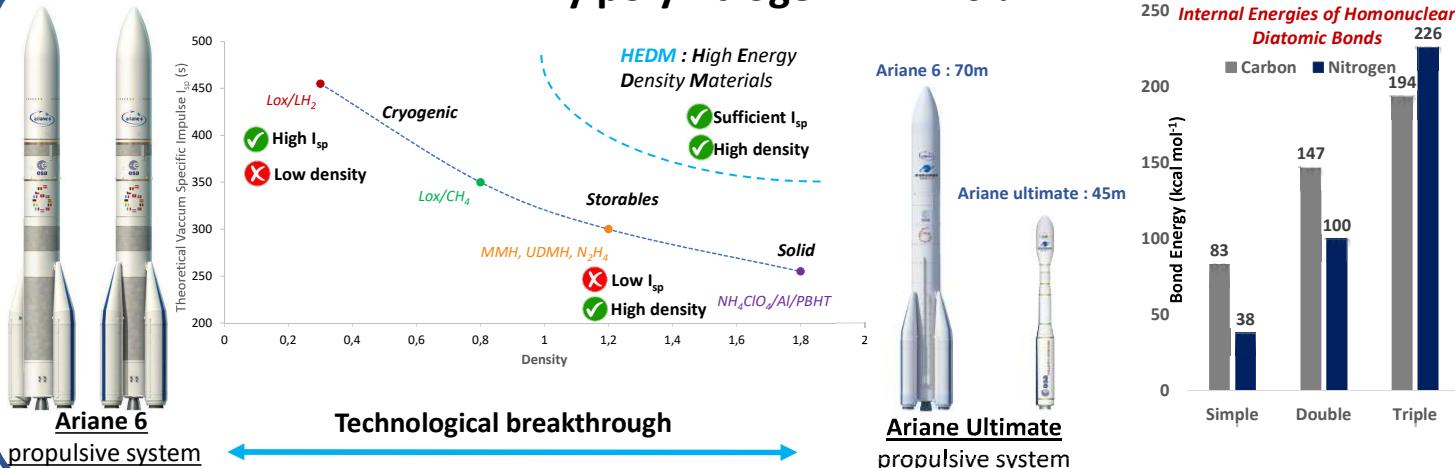


Future of space propulsion: toward Polynitrogen High Energy Density Materials

Chayma Ben Maamer^{1,2} (chayma.ben-maamer@univ-lyon1.fr), Pierre Cavalere^{1,2} Jennifer Lesage De La Haye^{2,3}, François Liger^{2,3}, Emmanuel Lacôte^{1,3}, Achraf Dyan²
 Université Claude Bernard Lyon 1, LHCEP¹, Centre National d'Etudes Spatiales² (CNES), Centre National de la Recherche Scientifique (CNRS)³

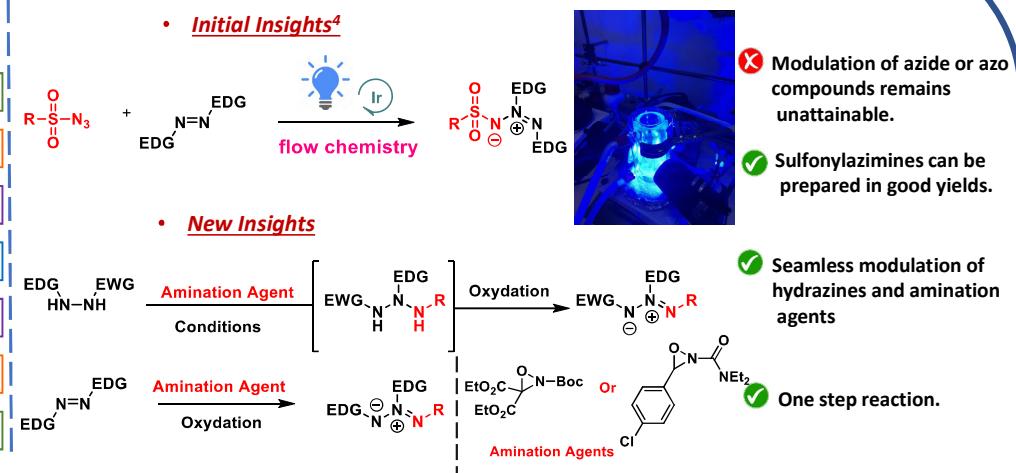
Why polynitrogen HEDMs ?



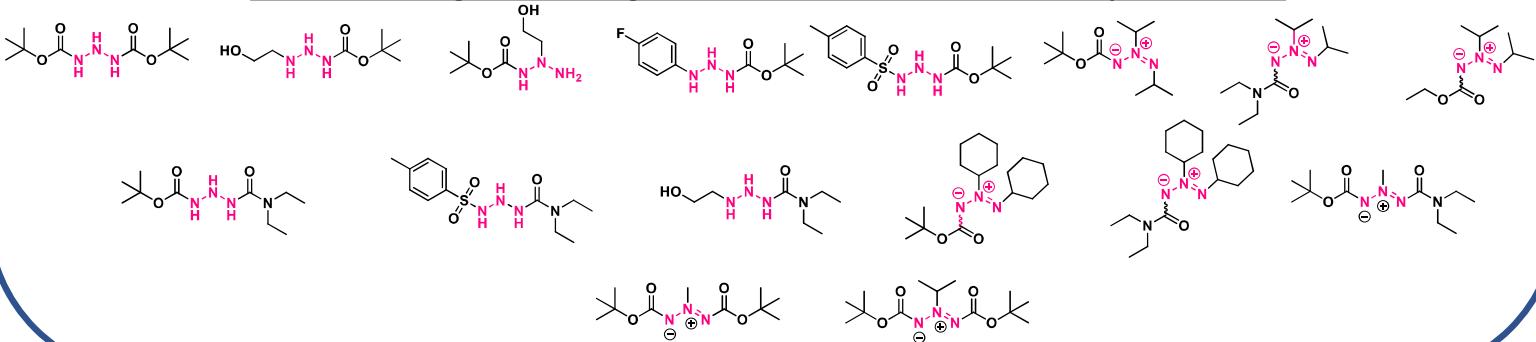
CNES Principal Innovative Vector

- Lower toxicity with N₂ and H₂ ejection gases
- Monoergol
- Cheapest and simplest reignitable rocket engine
- Small launcher by constructive Index
- Fully-decarbonated cyclic poly-nitrogen HEDM
- High density and I_{sp} , storables
- Single Stage To Orbit
- Decomposition not combustion

Pathways to High-Energy Density Materials: Key Components



Potential Building Blocks: Nitrogen-Rich Molecules as Precursors to Polyazotic HEDMs



HEDMs are required for greener, safer, smaller, reusable and more efficient launchers → **Technical breakthrough**.

HEDMs chemistry of polynitrogen compounds is very complex and difficult → **Poor literature data for reactivity**.
 → **Lots of by-products, instability of reactants and products**.

HEDMs are key for the future of space propulsion and space exploration → **Global competitive challenge for space agencies**.