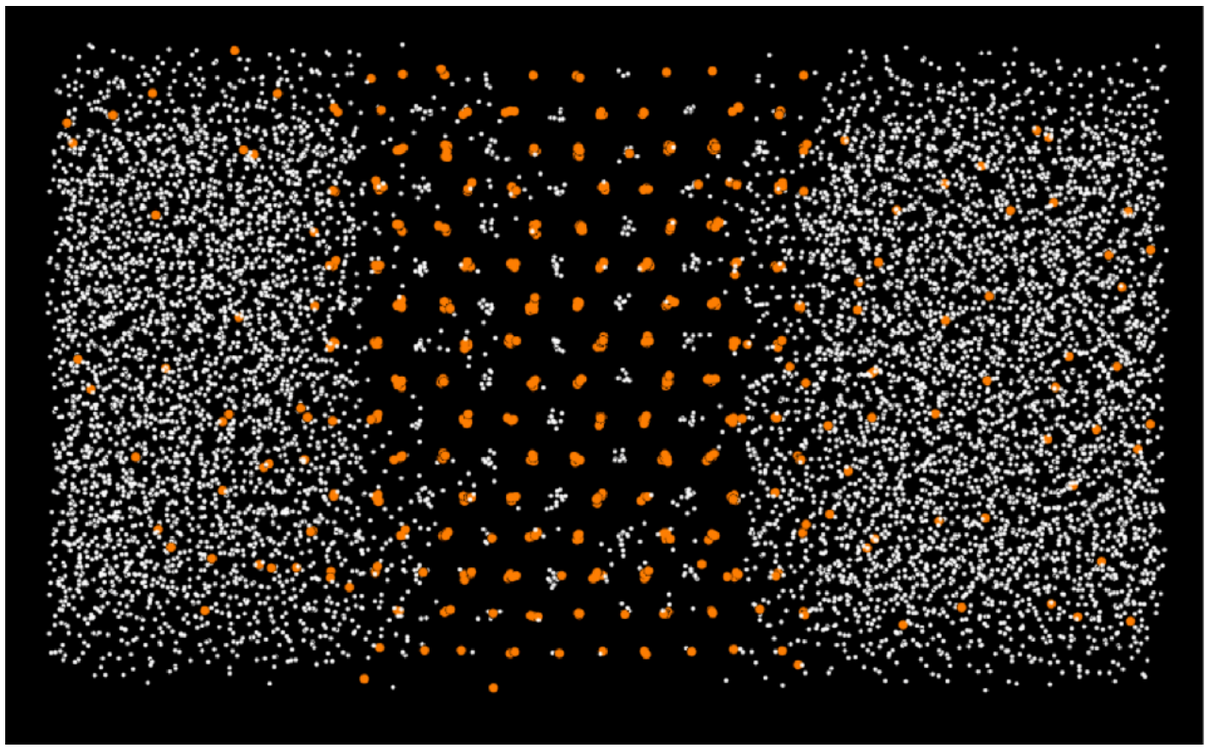
# Supernovae Ignited by Nuclear Fission

U.S. DEPARTMENT OF ENERGY | Office of Science

NUCLEI Nuclear Computational Low-Energy Initiative

## *Objectives*

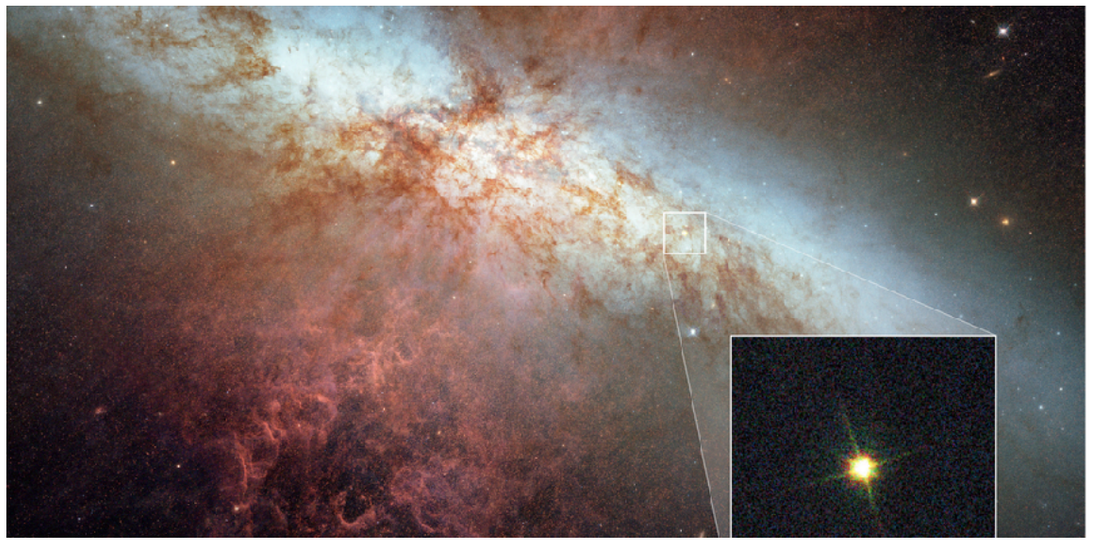
- Type 1A supernovae (SNIa) are giant stellar explosions that have been used to make the Noble Prize-winning discovery of the acceleration of the universe. SNIa are thought to involve white dwarf stars but it is unclear how they explode. We propose and explore a new supernova mechanism involving a natural nuclear fission explosion.



Molecular dynamics simulation of a potentially dangerous uranium rich crystal forming in a cooling white dwarf star. Uranium nuclei are orange, while carbon and oxygen nuclei are white. This crystal may become critical and support a fission chain reaction.

## *Impact*

- Our development of a completely new supernova mechanism can produce SNIa in single isolated white dwarf stars. This can explain observations of SN remnants that fail to find a companion star.
- Our SN mechanism may help explain which stars are likely to explode and may ultimately clarify and limit systematic biases in using SNIa for cosmology including the determination of the Hubble constant.



Hubble image of SN2014J (insert) in galaxy M82

## *Accomplishments*

- First molecular dynamics simulations of crystallization of highly charged impurities in cooling white dwarfs.
- Phys. Rev. Lett. 126, 131101 (2021) Editors' suggestion.
- Featured in Science, Physics, Phys.org, ScienceNews, LiveScience, Space.com, etc.