Recent updates in pre-compound and de-excitation

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Geant4 Hadronic group meeting

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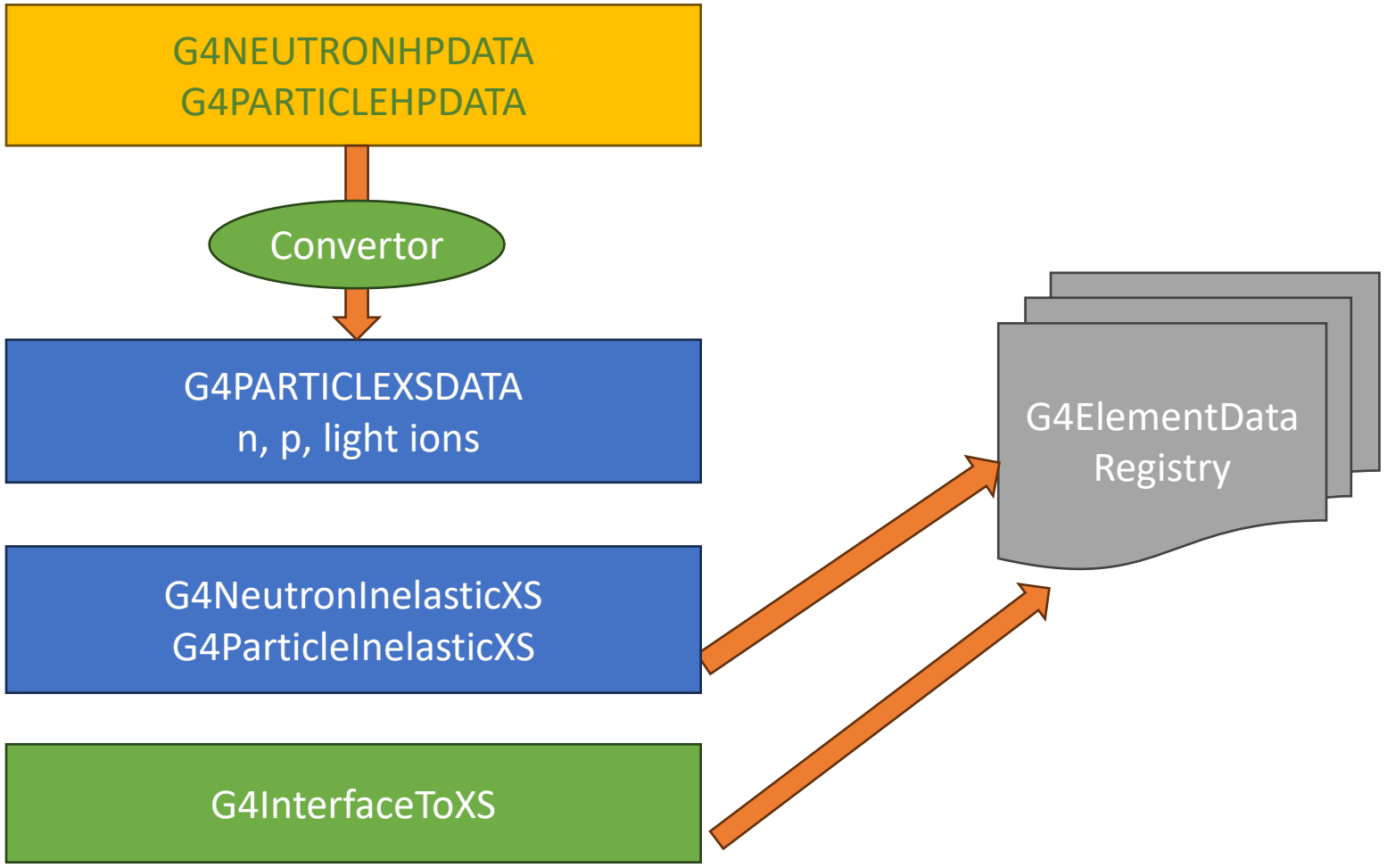
Outline

- New G4InterfaceToXS class
- Inverse cross section options
- Effect on calorimeter resolution
- Validation results
- Plans

New G4InterfaceToXS class



- G4NEUTRONHPDATA and G4PARTICLEHPDATA are converted into G4PARTICLEXSDATA for n, p, d, t, He3, alpha.
- Cross section classes store data in the G4ElementDataRegistry allowing sharing data between threads
- The new G4InterfaceToXS allows to access these data from any hadronic model
- Initialization of data done thread safely – no dependency on order of initialization from various classes.
- The destruction is performed by G4ElementDataRegistry.

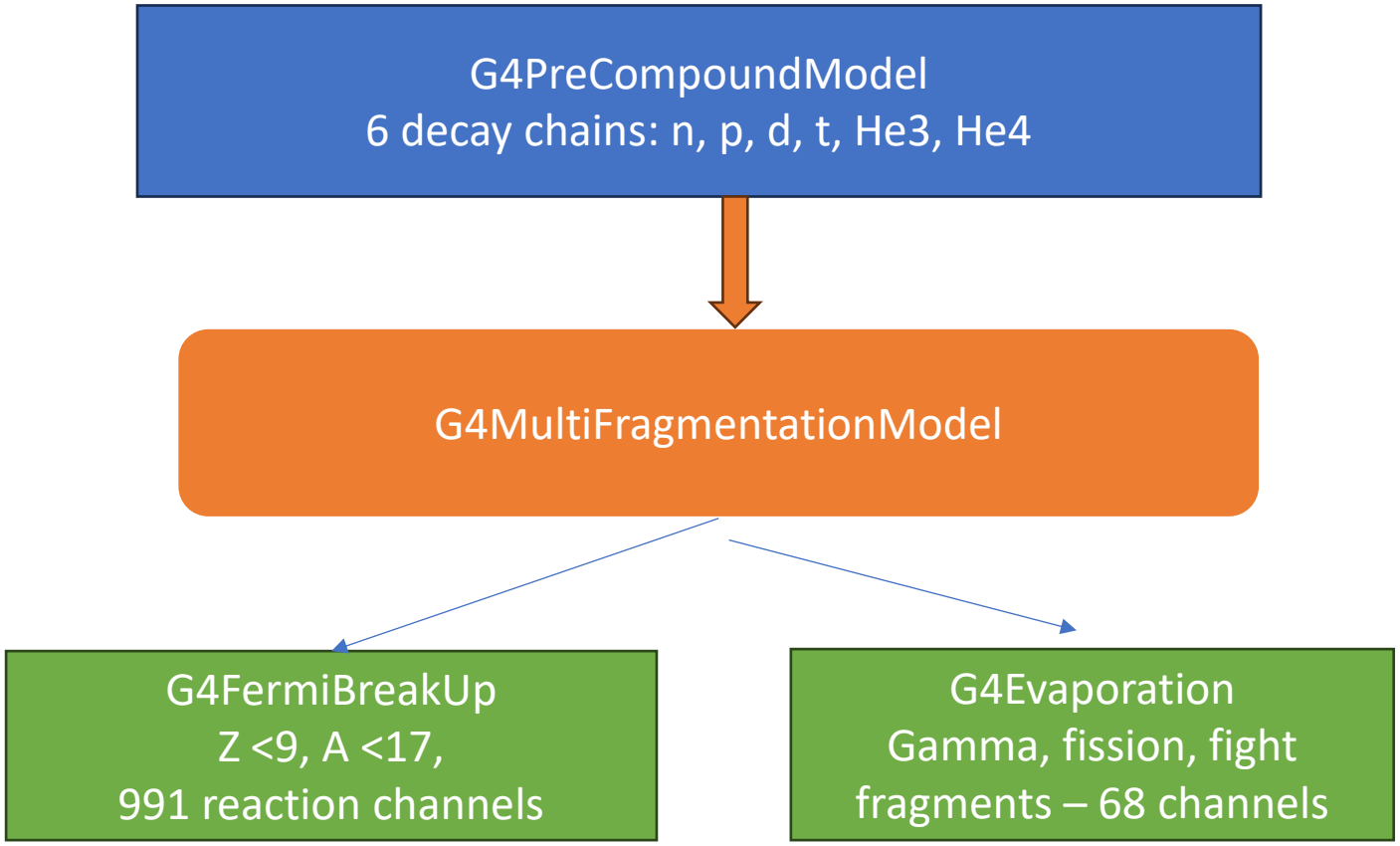
Inverse cross section options

- Inverse cross section is a part of the classical expression for probability of evaporation:

$$P_j(E_x,\varepsilon)d\varepsilon = g_i\sigma_{inv}(\varepsilon)\frac{\rho_d(E_x-\varepsilon)}{\rho_i(\varepsilon)}\varepsilon d\varepsilon$$

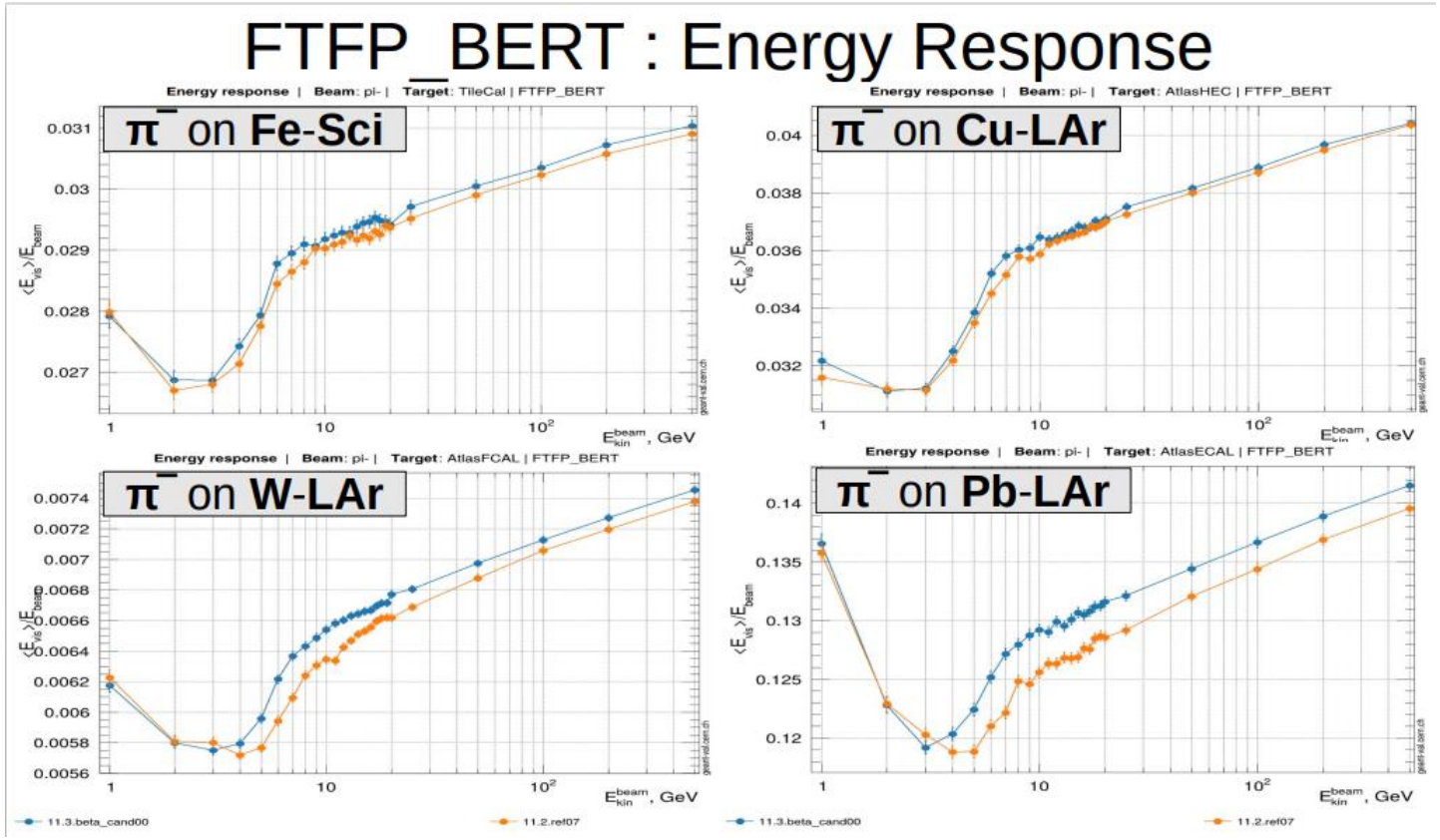
- Here Ex – excitation energy of the fragment, Ɛ –is kinetic energy of emitted particle.
  - In what coordinate systems? Laboratory or residual fragment?
- Parameter OPTxs for de-excitation and pre-compound are available:
  - 0 – Dostorovsky, 1- G4InterfaceToXS, 2 – Chatterjee, 3 – Kalbach (default in 11.2)
  - Can be configured via G4DeexPrecoParameters class

Pre-compound/de-excitation interface



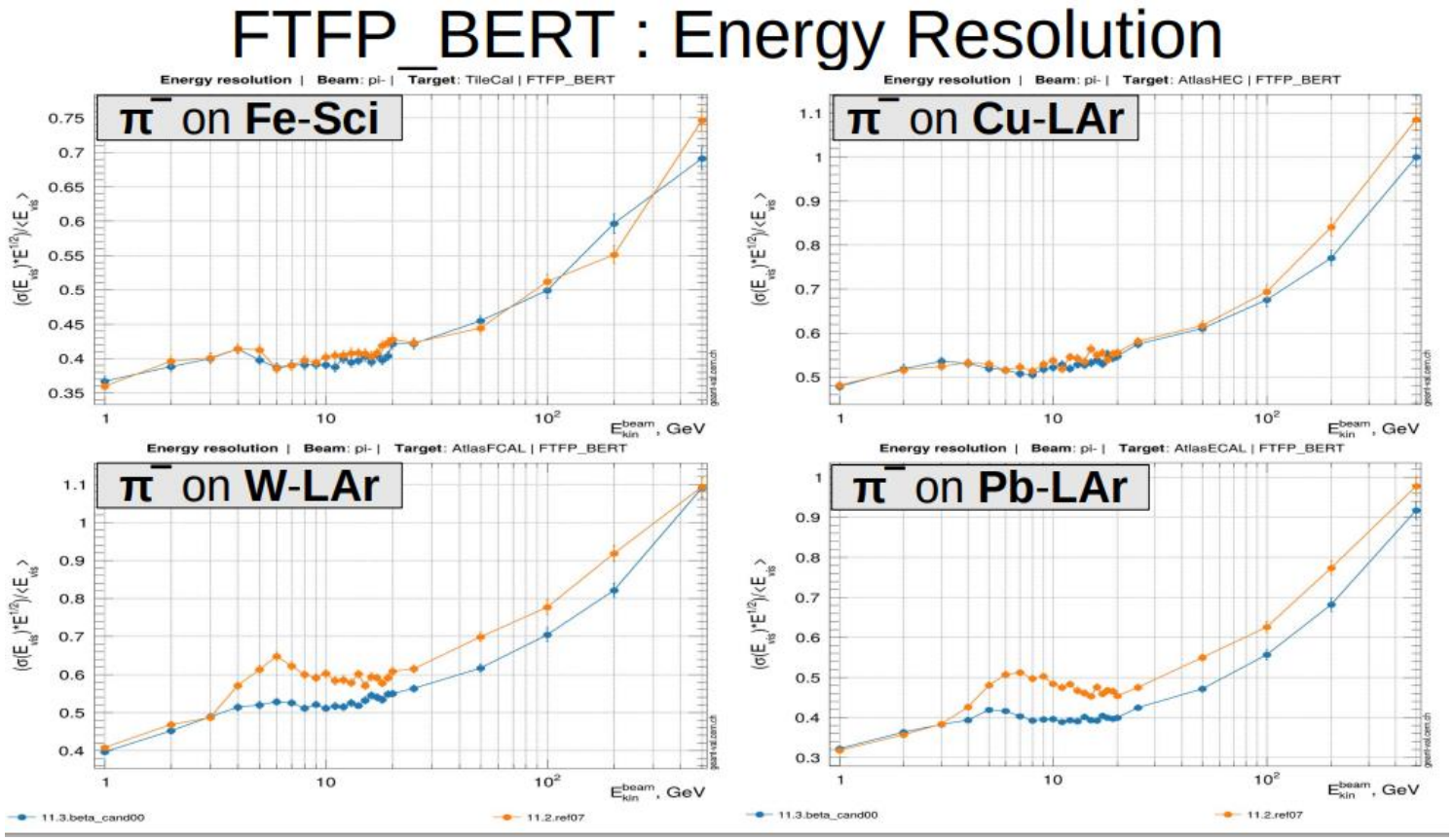
- Pre-compound model sample emission of n, p, light ions if
  - 0.1 MeV < Eex/A < 30 MeV
  - Only 1 emission
- Multifragmentation model sample secondaries if
  - Eex/A > 200 GeV
- FermiBreakUp is active for light fragments and
  - Eex < 20 MeV
- Evaporation is responsible for the rest

Calorimeter test in Geant4 11.2ref07



- Eex/A < 3 MeV instead of 30 MeV
- OPTxs = 1 for the pre-compound model
- OPTxs = 3 for de-excitation
- In calorimeters with heavy absorbers a significant effect is seen

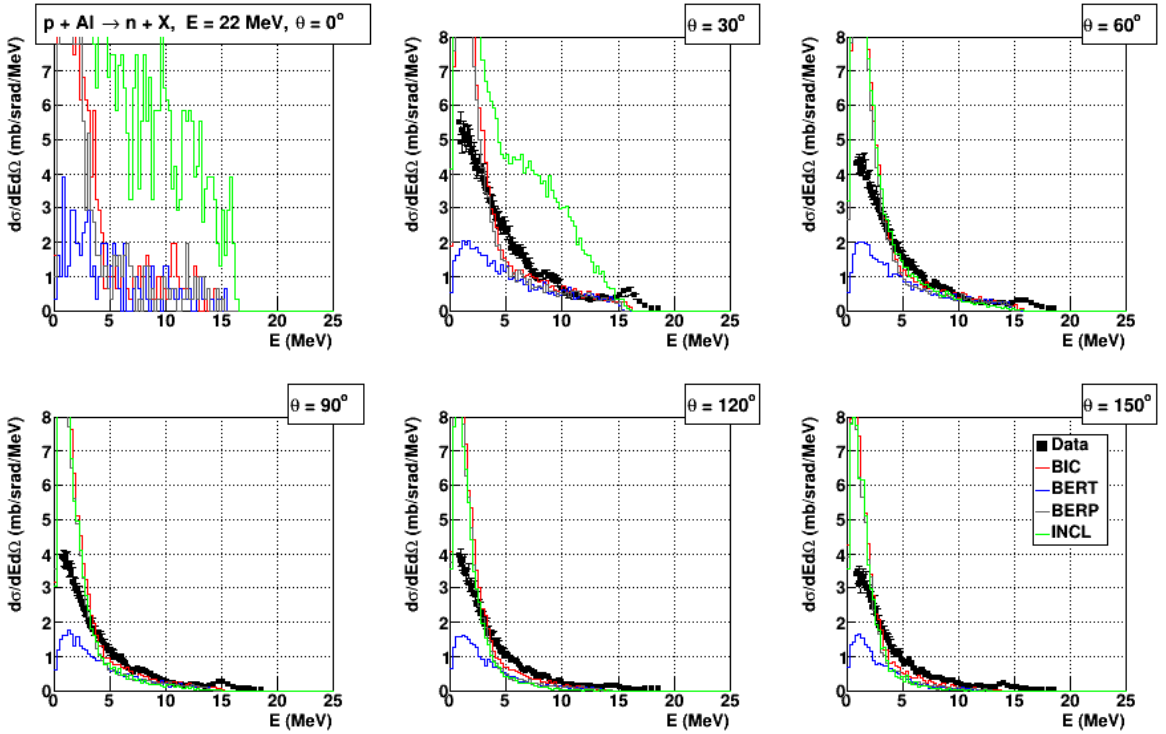
Calorimeter resolution in Geant4 11.2ref07



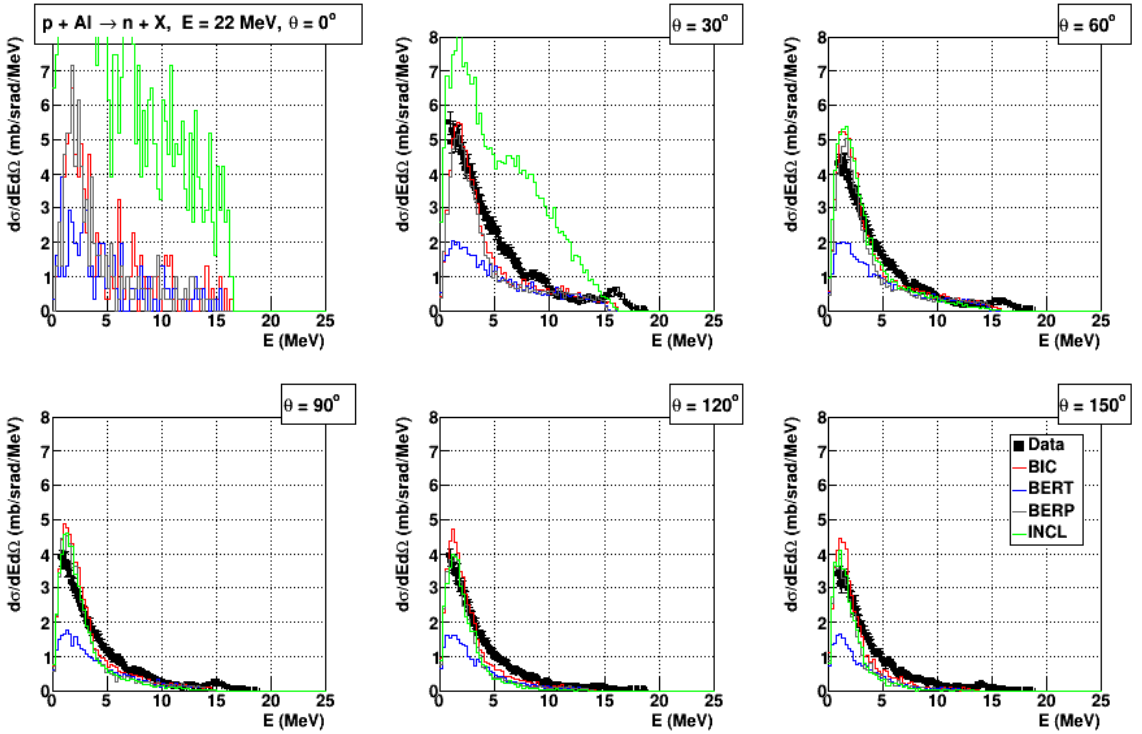
- The condition Eex/A< 3 MeV means disabling of pre-compound in FTFP and direct use of the de-excitation module
- Should this parameter be back to 30 MeV for ref08?

Neutron production by 22 MeV protons

11.2.0



11.3beta



- Outstanding problem was there for many years
- After change of probability function better agreement between the Binary cascade and the data

Plans

- For 11.3
  - Return limit 30 MeV?
  - Optimise OPTxs choice
  - Introduce alternative GEM model
- For the next year
  - Extra iteration for G4PARTICLEXS4.2
  - Move multi-fragmentation model before pre-compound