Emerging requirements from user domains - Nuclear Physics and Underground experiments

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Mostly based on Plenary Sessions and Parallel Sessions II and VII of the User Workshop

Underground physics - 1

- In general, community happy with the tools and the support provided by Geant4 Collaboration
- Physics items and requirements are **very specific** of this community, with small overlaps/sinergy with other Geant4 user communities
  - … with some exceptions
  - Difficult to find manpower in G4 to address requirements
- Usual physics items of interest for underground physics experiments
  - Low energy EM, low energy neutrons
  - Cosmic ray muons
  - Radioactive isotopes

Underground physics - 2

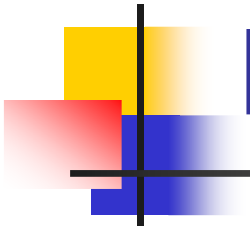
- Low-energy neutrons (< 20 MeV), including capture and inelastic interactions
  - Neutron inelastic scattering kinematics
  - Doppler broadening
    - Issue also reported by medical physics
  - Gamma rays from radiative captures
    - Somewhat related to the present database
- Radioactive decay
  - Need to **improve** the **interface** between RadioactiveDecay and AtomicDeexcitation
    - EC decays and production of x-rays with the proper branching ratios
    - **Energy non-conservation** in some cases
  - **Bug report #1001**, with also a possible patch (requires changing high-level interfaces)

Underground physics - 3

- **Low-energy EM** physics (e.g. Auger electrons)
  - No further requests at the moment.
  - Anticipated performance improvement very much appreciated
- **Showers** induced by cosmic ray **muons**
  - Still, it seems that Geant4 under-produces neutrons with respect to experimental data
  - New models, expected to increase the neutron yield, available in Geant4 (`QCapture`, CHIPS-based). People involved in MC will try them.
- **Optical photons**
  - Looks like the community is a good "customer" for these models: most experiments have simulation of the light response of detectors and are **happy** with them
  - Wavelength shifting defined as bulk process → a bit tricky to use (namely: a thin layer of material surrounding the reflecting surface), but **ok**!

Nuclear physics - 1

- [I am not an expert of the field, so this is my understanding from Section VII and talks with "nuclear physics" people]
- Of course, hadron/nuclear cascades are a key issue
  - Partially overlapping with HEP physics, but possibly different energy range and also **interest in ions** (overlap with **medical physics**)
    - Ion inelastic interactions
- Neutron interactions, expecially **inelastic** → both HP energy range (<20 MeV) and above
  - Issue in common with underground physics
  - Depending on the database files available and for the channel



Nuclear physics - 2

- Also important to describe accurately EM interactions (= ionisation) of hadrons and ions
  - People have to try and give feedback on the new **`G4IonParametrizedLoss`** model
  - In general, community potentially interested in multiply-charged ions