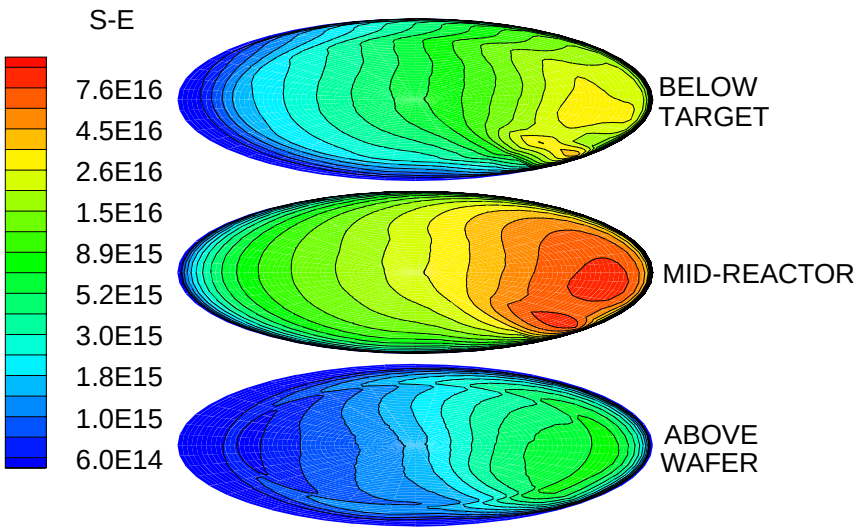
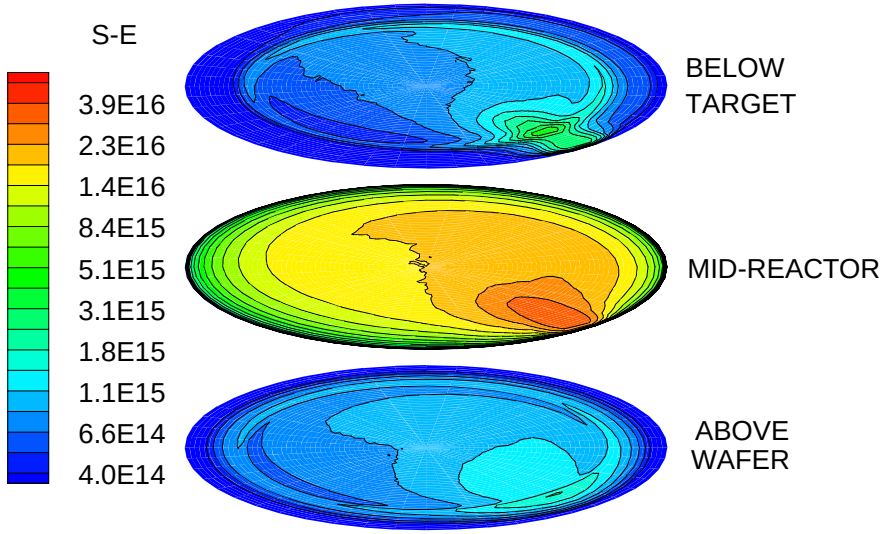
IMPVD REACTOR-ASYMMETRIC EXCITATION:
ELECTRON SOURCE AT TWO ASPECT RATIOS

- Peaks at mid-reactor, to the right, consistent with the electric field.
- Considerable asymmetry persists to the wafer for both cases, although uniformity is better for H/R = 0.75 due to the more uniform electron temperature.





- Height/Radius = 0.5

Electron source, ($cm^{-3}s^{-1}$)

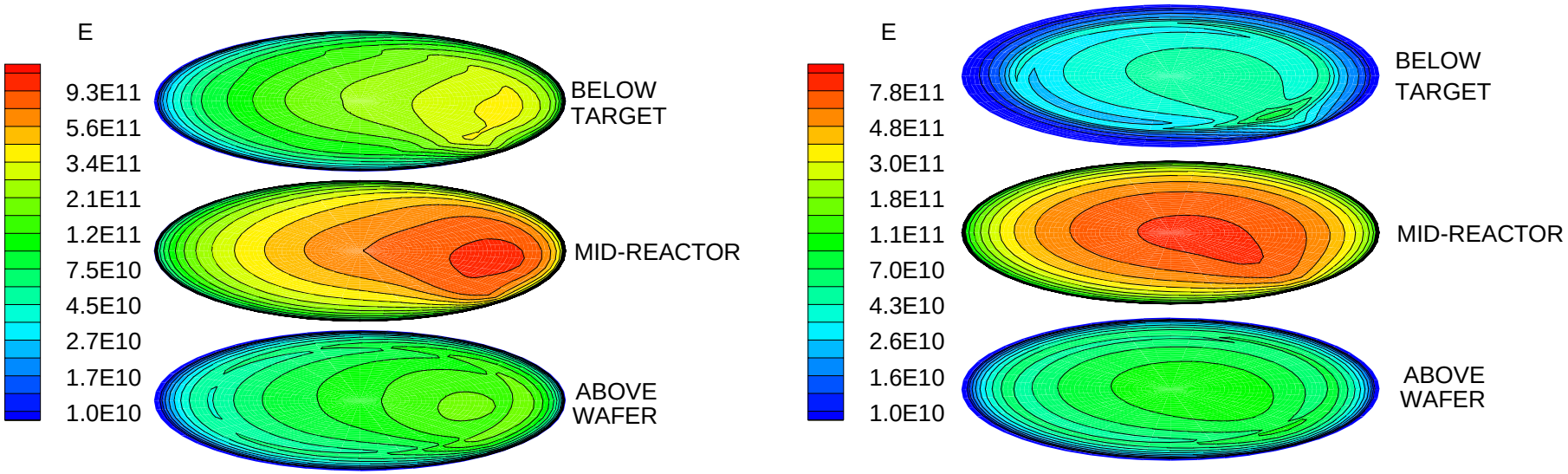
- Height/Radius = 0.75

- Ar, 10 mTorr, Al target, 600 W

IMPVD REACTOR-ASYMMETRIC EXCITATION:

ELECTRON DENSITY AT TWO ASPECT RATIOS

- Electron density profiles are smoother than the source due to more rapid diffusion and charge exchange of Ar^+ to Al^+.
- The high aspect ratio result is more symmetric at the wafer due to larger diffusion length



- Height/Radius = 0.5

Electron density, (cm^{-3})

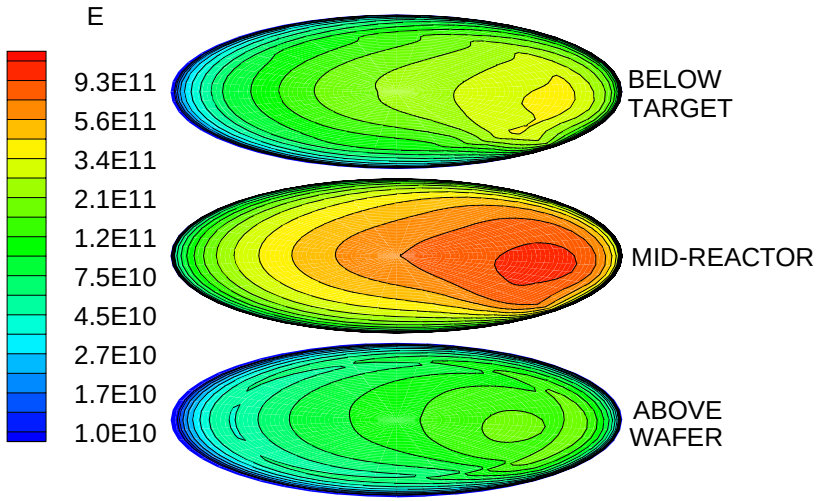
- Height/Radius = 0.75

- Ar, 10 mTorr, Al target, 600 W

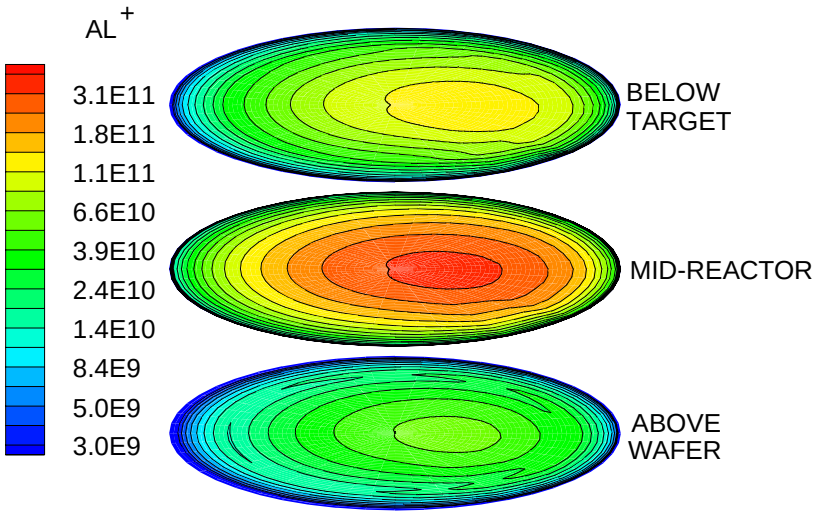
IMPVD REACTOR-ASYMMETRIC EXCITATION:

e, Al^+, Ar^+ DENSITIES

- An asymmetric electron density results from the sum of a quite asymmetric Ar^+ and fairly uniform Al^+.
- Locally generated Ar^+ charge exchanges to Al^+ which, with a larger mobility, then homogenizes by diffusion.
- Note depletion of ions by the substrate bias.

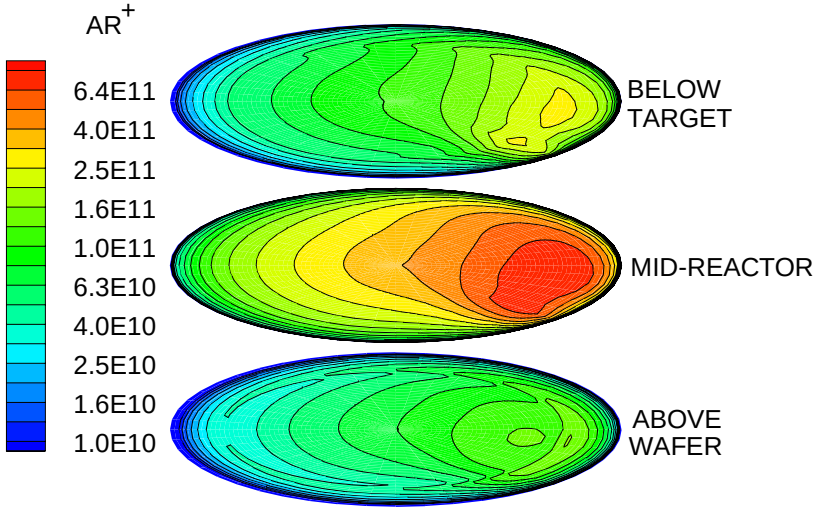


- Electron Density (cm^{-3})



- Al^+ Density (cm^{-3})

- Ar, 10 mTorr, Al target, 600 W, H/R = 0.5

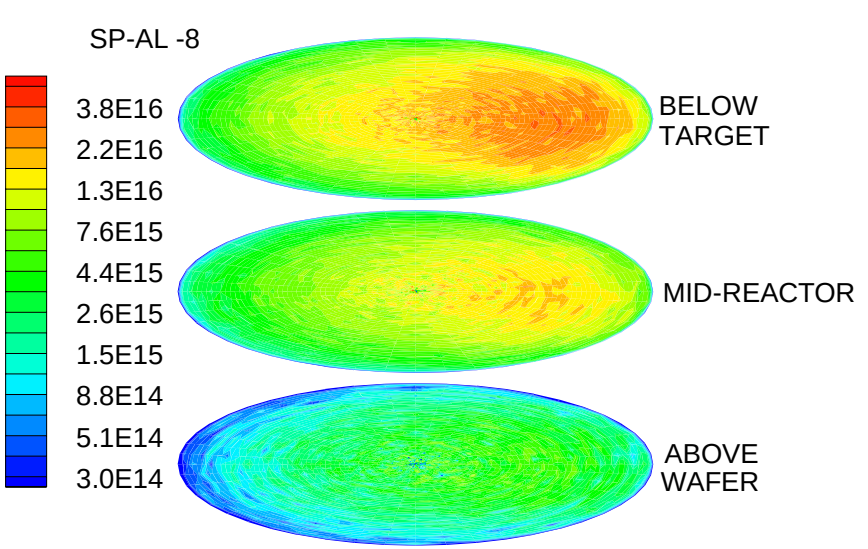


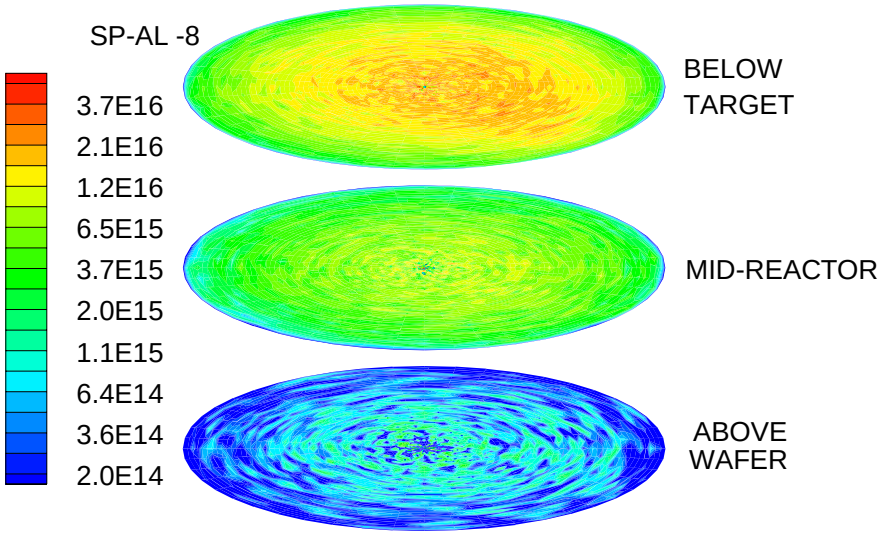
- Ar^+ Density (cm^{-3})

AVS98_E_ALP_ARP

IMPVD REACTOR-ASYMMETRIC EXCITATION:
Al SPUTTERING SOURCE AT TWO ASPECT RATIOS

- The loss of Al atom to the wall causes both sputtering sources to decrease from the target to the wafer. For the same reason, the sputtering source at the wafer for H/R = 0.75 is less than that for H/R =0.5.
- The sputtering source for H/R = 0.75 is more symmetric than that for H/R = 0.5 because the excitation is farther away from the target.





- Height/Radius = 0.5

Al sputtering source, ($cm^{-3}s^{-1}$)

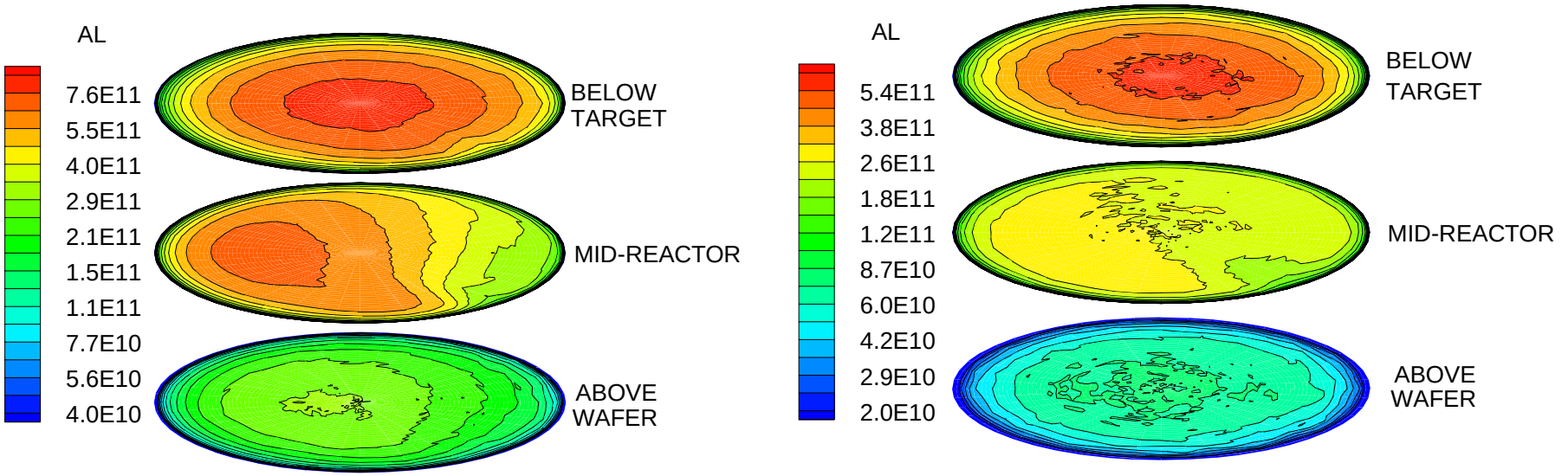
- Height/Radius = 0.75

- Ar, 10 mTorr, Al target, 600 W

IMPVD REACTOR-ASYMMETRIC EXCITATION:

Al ATOM DENSITY AT TWO ASPECT RATIOS

- Al density for H/R = 0.75 is more symmetric and uniform due to longer diffusion length. However, Al density above the wafer for H/R = 0.75 is about half that for H/R = 0.5 due to larger loss to the wall.
- Al density at mid-reactor peaks on the left, due to the high ionization rate on the right, caused by larger electric field.



- Height/Radius = 0.5

Al density, (cm^{-3})

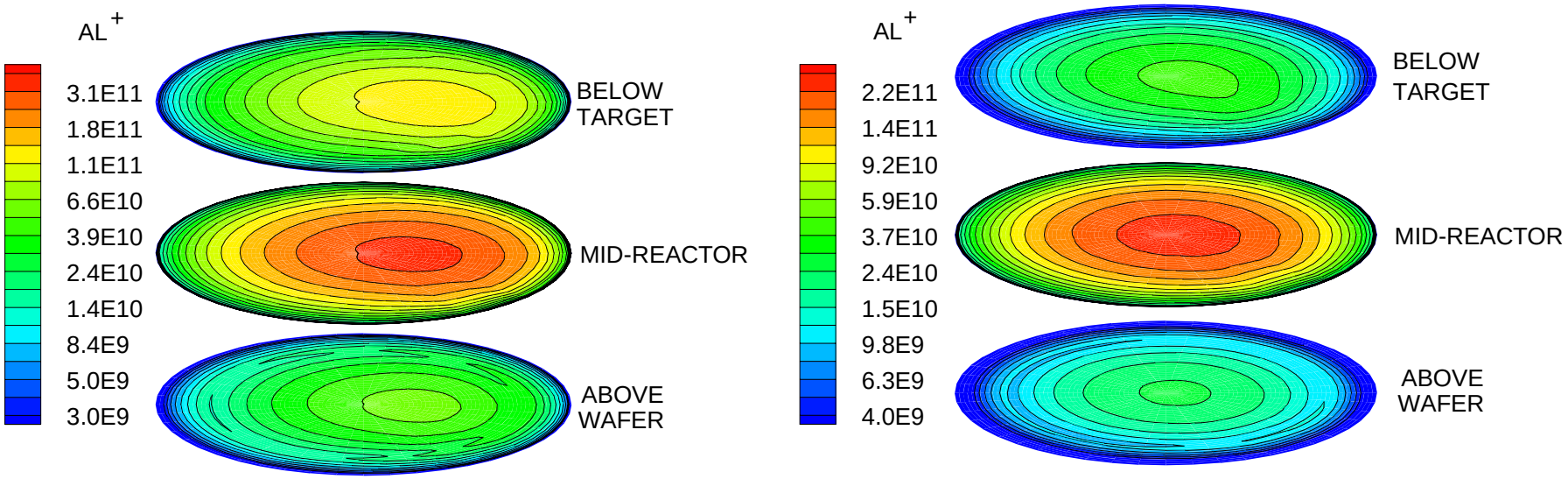
- Height/Radius = 0.75

- Ar, 10 mTorr, Al target, 600 W

IMPVD REACTOR-ASYMMETRIC EXCITATION:

Al ION DENSITY AT TWO ASPECT RATIOS

- The Al^+ densities peak at mid-reactor, consistent with the electric field.
- The Al^+ density contours are smoother and more symmetric than the atom density contours, due to more rapid diffusion and charge exchange.
- The Al^+ density of the high aspect ratio case is only about half of that of the low aspect ratio case, because of loss to the wall.



- Height/Radius = 0.5

Al^+ density, (cm^{-3})

- Height/Radius = 0.75

- Ar, 10 mTorr, Al target, 600 W

UNIVERSITY OF ILLINOIS
OPTICAL AND DISCHARGE PHYSICS

ASYMMETRIC SPUTTER TRACKS IN IMPVD

- In conventional PVD tools, sputter tracks are asymmetric, and the target is rotated to make the depositing metal flux more uniform.
- The sputter track is usually heart shaped , as shown in the Figure.
- In the following presentation, the consequences of asymmetric sputter tracks will be investigated.

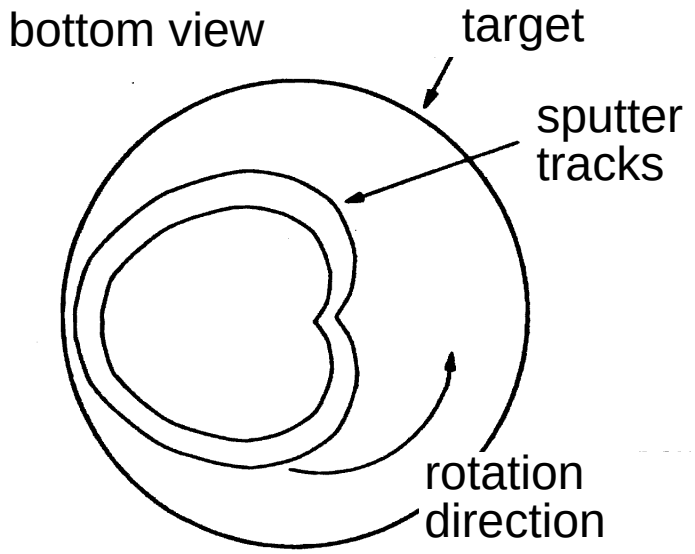


Figure 4 from S.M. Rossnagel, J. Vac. Sci. Technol. B 16(5), 1998, pp. 2585-2608.