

Prompt dipole γ -ray emission in fusion heavy - ion collisions: incident energy dependence

B. Martin^{1,2}, D. Pierroutsakou¹, G. Inghima^{1,2}, C. Agodi³, R. Alba³, V. Baran⁴,
A. Boiano¹, G. Cardella⁵, M. Colonna³, R. Coniglione³, E. De Filippo⁵, A. De Rosa^{1,2},
A. Del Zoppo³, M. Di Toro³, T. Glodariu^{4,6}, M. La Commara^{1,2}, C. Maiolino³,
M. Mazzocco⁶, A. Pagano⁵, S. Pirrone⁵, M. Romoli¹, M. Sandoli^{1,2}, D. Santonocito³,
P. Sapienza³, C. Signorini⁶

¹ INFN, Sezione di Napoli, Napoli, Italy

² Dip. di Scienze Fisiche, Univ. di Napoli "Federico II", Napoli, Italy

³ Dip. di Fisica e Astronomia, Univ. di Catania and INFN, LNS, Catania, Italy

⁴ NIPNE-HH and Bucarest University, Bucarest, Romania

⁵ INFN, Sezione di Catania, Catania, Italy

⁶ Dip. di Fisica, Univ. di Padova and INFN, Sezione di Padova, Padova, Italy

The prompt dipole γ -ray emission is related to the excitation of a pre-equilibrium Giant Dipole Resonance (GDR) in the dinuclear system formed in charge asymmetric heavy-ion collisions. Recently, it was suggested that this kind of pre-equilibrium radiation depends on the incident energy [1].

A systematic study of such a dependence could provide information on the damping of the dipole mode in very excited nuclear systems. Moreover it could be of aid in the formation of superheavy elements through "hot" fusion reactions. In fact, the emission of pre-equilibrium dipole photons could provide a way to cool down the hot fusion paths, increasing the composite system survival probability. The argument becomes more interesting when associated with the availability of exotic beams which, allowing to reach very large entrance channel charge asymmetries, maximize the prompt dipole γ -ray emission.

In the present contribution we report results of new measurements where the investigation of the prompt dipole radiation in fusion-evaporation events as a function of beam energy [2] was extended to higher energies. In the $^{32,36}\text{S} + ^{100,96}\text{Mo}$ ($E_{lab} = 6$ and 9 MeV/nucleon) [2] and $^{36,40}\text{Ar} + ^{96,92}\text{Zr}$ ($E_{lab} \approx 16$ MeV/nucleon) reaction pairs the same compound nucleus was formed at three different excitation energies through entrance channels having different charge asymmetry. The centroid and the width of the pre-equilibrium dipole component evidenced in the γ -ray multiplicity spectra were found to remain constant, within the errors, by increasing the beam energy. In a model-independent analysis it was evidenced that the strength of the prompt dipole radiation presents a "rise and fall" behavior as a function of the incident energy with a maximum at $E_{lab} = 9$ MeV/nucleon. Calculations based on a collective bremsstrahlung analysis of the reaction dynamics will be discussed and compared with the experimental findings.

Future developments to investigate the prompt dipole radiation in both fusion-evaporation and fusion-fission events will be discussed.

[1] V. Baran *et al.*, Nucl. Phys. **A 679**, 373 (2001) and Phys. Rev. Lett. **87**, 182501 (2001)

[2] D. Pierroutsakou *et al.*, Nucl. Phys. **A 687**, 245c (2001), Eur. Phys. J **A 16** 423 (2003), Eur. Phys. J **A 17** 71 (2003) and Phys. Rev. **C 71**, 054605 (2005)