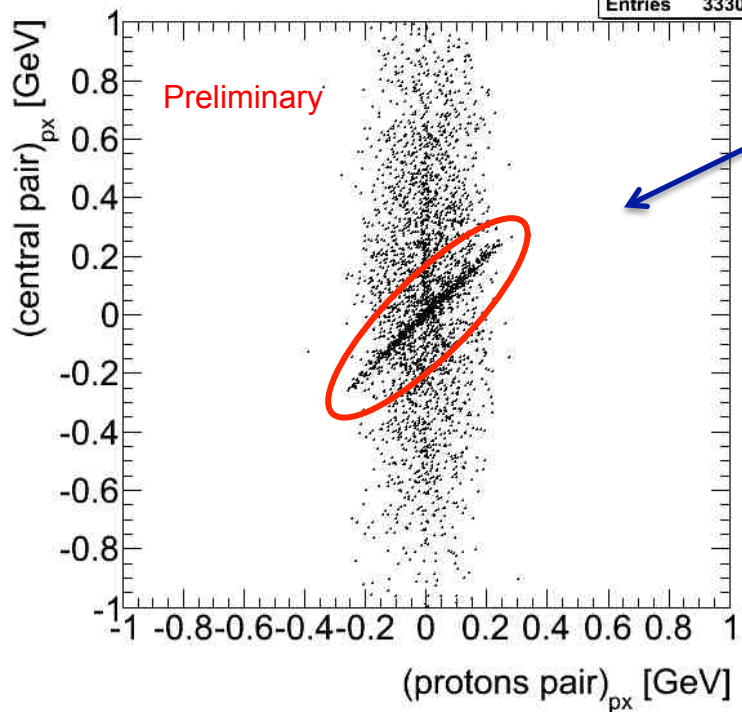
# Central Exclusive Production Run 2009

(The method works at RHIC very well)



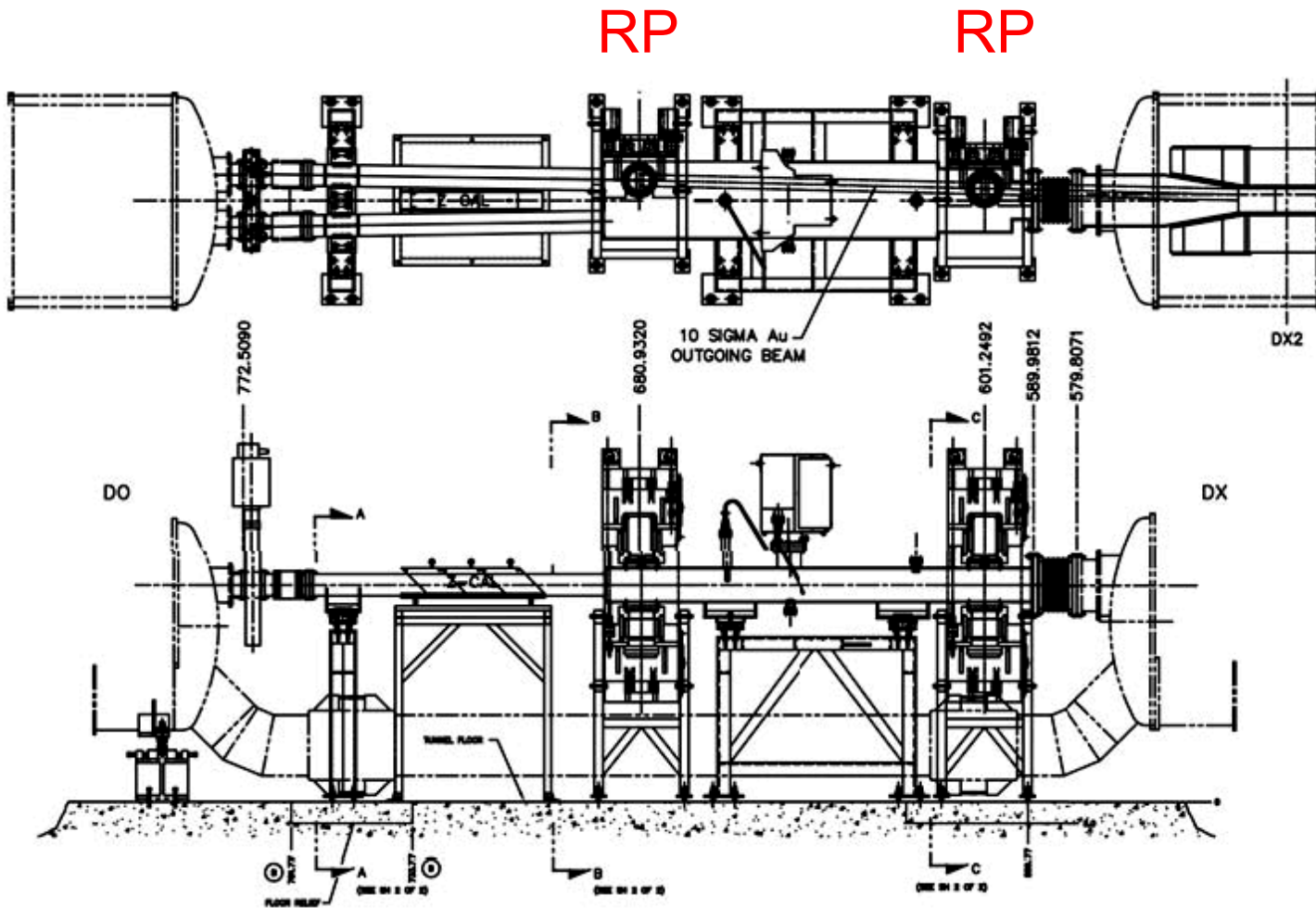
$$p + p \rightarrow p + X + p$$

Use momentum conservation between  $pp$  and  $M_X$

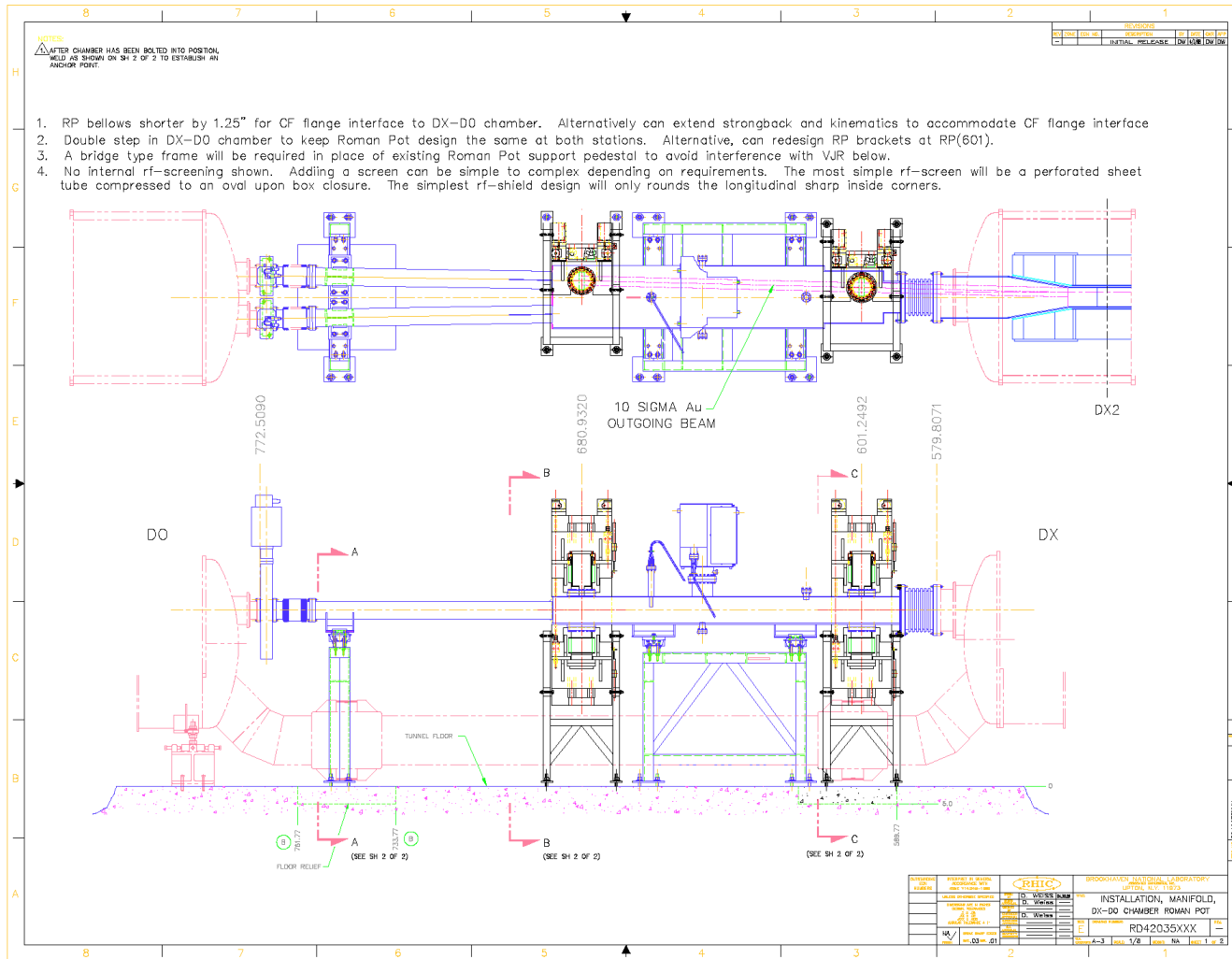


# Roman Pots in DX-D0 Region

Works at any IP (STAR, PHENIX....)



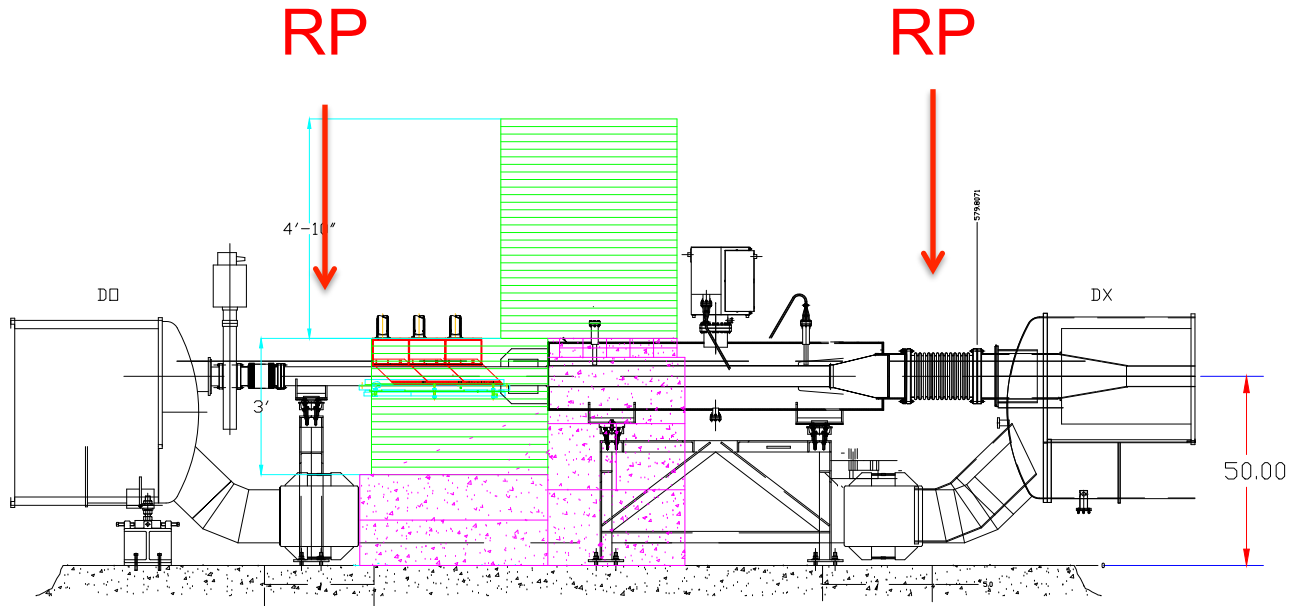
# Advanced Conceptual Design Exists





# New Approach Phase IIA

Minimal disruption, cost....  
driven by desire not to disassemble the shielding

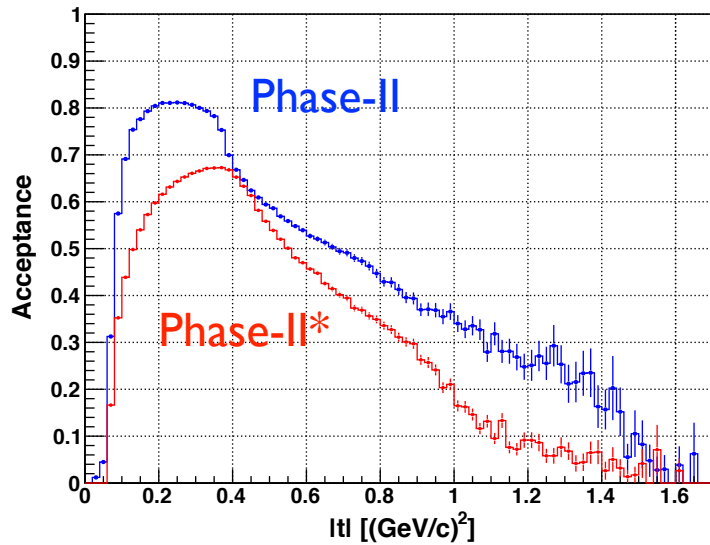


*Elevation view at 5:00*

# Acceptance for pp elastic

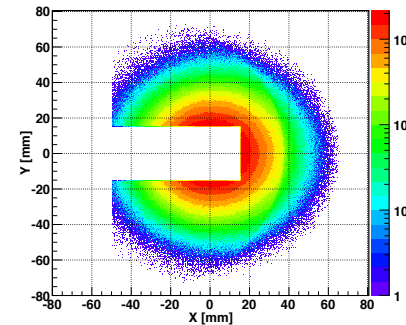
Minimal disruption, cost....

## Phase-II t-acceptance

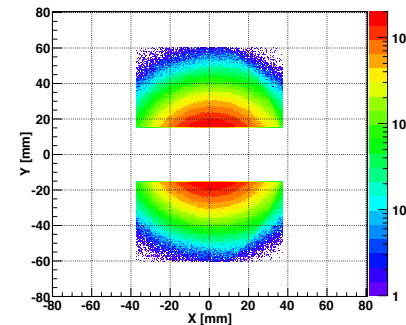


- beam: 250 GeV  $\beta^*=0.7\text{m}$   $\epsilon=10\pi$  min. dis. =  $12\sigma$
- acceptance at  $s=15.3\text{m}$
- acceptance for inelastic diffraction (DPE process)

## Phase-II



## Phase-II\* (with existing RP)



# Summary

Roman Pots at RHIC are an important tool for a lot of physics topics

There is a team of people who know how to implement those devices at RHIC

Need to know short and long term requirements so we can focus on a solution - there is no free lunch