AbstractID: 9521 Title: Aerosols/Nanoparticle therapy for malignancy involving the lung - a transport phenomenon study

Purpose: Study the nanoparticles/aerosols localized deposition patterns in morphometrically realistic lung bifurcations geometry using computational fluid dynamics code FLUENT®.

Method and Materials: Chest CT scan data from an unidentified patient, with 3 mm slices in the axial direction are used to reconstruct the lung airway bifurcation geometry using Amira 4.0 (Mercury Inc.) program. The 3D rendered airway bifurcations are exported to FLUENT® preprocessor GAMBIT where further meshing was performed and exported for FLUENT® computation. Species Transport and Reaction model in FLUENT® was used to explore the local deposition patterns of nanoparticles/aerosols. At this time, only the inspiratory phase of the breathing cycle has been studied in realistic bifurcation geometry for 3^{rd} and 4^{th} generations. Modeling using the CT scan data is currently in progress. N_2 has been assumed to be the bulk carrier gas in the flow fields carrying arbitrary particles uniformly sized (smoke, radon daughters, radiopharmaceuticals, etc.) with defined physical and diffusional properties. In this initial study a mass fraction of 10^{-8} was used for particle mass concentration. The particles interacting with the the airway wall surface are assumed to be deposited.

Results: Results from preliminary studies of localized particle deposition velocities and deposition fractions using unrealistic symmetric airway bifurcations geometries for 3^{rd} and 4^{th} generations using FLUENT® model for Po-218 nanoparticles are in close agreement with the experimental data of Kinsara et al. (*Health Phys.* **68(3)**, 1995). Further, results obtained with the realistic bifurcation geometry for 3^{rd} and 4^{th} generations, suggest that the particle deposition is maximum at the carinal region of the bifurcations.

Conclusions: Maximum particle deposition concentration was observed to occur at the carinal regions in the bifurcations. Further, the deposition patterns provide very useful information for the design of the inhalation drugs, with detail on where the particles end up after one breath in.