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Universidad del País Vasco

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ZTF-FCT

CHASING MONOPOLES

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OUTLINE

- Global Monopole Networks
- Velocities
- Results
- Applications

GLOBAL MONOPOLES

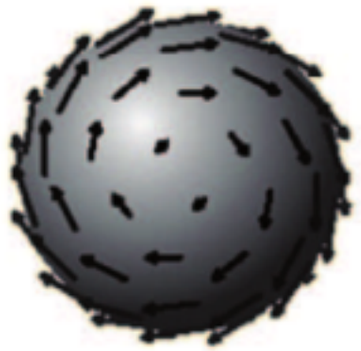
$$\mathcal{S} = \int d^4x \left[\frac{1}{2} \partial\mu\Phi^i \partial^\mu \Phi^i - \frac{\lambda}{4}(|\Phi|^2 - \eta^2)^2 \right]$$

$$i = 1, 2, 3; \quad |\Phi| \equiv \sqrt{\Phi^i \Phi^i}$$

- O(3) symmetry spontaneously broken to O(2)

- Topological charge can be used to detect monopoles

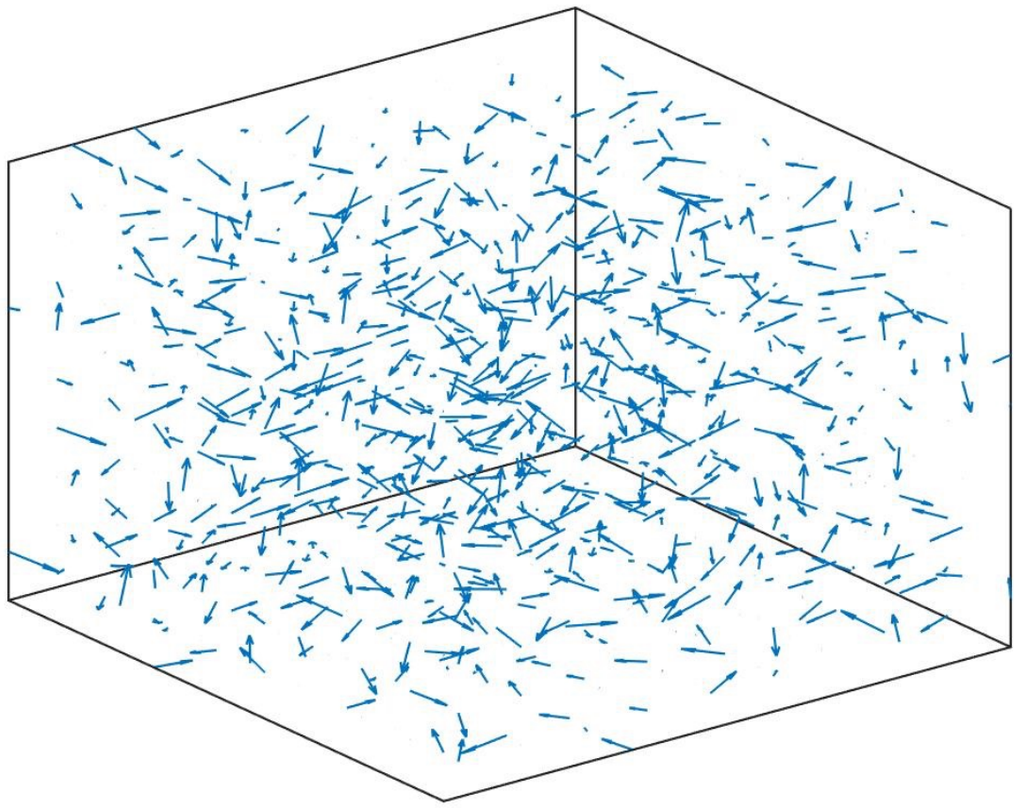
$$N = \frac{1}{8\pi} \oint dS^{ij} |\Phi|^{-3} \epsilon_{abc} \Phi^a \partial_i \Phi^b \partial_j \Phi^c$$



FIELD THEORY SIMULATIONS

- 2048^3 lattices in radiation and matter eras in expanding universe

- Discretised e.o.m. are evolved in the lattice



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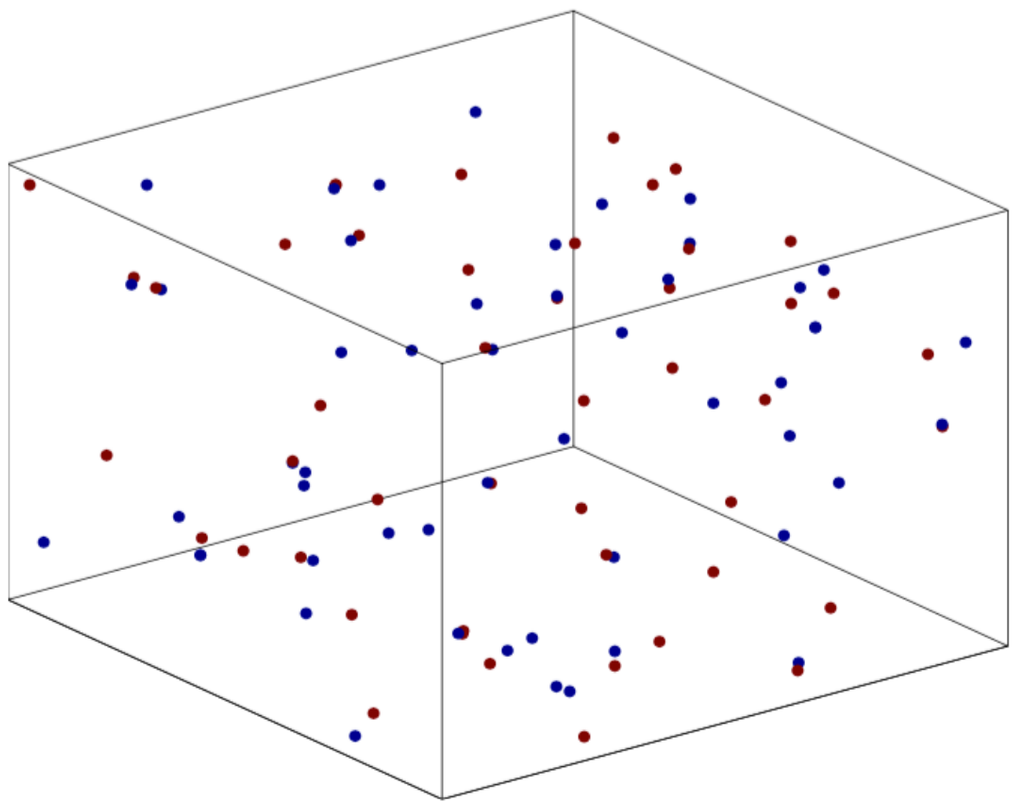


VELOCITIES

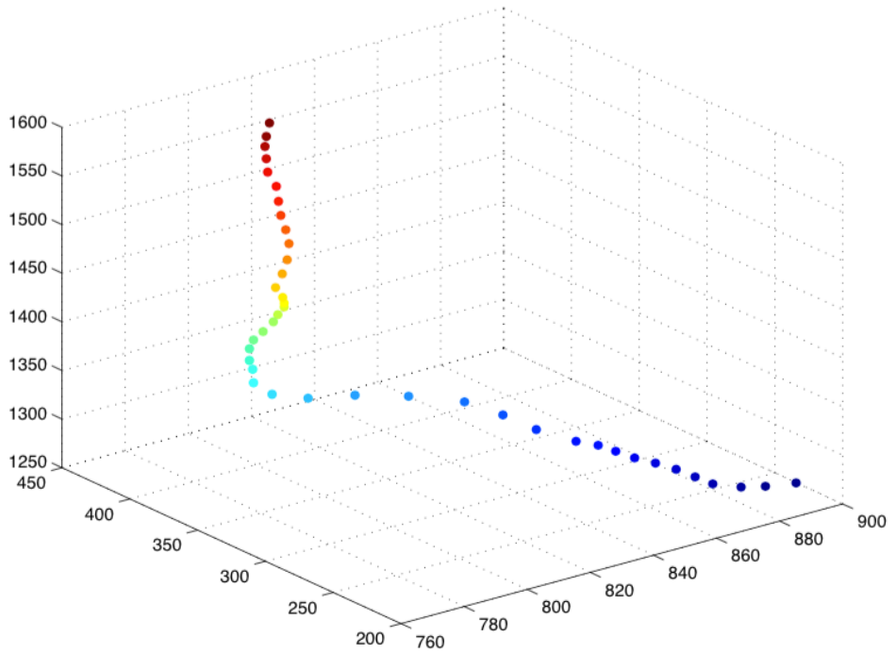
- Averaging method:

  Stuckey et al. 10.1103/PhysRevD.79.123504 arXiv:0812.1929

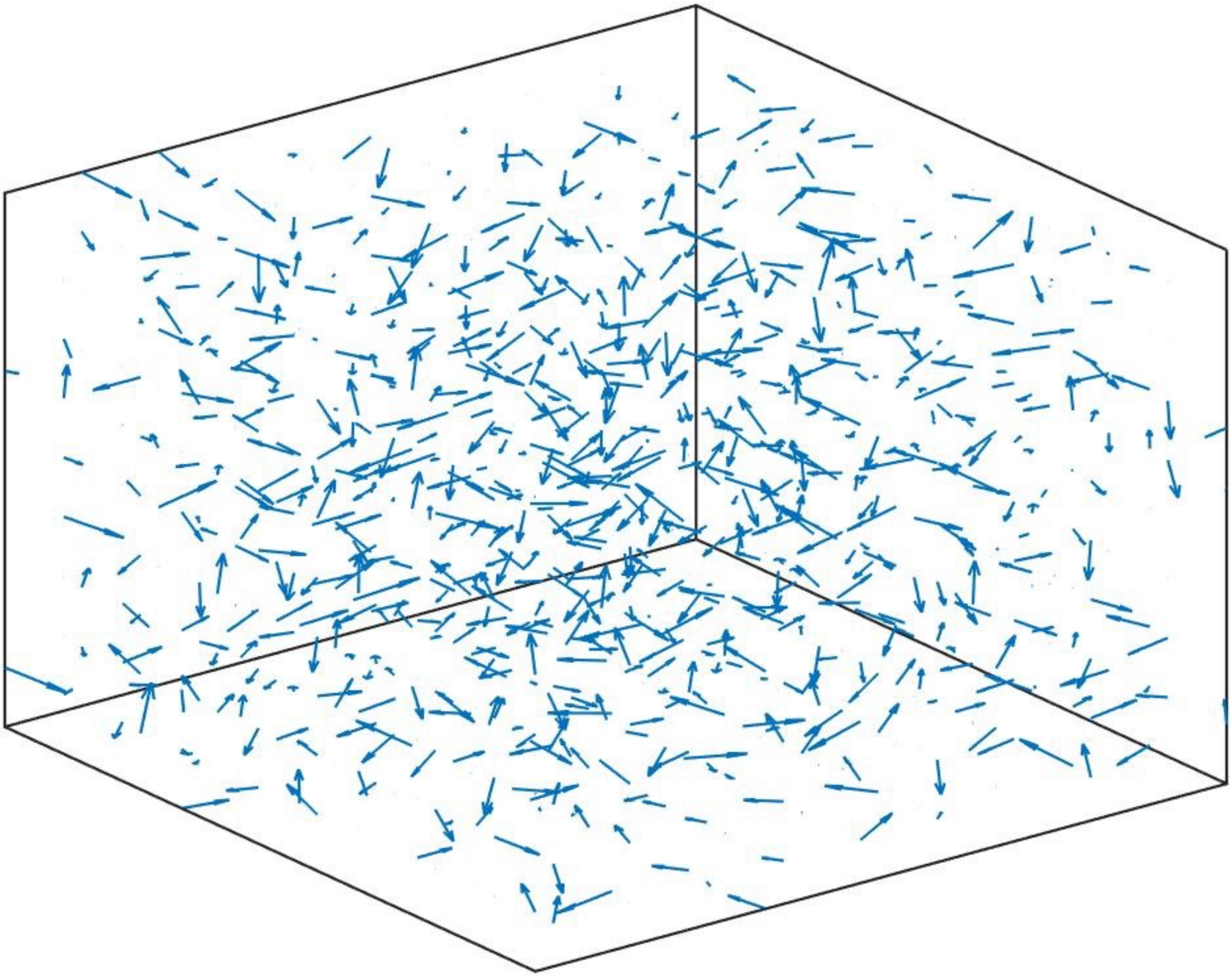
$$\gamma^2 \langle \dot{x}^2 \rangle = \frac{(\Pi^i)^2}{(\partial \Phi^i)^2}$$

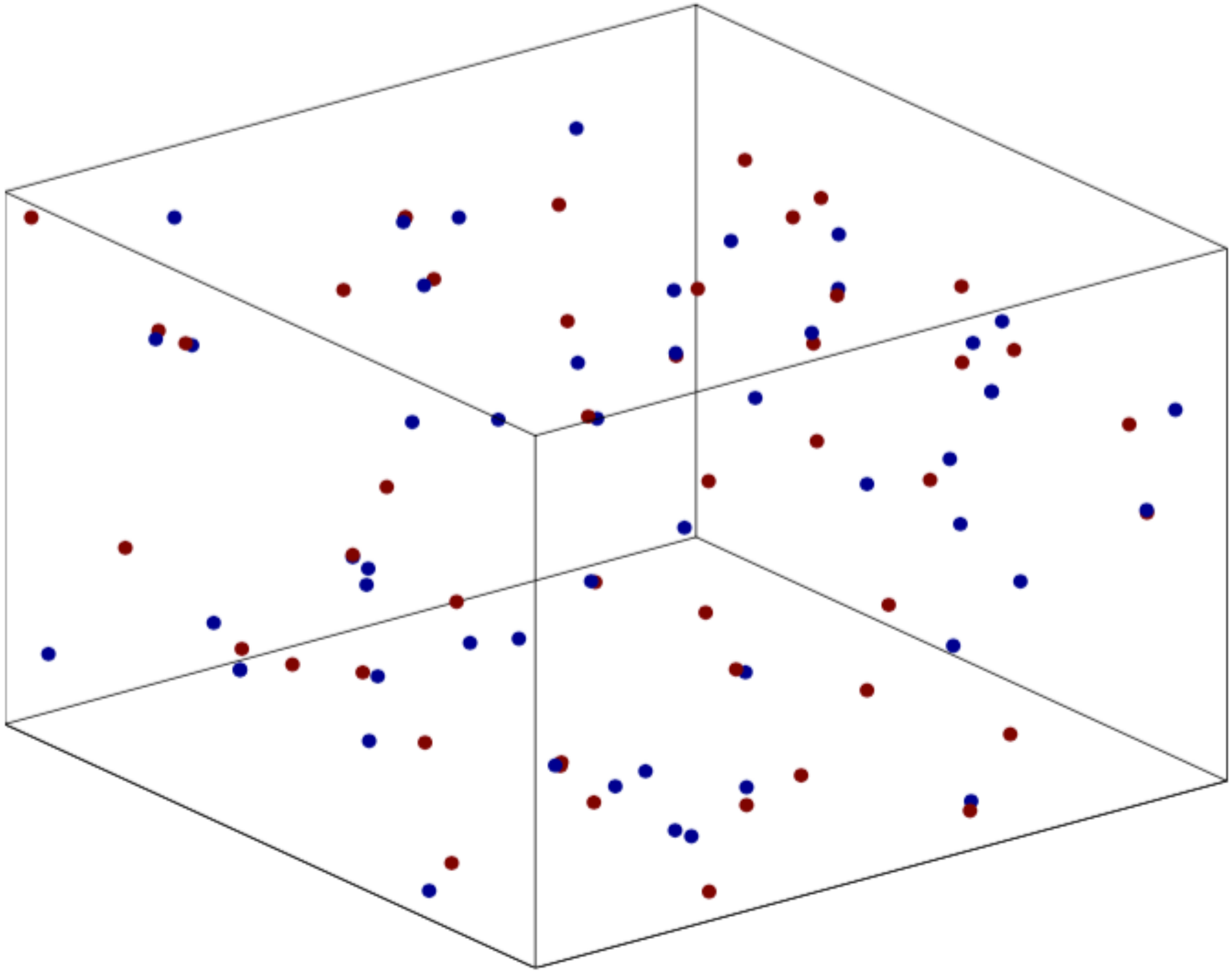
$$\Pi^i = \dot{\Phi}^i \quad \partial \Phi^i = \frac{\partial \Phi^i}{\partial \vec{x}}$$

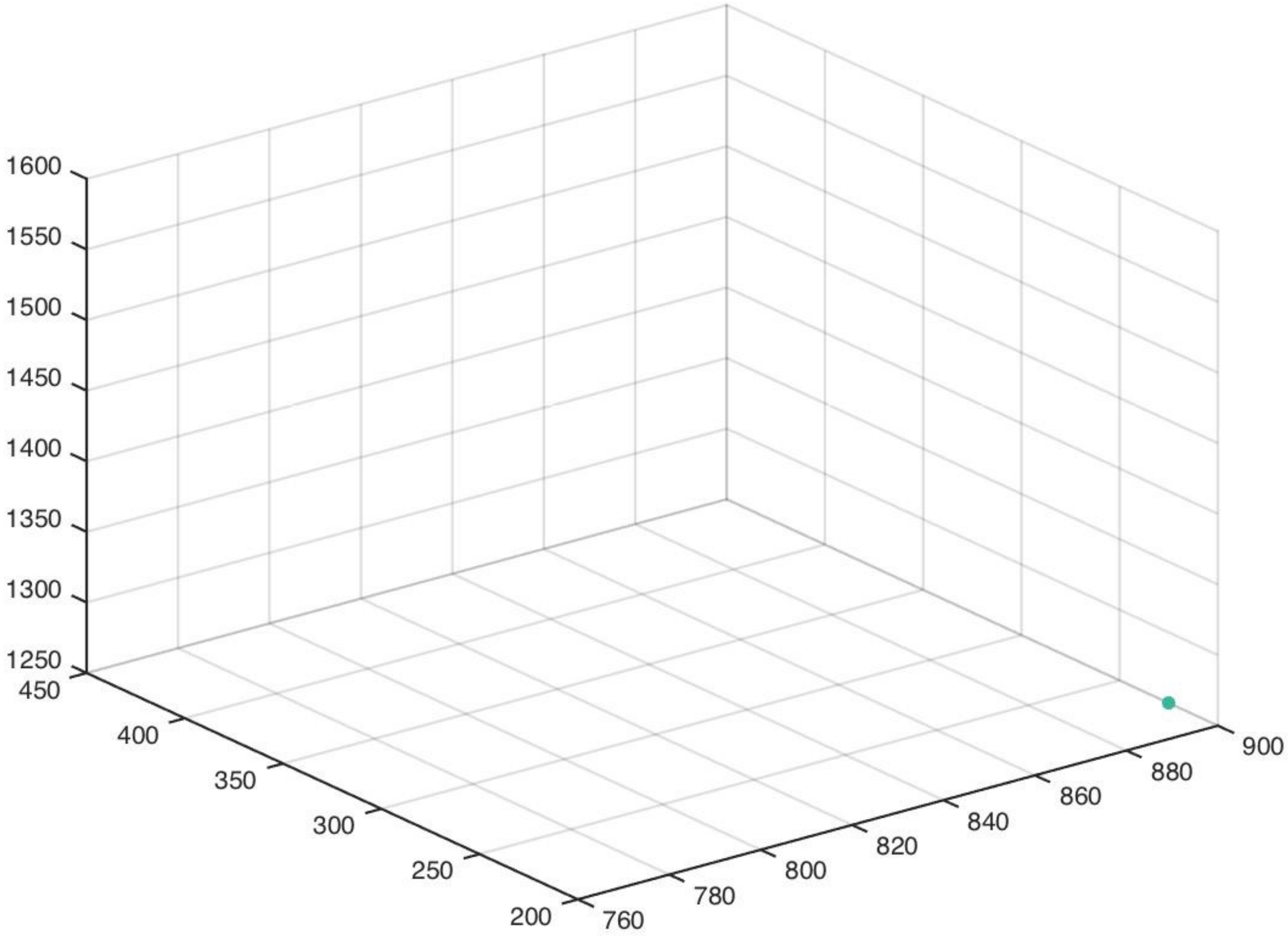
- Monopole tracking method:



$$v_m = \frac{\Delta d}{\Delta t}$$



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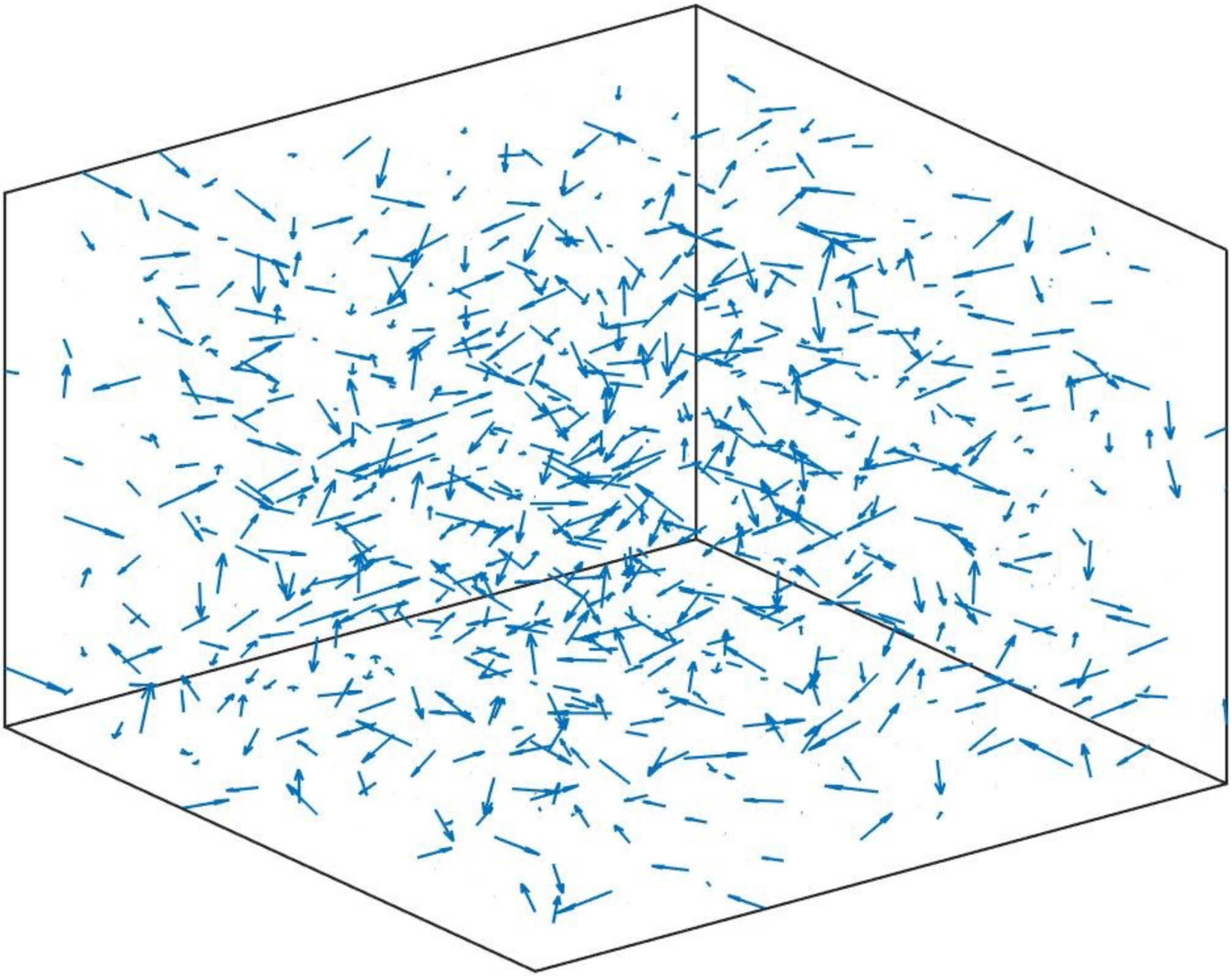

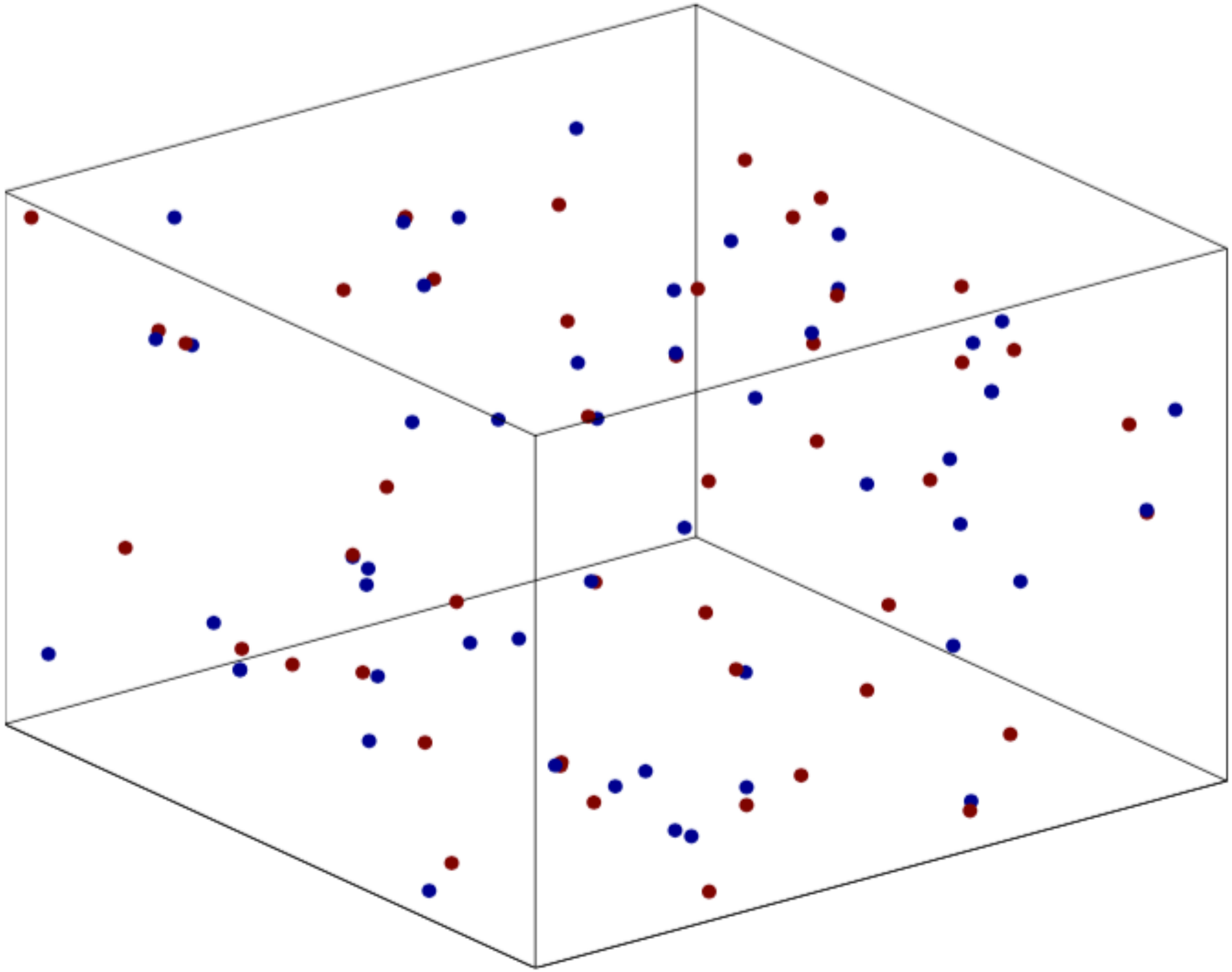

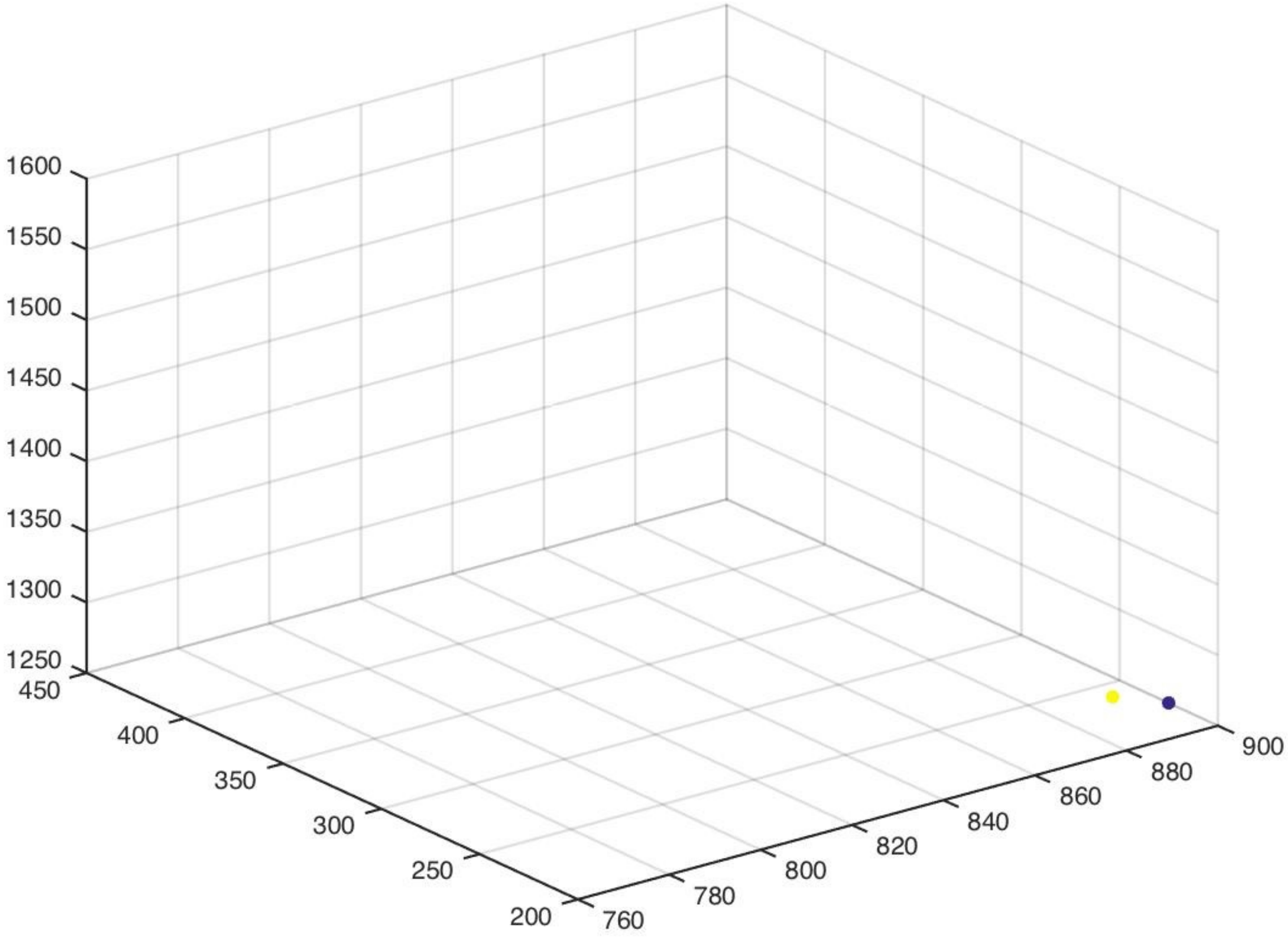
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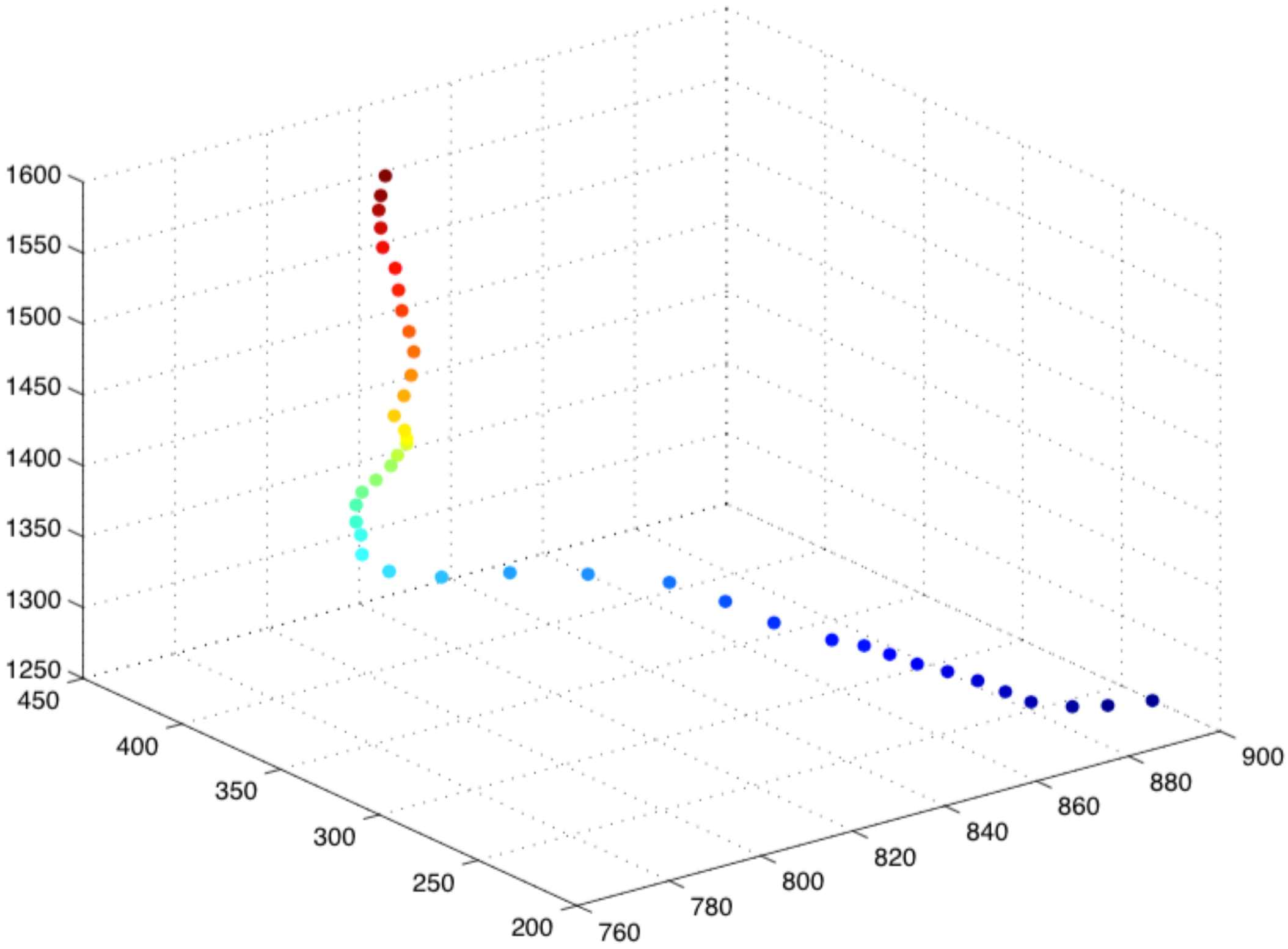
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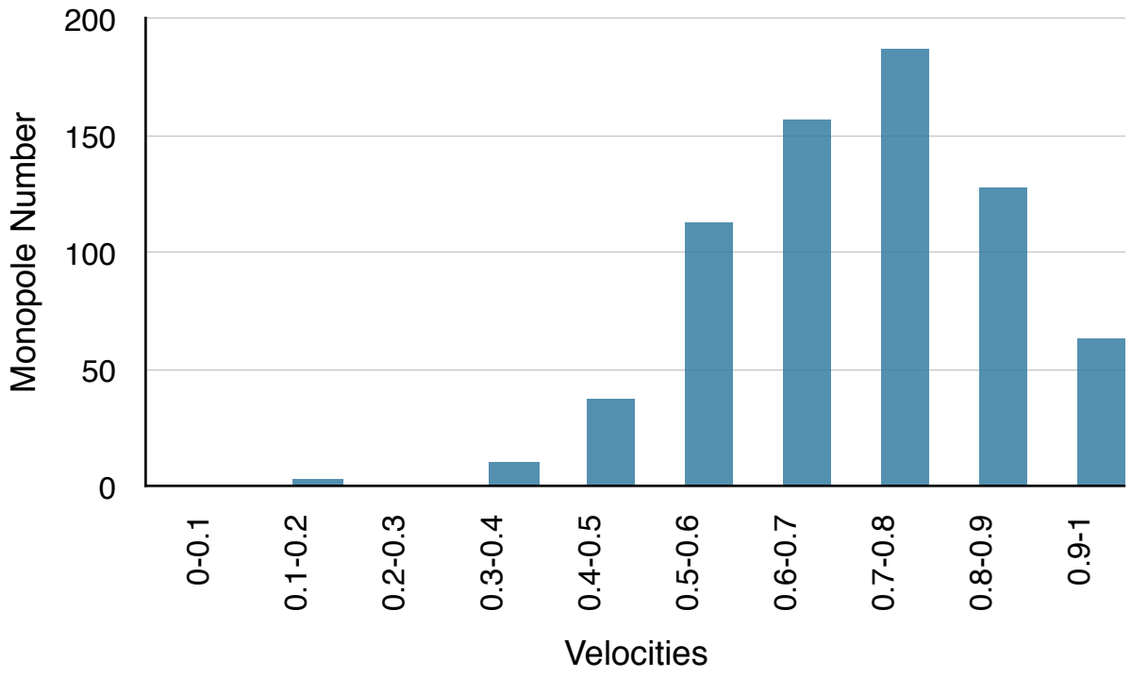
RESULTS



	Track	Averaging
Radiation	0.704±0.002	0.702±0.001
Matter	0.619±0.002	0.64±0.02

- Overall network velocity can be computed
- The history of each monopole can be followed:
  - Instantaneous velocities
  - Much more information than average network properties
- Our new method confirms the validity of the Averaging method
- The monopole network properties have been characterised better

APPLICATIONS

- Our results are necessary to calibrate parameters of analytic models:

- Global Monopoles

- Semilocal Strings:

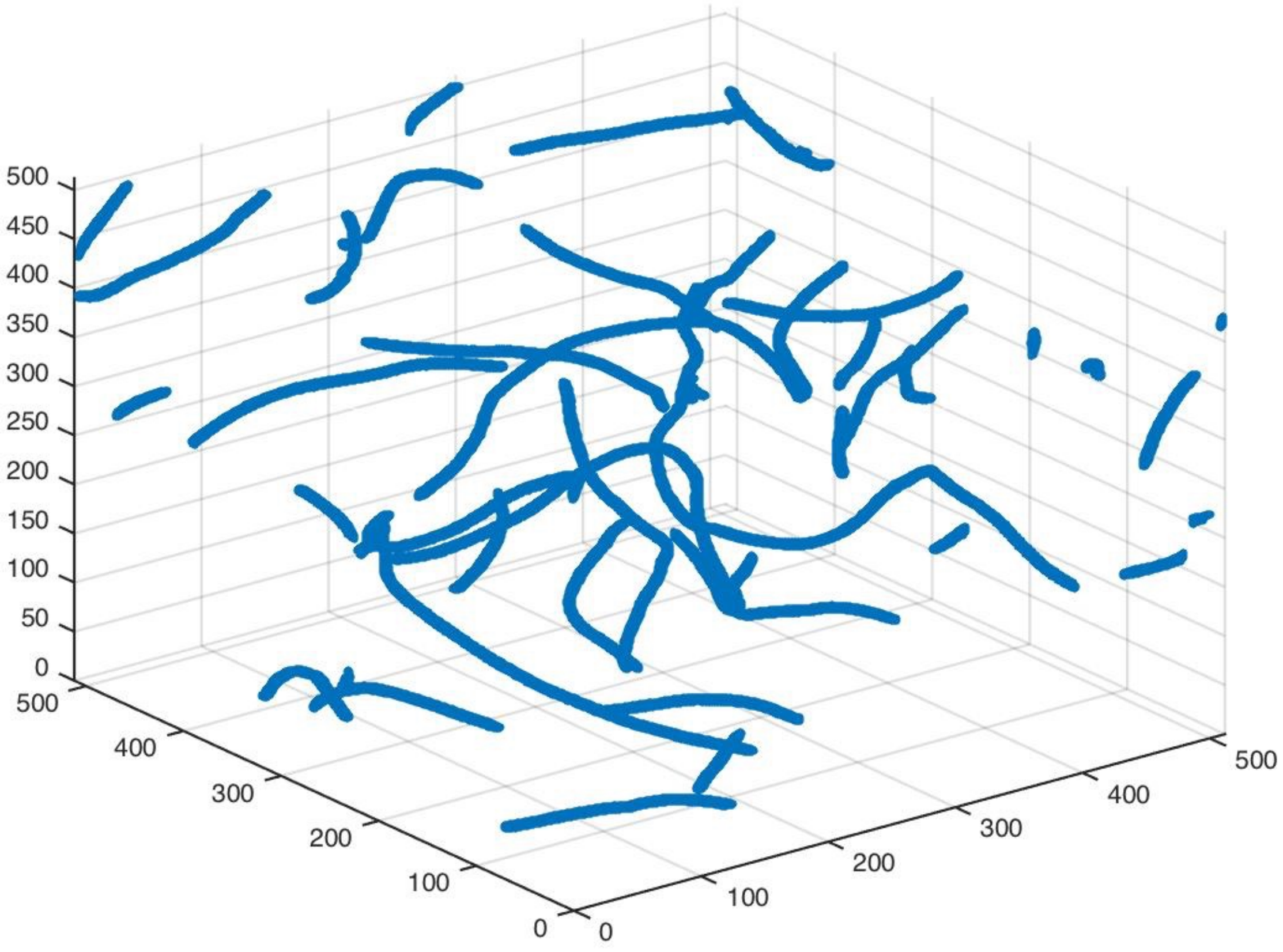
Achúcarro, Avgoustidis, Leite, ALE, Martins, Nunes and Urrestilla

-arXiv:1312.2123 10.1103/PhysRevD.89.063503

-arXiv: 15MM.XXXX

-arXiv:15MM.XXX

THANK YOU!!!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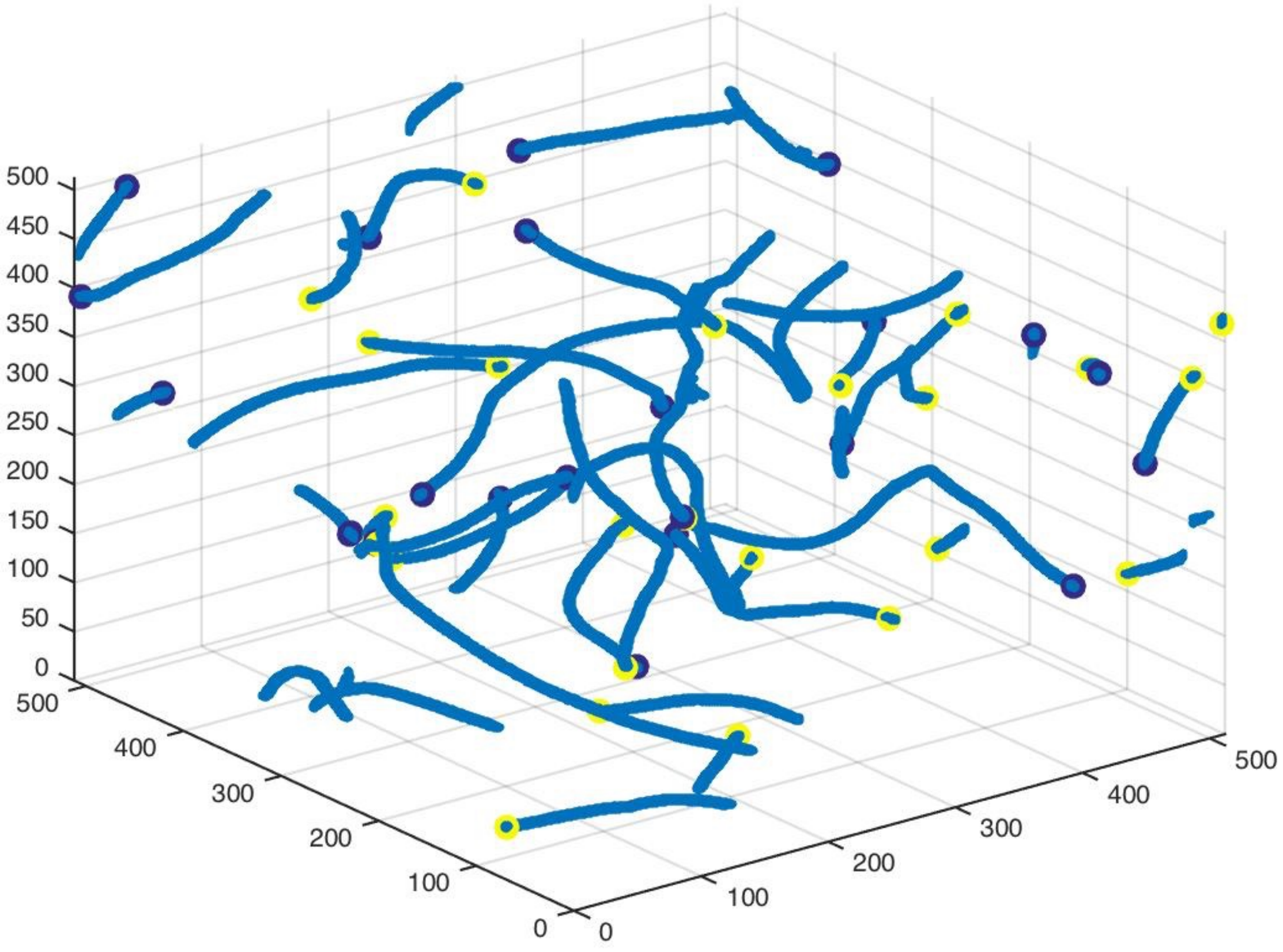
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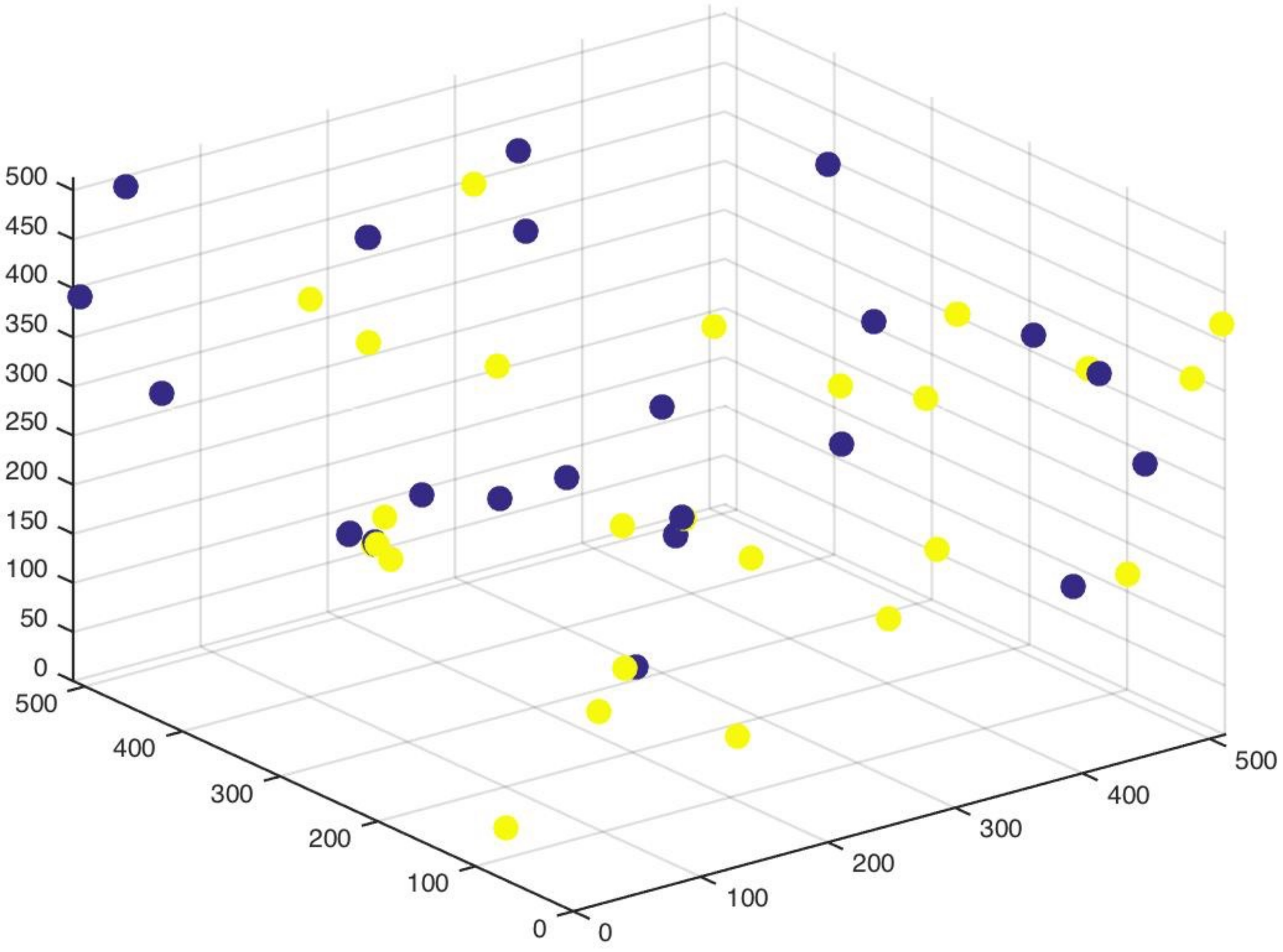
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