

EGS: Electron Gamma Shower

Douglas Peplow

Oak Ridge National Laboratory



OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY

UT-BATTELLE

Charged Particles in Monte Carlo Condensed History

- **Class I**

- large and small interactions together
- electron path length - standard fraction of energy to lose (~few %)
- interaction type is sampled, angular deflection is determined
- (ETRAN, ITS and MCNP)

- **Class II**

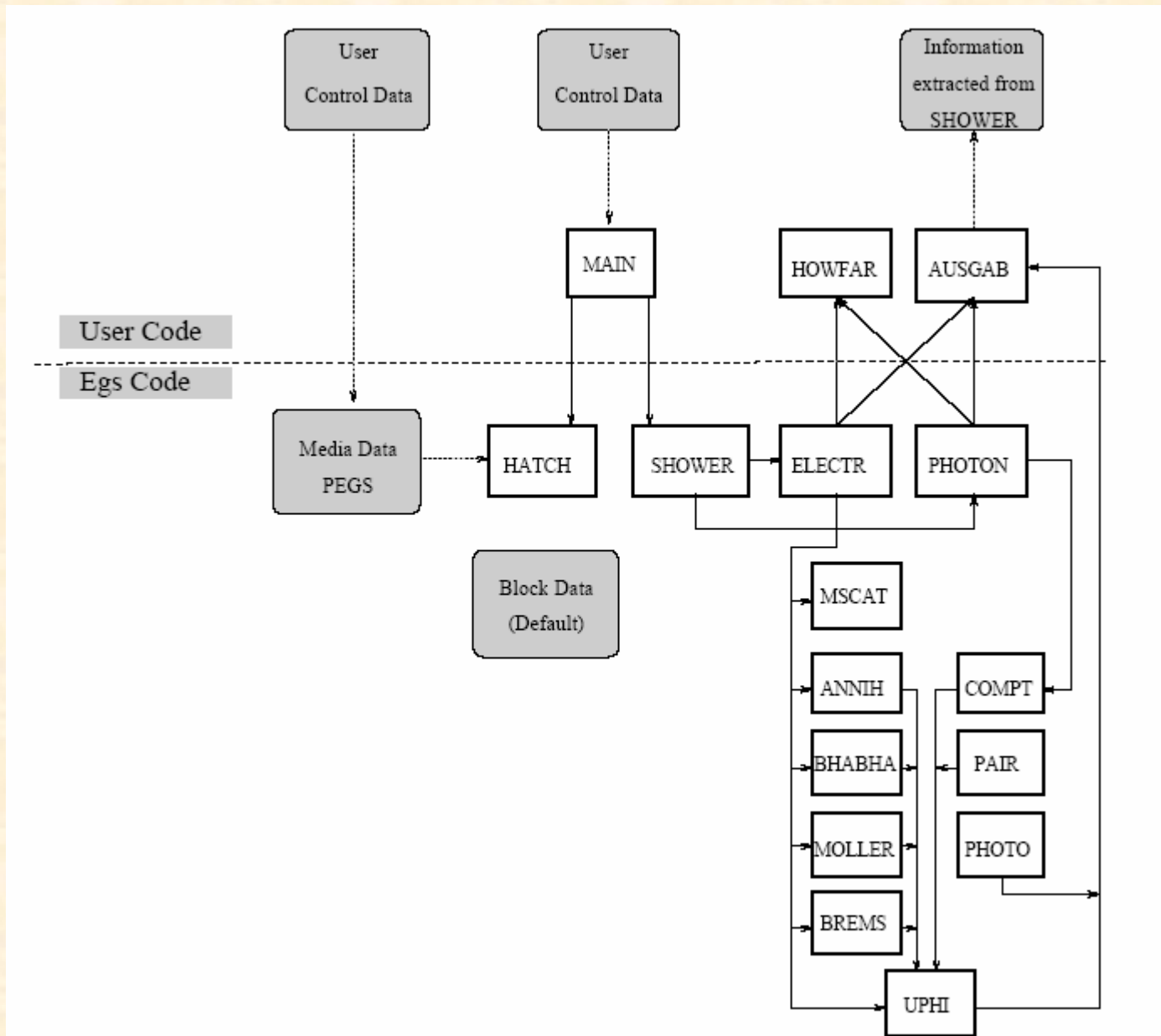
- major and minor interactions are treated separately
- bremsstrahlung and inelastic collisions are threshold processes, they are treated explicitly and their secondaries are transported
- sub-threshold inelastic, radiative events and elastic collisions are grouped together
- better correlation between energy loss and secondaries
- (EGS family)

EGSnrc Capabilities and Features

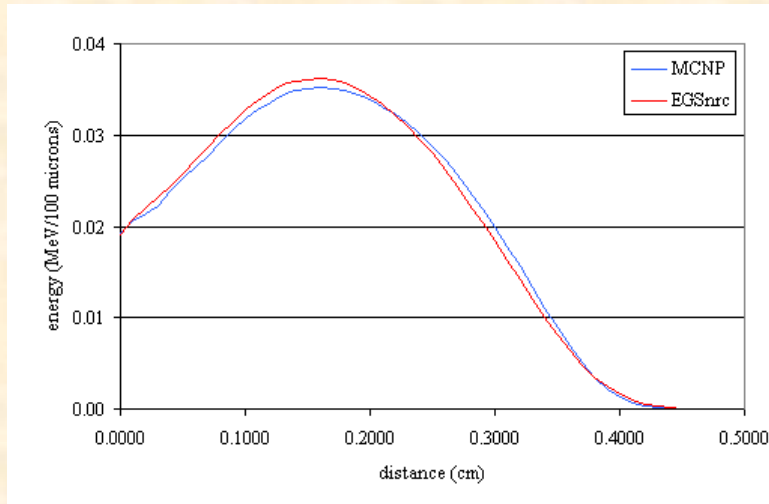
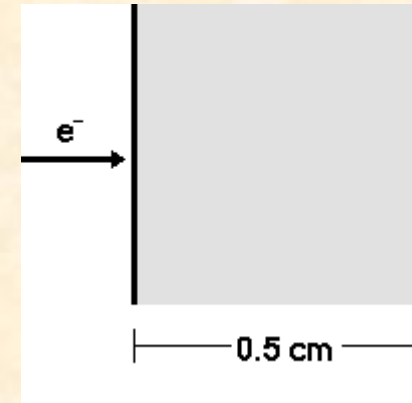
- **Photons: 1 keV to 100 GeV**
 - Pair production
 - Compton scattering, either Klein-Nishina or bound Compton
 - Coherent (Rayleigh) scattering can be included
 - Photoelectric effect
 - Fluorescent photons (K, L, M shells) and Auger/Coster-Kronig electrons produced
- **Electrons/positrons 10 keV to 100 GeV**
 - Bremsstrahlung production
 - Positron annihilation in flight and at rest
 - Multiple scattering of charged particles by coulomb scattering from nuclei
 - Møller and Bhabha scattering. Exact rather than asymptotic formulae are used.
 - Continuous energy loss applied to charged particle tracks between discrete interactions
 - Total restricted charged particle stopping power consists of soft bremsstrahlung and collision loss terms
 - Collision loss determined by the restricted Bethe-Bloch stopping power with Sternheimer treatment of the density effect in the general case but with provision of using an arbitrary density effect correction and data supplied to use the density effect recommended by the ICRU in Report 37.
- **Materials: Z=1 to Z=100**

User Code

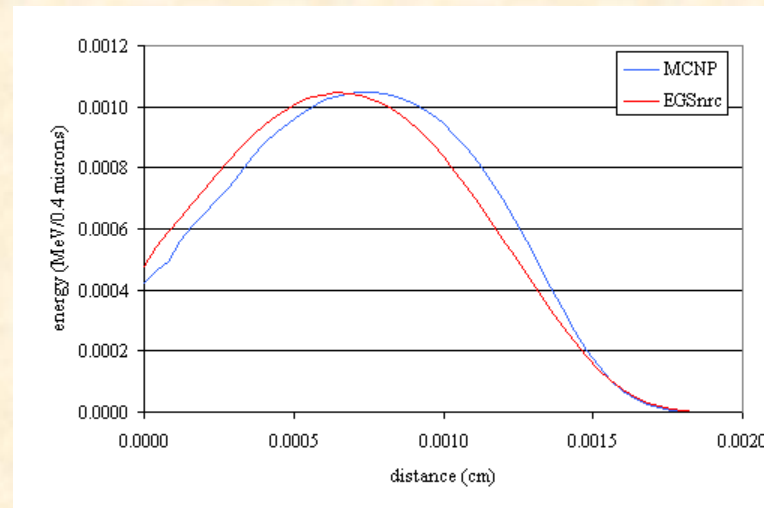
- **Main**
- **Source sampling routine(s)**
- **Geometry – could be complex**
 - **HOWFAR – distance to next boundary**
 - **HOWNEAR – distance to closest edge**
- **Tallies – what you want to calculate**
 - **AUSGAB**



Comparison: MCNP and EGSnrc

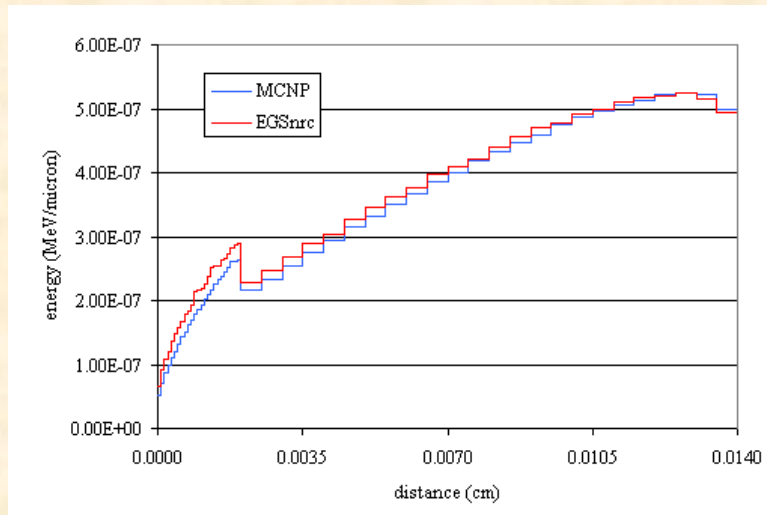
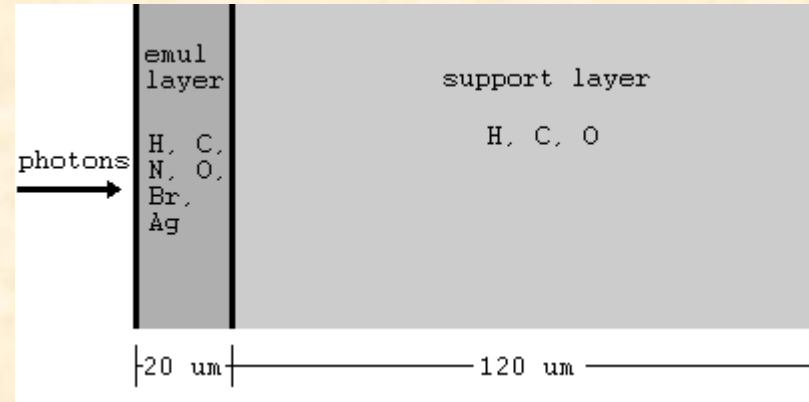


1 MeV

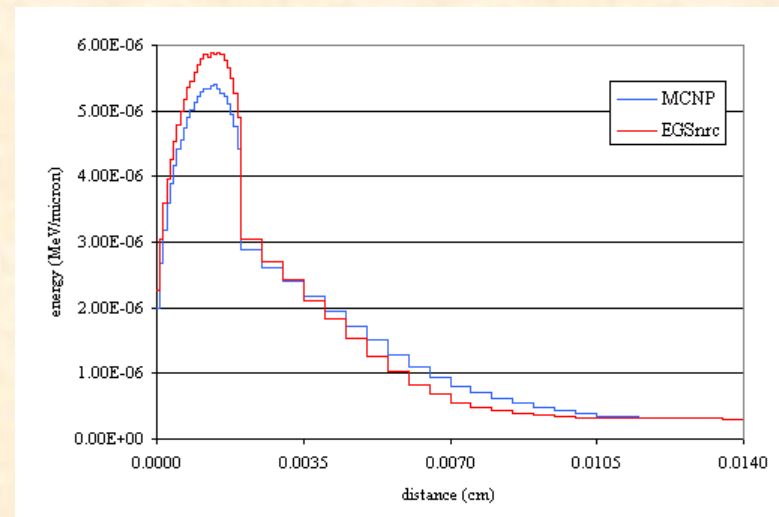


30 keV

Comparison: EGSnrc and MCNP

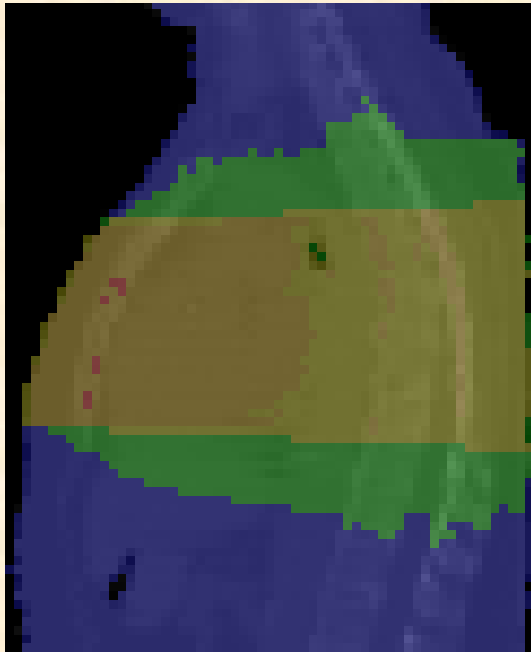


1 MeV

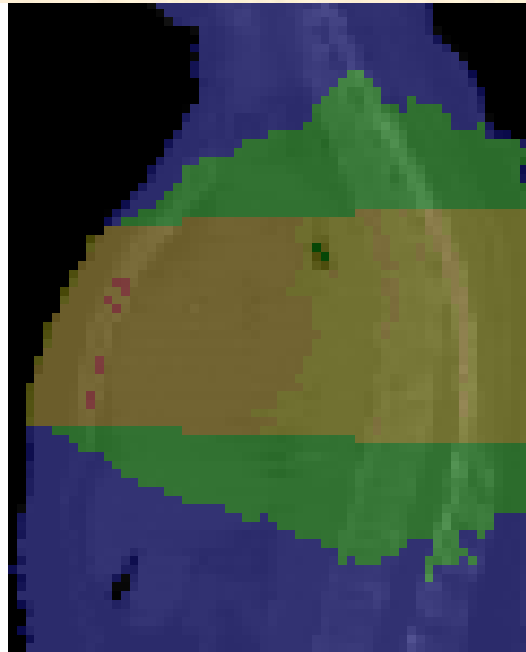


30 keV

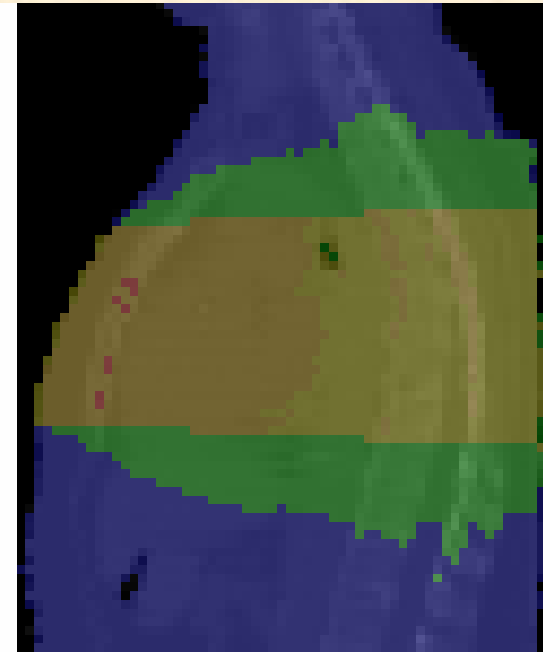
Comparison: EGSnrc and TORT



EGSnrc



TORT (P_3 scattering)



TORT (P_5 scattering)