

New Folder Name Action Item 37

Hydrogen and Getter Pumps

T950040

CALIFORNIA INSTITUTE OF TECHNOLOGY
Laser Interferometer Gravitational Wave Observatory (LIGO) Project

To/Mail Code: Distribution
 From/Mail Code: J. Worden
 Phone/FAX: 395-4438/304-9834
 Refer to: LIGO-T950040-00-V
 Date: January 18, 1995

Subject: AI 37- Hydrogen and Getter Pumps

As presented at the Jan 18, 1995 Project Control meeting, the getter pumps costed under WBS 1.1.1.2.4.4 and 1.1.1.3.4.4 can be deleted from the construction task. In the future, these pumps (or pumps serving a similar function) may be needed to obtain the performance required for the advanced interferometers but this would be several years after the start of LIGO operations. See the summary table below and the attached presentation material.

If the BT qualification test should reveal some unexpected outgassing rates then these pumps may need to be re-considered. However, this is unlikely.

Average BT Hydrogen Pressure (torr)

Gas Load (hydrogen)	Without BT pumps	With BT pumps
BT $j=1 \times 10^{-13}$ tl/s/cm ² $Q_{\text{station}} = 2.5 \times 10^{-5}$ tl/s	6×10^{-9}	1.5×10^{-9}
BT $j=1 \times 10^{-12}$ tl/s/cm ² $Q_{\text{station}} = 2.5 \times 10^{-4}$ tl/s	6×10^{-8}	1.5×10^{-8}
Initial IF Requirements	1×10^{-6}	
Advanced IF Requirements	1×10^{-9}	

Distribution:

W. Althouse	A. Lazzarini	G. Sanders	R. Vogt
F. Asiri	P. Lindquist	V. Schmidt	R. Weiss
B. Barish	I. Petrac	D. Shoemaker	S. Whitcomb
L. Jones	F. Raab	G. Stapfer	M. Zucker

Hydrogen and Beam Tube Pumps

Base LIGO configuration:

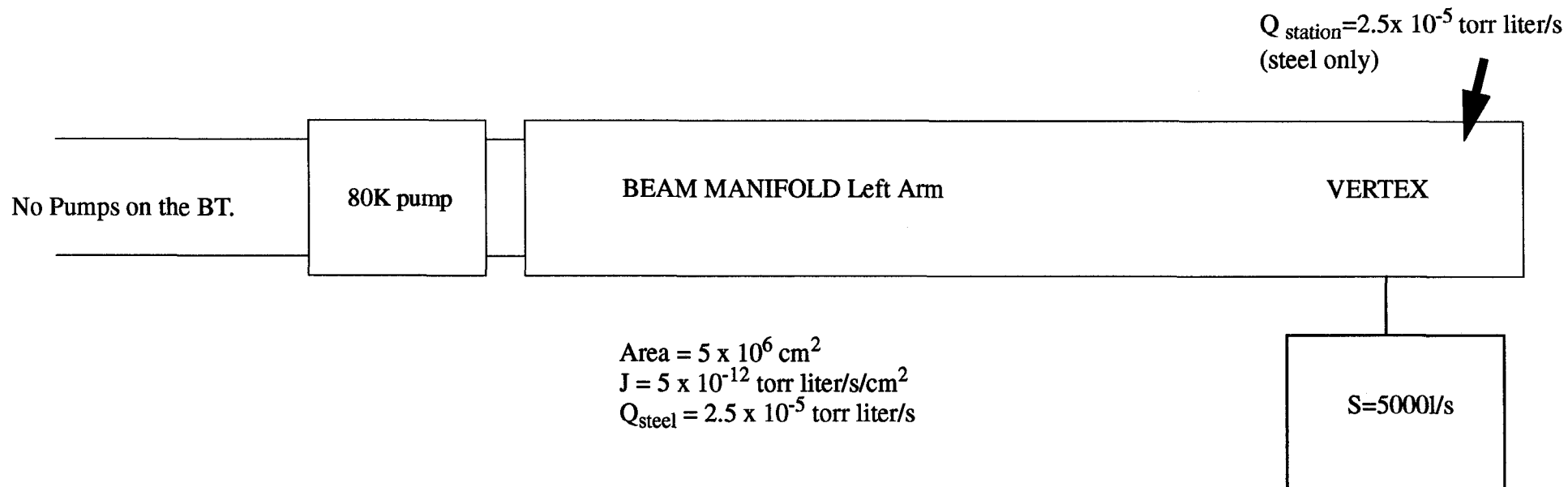
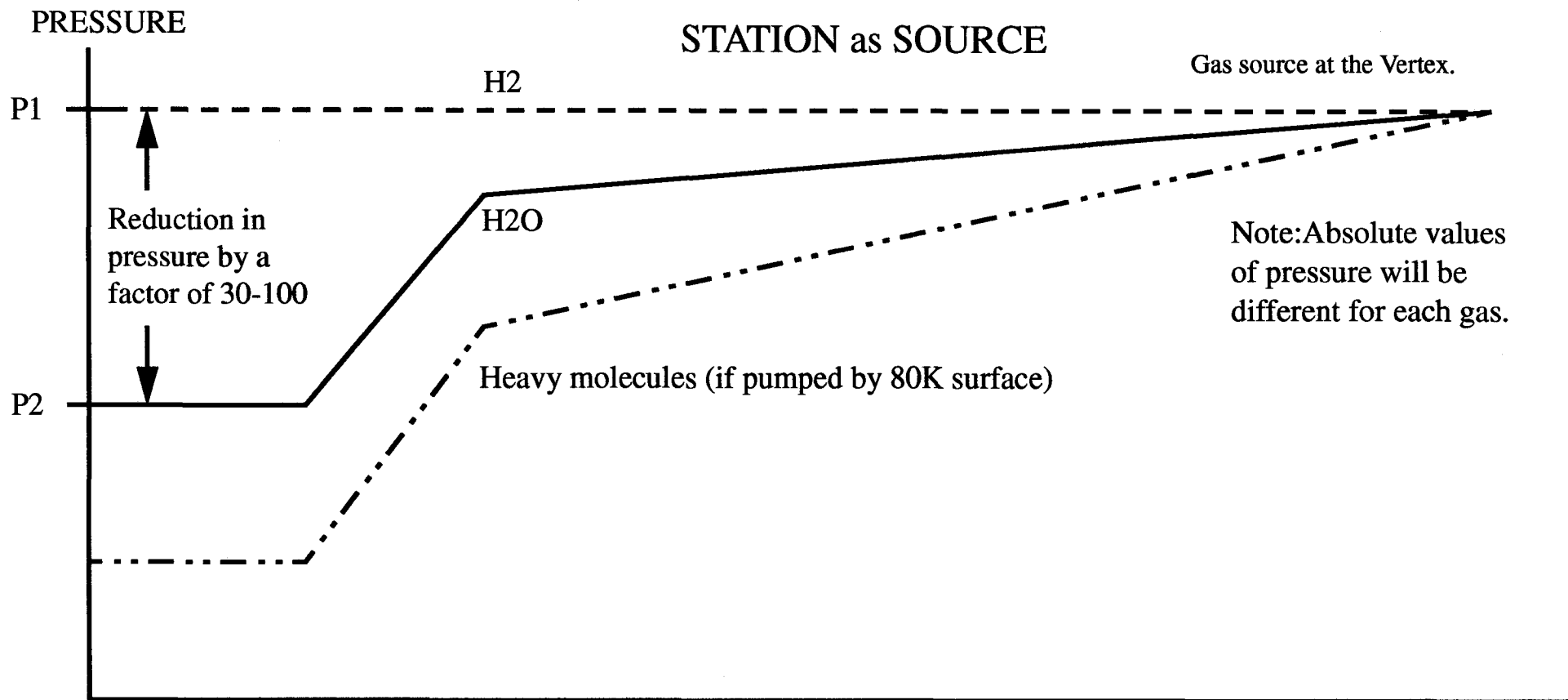
- Hydrogen is pumped only by the station ion pumps. Other gases (with some exceptions) are pumped by the 80K pumps (and the ion pumps).

If (When) pumps are added to lower the BT pressure:

- Station gas dominating:
 - Distributed pumps yield small (~50%) reduction over lumped pumps.
- Beam Tube gas dominating:
 - Distributed pumps yield large (>500%) reduction over lumped pumps.
 - For higher masses this becomes even more significant.

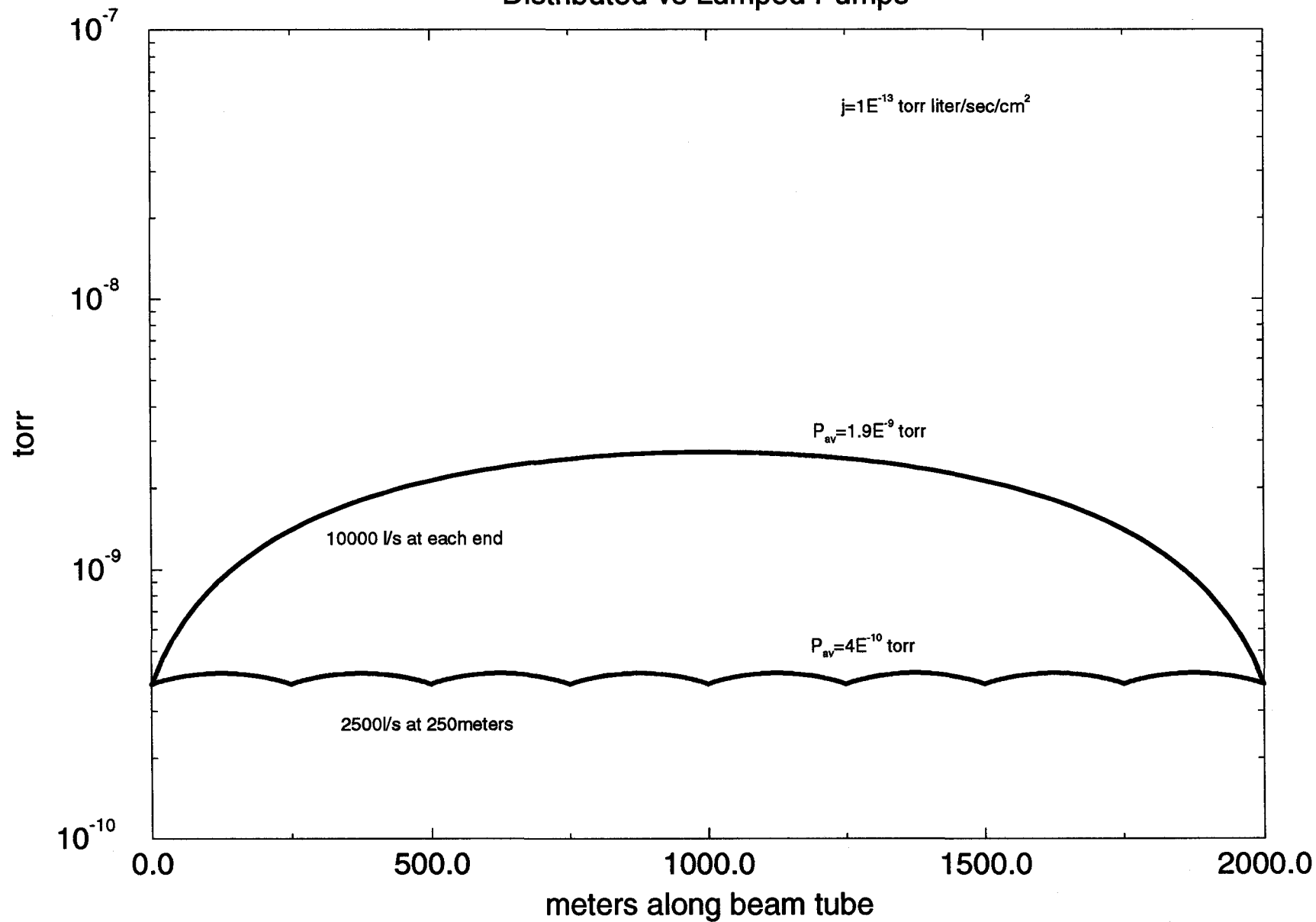
Conclusion:

Beam Tube pumps are probably not needed for the initial interferometers. It is unlikely that the IF will be a source of H₂ : Therefore, the BT qualification test will decide this issue.



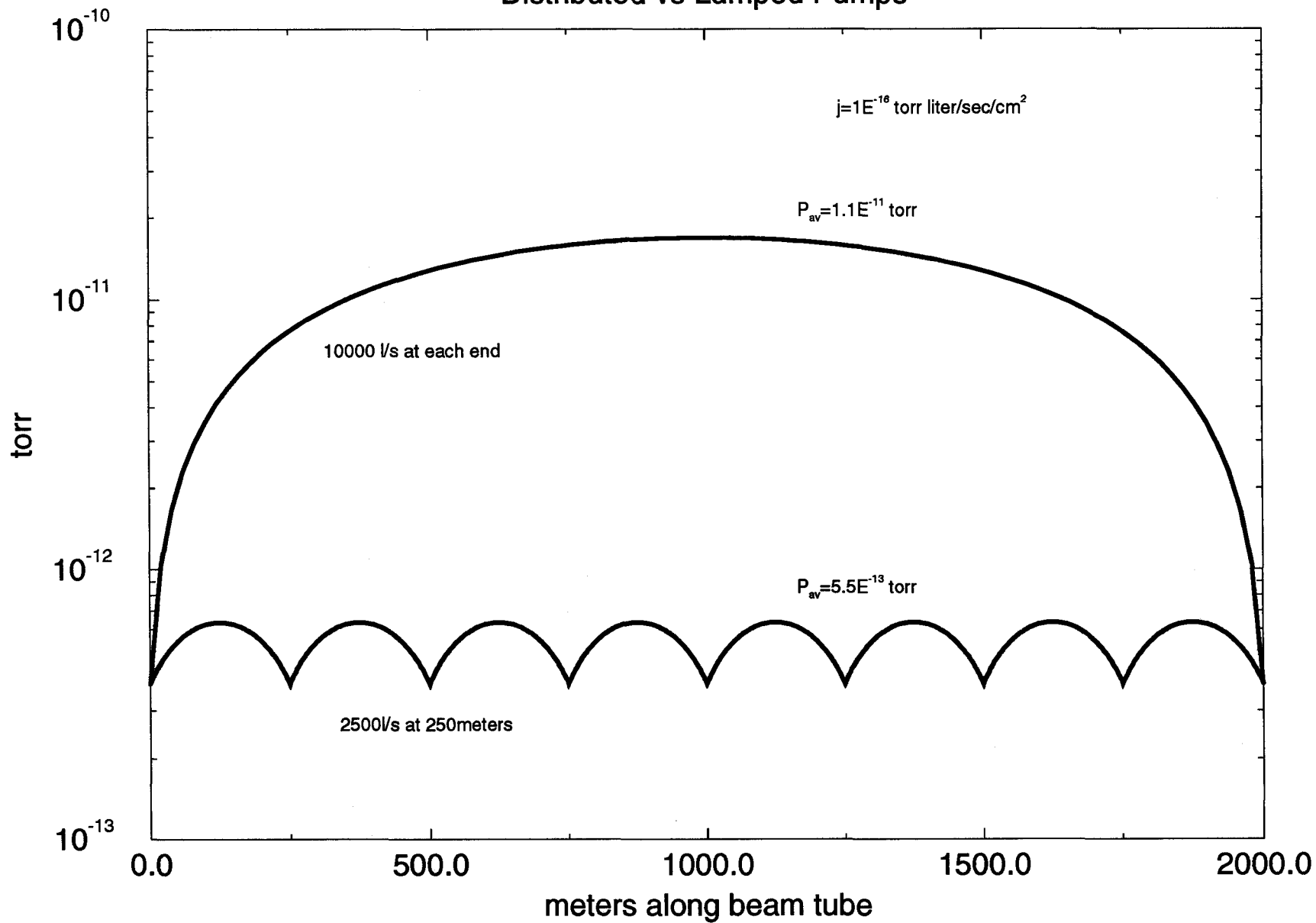
BT Pressure Mass 2

Distributed vs Lumped Pumps



BT Pressure Mass 100

Distributed vs Lumped Pumps



Average BT Hydrogen Pressure (torr)

Gas Load (hydrogen)	Without BT pumps	With BT pumps
BT $j=1 \times 10^{-13}$ t/s/cm ² $Q_{\text{station}} = 2.5 \times 10^{-5}$ t/s	6×10^{-9}	1.5×10^{-9}
BT $j=1 \times 10^{-12}$ t/s/cm ² $Q_{\text{station}} = 2.5 \times 10^{-4}$ t/s	6×10^{-8}	1.5×10^{-8}
Initial IF Requirements	1×10^{-6}	
Advanced IF Requirements	1×10^{-9}	

NOTE: BT pumps are 2500l/s at each 250m port (9 per BT module).

If the BT is isolated from the end pumps the hydrogen pressure in the beam tube rises by $\sim 3 \times 10^{-7}$ torr per day (at $j=1 \times 10^{-13}$ t/s/cm²).

Distributed vs Local Pumps (Monte Carlo)

Point Gas Source Mass 2

