Searching for quantum gravity with gas dynamics near black holes

Manuel Hohmann

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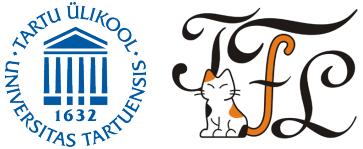
Center of Excellence “Fundamental Universe”



Tuorla-Tartu Meeting - 7. May 2024

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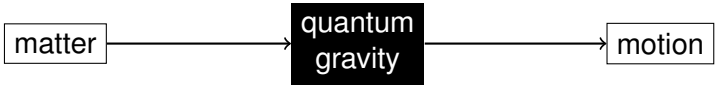
$\Rightarrow$ Here: effective quantum gravity phenomenology with gas dynamics near black holes.

How does quantum gravity phenomenology work?

- Basic operating principle of (quantum) gravity theory:



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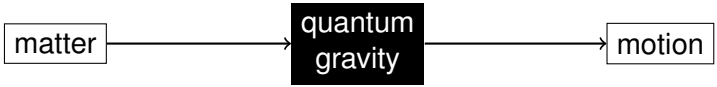

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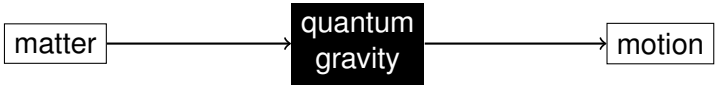

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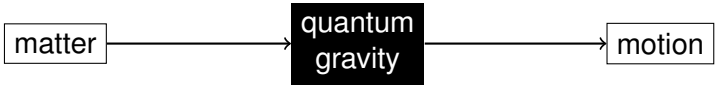

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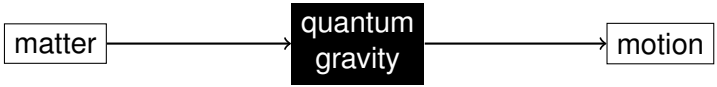

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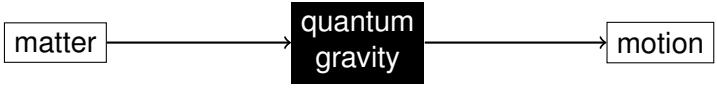

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⇝ Only need to study (all) possible quantum corrections!

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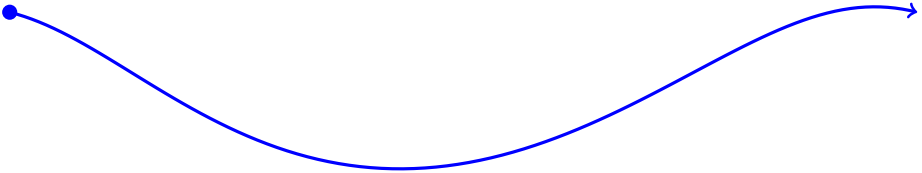

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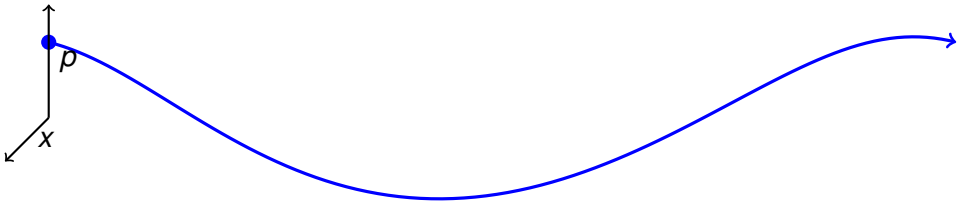

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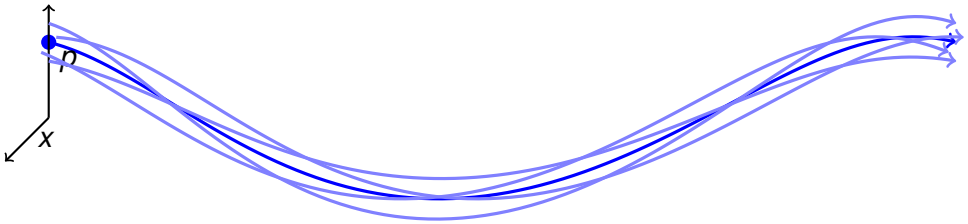

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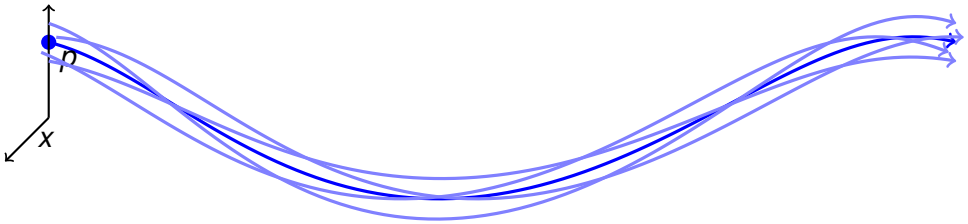

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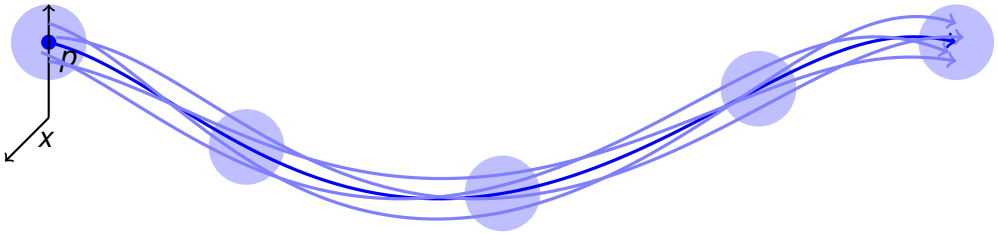
Collisionless gas

Particle density function is constant along particle trajectories in phase space.



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- κ-Poincaré modification of spacetime:
  - Interaction between particles and "quantum structure of spacetime".
  - Interaction depends on de Broglie wavelength (momentum).
  - $\rightsquigarrow$ Distinguished time direction (vector field).
  - $\Rightarrow$ κ-Minkowski spacetime has modified symmetry algebra.
  - Black hole spacetime: assume spherically symmetric vector field.
  - $\Rightarrow$ Vector field may only have time and radial components.
  - Modification depends on a parameter ℓ (Planck length).
  - Spacetime approaches Schwarzschild for $\ell \to 0$.

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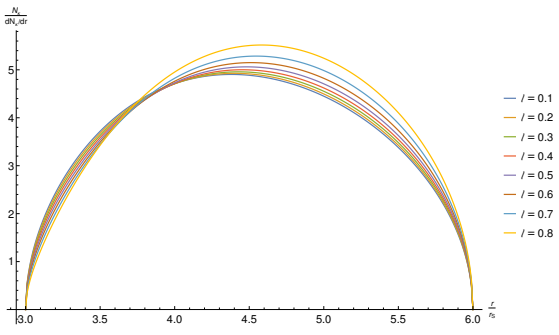
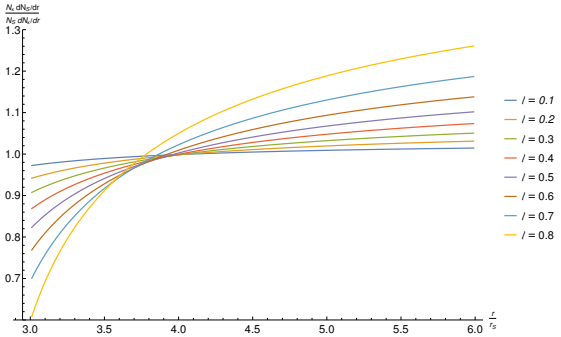
$\Rightarrow$ κ-Poincaré modification shifts particles inward.





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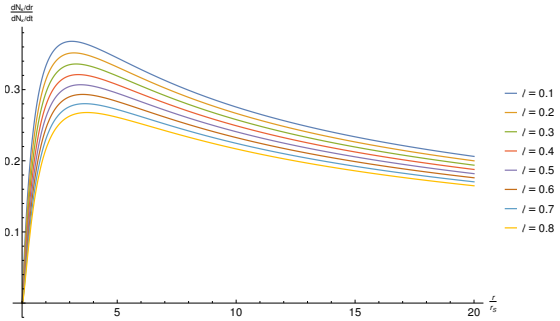

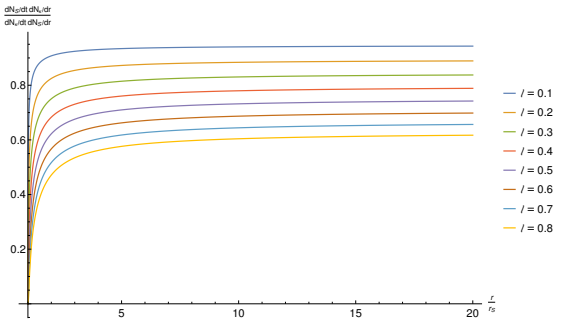

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- MH, "Kinetic gases in static spherically symmetric modified dispersion relations," Class. Quant. Grav. **41** (2024) no.1, 015025 [arXiv:2310.01487 [gr-qc]].