# Polarimeter plans at COSY (Jülich)

Ed Stephenson, IUCF

June 19, 2007

## Proposal presented to PAC, May 3

- Outlined 8-week program of development
- Requested 1 week for high-efficiency polarimeter demonstration

## Proposal approved

- No running time allocated
- Next open slot in schedule after Feb. 15, 2008
- Must present preparations at next PAC, Nov. 26

I suggest for EDDA (polarimeter):

- Engineering and fabrication of targets/improvements complete
- Simulations done and plan in place for spin precession into horizontal
- Replacement electronics ready
- Extended collaborator list for shift support

Note: This assumes internal polarimeter operating at forward angles.

# COSY floor plan

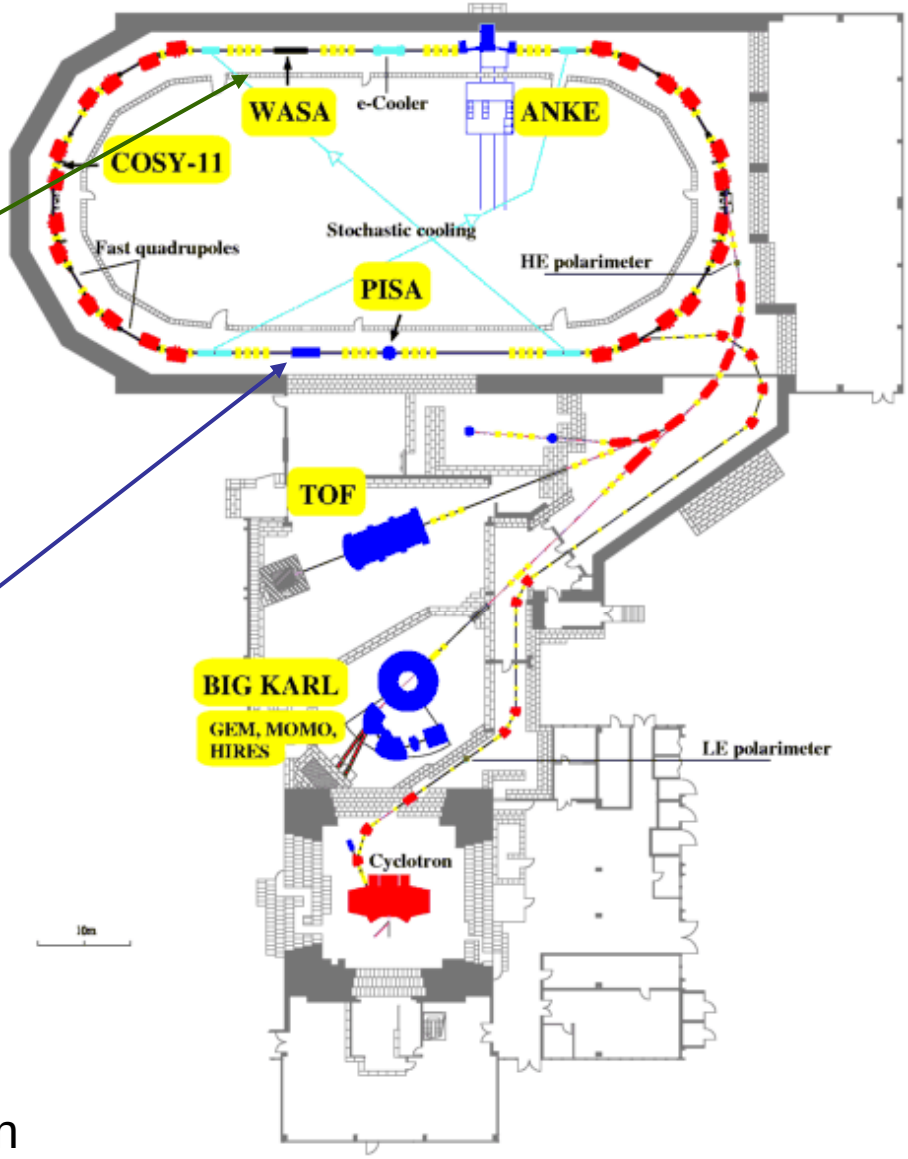
## Database:

Use forward angle tracking scintillation detectors of WASA 4-π system to look at broad range of charged particles from deuteron+ carbon scattering.

## Polarimeter demonstration:

Use scintillators from EDDA experiment as a substitute polarimeter to demonstrate principles for dEDM use.

high efficiency
precess vertical to in-plane
measure in-plane precession
synchrotron oscillation effects



# Results from COSY PAC

May, 2007

The long term goal behind the polarimeter development described in this proposal is a test of the Standard Model of particle physics by means of a precision measurement of the electric dipole moment of the deuteron. The method proposed is novel and involves measuring the build-up of vertical polarization in a storage ring. The signal would allow unprecedented accuracies for the deuteron electric dipole moment, namely at the level of $10^{-29}$ e·cm. The PAC is intrigued by this possibility and expresses its strong support toward this very rewarding goal.

In order to achieve the necessary sensitivity, new methods have to be developed for the polarization measurement as well as for a detailed understanding of the spin dynamics of the ring. So far, it is estimated that a total 8 weeks of beam-time will be required. The spin studies will need to be based on quantitative modeling of the spin motion in the ring as well as on spin manipulations like the ones that are performed by the SPIN@COSY project. It appears highly advisable to coordinate the programs among the two groups.

As a first step the development of a highly efficient polarimeter making use of the EDDA target station and the EDDA scintillator is proposed. A thick annular carbon target is to be designed and placed at the EDDA position. While the PAC accepts and supports this development effort by granting one week of beam-time it appears unlikely that the measurement can be performed in the next period. In particular, the collaboration first has to become familiar with the EDDA and COSY setups so that it will be able to make efficient use of the limited beam-time. The PAC therefore encourages members of the collaboration to participate in scheduled runs at COSY. The PAC appreciates the effort to involve more people in the project and asks the collaboration to prepare detailed plans of the next steps including quantitative milestones and manpower resources for its next meeting. In the meantime, the collaboration can be assured of the continuing support of the PAC.

Support for the physics goals.

Need simulations for spin manipulations! We did observe SPIN@COSY run; we plan to follow lead where appropriate.

Beam time granted (but not scheduled) for first goal: high efficiency polarimeter with annular carbon target.

We need to:
learn the lab
provide detailed plan
set quantitative goals
get more people

Running to be scheduled
in early 2008 through 2010

Defend at next PAC

# Polarimeter Development

Use existing beam setup.

Operate at 1.85 GeV/c (same as SPIN@COSY)

+ experience with machine setup, polarimeter response
+ use RF solenoid (designed for narrow frequency range)
– above optimum momentum for dEDM

To what extent do we try lower energies for demonstration?

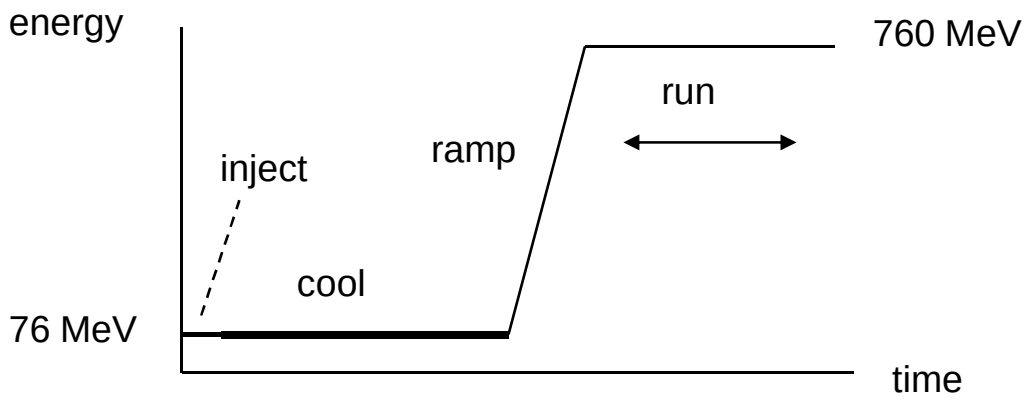
Use existing equipment as much as possible with minimal changes.

EDDA detector has minimum angle of 10° (~7° retracted)

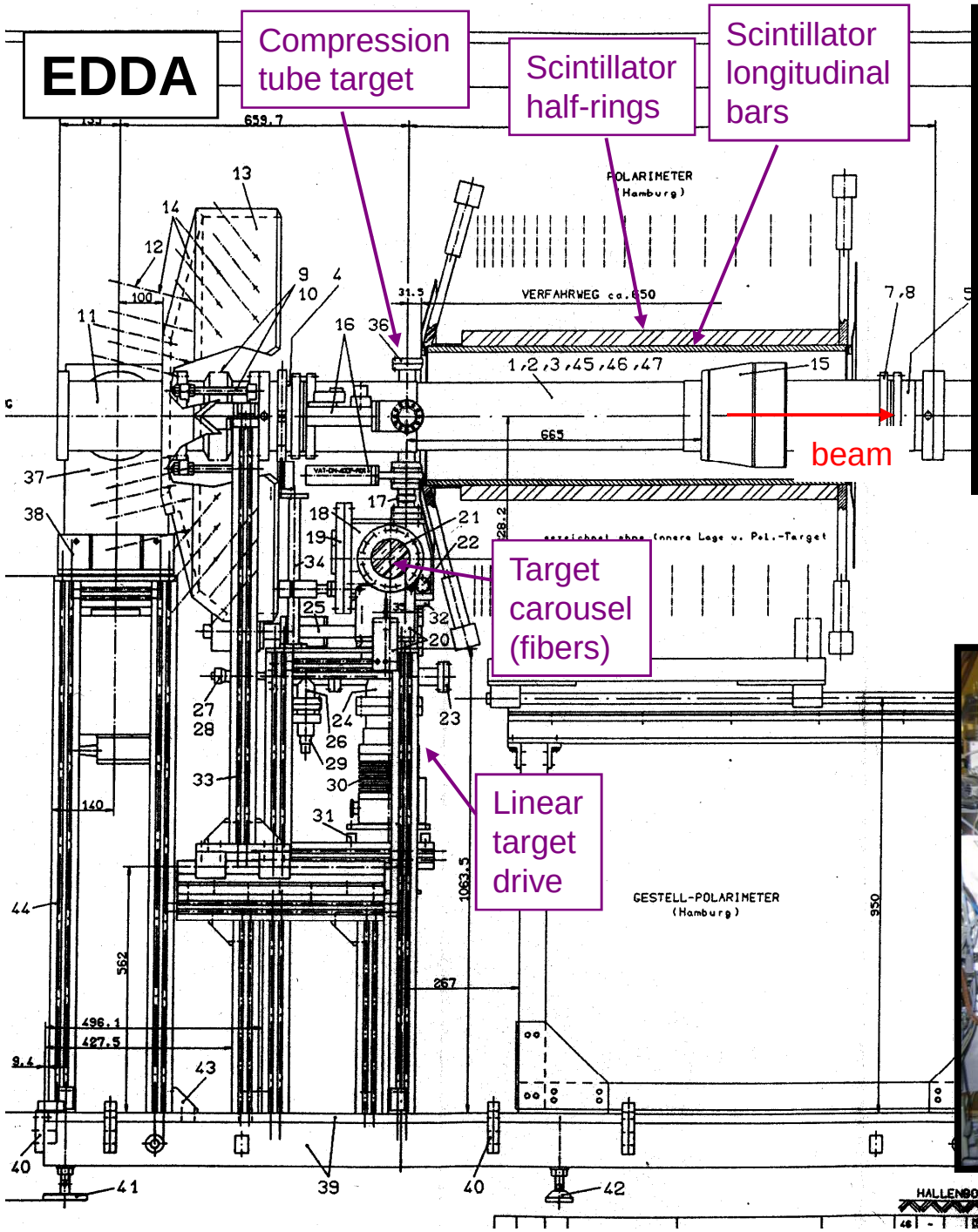
Target are thinner than optimum in design.

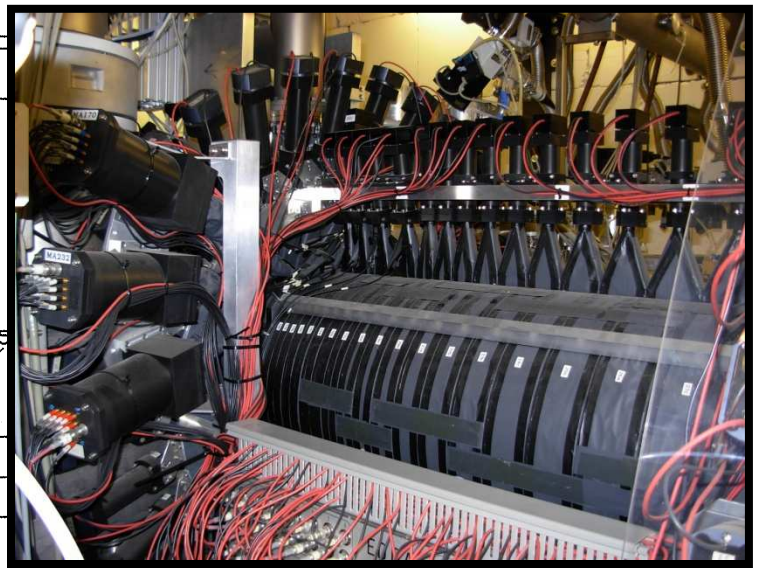
Target must remain in place during beam injection and ramp.

Typical machine cycle



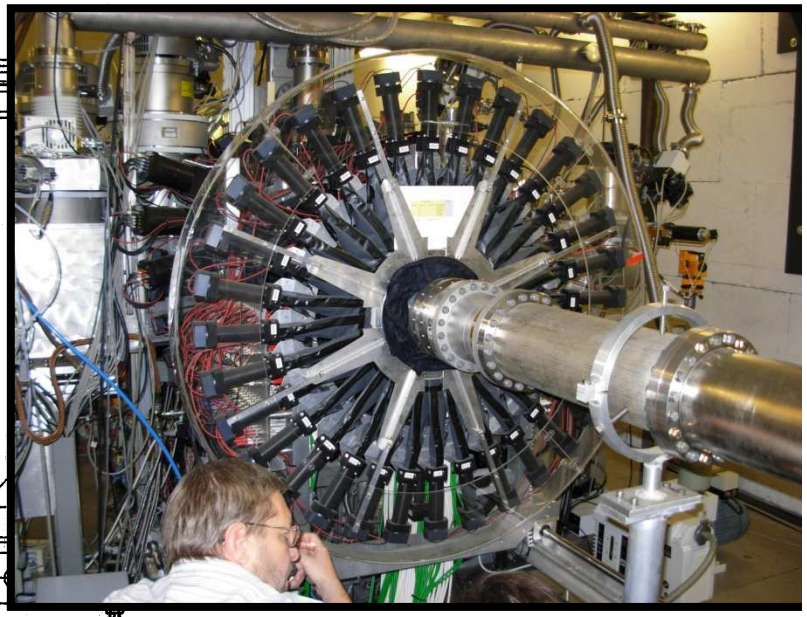
# EDDA

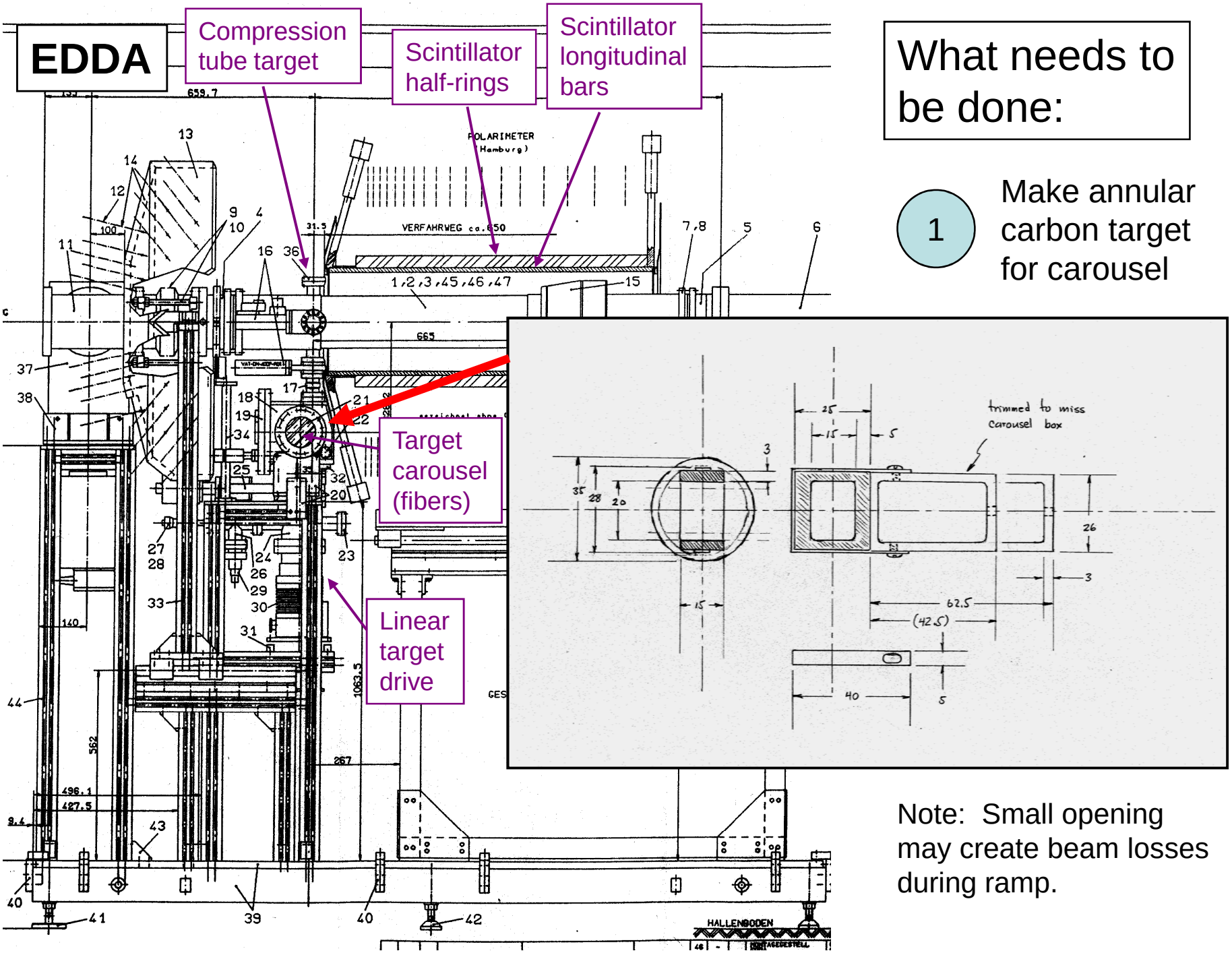


half-rings with PMTs

end view of bar PMTs






# What needs to be done:

1. Make annular carbon target for carousel

Note: Small opening may create beam losses during ramp.

# EDDA

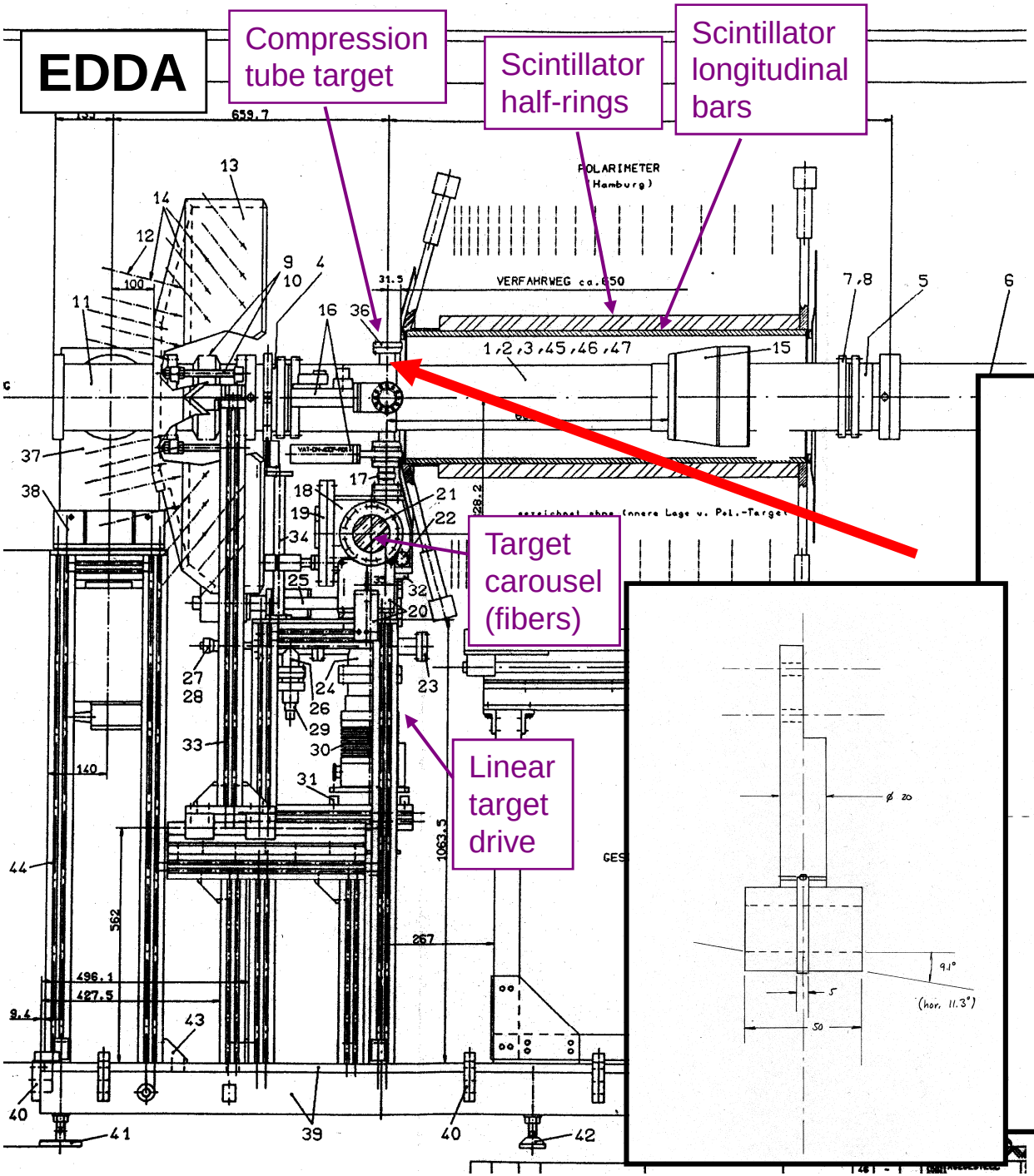
Compression tube target

Scintillator half-rings

Scintillator longitudinal bars

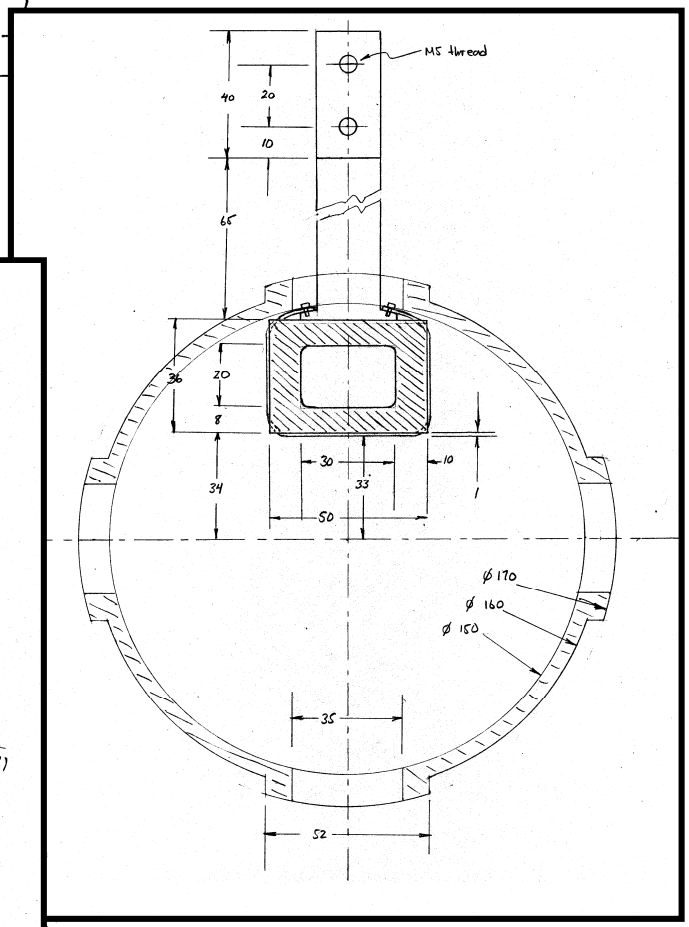
Target carousel (fibers)

Linear target drive



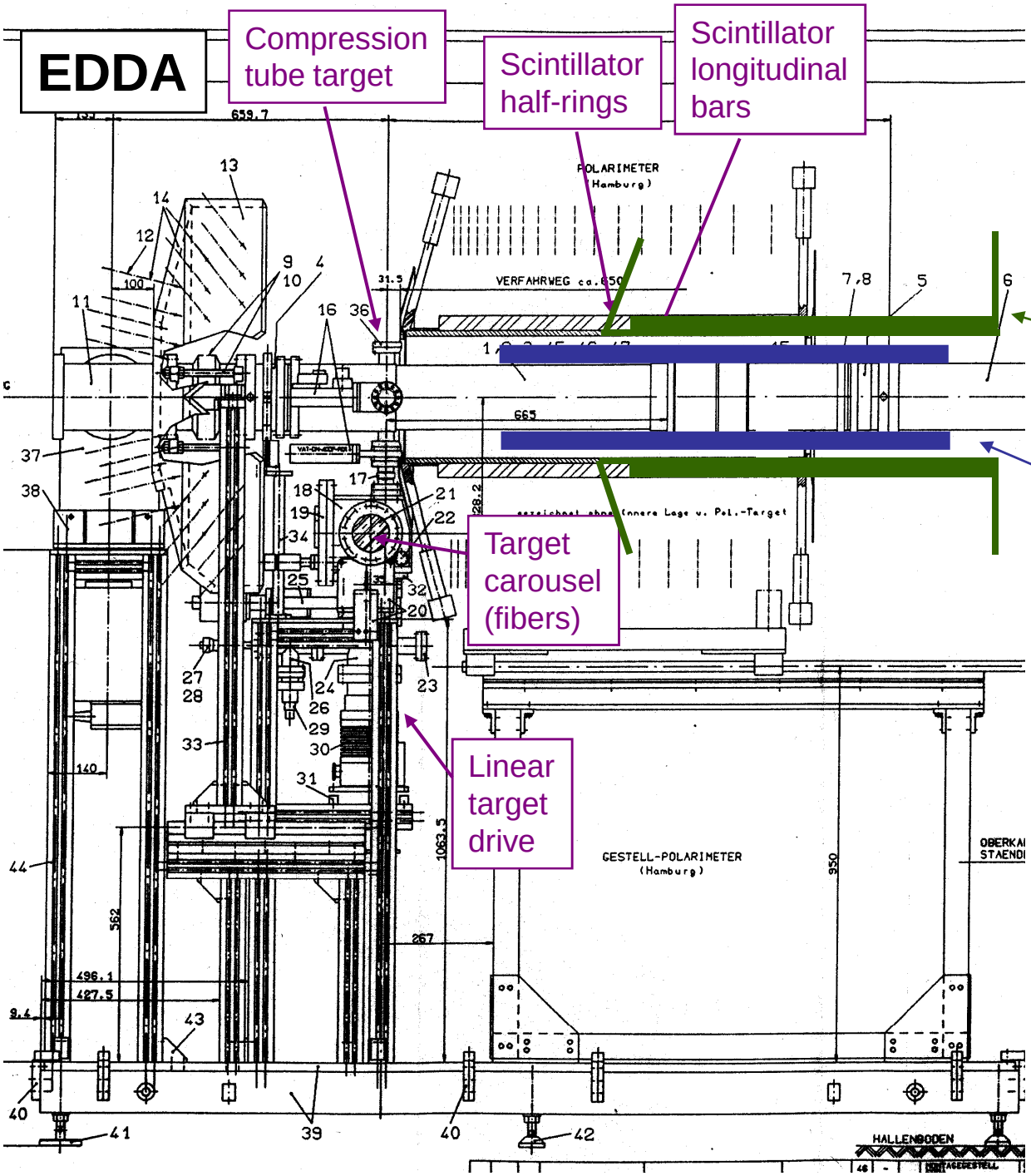







## What needs to be done:

2 Make annular carbon target for top drive




# What needs to be done:

3 Consider operating with detectors in the retracted position.

4 Add iron absorber

Expected to increase analyzing power. At present, p ~ 0.1. This more closely reproduces conditions at Saturne, allowing predictions.

Frank Hinterberger has offered the services of Univ. Bonn for design and fabrication.

## EDDA electronics/DAQ

Recommendation: replace!

Present system old, especially DAQ computer.
There are no experts to help.

Issue: COSY needs polarimeter for polarized proton tuning.
Something must remain in place that works.

Suggestion: Swap systems at the PMT patch.

Read out only PMTs (~100 channels)
Record times. (Do we need pulse heights?)
Other control information to record:
RF pulse count, run control, RF solenoid control, spin bits, etc.

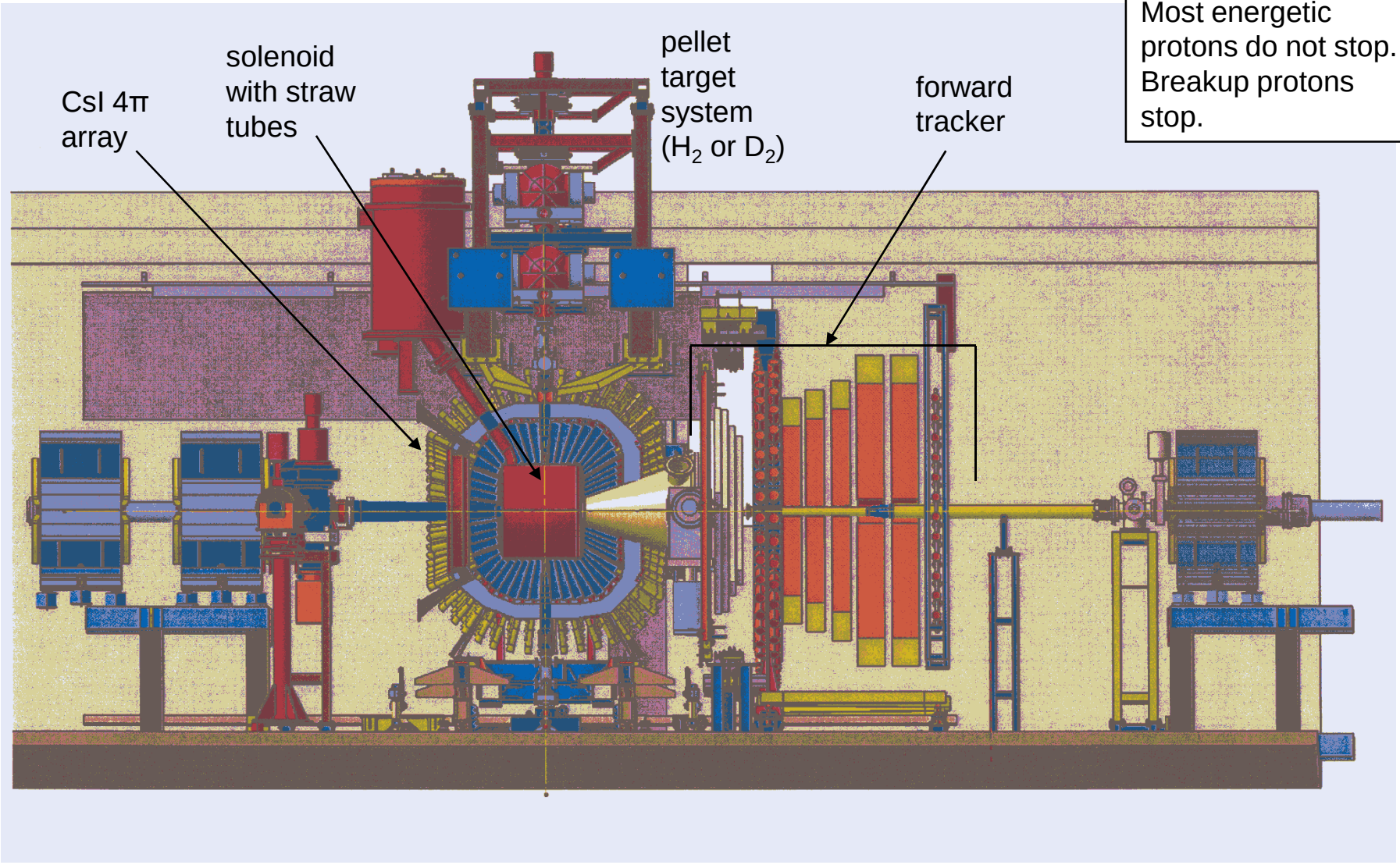
Implication: We should try RF solenoid from the earliest run.

Must have spin tracking simulation.

# Acquiring an adequate data base

Best prospect: use forward tracking detectors in WASA
Need to develop solid targets.

NOTE: The stack stops deuterons in next to last element. Most energetic protons do not stop. Breakup protons stop.

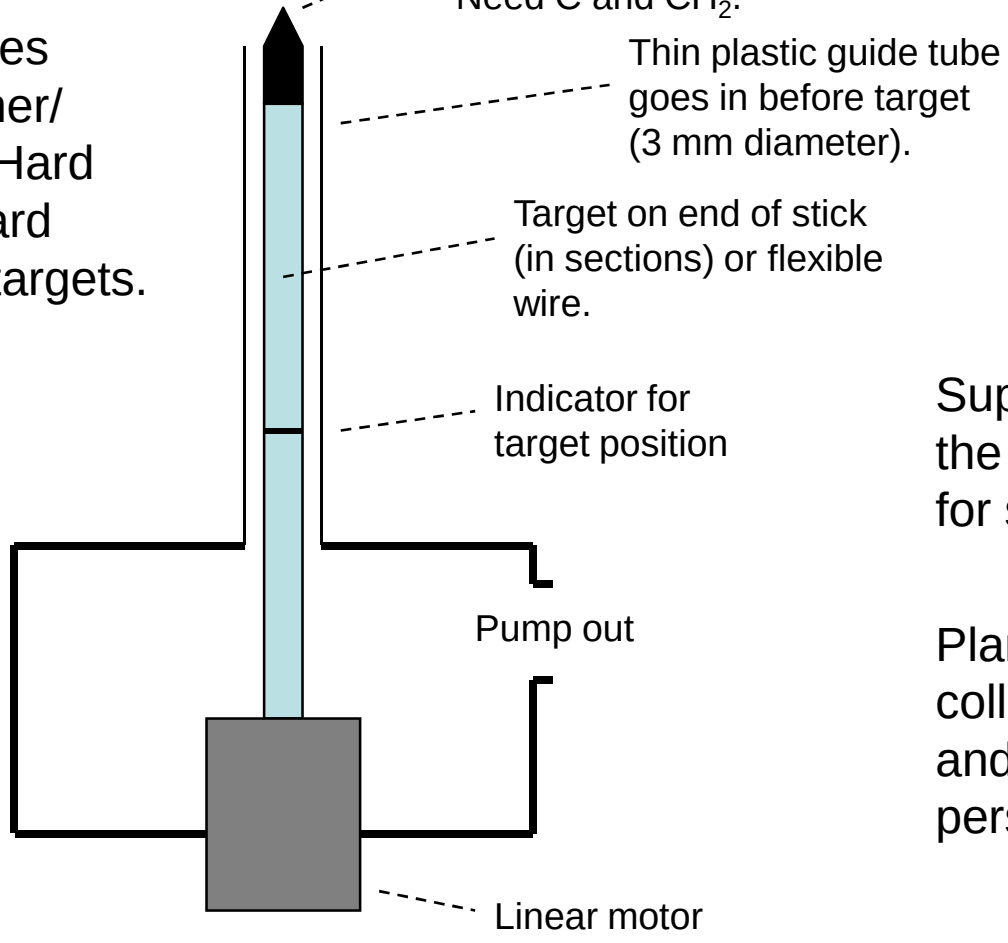


# Concept for WASA solid target

## Insert from below in target exit tube

More elaborate concept: carousel with multiple targets and roller drive for flexible insertion along guide.

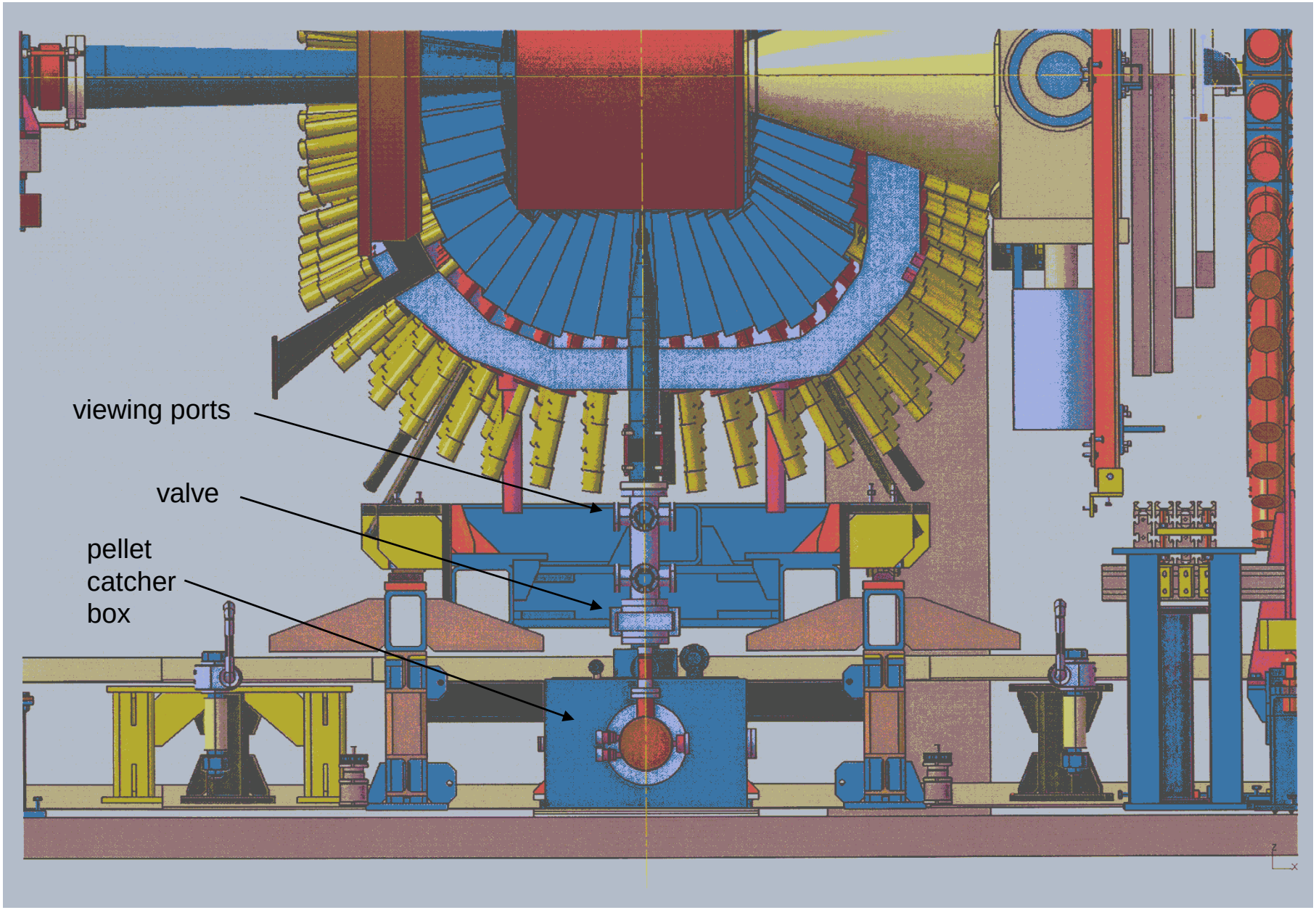
This replaces pellet catcher/ pumpout. Hard to swap; hard to change targets.



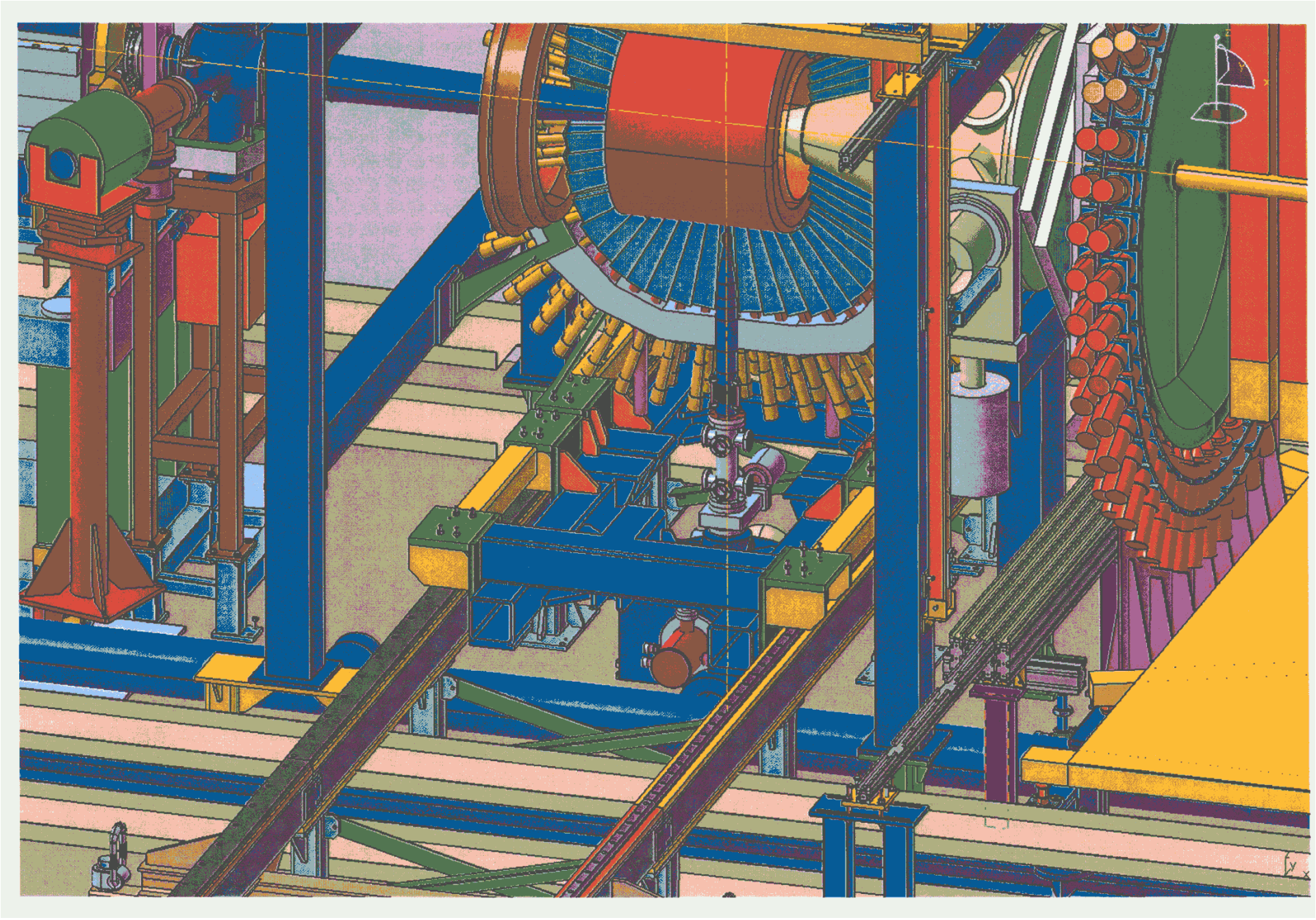

Support exists within the WASA collaboration for solid target physics.

Plan to attend August collaboration meeting and share dEDM physis perspective.

# Cutaway of WASA showing present structures



# Perspective (partial cutaway)



# Issues for further discussion

How quickly should we move ahead before we know more about the ring lattice and the constrains on any dEDM polarimeter?

If we go ahead:

- Allocation of engineering/fabrication resources; who leads?
- Electronics/DAQ design; borrow/buy; who leads?
- Spin tracking?
- Expansion of group?

What is relationship to KVI effort?  Thesis projects?

New hires?  IUCF, BNL, elsewhere?

Publication of development efforts?