Study of quasi-projectile properties at Fermi energies in ^{48}Ca projectile systems

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FAZIA Collaboration

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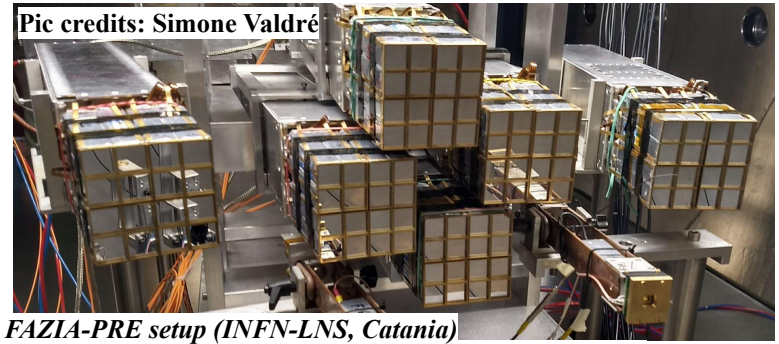
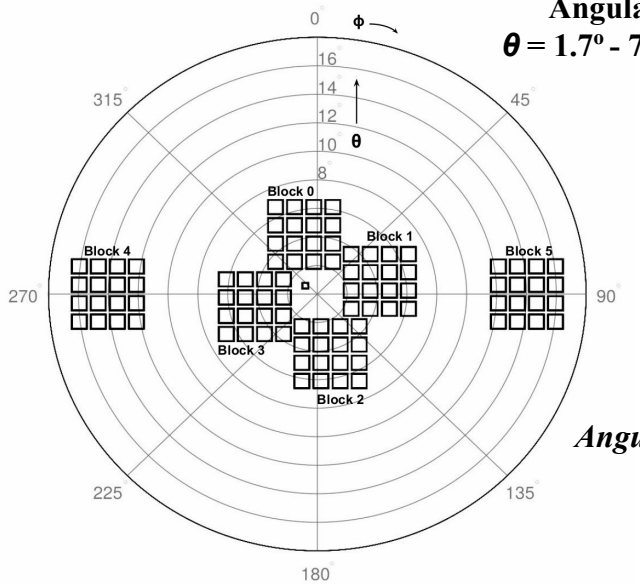
FAZIA-PRE experiment



FAZIA-PRE setup (INFN-LNS, Catania)

Goal: **Study the effect of initial neutron richness on properties of the quasi- projectile (*QP*) fragment**

Angular acceptance:
θ = 1.7° - 7.6° & 11.5° - 16.7°



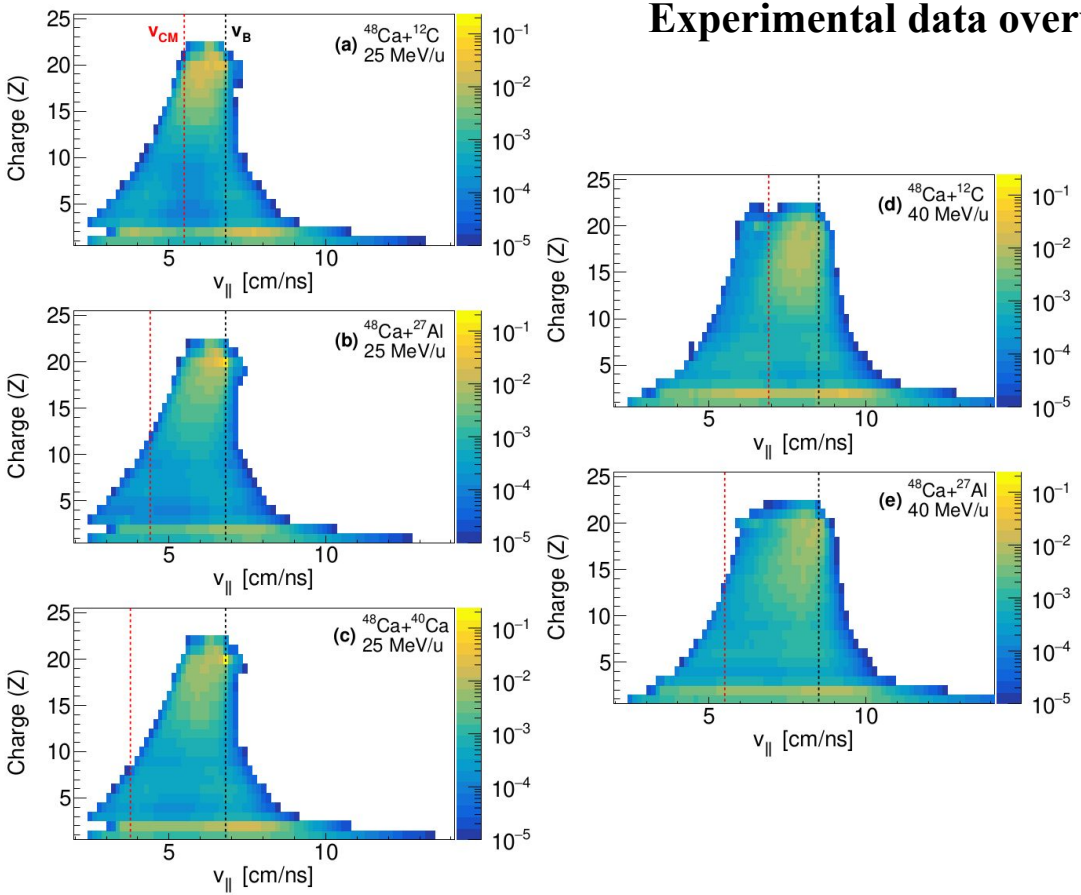
FAZIA-PRE Angular Coverage

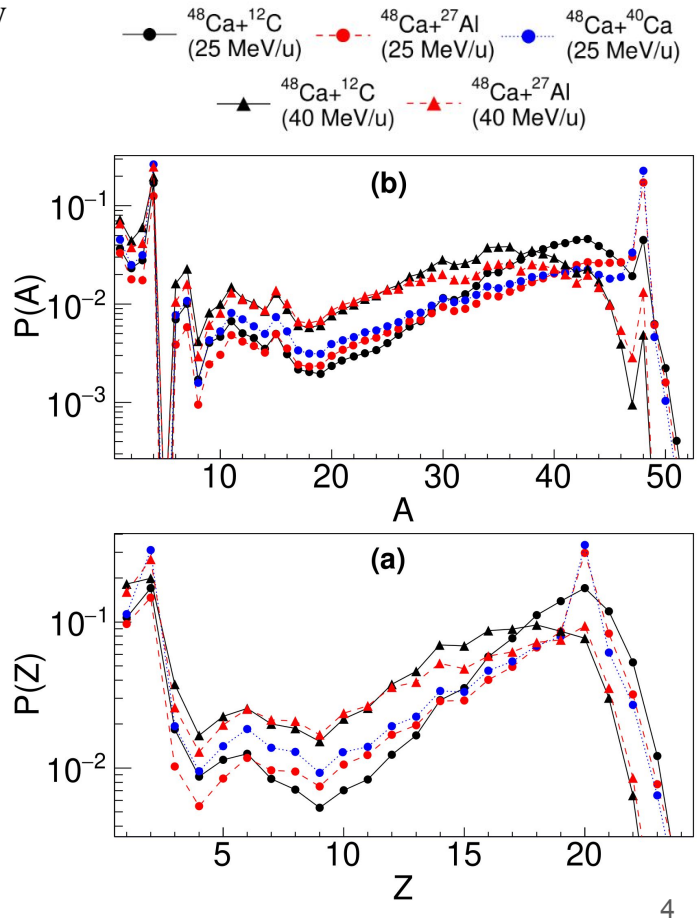
Table 1. FAZIA-PRE experimental details. $^{48}_{20}$Ca projectile on $^{12}_{6}$C, $^{27}_{13}$Al and $^{40}_{20}$Ca targets at 25 and 40 MeV/u beam energies (E_B) along with their corresponding target thicknesses (t), beam velocities (v_B), centre-of-mass velocities (v_{CM}), energies in centre-of-mass (E_{CM}), total isospin of the system ($N/Z_{\mathrm{proj+tar}}$) and grazing angles in laboratory frame (θ_{gr}).

Projectile	$^{48}_{20}$Ca				
E_B [MeV/u]	25			40	
Target	$^{12}_{6}$C	$^{27}_{13}$Al	$^{40}_{20}$Ca	$^{12}_{6}$C	$^{27}_{13}$Al
t [μg/cm^2]	239	216	500	239	216
v_B [cm/ns]	6.8	6.8	6.8	8.5	8.5
v_{CM} [cm/ns]	5.5	4.4	3.8	7.0	5.5
E_{CM} [MeV/u]	4.0	5.7	6.2	6.4	9.2
$N/Z_{\mathrm{proj+tar}}$	1.31	1.27	1.2	1.31	1.27
θ_{gr}	0.9°	1.8°	2.7°	0.5°	1.1°

FAZIA-PRE experiment

Experimental data overview



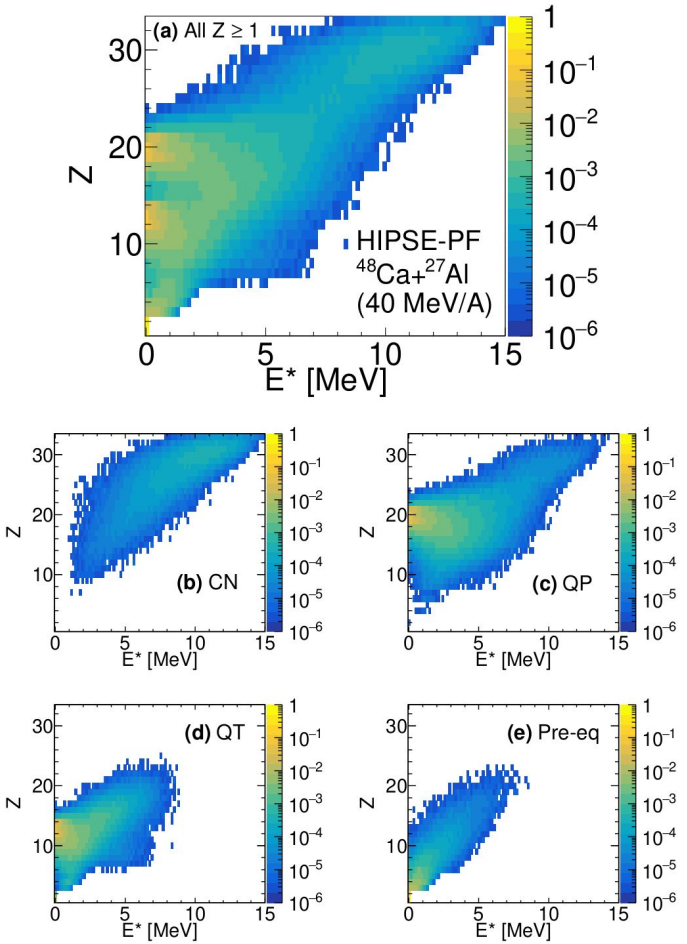


HIPSE Event Generator

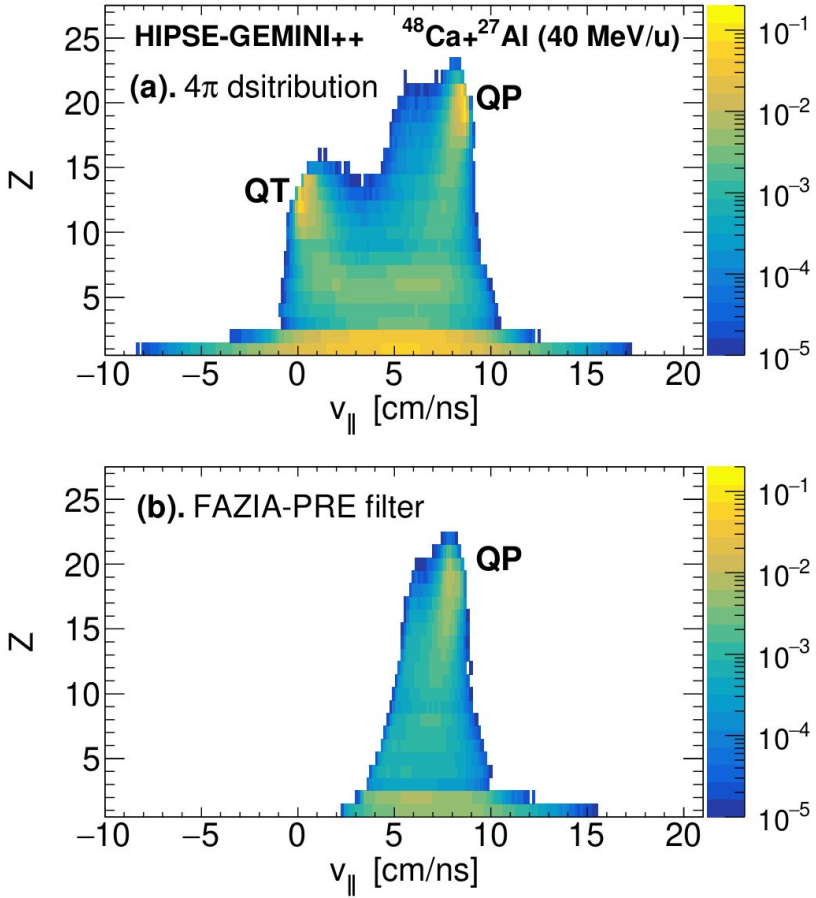
→ The **H**eavy-**I**on **P**hase **S**pace **E**xploration (**HIPSE**) event generator – semi-phenomenological model – can simulate **intermediate energy** nuclear reactions at **all impact parameters** (***b***)

→ The primary fragments (**HIPSE-PF**) generated by HIPSE have **well-defined excitation energies** (***E****)

→ HIPSE data can be split according to the emission source of each fragment, namely: Pre-equilibrium (**Pre-eq**), quasi-projectile (**QP**), quasi-target (**QT**) and fusion-like fragments (**CN**).

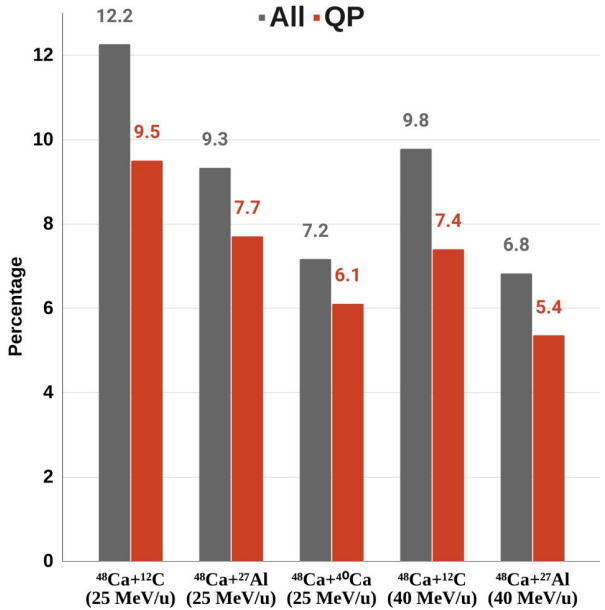


HIPSE Event Generator



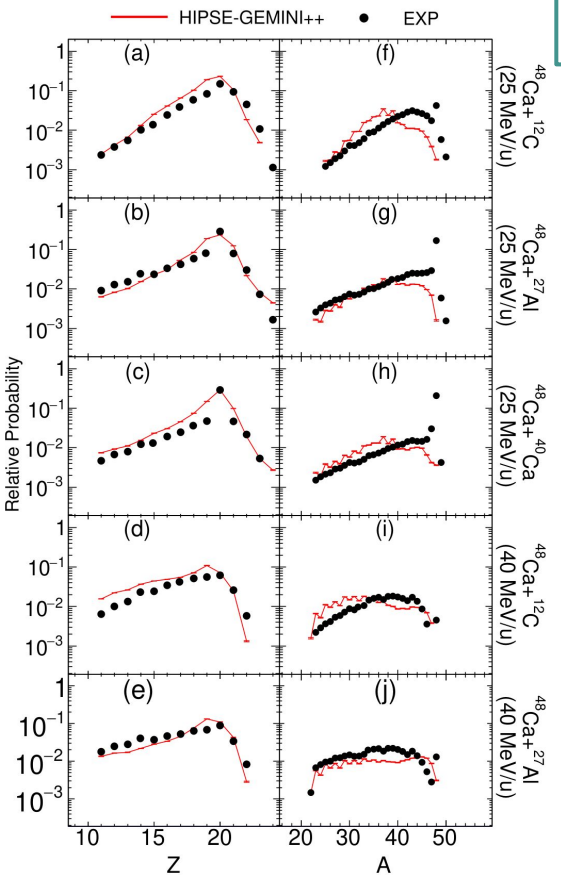
→ For comparison, **experimental conditions applied on HIPSE simulations**

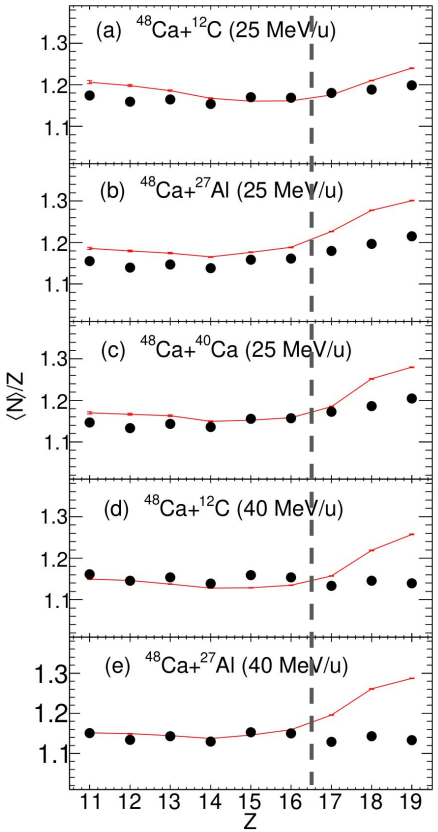
→ According to the model, most of the detected ejecta (**>70% overall**) are **QP fragments**.

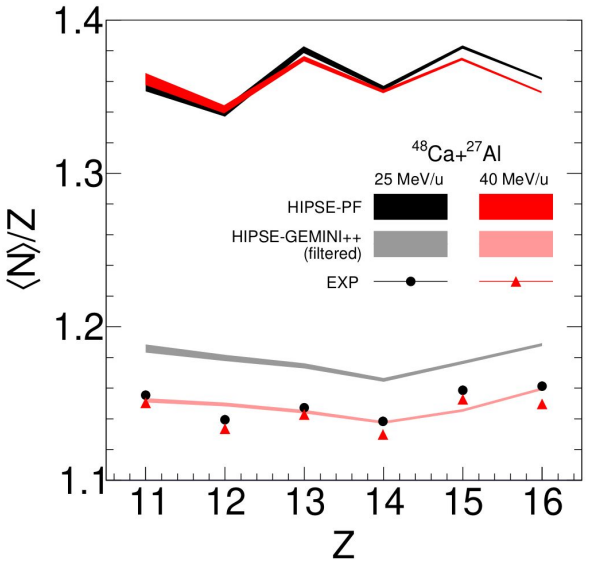


Data comparison

→ Extracting QP fragment:
QP-cut → **Z>10** ; **Multiplicity = 1**







→ **Entrance channel** rather well described by HIPSE – **variation of beam energy** studied (^{48}Ca at 25 and 40 MeV/u)

→ **Not for ^{40}Ca and ^{12}C systems**

Result and conclusion

→ Idea of increasing neutron pre-equilibrium emissions with beam energy **is not excluded but cannot be confirmed**.

→ There are **multiple effects under consideration** that alter the fragment ⟨N⟩/Z; therefore it is a **difficult task for the models**, and also for HIPSE, **to accurately describe** all those effects.

→ From the results, it can be concluded that **HIPSE has proved to be a fine tool to generate the fragments** in nuclear reactions at intermediate energy range and **satisfactorily describe the basic reaction dynamics**.

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