MCG / GNASH Nuclear Reaction Code

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- Heir of GNASH [P.G.Young, E.D.Arthur, M.B.Chadwick]
- Modern nuclear reaction code
- Aims at describing nuclear reactions in the 1 keV-200 MeV energy range, and for a wide range of projectiles and target nuclei.

→ *Why a new GNASH?*

Main goals: improve both physics and coding found in GNASH, and automatize various post-calculations tasks.

Improved Coding Practices

Coding in **modern Fortran 95 language** (modularity, data encapsulation, dynamic allocation, derived-types, ...) for better lisibility and ***faster evolution***.

Large space devoted to **comments** within the code + writing of a detailed **user manual**

Much **simplified input file**(s)

Automatic processing of results (such as ENDF formatting & plots)

Physics Modeling

Implementation of the **statistical description** of a nuclear reaction [Hauser-Feshbach] with the formation of a so-called compound nucleus

Non-statistical effects taken into account: Preequilibrium emission [DDHMS], direct reactions [with ECIS code], and with fluctuations corrections at low-incident energies [within MCG].

Coupled-channels calculations using the **ECIS code** [J.Raynal, Saclay]

Physics Modeling [cont'd]

Inclusion of spin information in transmission coefficients (not present in GNASH)

Width Fluctuation corrections (a module submitted to the *ModLib project*) [developed with the help of S.Hilaire, BRC]

Preequilibrium (Monte Carlo) **DDHMS code** [M.B.Chadwick]

Fission model similar to what is present in GNASH + new formulations to be developed (with the help of E.Lynn and P.Moller)

Exclusive spectra (yet to be tested)

An excerpt from MCG...

```
Program MCG

use precision                          !module defining precision of calculations
use definition                         !module with new objects definitions
...                                    !...
use levels                             !module containing level density prescriptions
use fission                            !module with fission models
use compound                           !(main) module for Hauser-Feshbach calculations
use results                            !module with routines to format output

call read_input                        !read in input information

call create_nucleus (CNt, Zt, At)      !create Target nucleus
call create_nucleus (Cnp, Zp, Ap)      !create Projectile nucleus

call create_nucleus (CNi, Z, A)        !create initial CN

cn => CNi
call populate_first_nucleus (cn)       !populate first CN (w/ WFCF)

do while (.not.emptychain)             !while chain reaction still active
  call decay_nucleus (cn)              !let current CN decay
  cn => chain%cn                       !point toward next CN in the chain
end do

call report                            !write a formatted results report


end program MCG
```

HRTW / Moldauer vs. GOE

Width Fluctuation Corrections to pure HF calculations