TARGET/SOURCE STUDIES

LiD at COMPASS Why are P^+ and P^- relaxations unequal?
(Y. Kisselev)

^{3}He Calibration of NMR

HERMES beam induced depolarization
$\Delta B/B < 5 \times 10^{-4}$ SUCESSFUL

Atomic beam formation and scattering studies.
COMPUTER MODELING OF BEAM FORMATION

Atomic discharge studies optical monitors

FURTHER INCREASES IN ATOMIC BEAM INTENSITY WILL BE MODEST WITH EXISTING TECHNIQUES

ADVANCES IN CRYOGENICS HAVE RECENTLY DRIVEN IMPROVEMENTS IN SOLID TARGETS

POLARIZED e- BEAM SOURCES ARE CONTINUING TO DEVELOP TO MEET DEMANDS OF ACCELERATORS

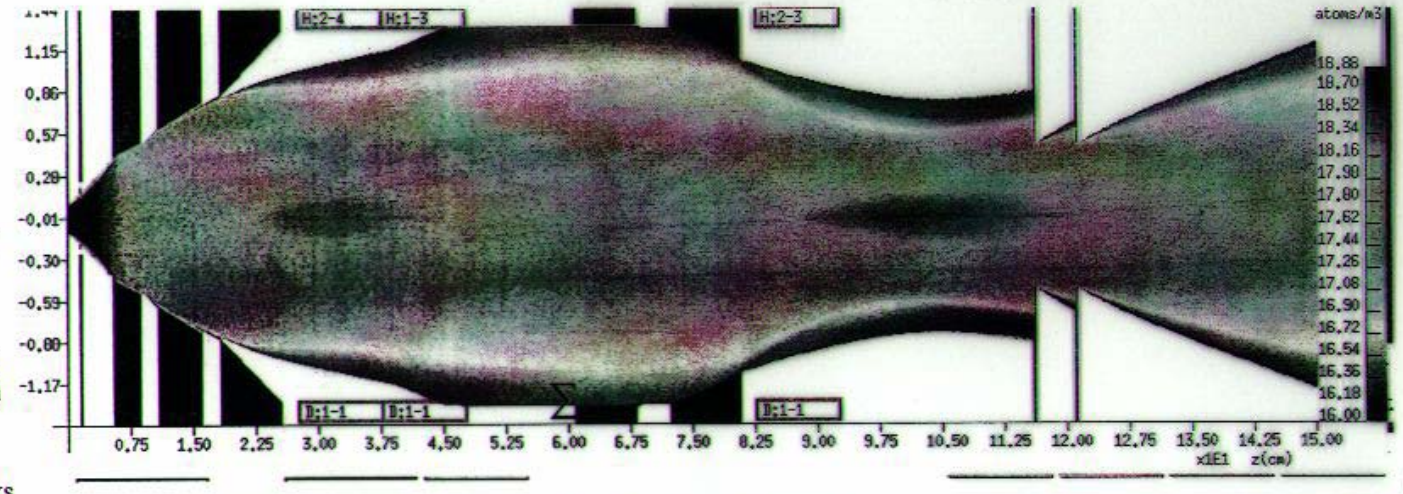
Application to HERMES

Total density

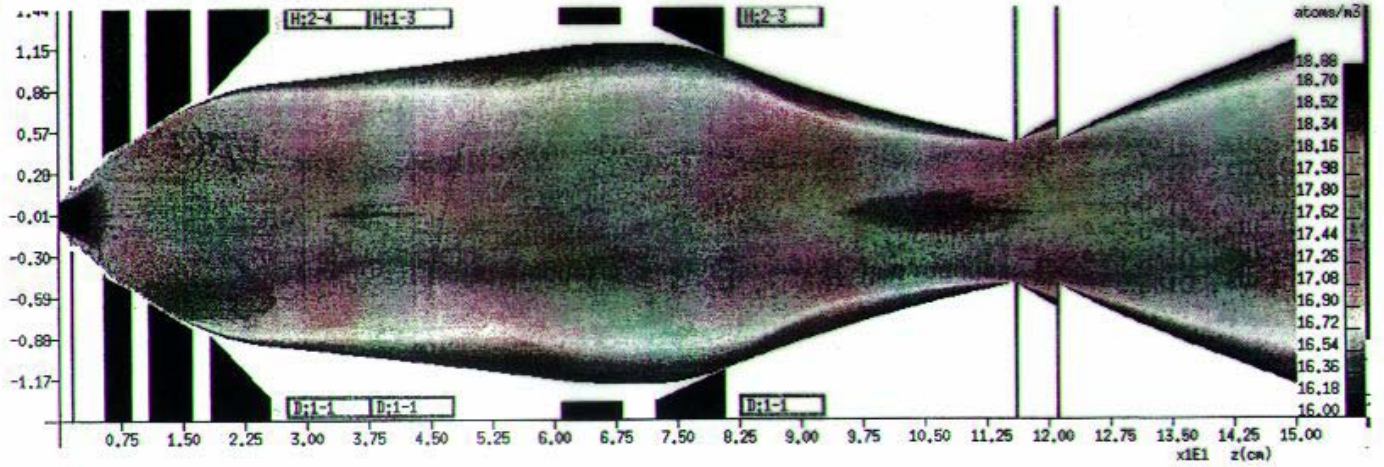
$$\propto \frac{1}{N}\sum \frac{1}{v}\frac{1}{2\pi r dr}$$

Sum over tracks that pass through dr

Total number of tracks



Envelope density



We present the data obtained during 2001-2004 at CERN which demonstrate the following features of DNP in LiD target :

1) **Ultimate negative polarization is lower then the positive one at 2.5 T :**

P_{up} = + 57 %, P_{down} = - 52 % ;

P_{up} = - 49 %, P_{down} = + 54 %;

2) **When |P| > 37% with a 0.1 T longitudinal field , the relaxation times depend on polarization; in this case $T_1(-) < T_1(+)$ => negative polarization relaxes faster**

3) **The negative polarization relaxes slower in 0.42 T transverse field and T = 65 mK:**
T_1up(+) = 1400 h, T_1down(-) = 2100 h;
T_1up(-) = 2200 h, T_1down(+) = 900 h;

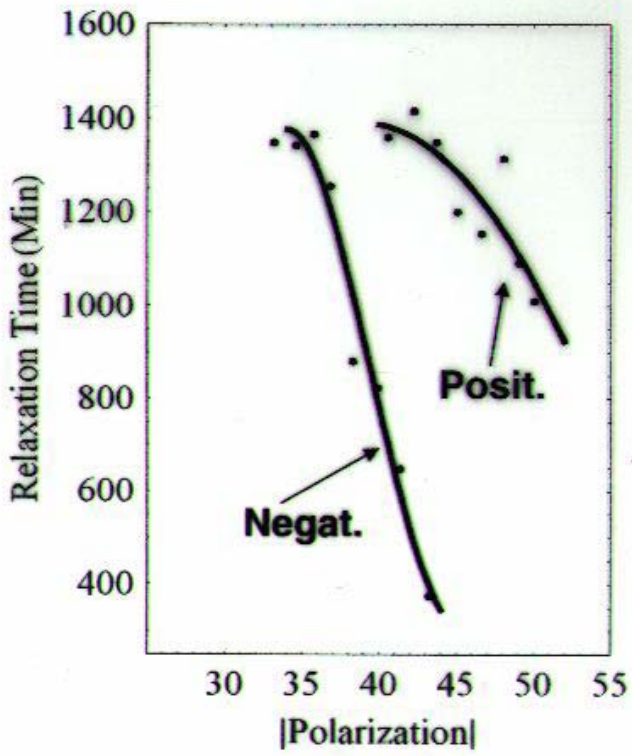
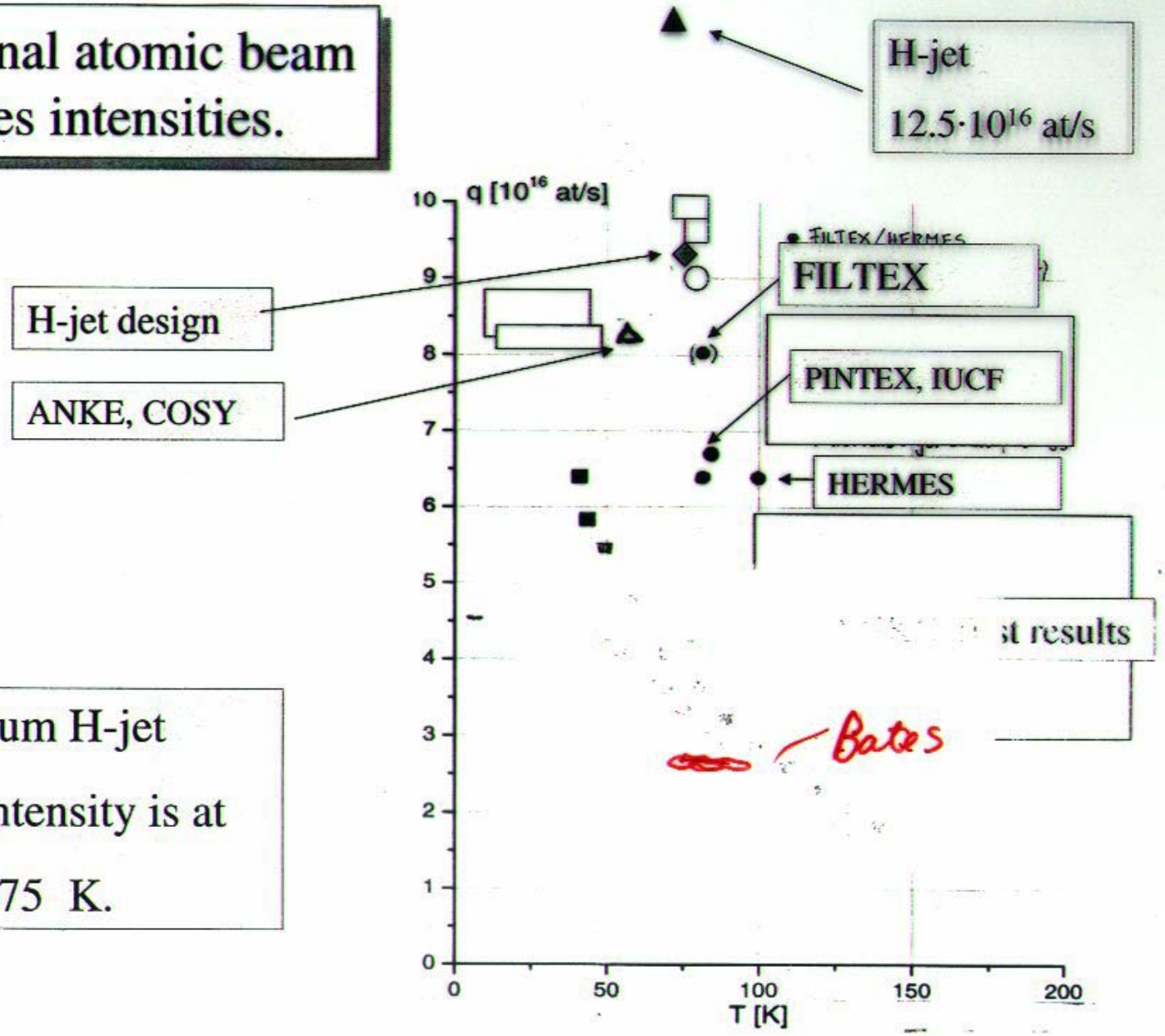


Fig.1 Measured relaxation time over D-polarization at B = 0.1 Tesla and T= 65 mK

COMPARISON OF GAS TARGETS

	FLUX atom/s	THICKNESS $atom/cm^2$	POLARIZATION	FOM $(p^2 t)\times 10^{14}$
BATES	2.5×10^{16}	7×10^{13}	70%	0.35
COSY (ANKE)	8×10^{16}	future	future	6 (estimate)
HERMES	6×10^{16}	$1\text{-}2\times10^{14}$	80-85%	7-14
MICHIGAN (ultra-cold JET)	0.13×10^{16}	1.3×10^{12}	>90% (estimate)	$\sim10^{-2}$ (estimate)
BNL (ABS JET)	1.2×10^{17}	1.3×10^{12}	92%	1.1×10^{-2}

Operational atomic beam sources intensities.



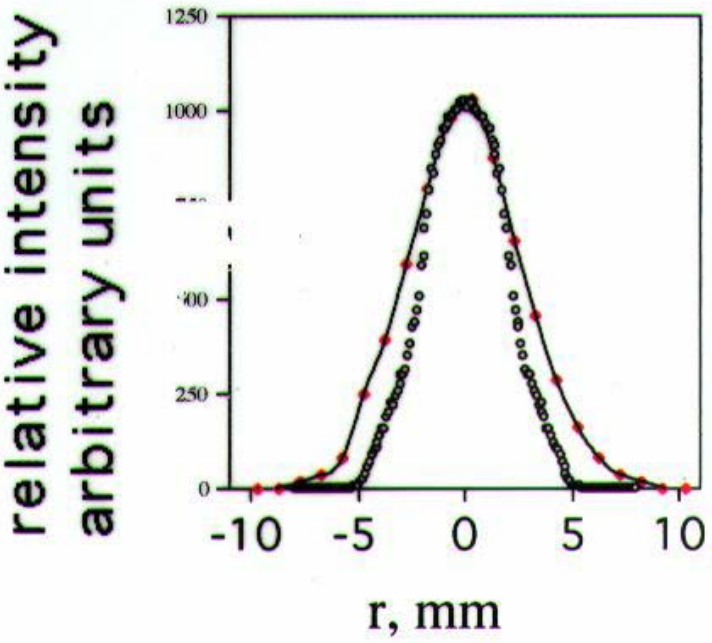
Maximum H-jet beam intensity is at T_{nozzle}~75 K.

PERFORMANCE OF SOURCE AS A JET TARGET

VACUUM ACCEPTABLE AT I.P.

BASE 5x10-9 (VALVE CLOSED)
JET ON: 1.4x10-8

CALCULATED AND MEASURED BEAM PROFILE



CALCULATED PROFILE NARROWER THAN MEASURED
Central intensity was normalized.

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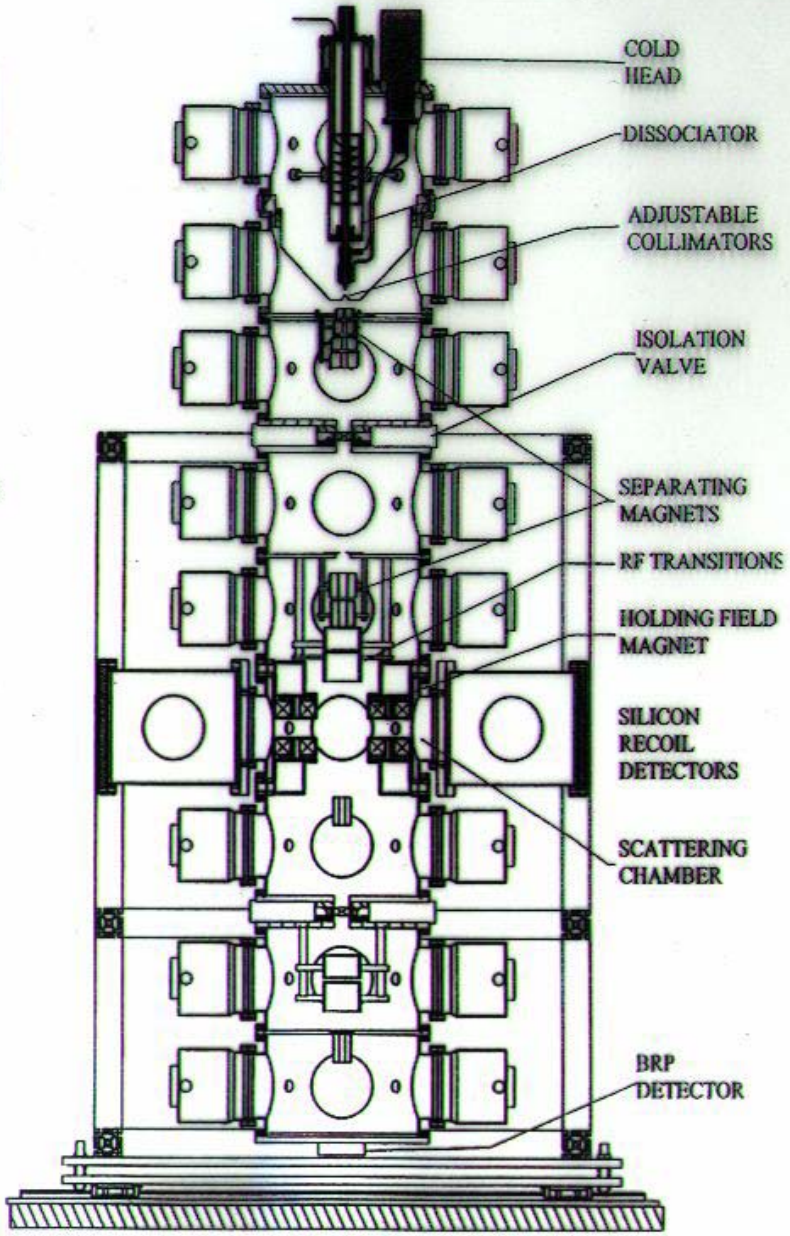
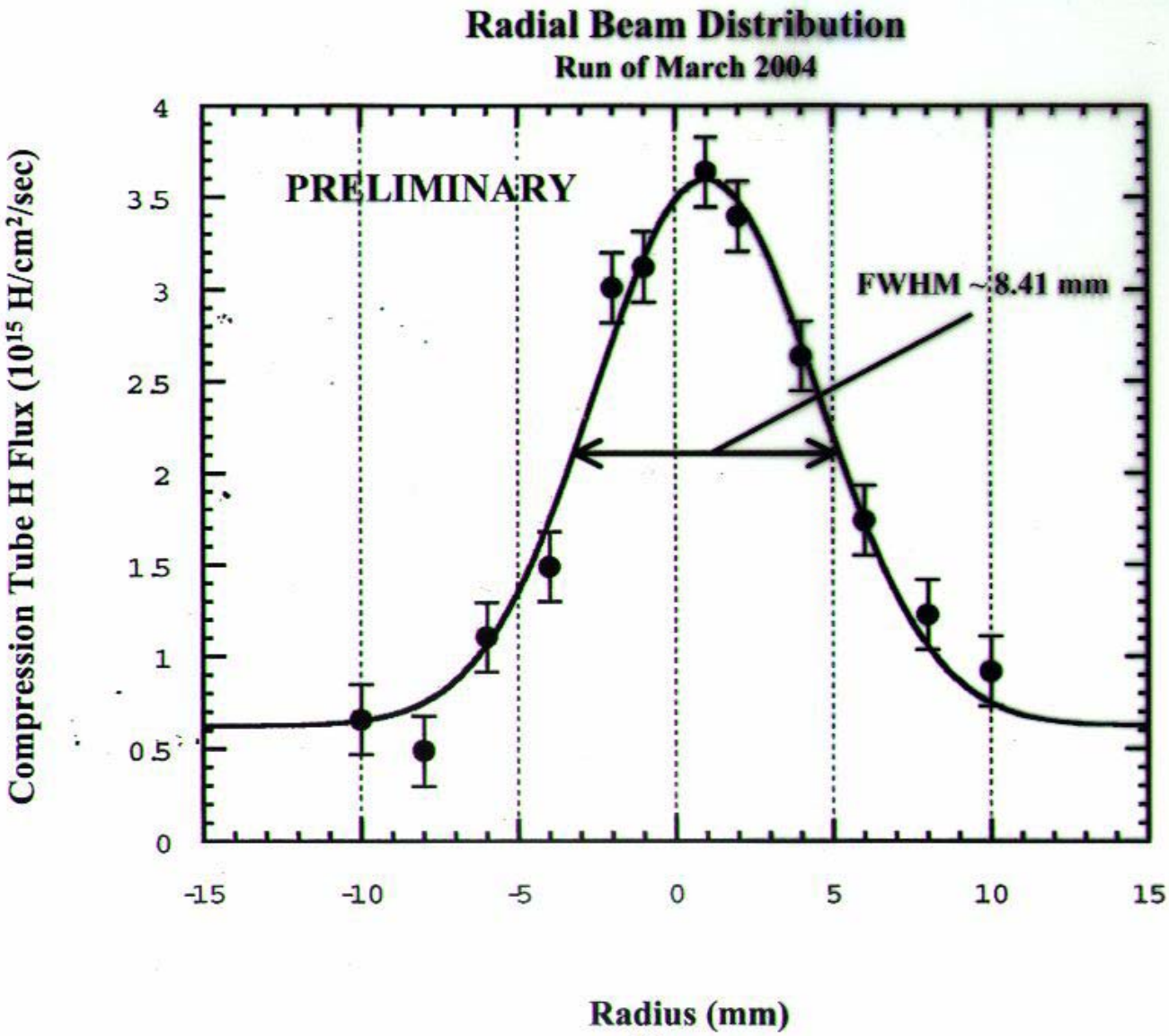
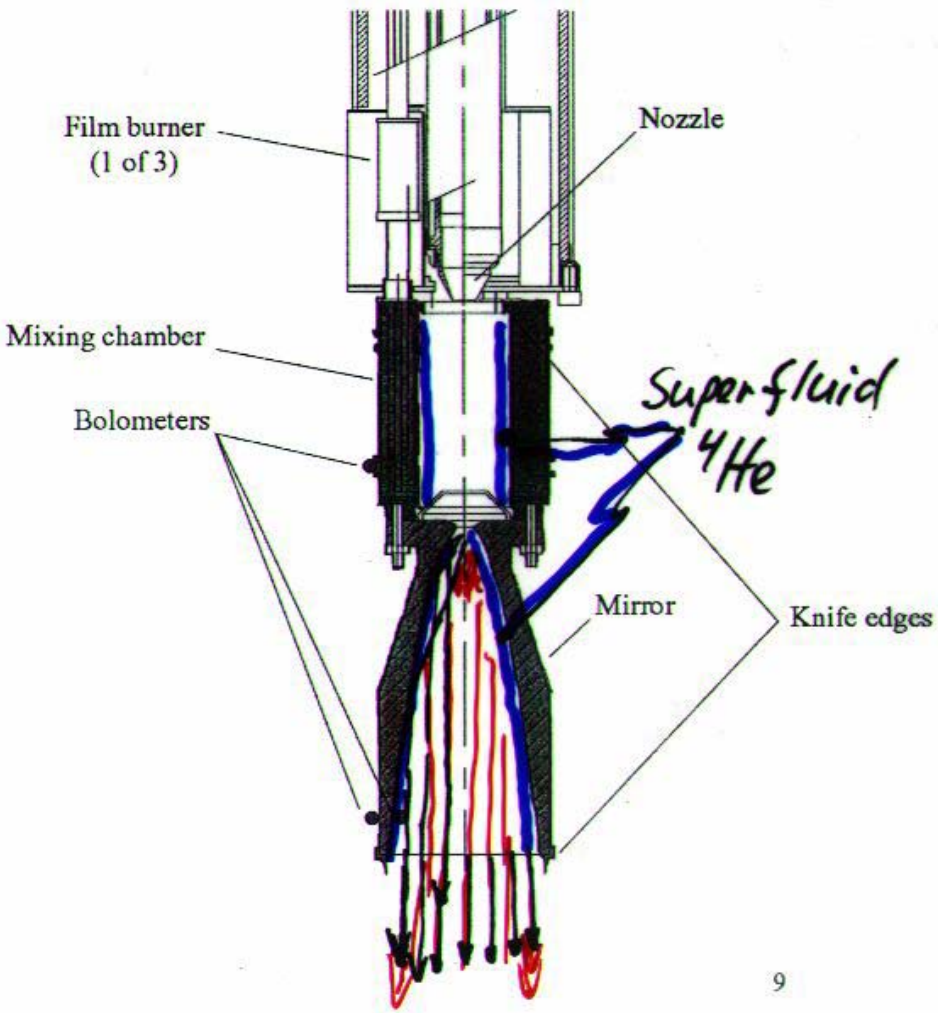
Polarimeter vacuum system.

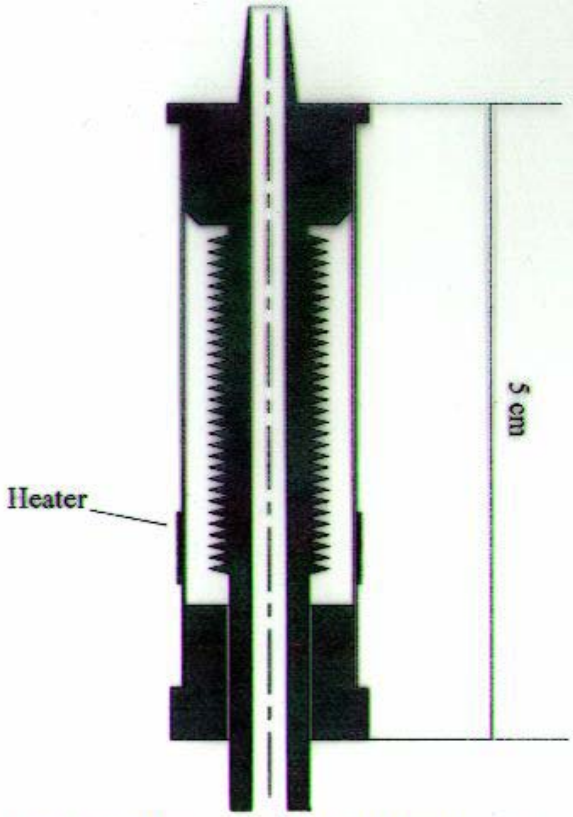
- The H-jet polarimeter includes three major parts: polarized Atomic Beam Source (ABS), scattering chamber, and Breit-Rabi polarimeter.
- The polarimeter axis is vertical and the recoil protons are detected in the horizontal plane.
- The common vacuum system is assembled from nine identical vacuum chambers, which provide nine stages of differential pumping.
- The system building block is a cylindrical vacuum chamber 50 cm in diameter and of 32 cm length with the four 20 cm (8.0") ID pumping ports.
- 19 TMP , 1000 l/s pumping speed for hydrogen.




Radial Beam Distribution
Run of March 2004
PRELIMINARY
FWHM ~8.41 mm
Compression Tube H Flux (10^{15} H/cm^2/sec)
Radius (mm)
4
3.5
3
2.5
2
1.5
1
0.5
0
-15
-10
-5
0
5
10
15

16





Cross-sectional view of film burner

Conclusions

- The HERMES H/D polarized target is stably and reliably running since 1996.
  - High-polarization (P>80 %)
  - The systematics is fully under control (ΔP = 3%)
- It expresses the work of:
  - 10 PhD thesis
  - 7 Diploma thesis
  - 17 senior scientists
- It will be decommissoned in sommer 2005 (?)

but this is not the end of the story...

The target is ready for new challenges:

F. Rathmann : "Spin-physics at GSI"

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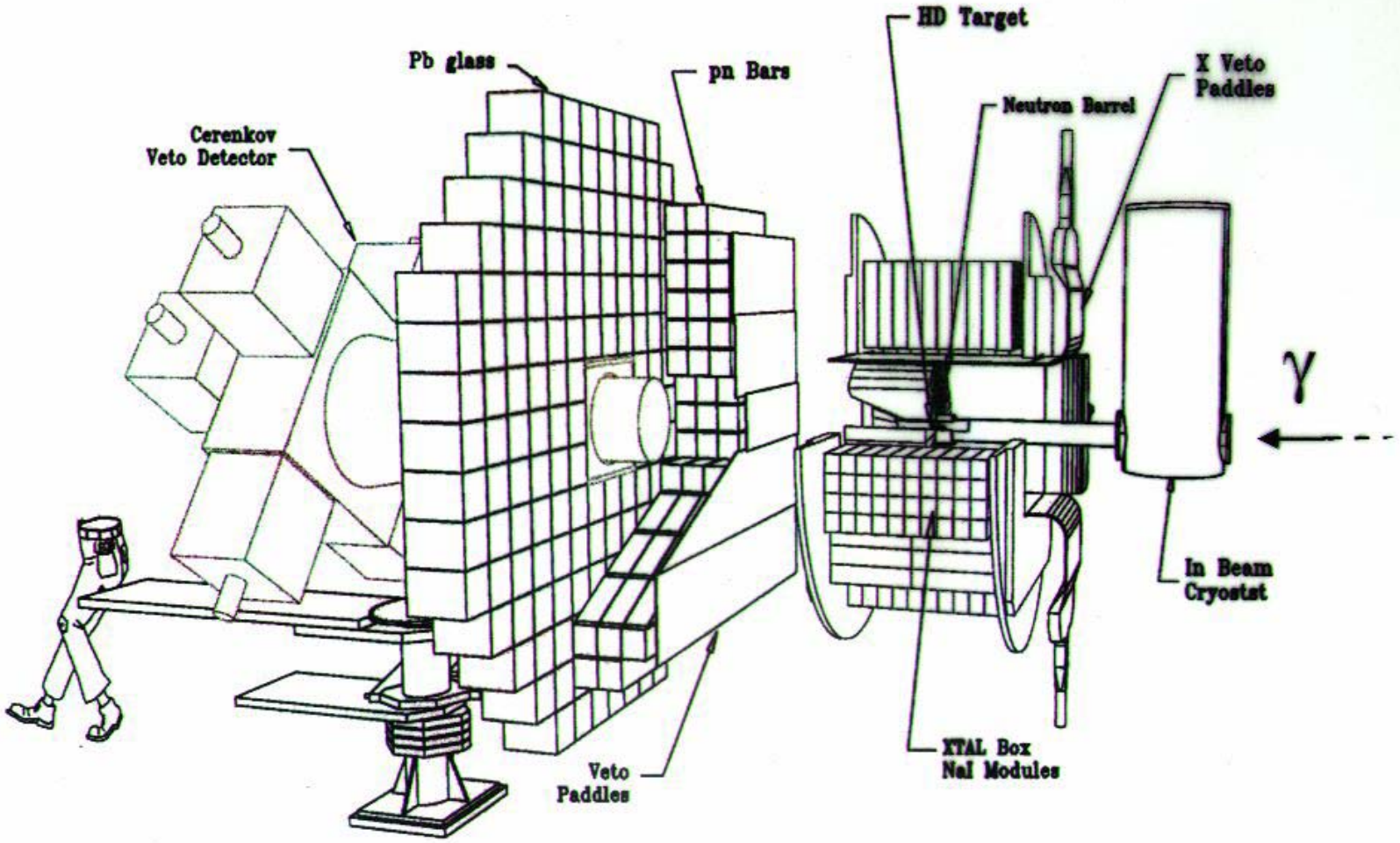
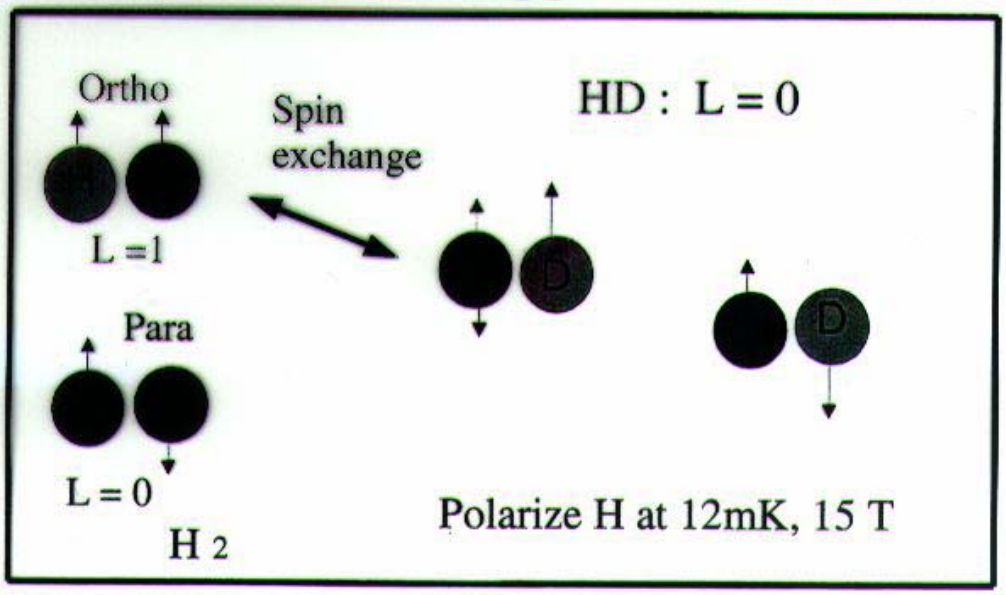
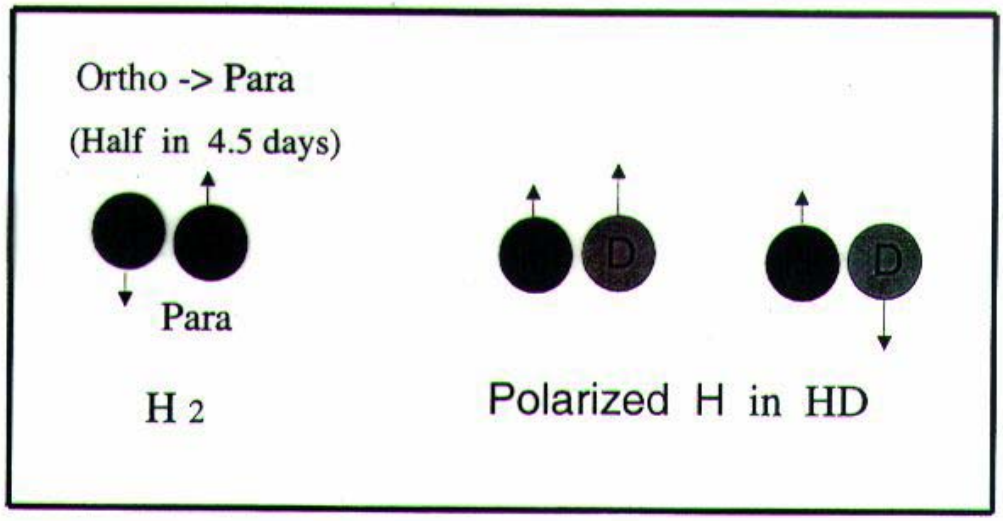
SASY Current Setup



Polarize H in HD using polarized ortho -H_2



12 mK, 15 T ⬇ Age: 2 - 3 months



No spin exchange to HD (Frozen Spin)

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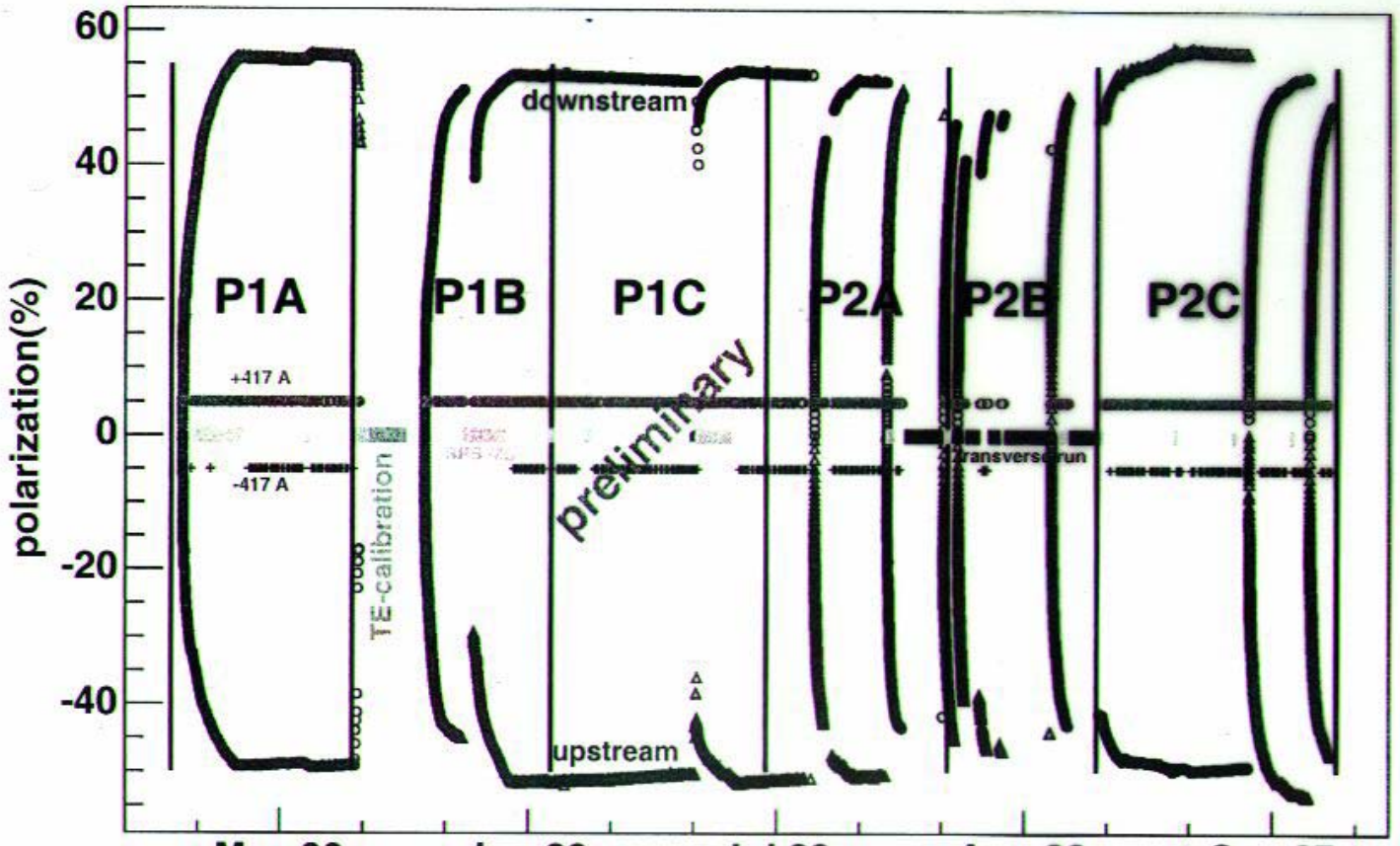
Polarization 2004



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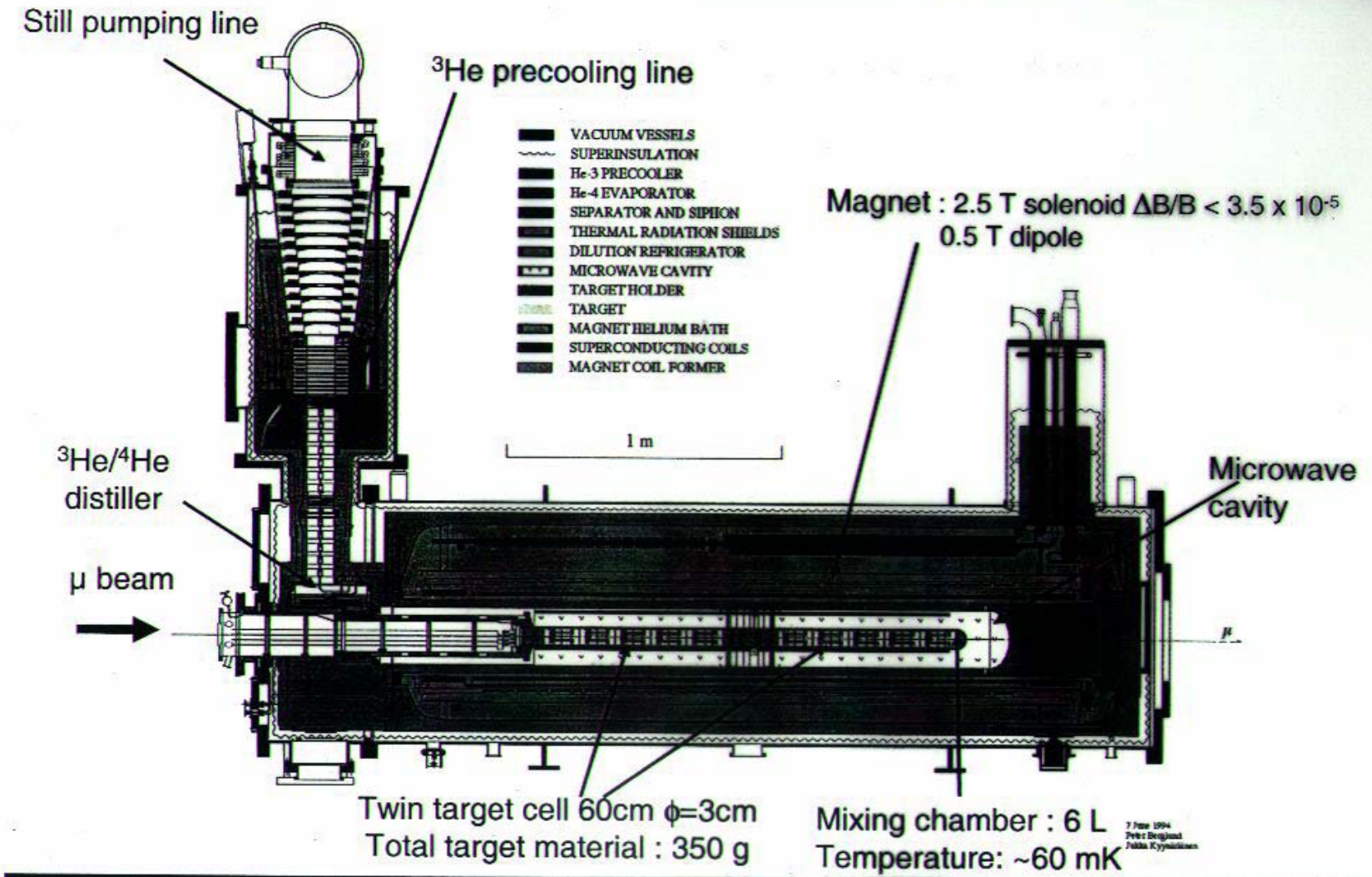
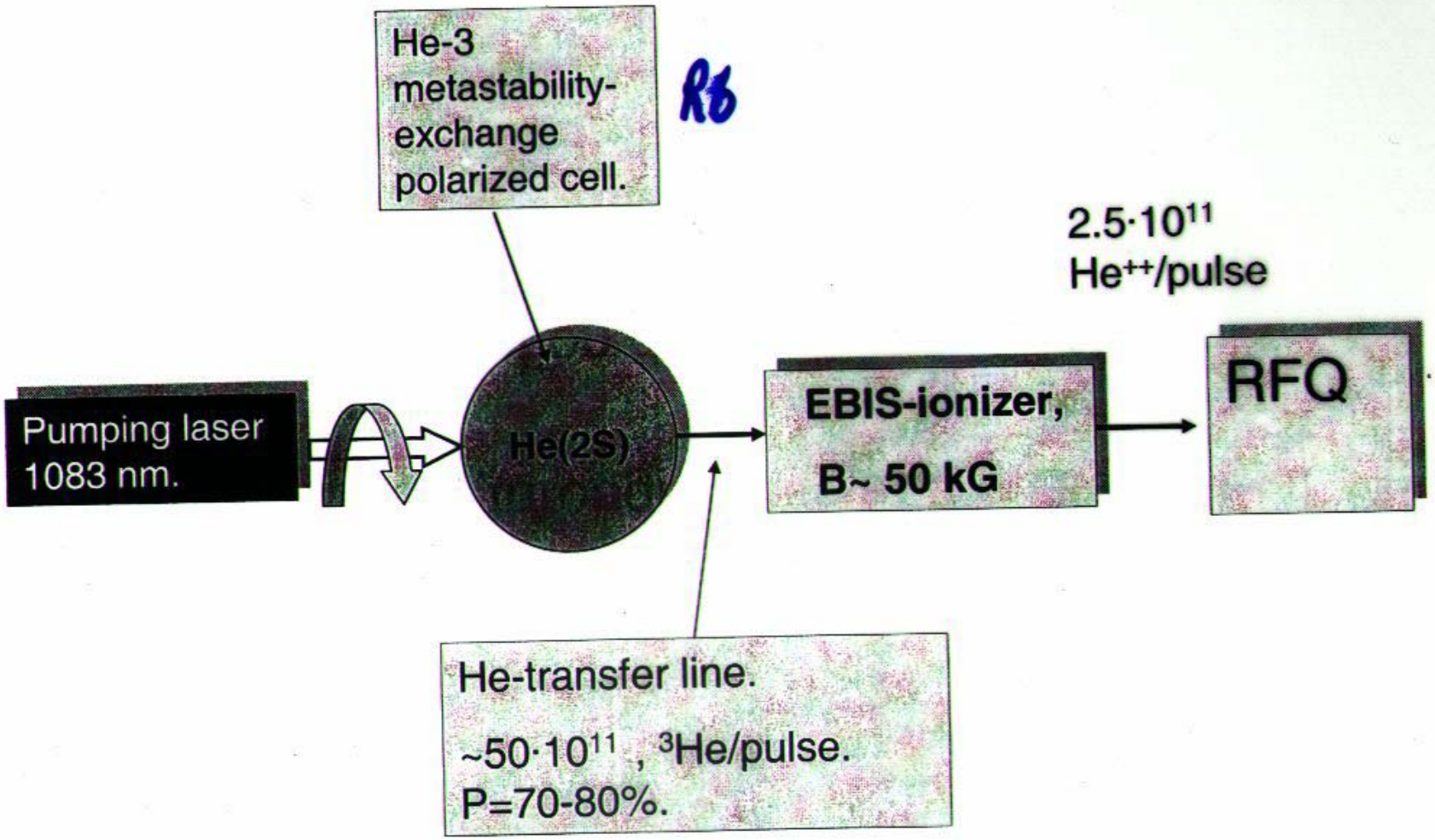
The COMPASS polarized Target

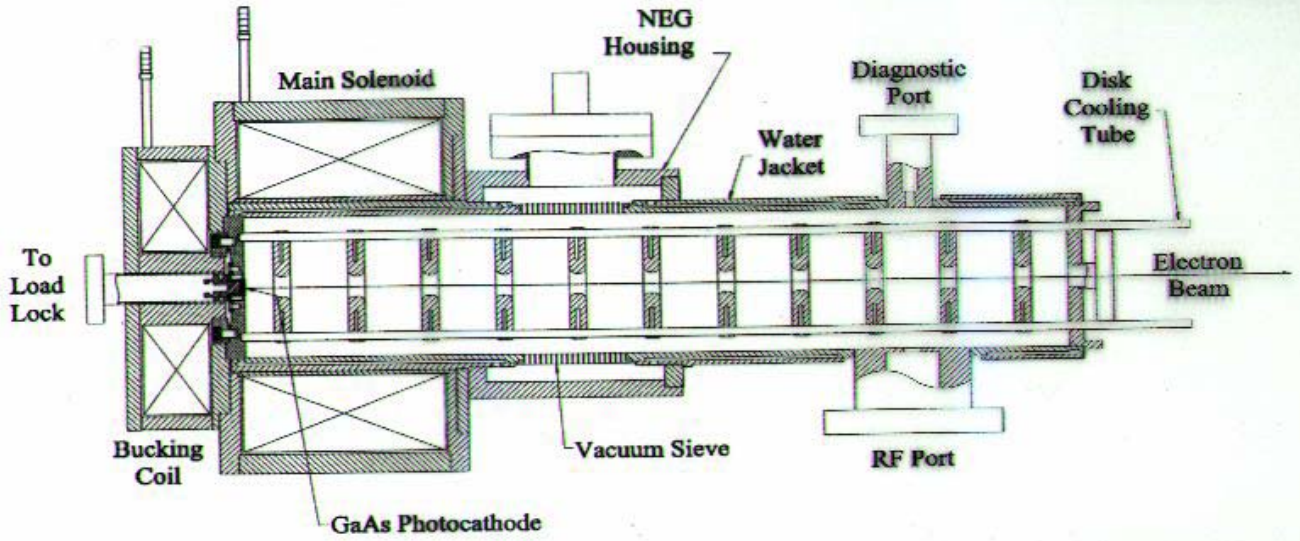


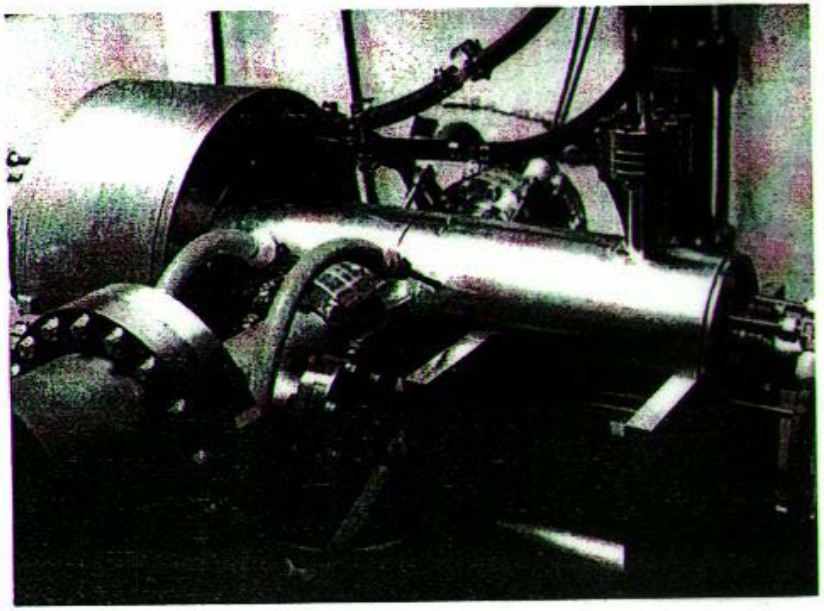
EBIS ionizer for polarized ^{3}He gas (proposal).

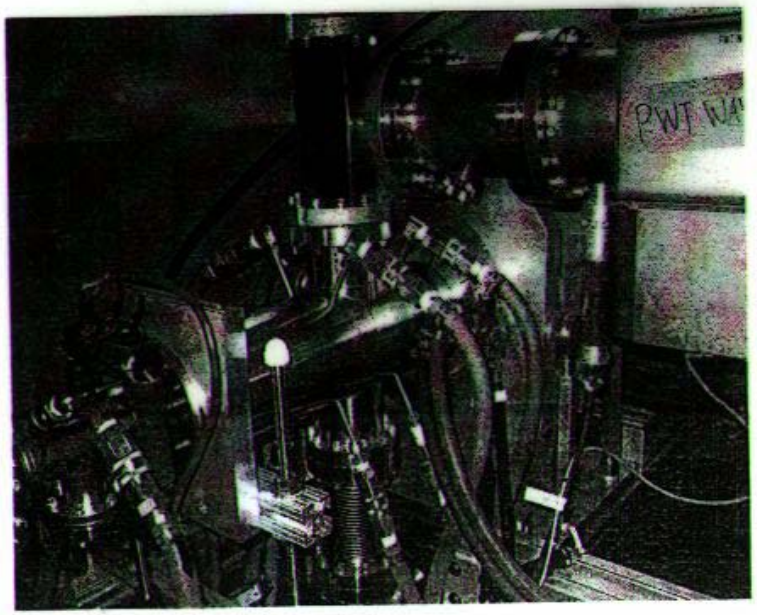


Parameters of an S-Band PWT Polarized Electron Gun

Charge per Bunch (nC)	0.1	1.0	2.0
Frequency (MHz)	2856		
Energy (MeV)	9.5	17.4	18.3
Normalized RMS Emittance (mm-mrad, no thermal emit.)	0.34	0.5	1.5
Energy Spread (%)	1.1	0.6	0.95
Bunch Length (rms, ps)	2.3	2.8	2.3
Peak Current (A)	12.5	103	251
Linac Length (cm)	58		
Beam Size (rms, mm)	1.59	2.1	2.0
Peak Magnetic Field (Gauss)	778	1376	1358
Peak Electric Field (MV/m)	30	55	60
Peak Brightness (10^{14} A/m^2-rad^2)	2.1	8.2	2.2


NEG
Housing
Main Solenoid
Diagnostic
Port
Disk
Cooling
Tube
Water
Jacket
To
Load
Lock
Electron
Beam
Bucking
Coil
Vacuum Sieve
RF Port
GaAs Photocathode





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SESSION 8 SUMMARY
POLARIZED SOURCES, TARGETS, and POLARIMETRY

SOURCES:

e^- developed

e^- proposed

D^+ under construction

$^3He^{++}$ proposed

SOLID TARGETS:

^6LiD
HD frozen spin

GAS TARGETS:

ABS based	Bates	(storage cell)
	COSY	(storage cell)
	HERMES	(storage cell)
	BNL	(jet)
Ultra-cold	Michigan	(jet)
3He	Kungpook Univ. S Korea (under construction)	

TARGET/BEAM STUDIES:

e-
^3He
solid (CH2) and ^3LiD
ABS (three talks)