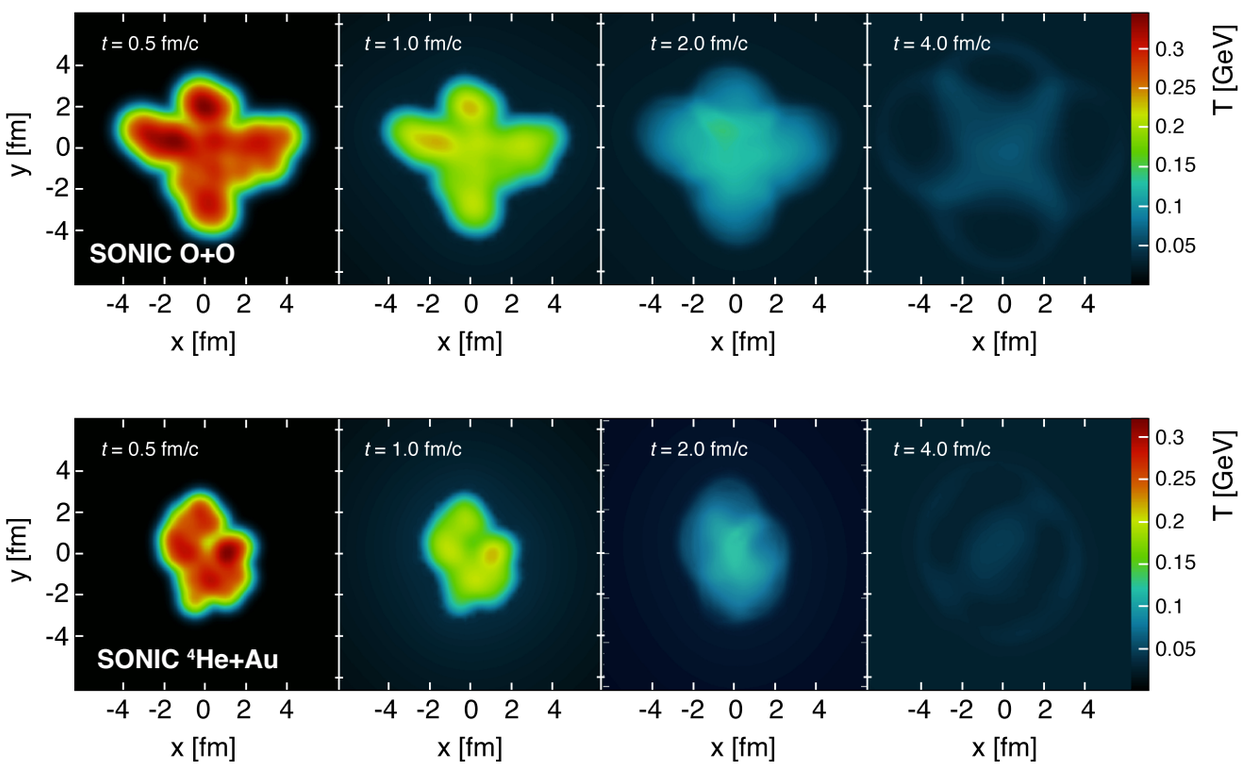
Exploring new small system geometries in heavy ion collisions

U.S. DEPARTMENT OF ENERGY | Office of Science

NUCLEI Nuclear Computational Low-Energy Initiative

Objectives

- We explore various new collision geometries in the context of the publicly available hydrodynamic model SONIC.
- We incorporate full *A*-nucleon configurations for ^{4}He, ^{12}C, and ^{16}O obtained from quantum Monte Carlo calculations with realistic nuclear potentials, and use a Monte Carlo Glauber calculation for the initial conditions.



Time evolution of a O+O event (top panel) and ^{4}He+Au event (bottom panel) from SONIC. The color scale indicates the local temperature.

Impact

- New collision geometries are investigated, with particular focus on p+O and O+O, proposed for running at the Large Hadron Collider (LHC), as well as ^{4}He+Au, C+Au, O+Au, and ^{7,9}Be+Au, proposed for running at the Relativistic Heavy Ion Collider (RHIC).
- Hydrodynamic calculations with SONIC indicate flow anisotropies that approximately scale with initial eccentricities, and have an additional dependence on the compactness of the initial geometry (the more compact the source, the larger the flow).
- The comparison between the nucleon distributions obtained from the full 16-nucleon configurations in oxygen and from the α-cluster tetrahedron model shows significant changes in both p+O and O+O events, suggesting that the new experimental data at LHC should easily be able to discriminate the two cases.

Accomplishments

S. H. Lim, J. Carlson, C. Loizides, D. Lonardoni, J. E. Lynn, J. L. Nagle, J. D. Orjuela Koop, and J. Ouellette, Phys. Rev. C 99, 044904 (2019)