Lecture 3.1a(1) Unclear Points:

When talking about direct ionizing, on slide 4, you say that most of it is charged particle and that the dominant interaction is a low LET. Typically low LET are uncharged particles (like x rays) and High LET are charged particles (like alpha). So my question is, how can you have a dominant interaction with low LET when you have charged particles? Wouldn't the dominant interaction be high LET?

Because of the low ionization density of electrons, they are considered low LET particles.

Can we talk about why broad beams are better than narrow beams? I was not confident with my answer on the pre test exam.

Only for shielding calculations. Narrow-beam geometry used for beam characterization.

Aren't all the answers in question 5 correct?

Correct, but perhaps not relevant.

Can Directly ionizing radiation produce types of indirectly ionizing radiation?

Radiative interactions that produce Bremsstrahlung

Are there any practical applications for HVL measurements using narrow beam geometry?

These measurements are used to characterize an x-ray beam.

On slide 18, the following is stated about broad beam geometry: When we are dealing with broad beam geometry we no longer have purely exponential behavior. Is this due to the fact that the detector is also receiving scattered radiation, and not just the attenuated primary photons?

Yes.

For shielding calculations, how are the buildup factors determined? Is it based on experience or certain experiments have been performed regarding this issue? And should the buildup factors be different for different areas (like patient waiting room, offices, exam rooms etc)?

Shielding calculations are approximate, with relatively large error margins, so buildup factors are generally ignored in place of broad-beam half-value layers.

When calculating μ, is this value determined relative to the original beam only? If that's the case, is it true that we can essentially use μ to determine initial attenuation of only the primary beam, as it does not account for the attenuation of scattered photons?

Determination of μ is based on thin slab of attenuator, so scattered photons can be neglected, along with beam hardening.
"Charged particles transfer energy, in general, at the same rate independent of the energy of the particles." Please elaborate on this approximation.

Bethe-Bloch equation:

\[
\frac{S}{\rho}_{\text{coll}} = \frac{1}{\rho} \left( \frac{dE}{dx} \right)_{\text{coll}} = 4\pi r_0^2 N_e \frac{Z^2 m_0 c^2}{\beta^2} \left\{ \log \left[ \frac{2 \cdot m_0 c^2 \cdot \beta^2}{I \cdot (1 - \beta^2)} \right] - \beta^2 - \sum_i \frac{C_i}{Z} \right\}
\]

Energy-dependent term is function of \( \beta \), which is close to being constant at relativistic energies.

The attenuation coefficients are initially confusing, but I expect to understand them better after using them to work problems.

Hope so.

Can we go over the answer to number 5 in class? I think I am getting confused on the wording.

Question had to do with directly ionizing radiation. Uncharged particles are indirectly ionizing radiation.

In question 6 above, the answer is "when uncharged particles undergo interactions with matter, they first transfer their energy to charged particles" is true, but this is not considered a directly ionizing radiation. so I selected this as the answer to the question. correct? Is this the type of question we might see on the test on Friday? We need to read the question very carefully?
That type of question is not likely on the exam, but you need to read the questions very carefully anyway.

Are the path lengths on the table in slide 26 all interpreted as the average distance traveled before interaction?

Slide 26 shows how path lengths are expressed. They represent distance photons travel through medium.