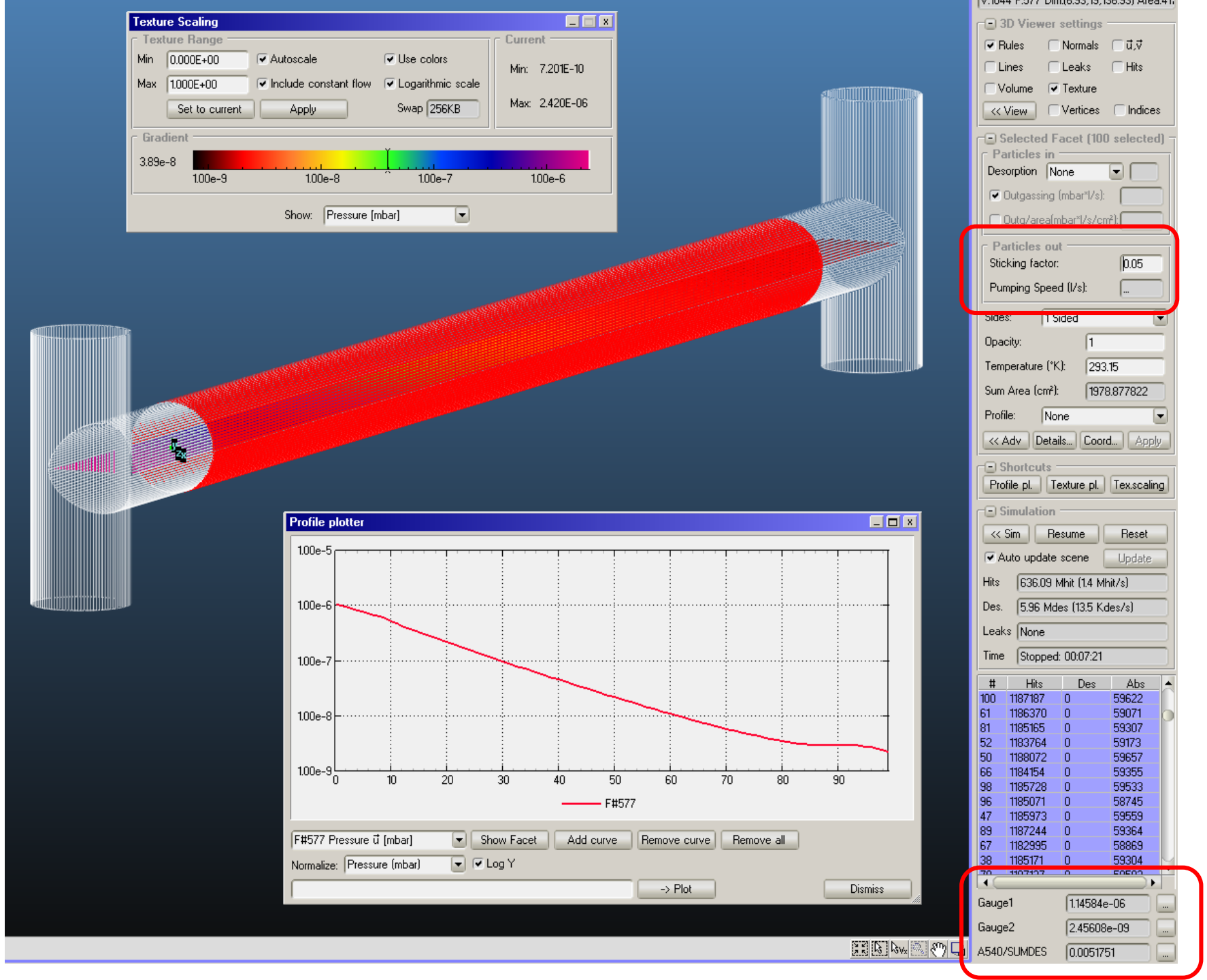
CAS 2017
Vacuum simulations tutorial

Individual work - solutions

Exercise 1

- Ultra-high vacuum systems are linear, therefore the key is to find the sticking factor corresponding to the pressure ratio:
- 2.5E-9 mbar / 1E-6 mbar = 0.0025
- By changing the sticking factor on the NEG sample, we'll get this ratio at a sticking of around 0.05
- The absolute pressure values scale linearly with the outgassing rate. Once we find the NEG's sticking factor (above), we can vary (or calculate directly) the outgassing rate, which should be around 1E-4 mbar.l/s


Texture Scaling
Texture Range
Min 0.000E+00
Max 1.000E+00
Autoscale
Include constant flow
Use colors
Logarithmic scale
Set to current
Apply
Swap 256KB
Current
Min: 7.201E-10
Max: 2.420E-06
Gradient
3.89e-8
1.00e-9
1.00e-8
1.00e-7
1.00e-6
Show: Pressure [mbar]
Profile plotter
1.00e-5
1.00e-6
1.00e-7
1.00e-8
1.00e-9
0
10
20
30
40
50
60
70
80
90
F#577
F#577 Pressure d [mbar]
Show Facet
Add curve
Remove curve
Remove all
Normalize: Pressure (mbar)
Log Y
-> Plot
Dismiss
3D Viewer settings
Rules
Normals
Lines
Leaks
Hits
Volume
Texture
<< View
Vertices
Indices
Selected Facet (100 selected)
Particles in
Desorption None
Outgassing (mbar*l/s):
Outg/area(mbar*l/s/cm²):
Particles out
Sticking factor: 0.05
Pumping Speed (l/s):
Sides: 1 Sided
Opacity: 1
Temperature (°K): 293.15
Sum Area (cm²): 1978.877822
Profile: None
<< Adv
Details...
Coord...
Apply
Shortcuts
Profile pl.
Texture pl.
Tex.scaling
Simulation
<< Sim
Resume
Reset
Auto update scene
Update
Hits 636.09 Mhit (1.4 Mhit/s)
Des. 5.96 Mdes (13.5 Kdes/s)
Leaks None
Time Stopped: 00:07:21
Hits Des Abs
100 1187187 0 59622
61 1186370 0 59071
81 1185165 0 59307
52 1183764 0 59173
50 1188072 0 59657
66 1184154 0 59355
98 1185728 0 59533
96 1185071 0 58745
47 1185973 0 59559
89 1187244 0 59364
67 1182995 0 58869
38 1185171 0 59304
Gauge1 1.14584e-06
Gauge2 2.45608e-09
A540/SUMDES 0.0051751

Exercise 2

- Pumped gas = area * coverage
- Area = 2*R*PI*L = 2*3.15*3.14*100=1978cm^2
- 1978 cm2 * 1E15 molecules / cm2 = 2E18 molecules
  (3.3E-6 mole of N_2)

- The pressure at the pump is around 2.5E-9 mbar, its speed is 300 l/s, so the gas outflow is Q = P * S = 7.5E-7 mbar.l/s
- We inject at 1E-4 mbar.l/s, so the transmission ratio is around 0.0075
- (You can see the number of pumped particles on the pump facet and the number of desorbed particles the read this ratio directly)
- The rest (9.925E-5mbar.l/s) sticks to the NEG
- From pV=NkT, you can convert the outgassing rate: 9.925E-5 mbar.l/s =
  2.4E-16 molecules / second
- So it takes 2E18 / 2.4E-16 = 83 seconds to saturate our pipe

Exercise 3

NEG sticking	Gauge 1 [mbar]	Gauge 2 [mbar]	Pressure ratio	Tr. Ratio		Q=1E-4 mbar.l/s
0.00001	5.00E-06	4.67E-07	9.34E-02	0.993		
0.0001	4.80E-06	4.43E-07	9.23E-02	0.94		
0.001	3.69E-06	2.90E-07	7.86E-02	0.59		
0.01	1.80E-06	3.40E-08	1.89E-02	0.071		
0.05	1.15E-06	2.50E-09	2.17E-03	0.005		
0.1	1.00E-06	1.20E-09	1.20E-03	0.0026		
0.5	7.90E-07	6.65E-10	8.42E-04	0.0014		
1	7.40E-07	5.80E-10	7.84E-04	0.0012