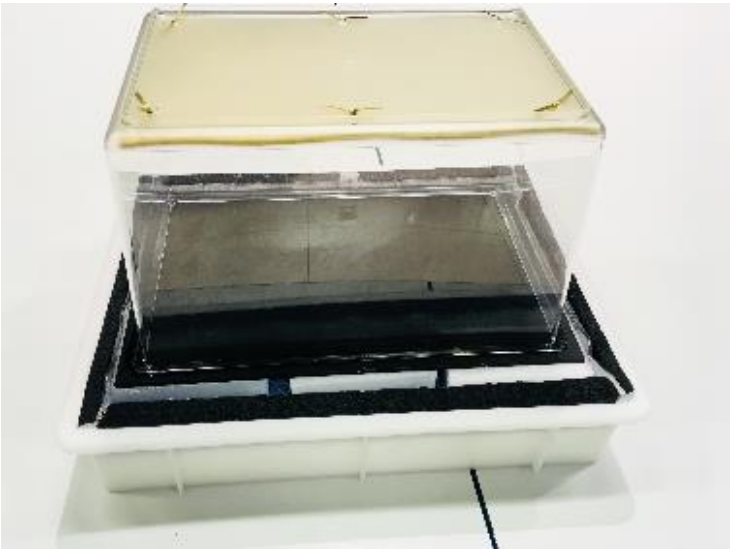

# CERN Ideasquare

Activity Night

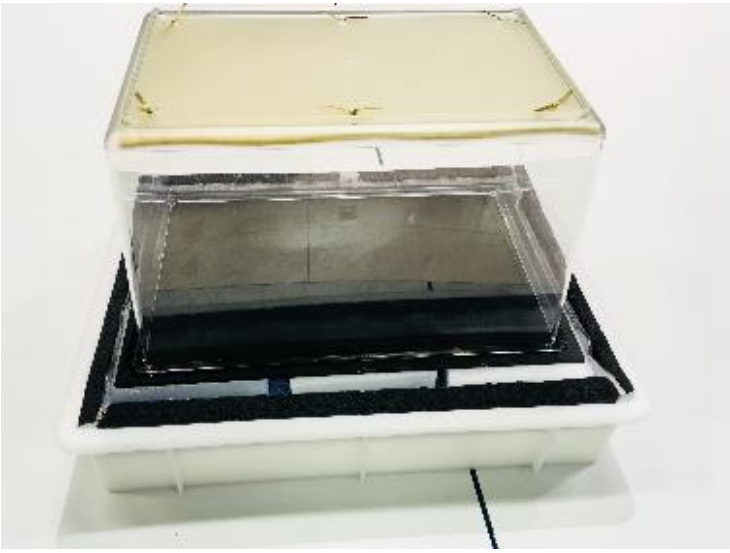
# Program for the evening 1/2

- Put together two different kinds of particle detectors
  1. Assemblying a MuonHunter – a coincidence detector
     - Open source kit for learning about particle physics, detector design, electronics and programming. Project started in 2014, hardware currently in revision 3.
  2. Assemblying a cloud chamber – an “analog” detector
     - Widely used for educational purposes to learn about the presence of charged particles all around us.

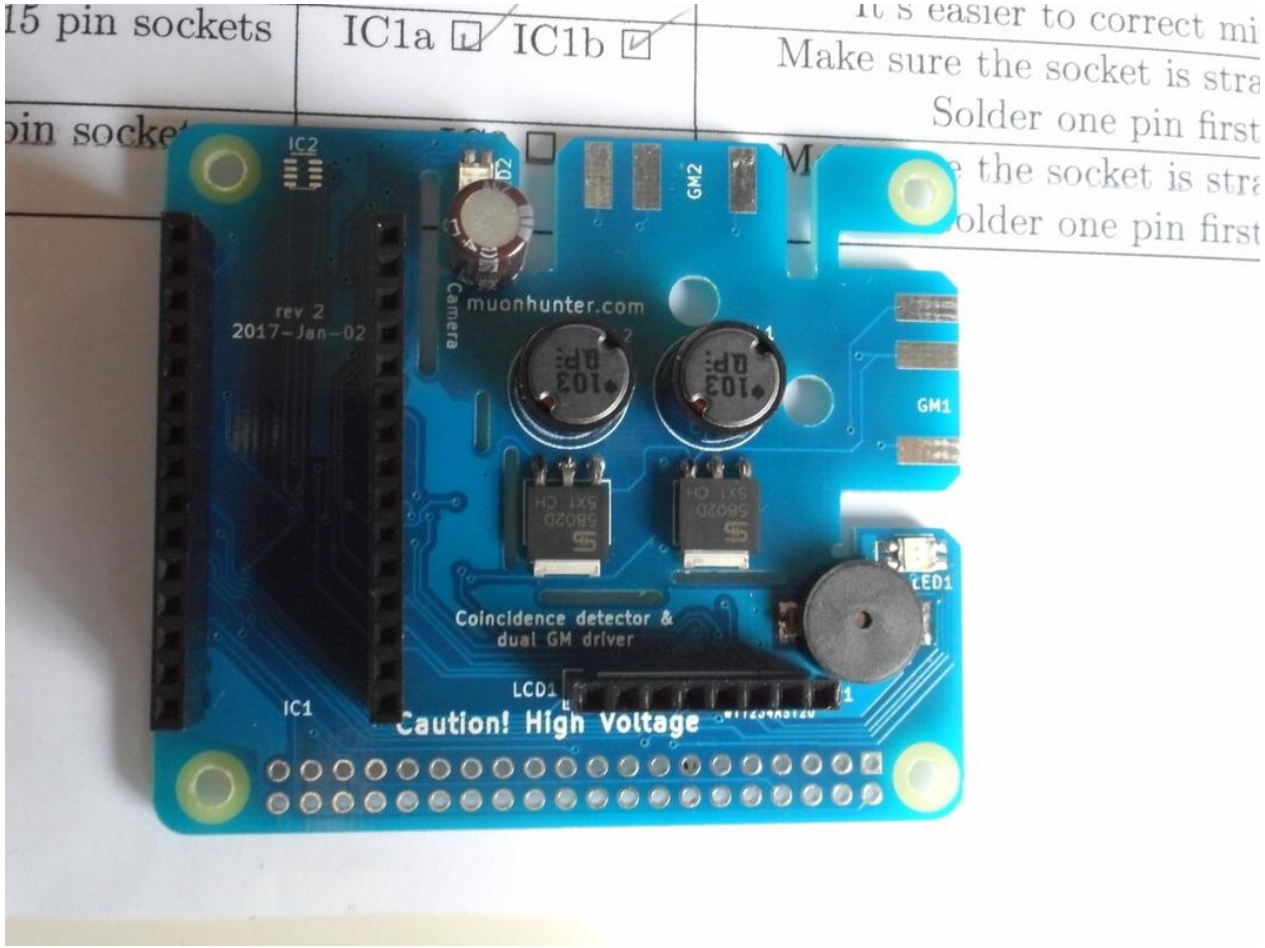


# Program for the evening 2/2

- If time allows:
  3. Putting these two detectors together, to form a „hybrid“ detector
     - To take photos of the tracks of charged particles, in a (distantly) similar manner than is done with the large detector experiments at CERN (in a miniature, slightly less accurate way).



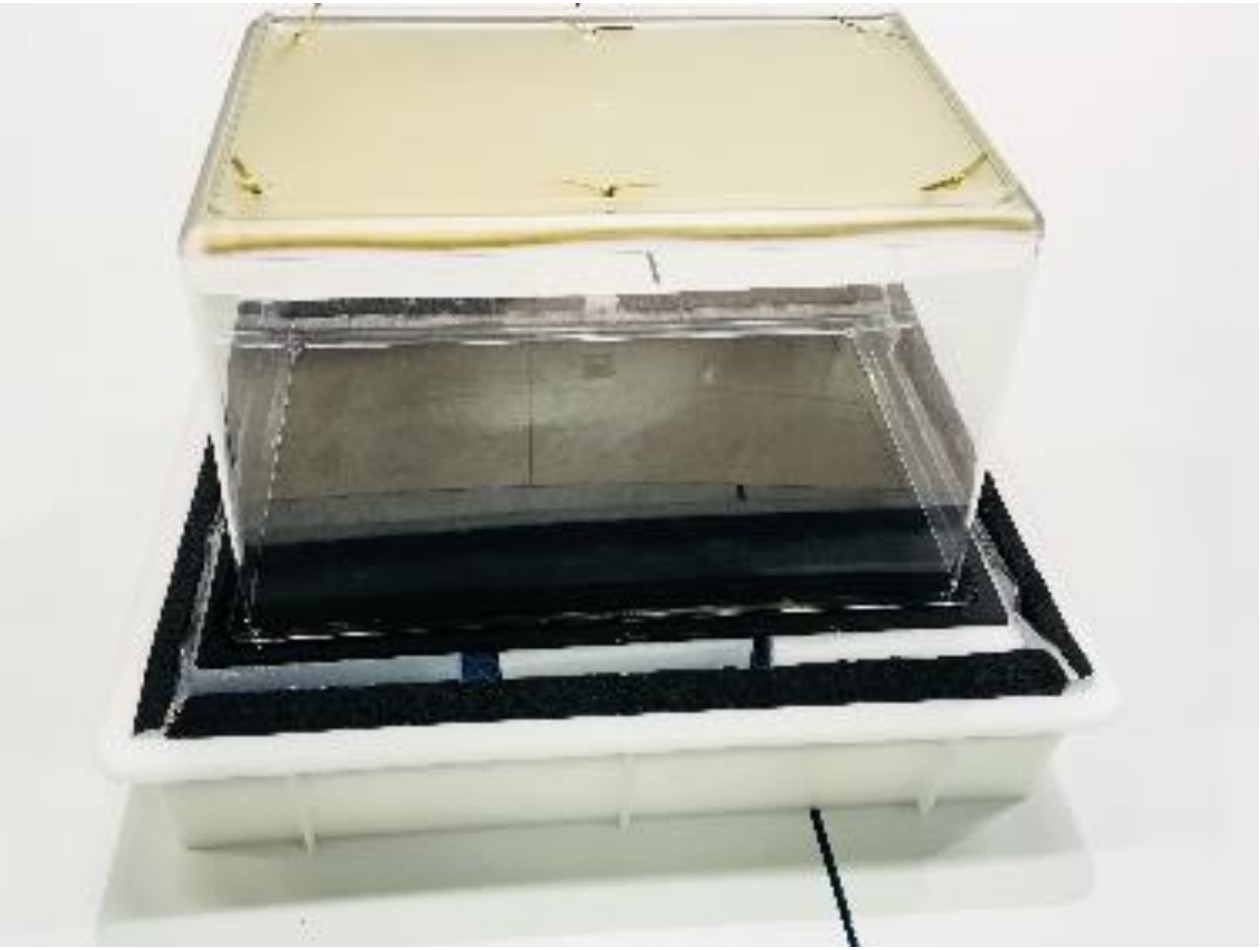
# MuonHunter assembly & test



# Assembly and observation tasks!

- Observe your MuonHunter
- Test whether different positioning angles effect coincidence detection frequency.
- Test whether spacing between GM counters have an effect on coincidence detection frequency.
- Assemble a MuonHunter “selfie machine” (i.e. take a photo of the MuonHunter when coincidence detected (leds flash)

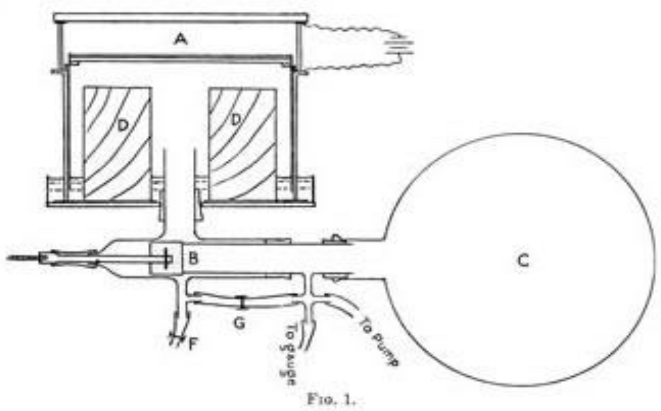
# Cloud chamber assembly & observation



# Cloud Chambers - History

## Charles T. R. Wilson (1869 - 1959)

This Scottish physicist perfected the first (expansion) cloud chamber in 1911 and received the Nobel Prize in 1927.

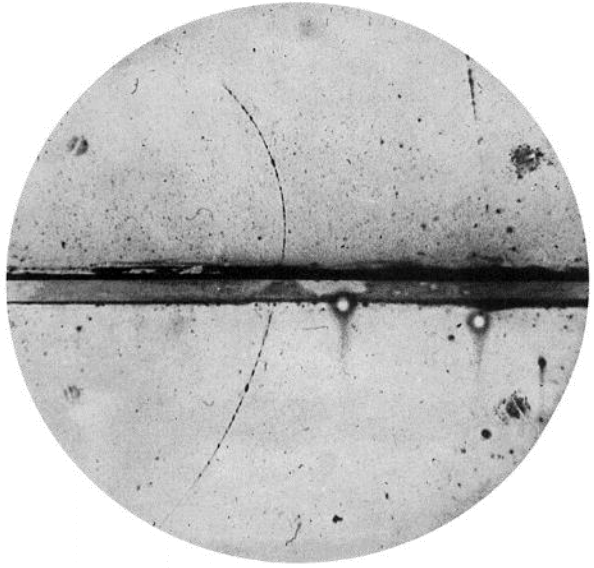



A diagram of Wilson's apparatus. The cylindrical cloud chamber ('A') is 16.5cm across by 3.4cm deep.

*C. T. R. WILSON: On an Expansion Apparatus for Making Visible the Tracks of Ionising Particles in Gases and Some Results Obtained by Its Use. Proc. R. Soc. Lond. A. 1912 87 277-292 DOI:10.1098/rspa.1912.0081*

## Carl Anderson (1905 - 1991)

This physicist discovered the positron in 1932 and the muon in 1936 using a cloud chamber. He received the Nobel Prize in 1936.

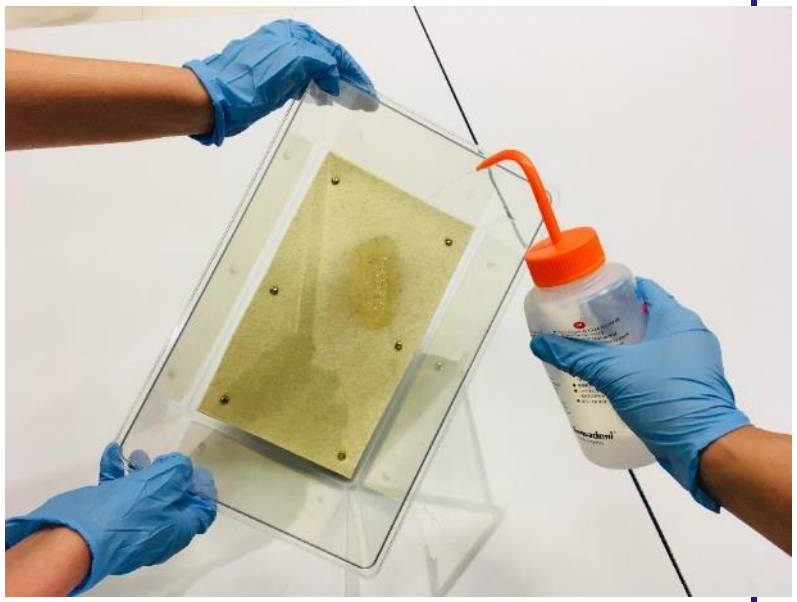


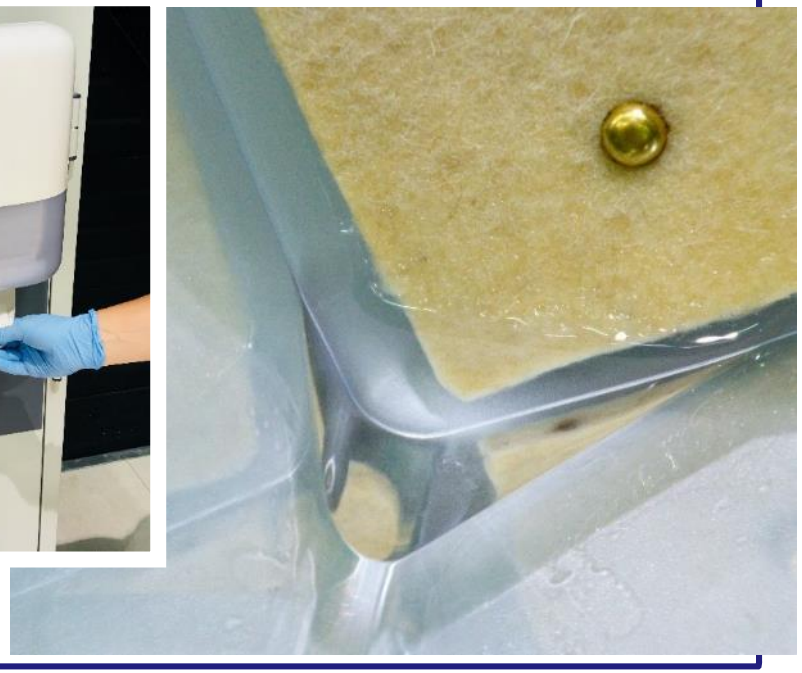
*Carl D. Anderson (1905–1991) - Anderson, Carl D. (1933). "The Positive Electron". Physical Review 43 (6): 491–494. DOI:10.1103/PhysRev.43.491.*

# Build your cloud chamber - step by step

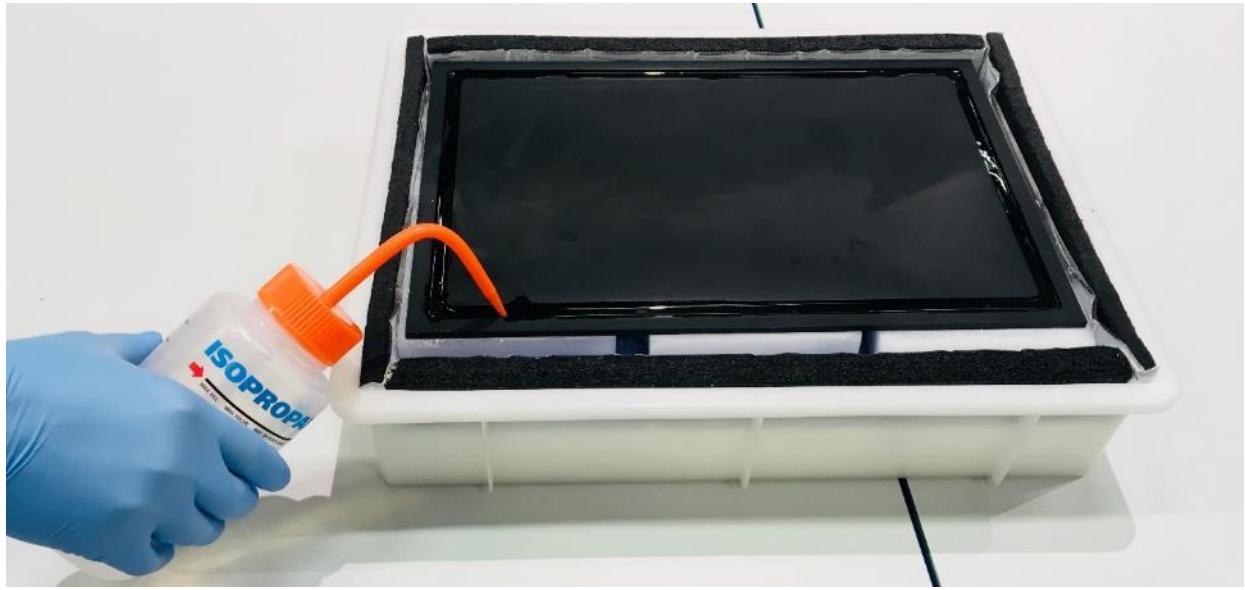
# Team Dry ICE


# Team ALCOHOL






CERN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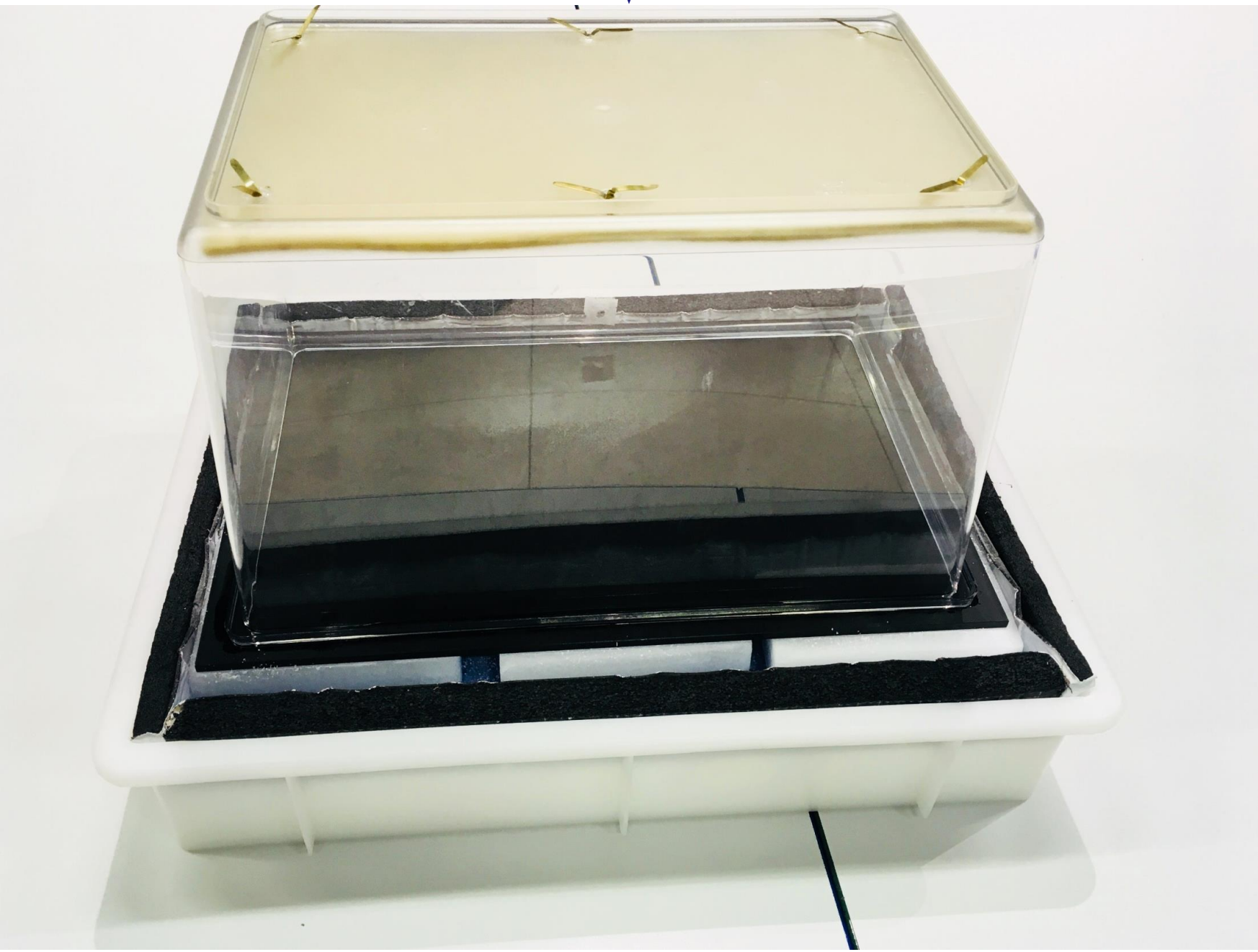

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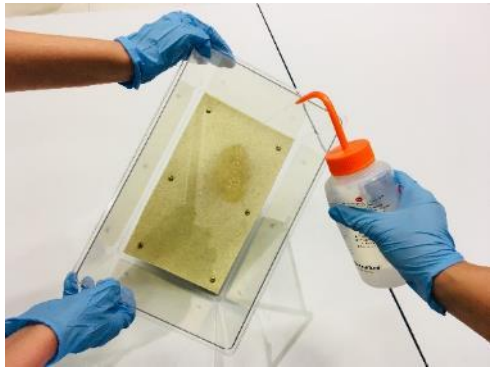
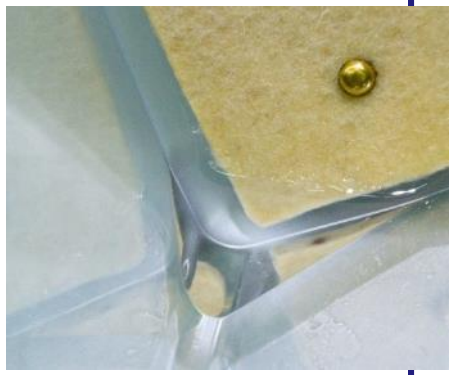
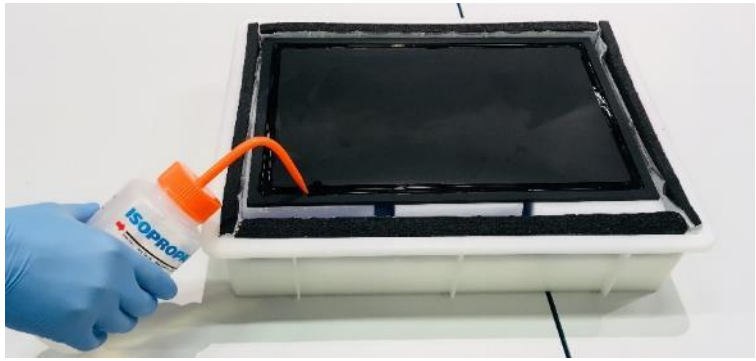
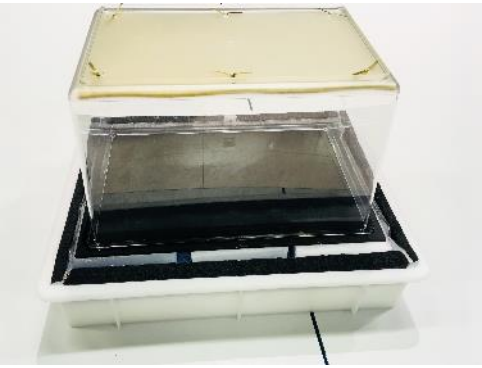




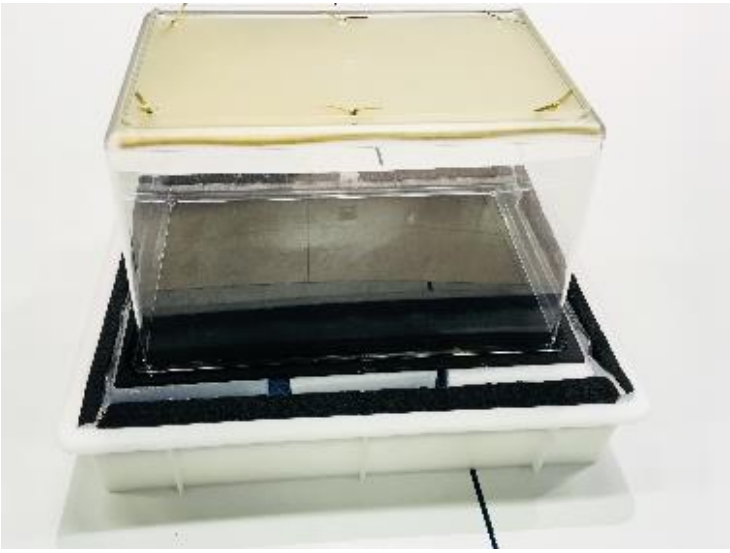



# Observation tasks!

- Find the optimal torch position and the optimal observation position
- Observe your Cloud Chamber
- Describe visible tracks (shape, length, width, …)
- Discuss the reason for these tracks
- Count the number of tracks you can see for 1 minute, repeat this measurement 2 times

# If there is time..

- Putting MuonHunter and Cloud Chamber together, to form a „hybrid“ detector
    - To take photos of the tracks of charged particles, in a (distantly) similar manner than is done with the large detector experiments at CERN (in a miniature, slightly less accurate way).
  - Optimal position for the electronics? Camera? Lights? Can you catch a particle track with the camera?

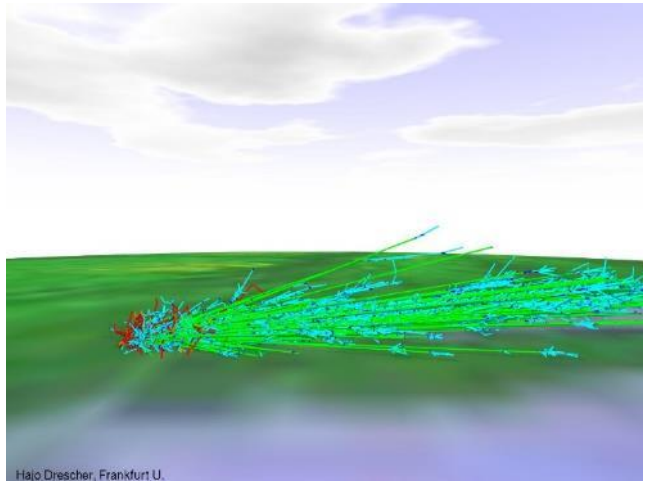


# Additional Material: Air Shower Simulation

## Cosmic Ray Air Shower Pictures

by H.-J. Drescher drescher@th.physik.uni-frankfurt.de.

Air showers are cascades of secondary particles induced in the atmosphere by high energy cosmic rays. What you see here is a **visualisation of realistic simulations of these showers**. Of course, not all of the particles in a shower are displayed, there are far too many! The **fraction displayed here is about 1e-6**, sampled with a **thinning algorithm**.




blue:electrons/positrons
cyan:photons
red:neutrons
orange: protons
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http://th.physik.uni-frankfurt.de/~drescher/CASSIM/

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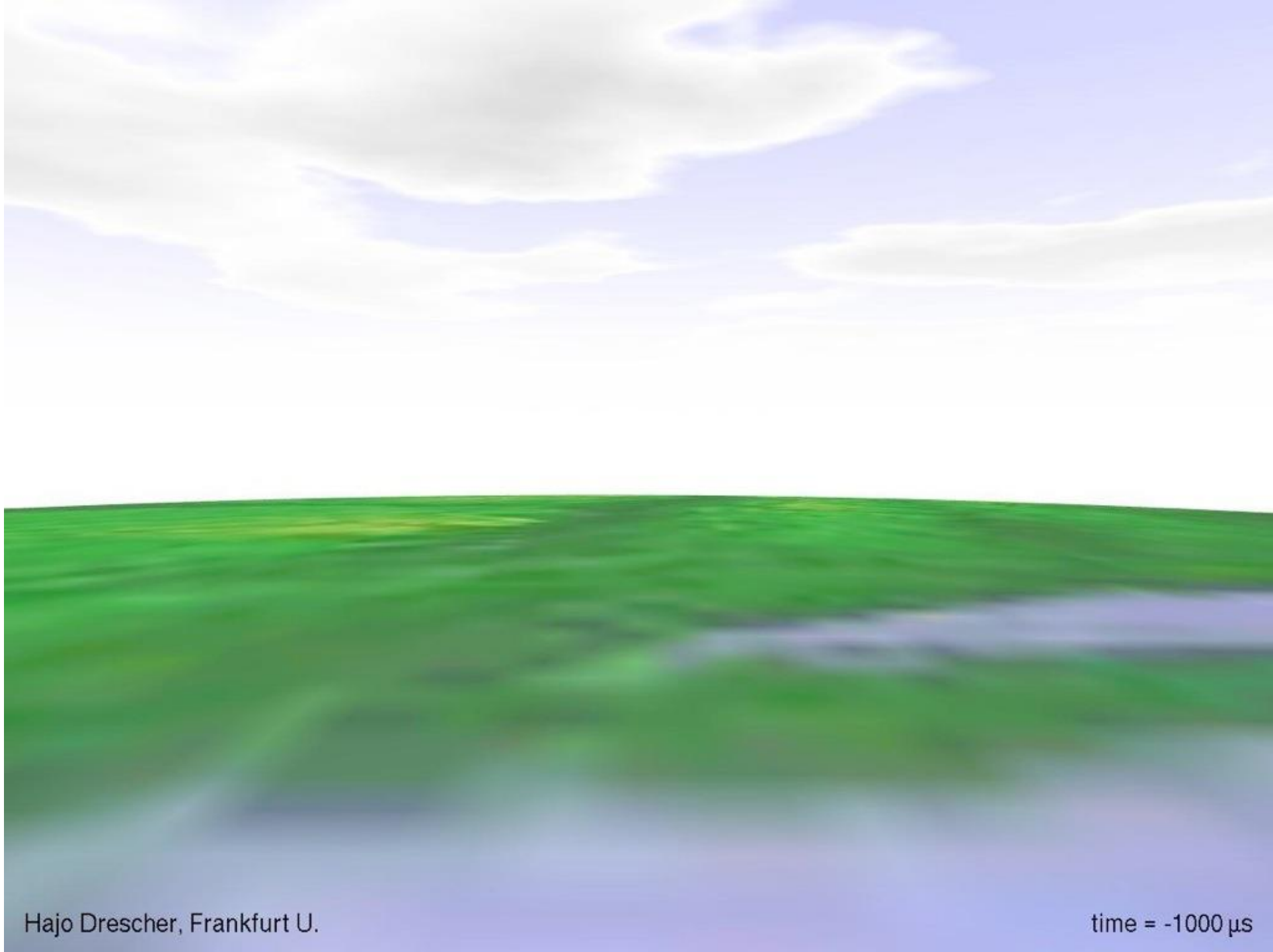

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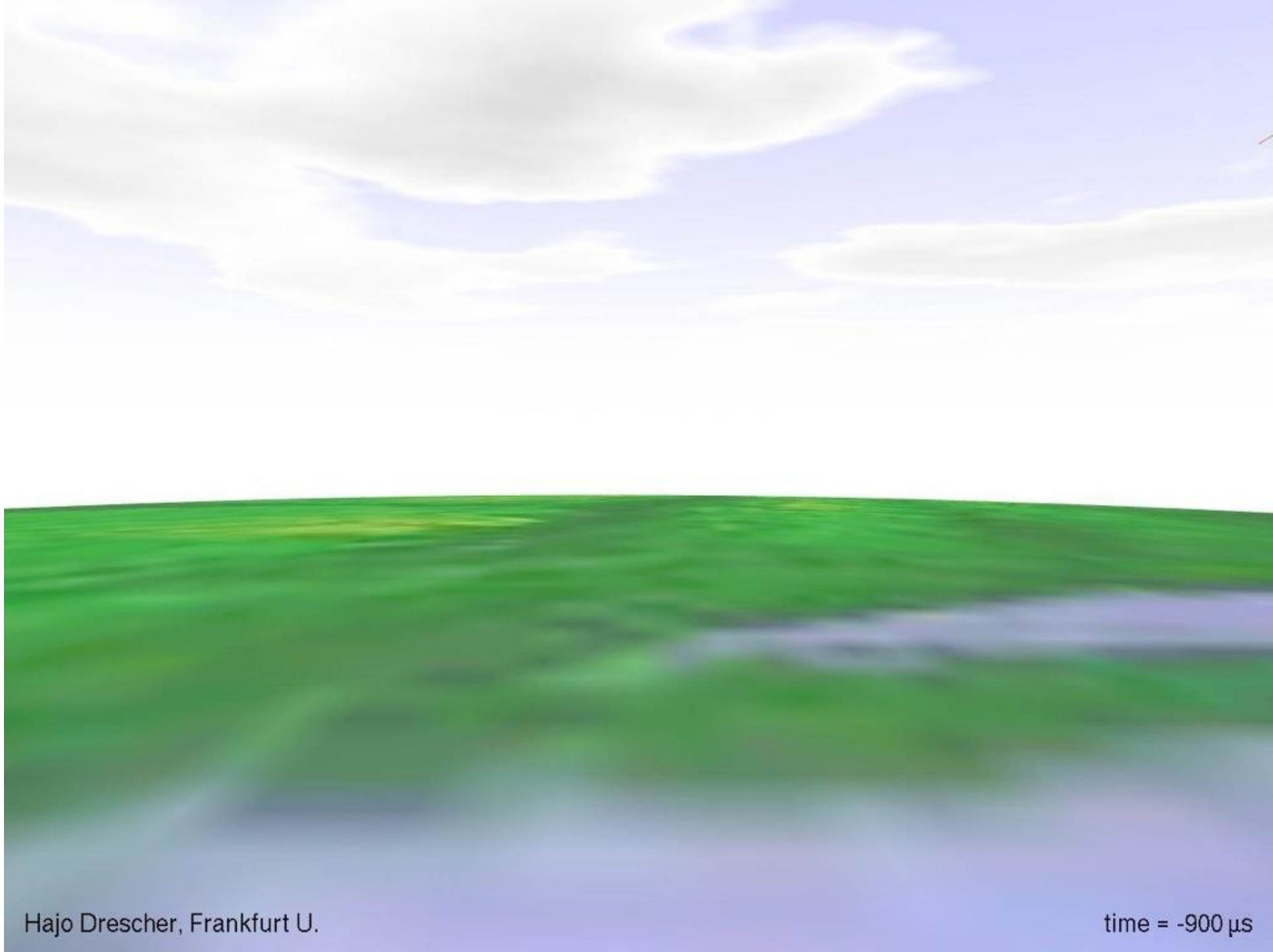

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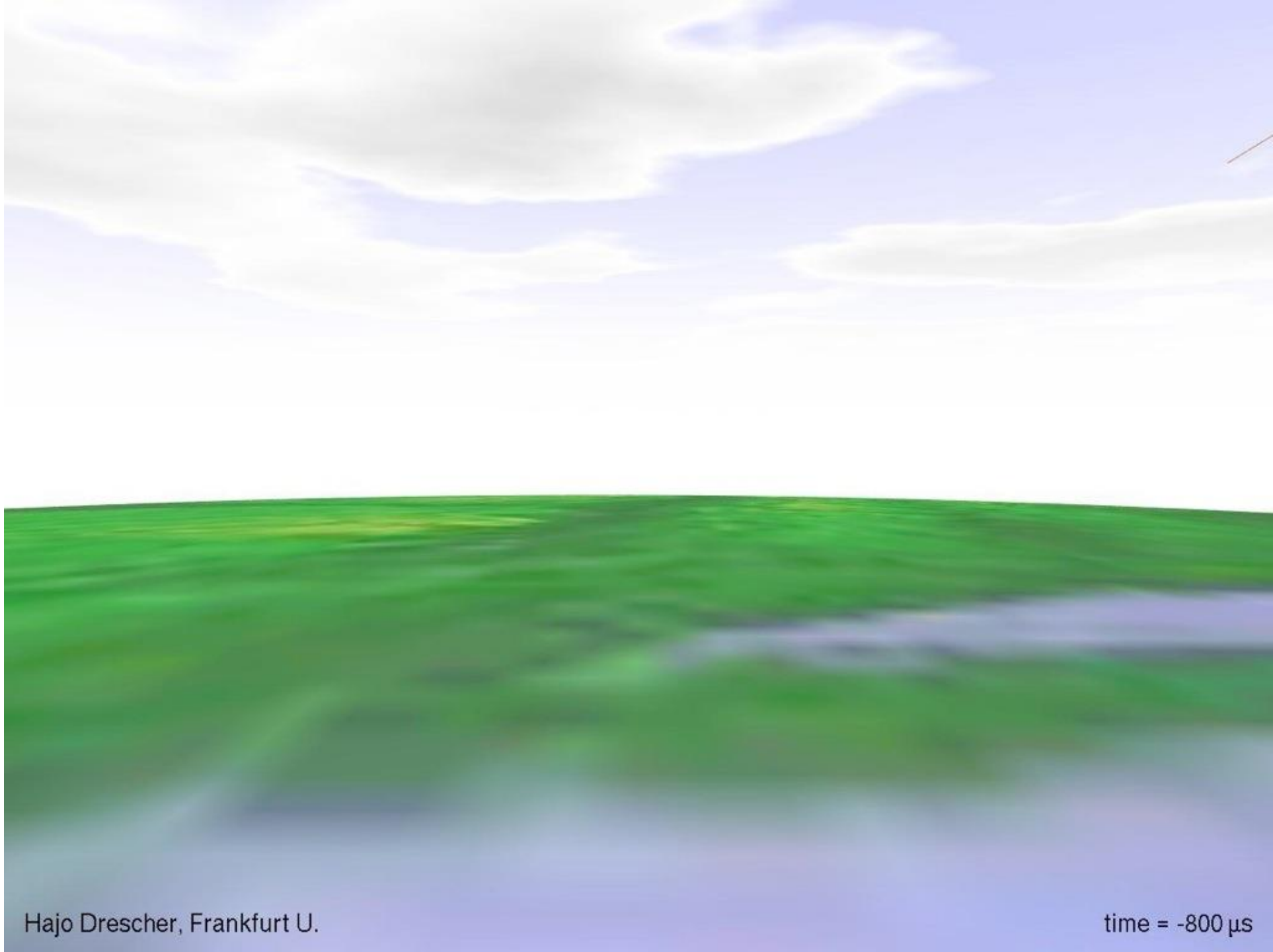

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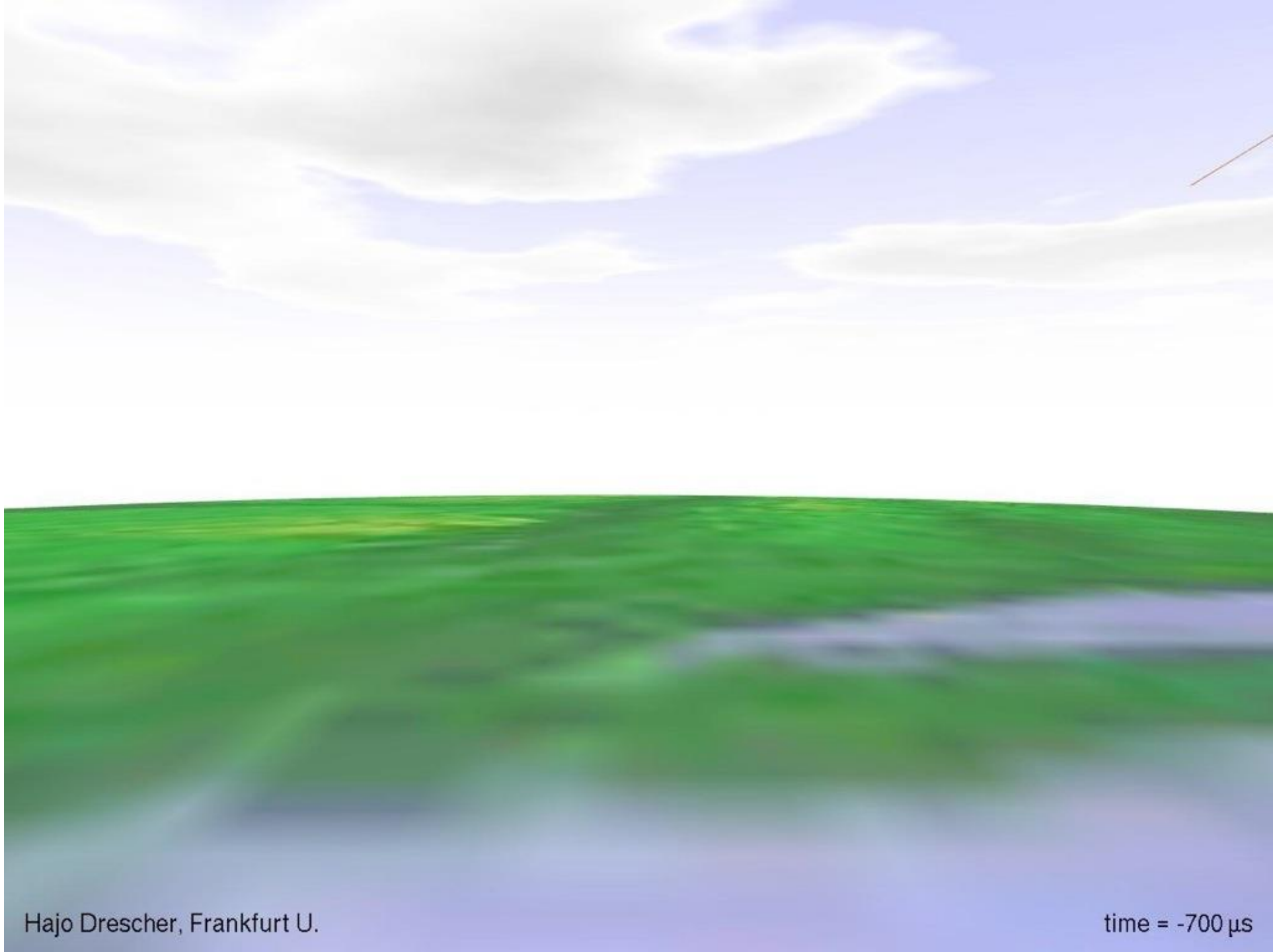

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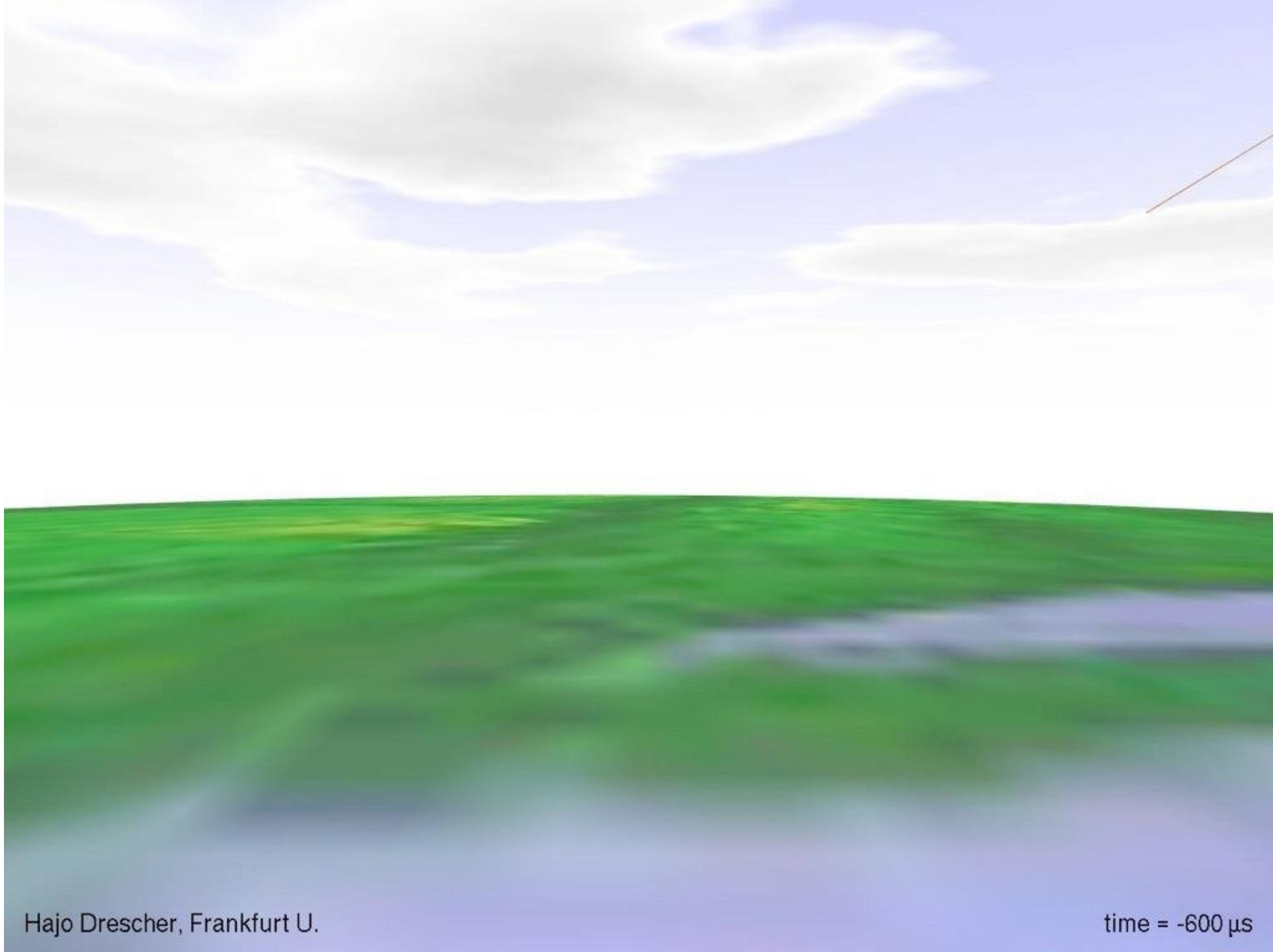

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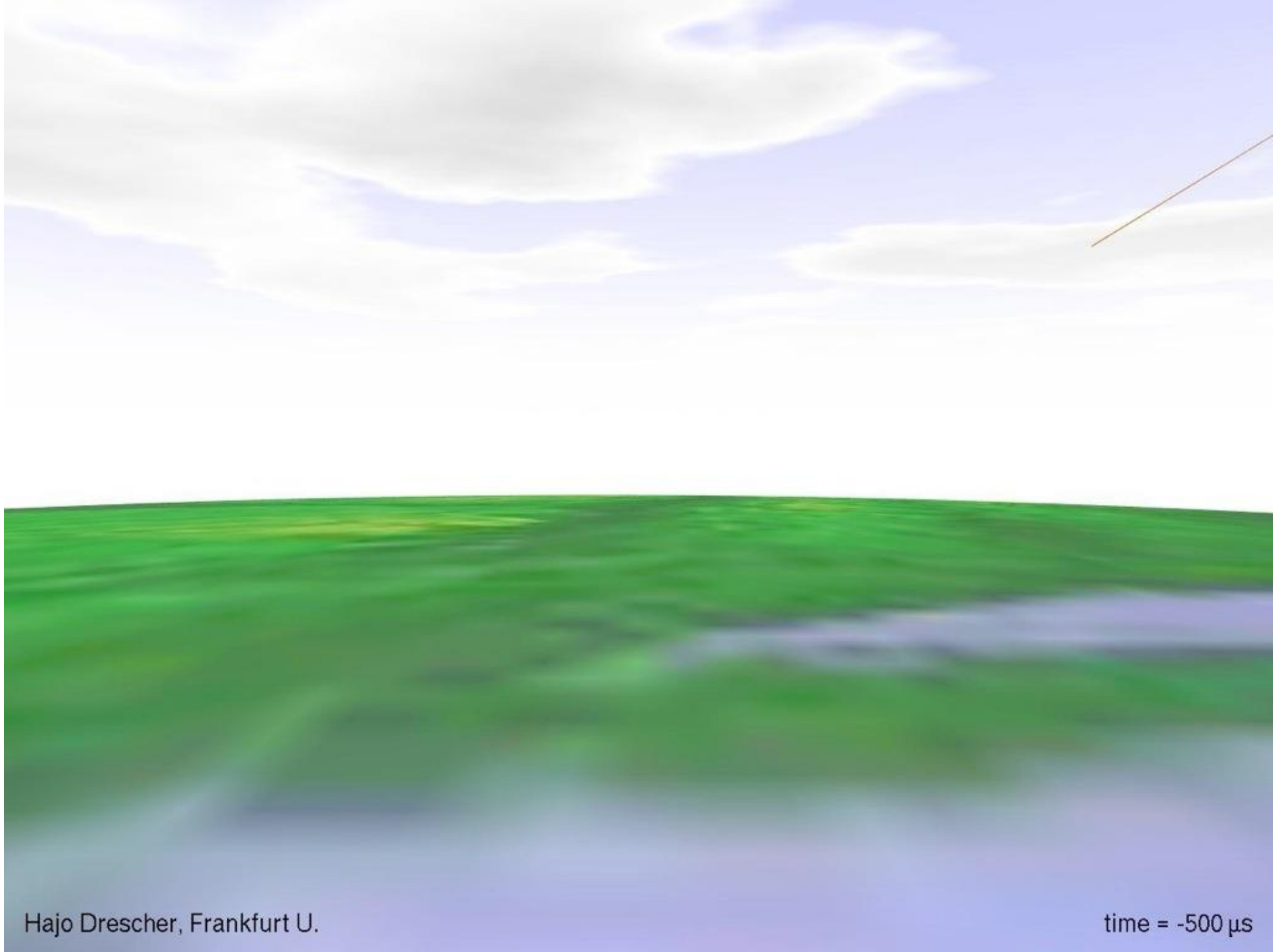

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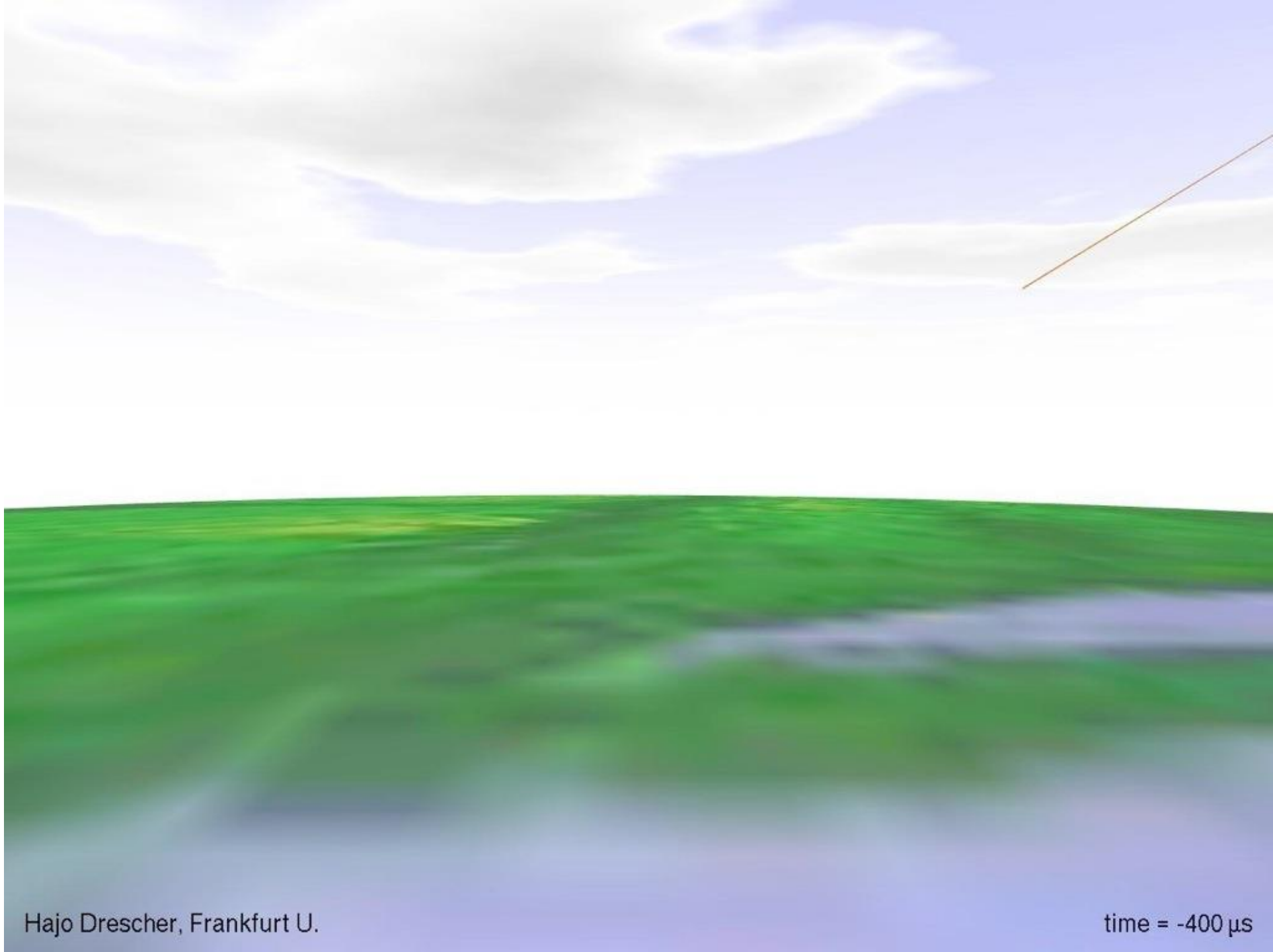

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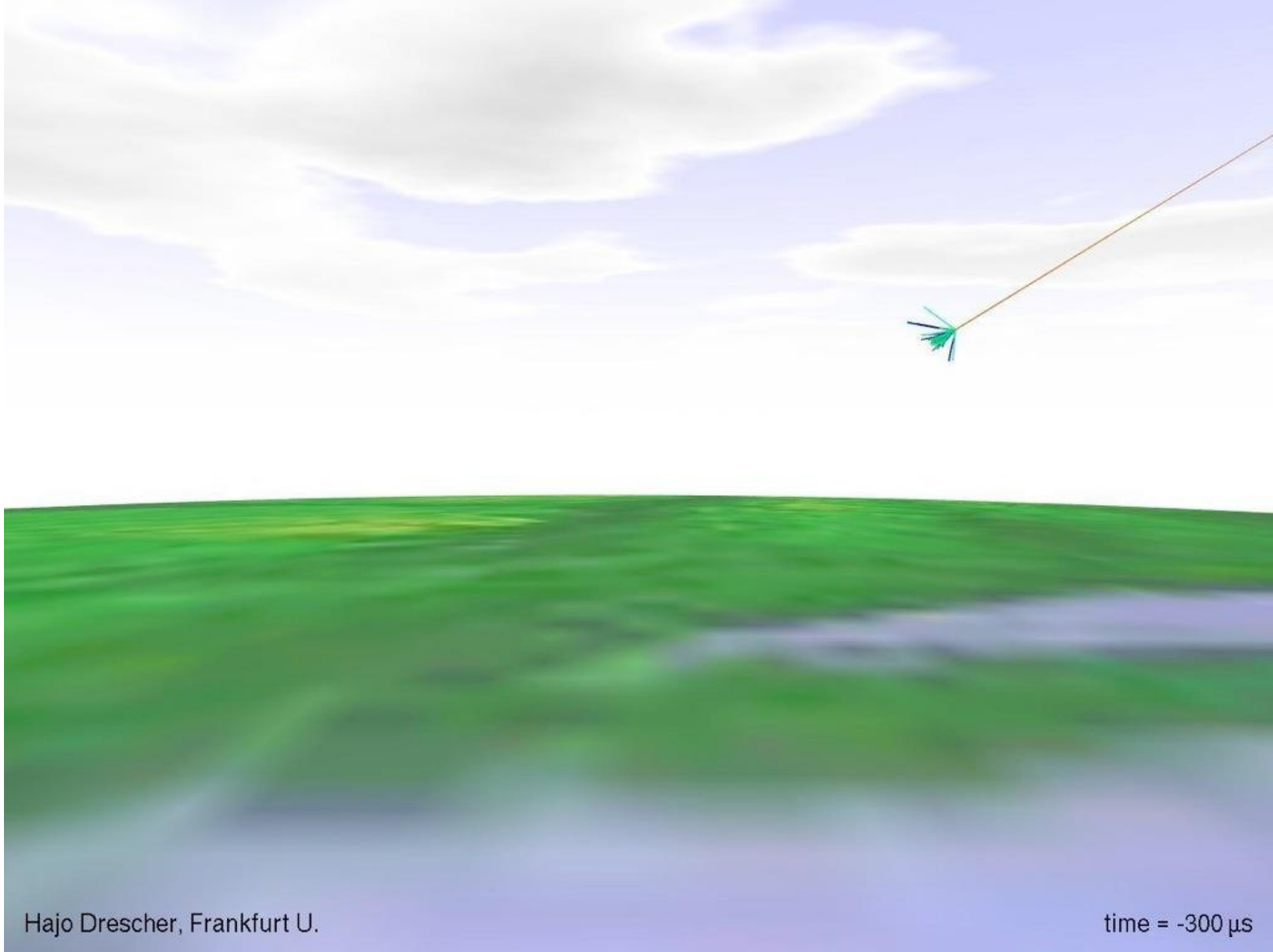

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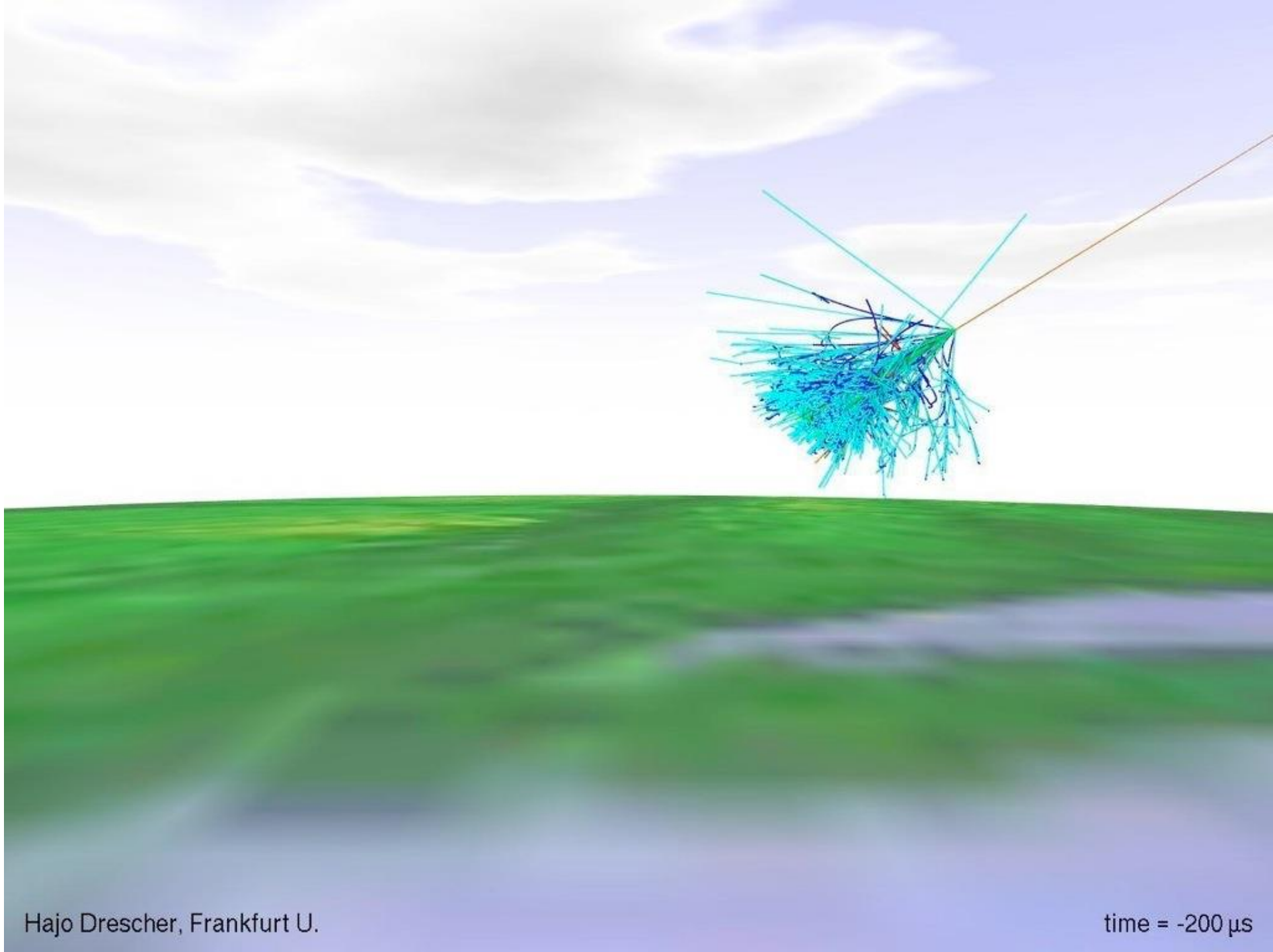

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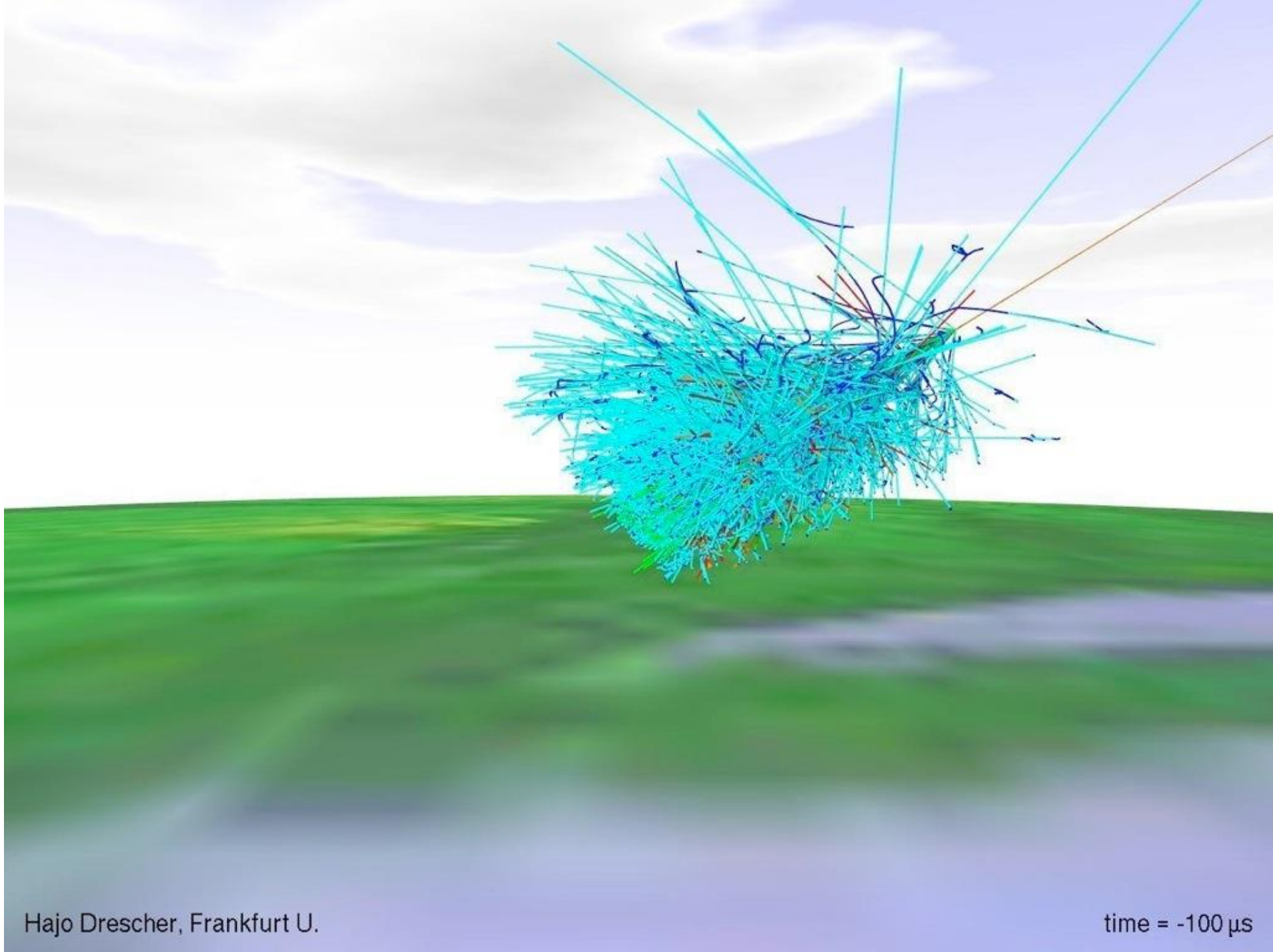

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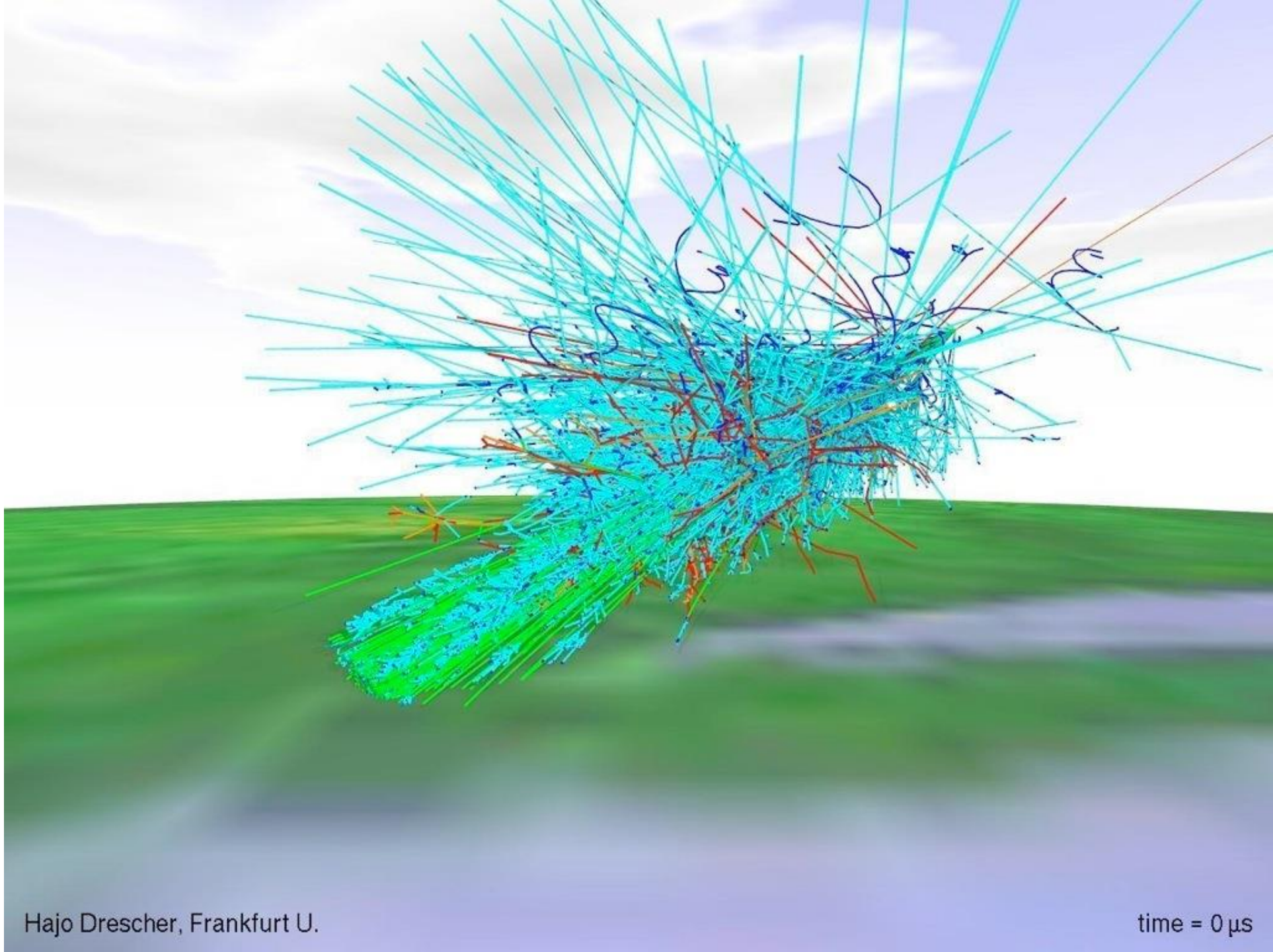

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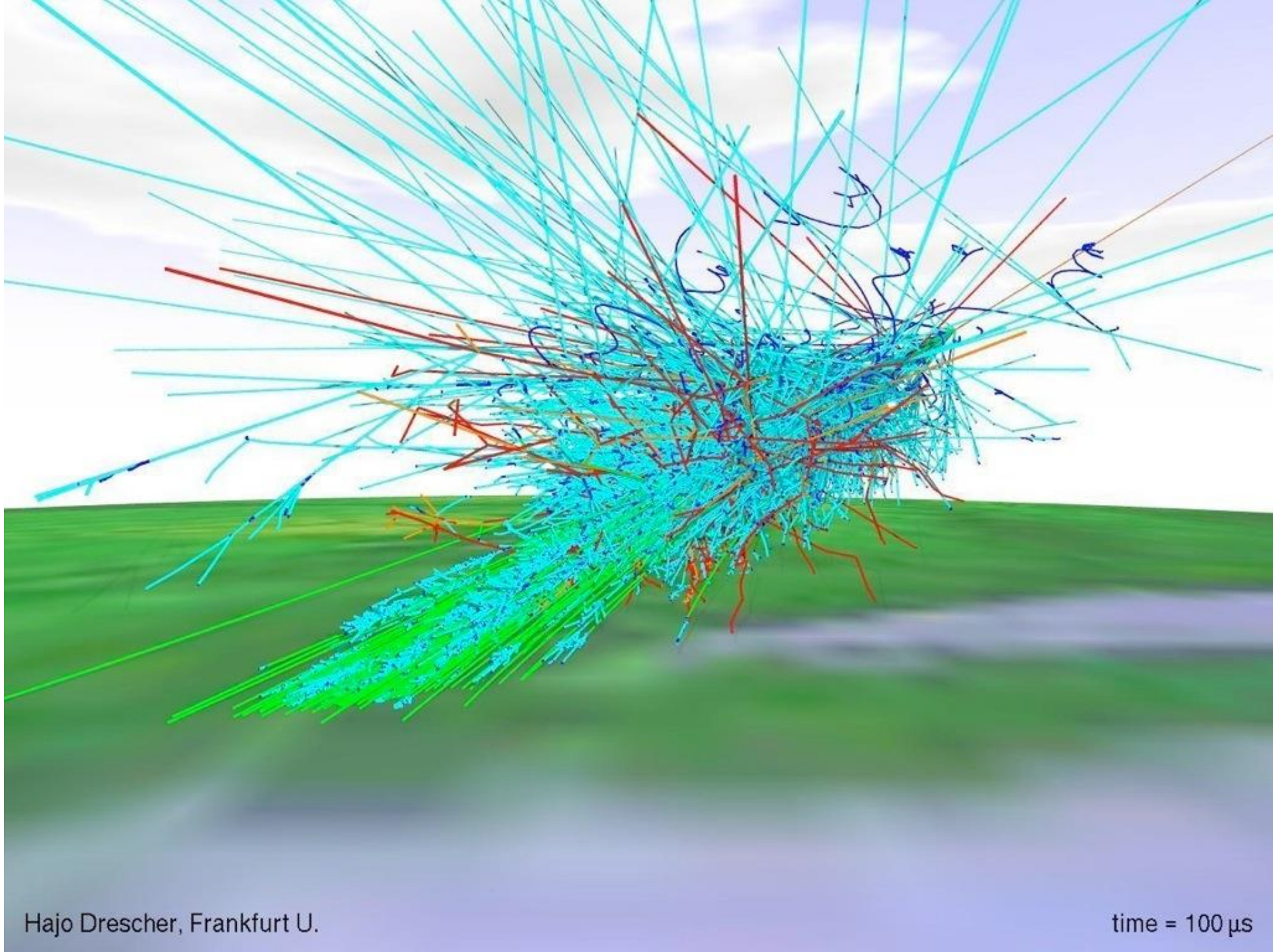

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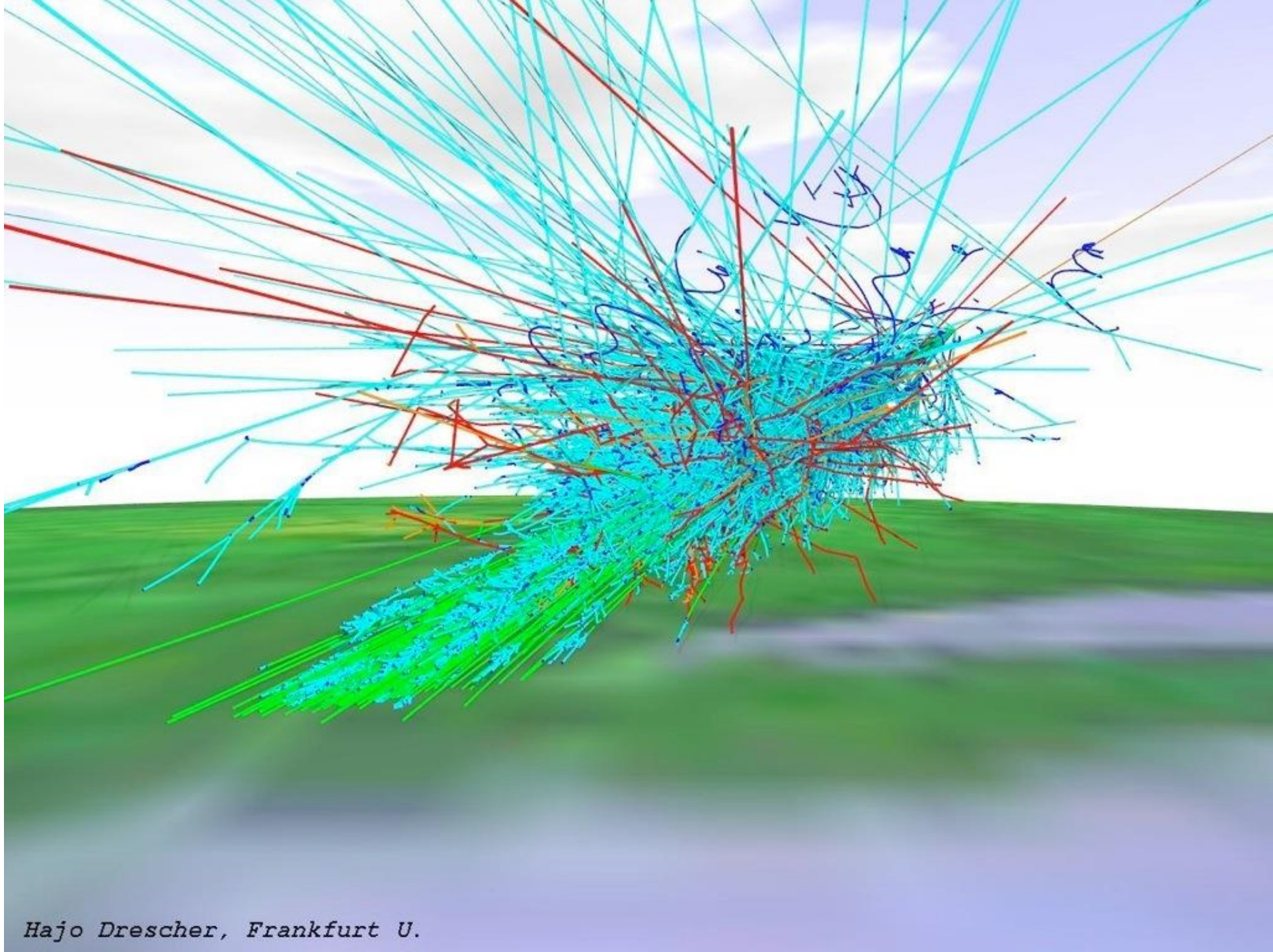

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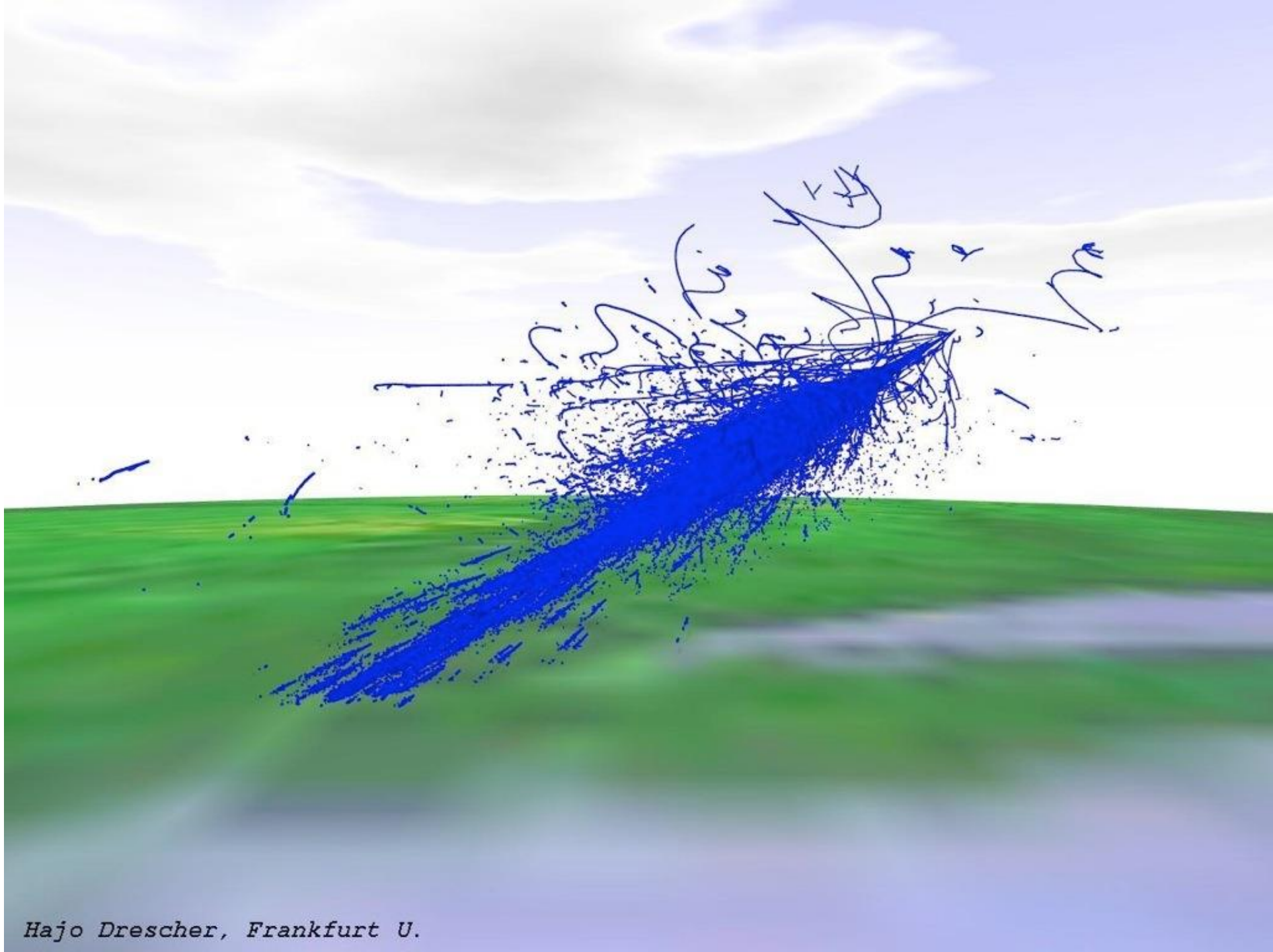

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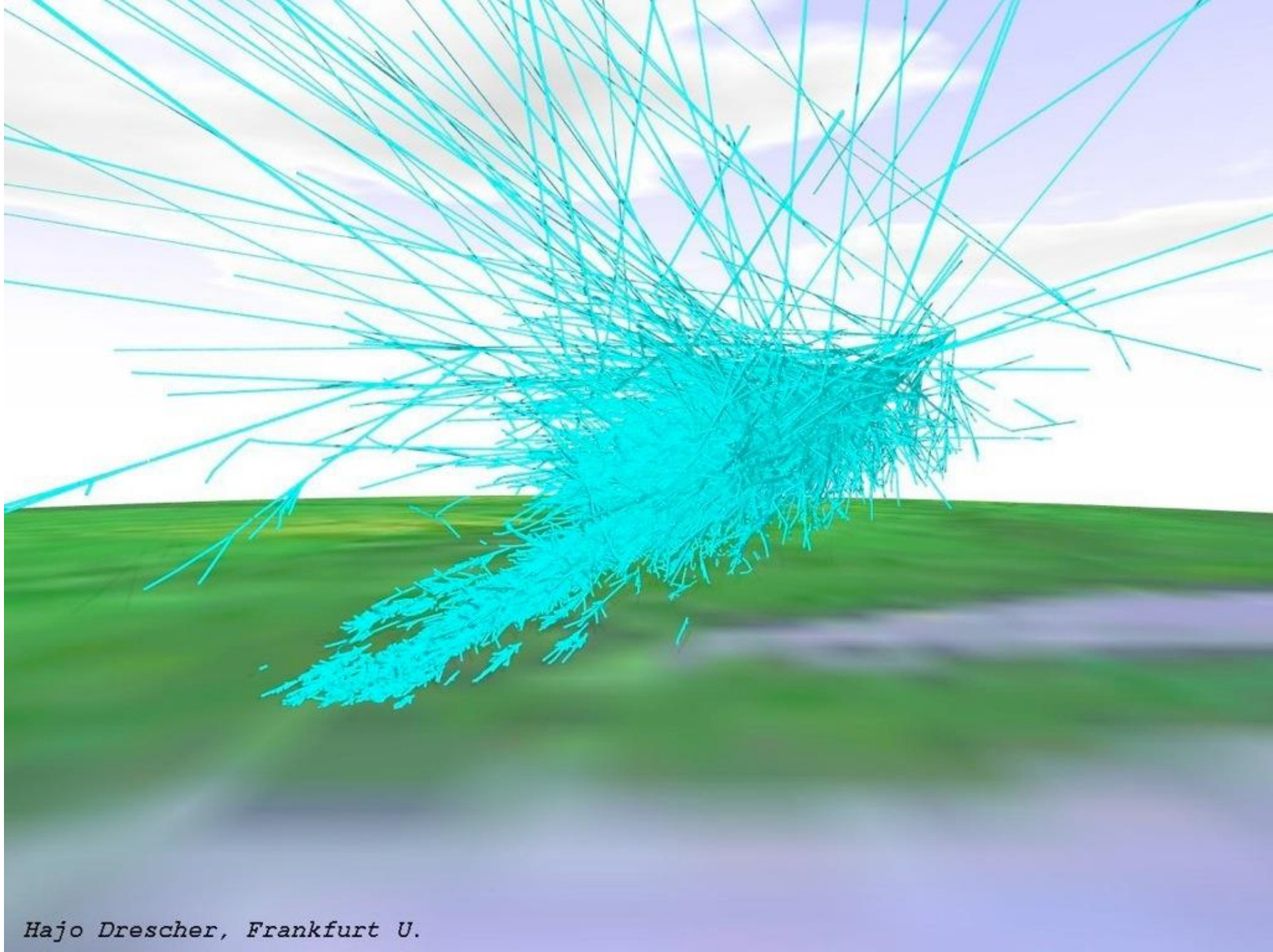

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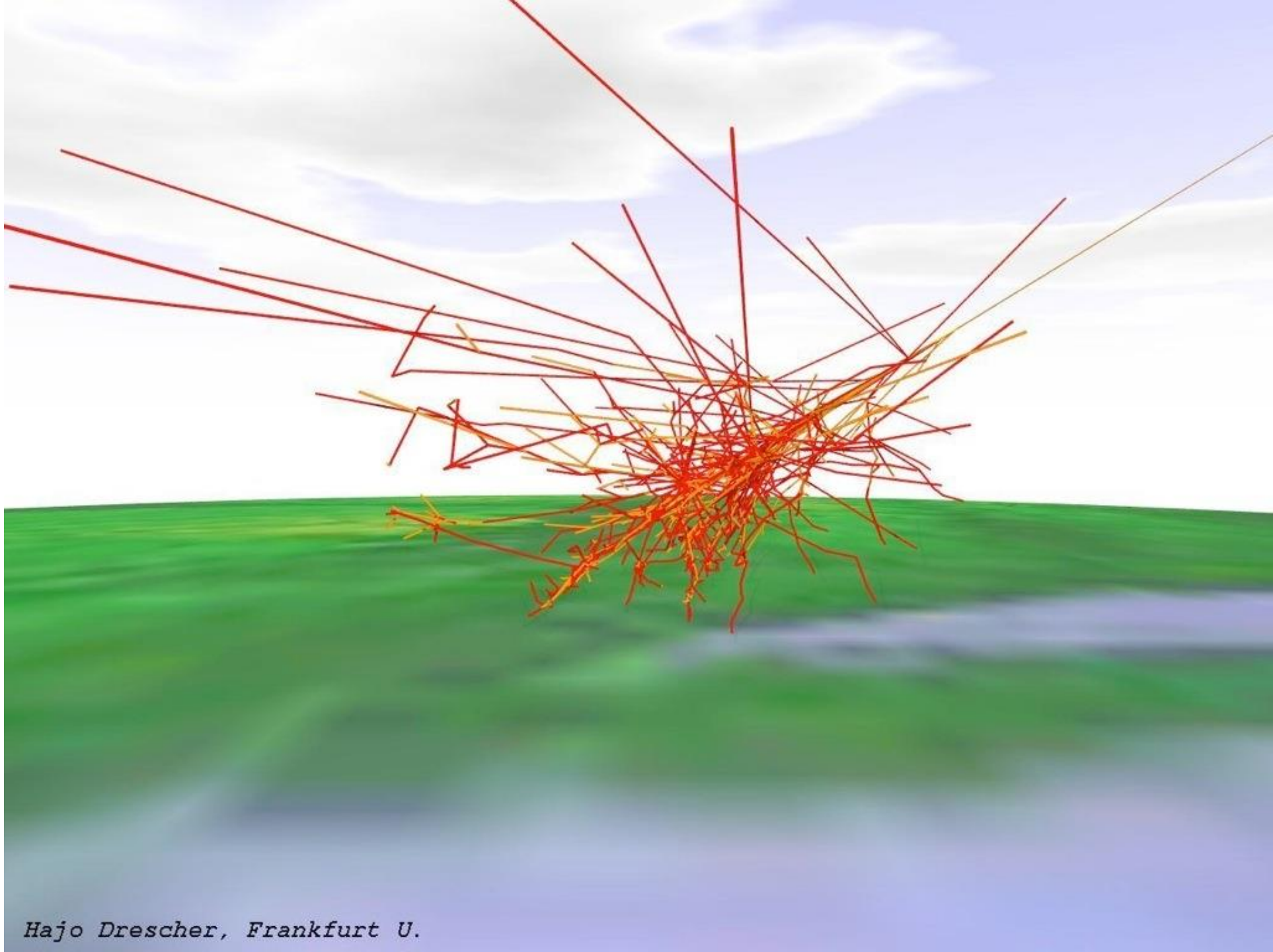

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