E614 GAS SYSTEM(S)

4 GAS SYSTEMS:

DME	44 drift chambers
CF4/Isobutane	12 proportional chambers
Helium	20 gaps
DME low pressure	xy time expansion chambers

DME, CF4 and He

share same volume seperated by thin (6 µm) flexible membranes

==> gas systems are strongly coupled

Low pressure DME

pressure ~ 20 Torr
complete requirements not defined yet
anticipate a system similar to that already constructed for DRAGON IC will work

CONSTRAINTS IMPOSED BY PHYSICS GOALS

1. STABILITY OF DRIFT GAS MIXTURE

Source gas purity and consistency

Require <1% drift time instability due to He contamination in DME

Garfield models suggest 1% change in drift time per 1% He contamination
==> instability of He contamination < +/- 1%

for small leaks:
contaminant% = (contaminant diffusion rate)/(pure gas supply rate)

a) Contamination by diffusion thru chamber foils:

from measurements made on 6 μm double sided Al mylar

expect ~ 0.015 cc/min/chamber He into DME

==> pure gas flow > 1.5 cc/min/chamber keeps He contamination <1%

flows controlled to +/- 10%
==> instability of He contamination < 0.1%

b) He contamination from leaks thru various seals between He and DME volumes:

Leak checks of all seals during assembly

Design gas system to allow much higher flows if necessary:

nom flow	**20 cc/min/chamber**
max flow	**100 cc/min/chamber**

individual flow control per chamber
minimize chamber o/p flow impedance

NOTE: DME gas flow of 100 cc/min +/- 10% and He leak of 10 cc/min
==> He contamination ~ 10% +/- 1% .... meeting requirements

2. CATHODE FOIL DEFLECTION

Require foil deflection stable to < +/- 50 μm on drift chambers (DME)

can show **$P = 4xT/r^2$** where

P = diff pressure across foil
x = foil deflection at center
T = foil tension
r = foil radius
$x \ll r$

for our chambers x= 50 μm, T = 1.25 lb/in, r = 6.7 in

==> P must be stable to < +/- 12 mTorr

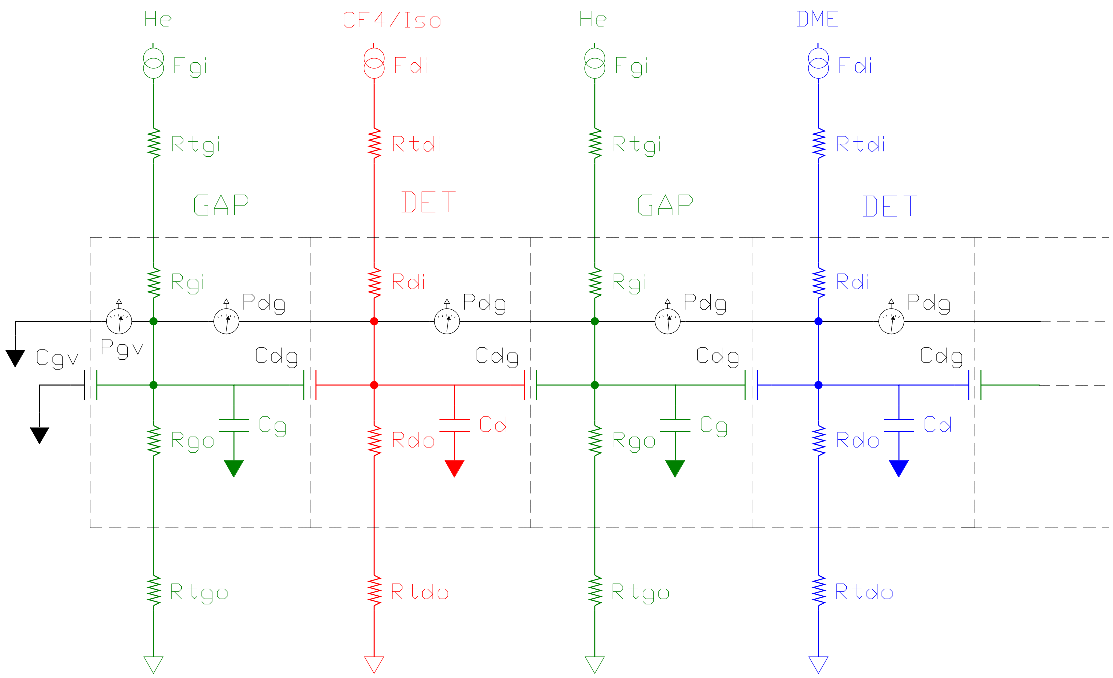
NOTE: electrostatic "pressure" will be equivalent to ~ 3 mTorr

Sources of differential P instability:

- pressure xducer instability
  - choose xducer with appropriate specs ... 1 Torr +/- 0.2 mTorr available
- flow rate instability
  - minimize effect by minimizing "flow X impedance" between pressure measurement point and inside of chambers
- control system oscillations
  - don't control He system, just exhaust thru low impedance to atmosphere
  - decouple DME and CF4 systems by choosing control system time constants

E614 GAS SYSTEM

(ANALYTICAL PERSPECTIVE)



P=FR Torr	τ=RC MIN	F = CdP/dt L/min
Rdi ~ 3000 mTorr/(l/min) Rdo ~ 1 mTorr/(L/min) Rtdo ~ 370 (mTorr/m)/(L/min) 1.4"tube 90 (mTorr/m)/(L/min) 3/8"tube 10 (mTorr/m)/(L/min) 1/2" tube		Cd = Vd/760 ~ 0.0005 L/Torr Cg(40mm) = Vg/760 ~ 0.016 L/Torr Cdg = $\pi r^4/8T$ ~ 0.20 L/Torr

PROPOSED E614 GAS SYSTEM (1/2 OF SYSTEM)