A Distribution For Magnetic Fields

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What we study:

Role of galactic winds and outflows in galaxy evolution.

Remove gas and metals from the disk and nuclear regions of star-forming galaxies and deposit them in the circumgalactic medium.

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What we want to understand:

The presence of cold gas (clouds) in such outflows.

The Wind/Shock - Cloud simulations:

Transport via momentum transfer from hot gas?

- In purely hydrodynamic regimes: Too many instabilities, cloud gets destroyed rapidly.
- Recent simulations show that magnetic stresses can aid cloud acceleration and survival.

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In this talk:

- Tools for a systematic statistical study of the effect of magnetic fields.

Need: Probaility distribution over magnetic fileds.
(Herr W.: For magnetic fields with compact support, sometimes symmetric and div-free! And... depending on the day turbelent too.)

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Need: Probaility distribution over $f : \mathbf{R}^m \to \mathbf{R}^n$.
Gaussian Process: A proba. distribution over a function space.

$$f(x) \sim \mathbf{GP}\left(0,\ k(x, x')\right)$$

For any $\mathbf{x} := [x_1, ..., x_n]^T$,

$$f(\mathbf{x}) \sim \mathbf{N}\left(\begin{bmatrix}0\\ \vdots \\ 0\end{bmatrix}, \begin{bmatrix}k(x_1, x_1) \cdots k(x_1, x_n) \\ \ddots \\ k(x_n, x_1) \cdots k(x_n, x_n)\end{bmatrix}\right)$$

where $f(\mathbf{x}) := [f(x_1), ..., f(x_n)]^T$.

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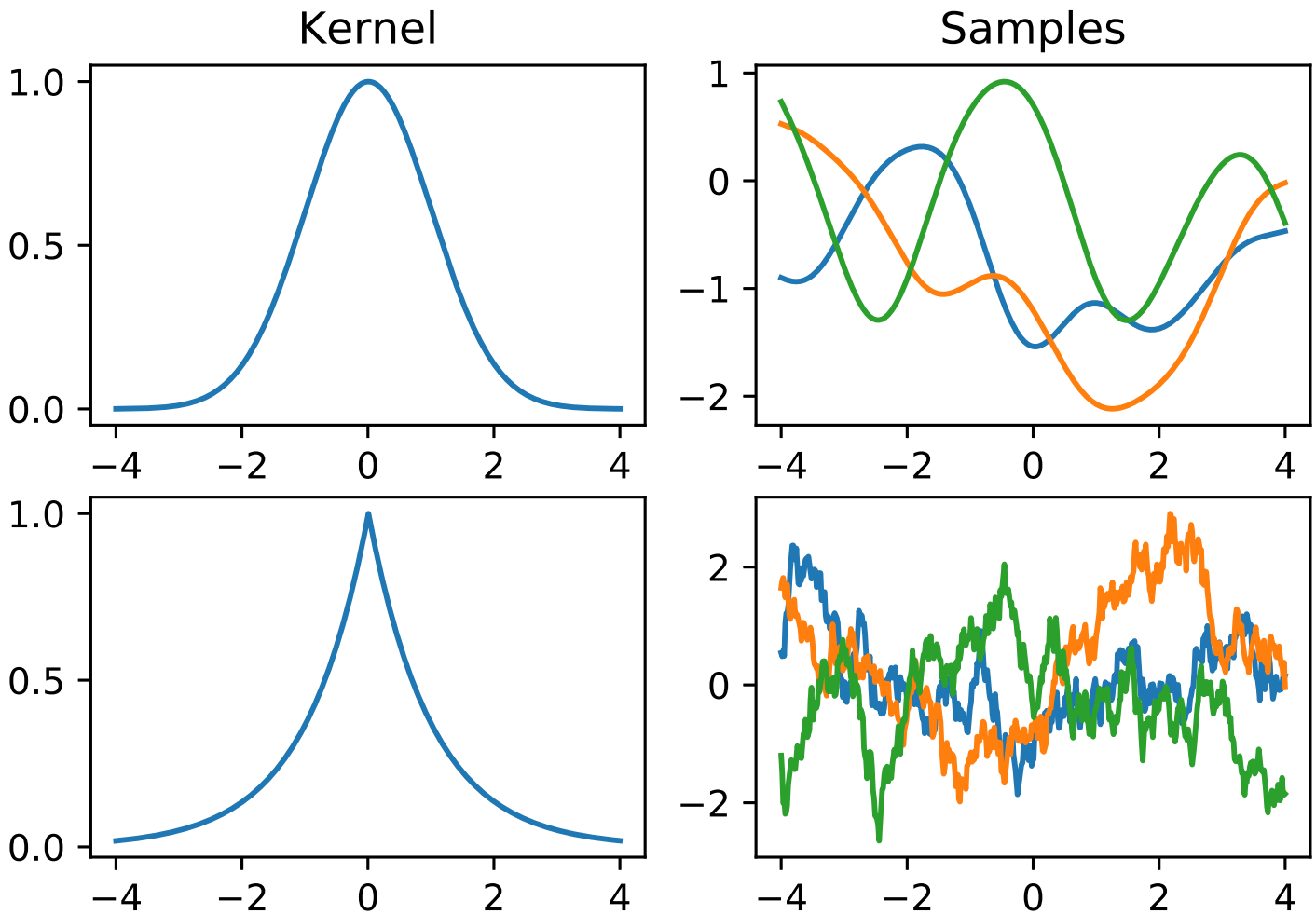
Which function space? You get choose by chossing the covariance function k.



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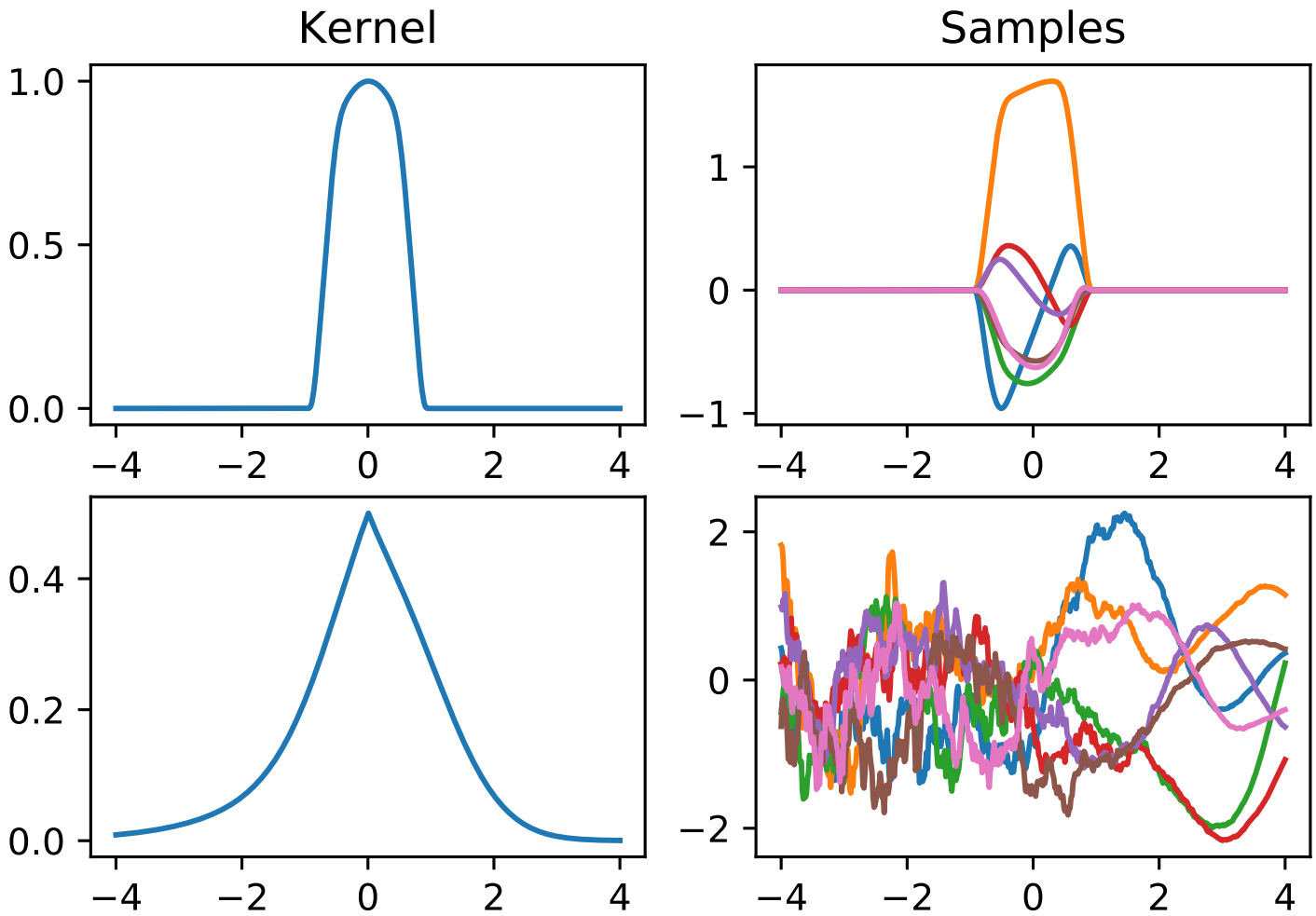
Algebra of Kernels Can combine kernels to encode other characteristics: $k_1 \times k_2$



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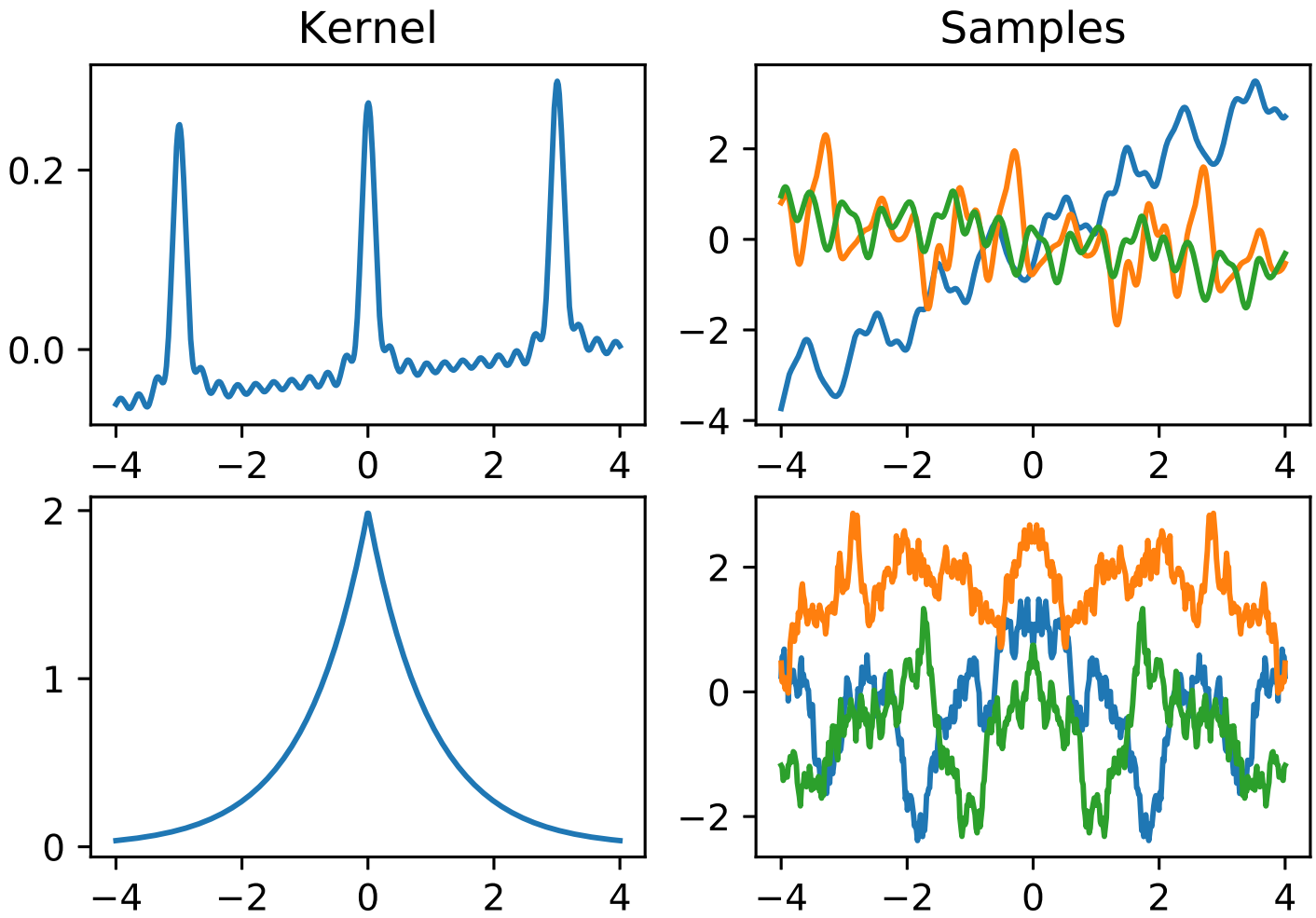
Algebra of Kernels Can combine kernels to encode other characteristics: $k_1 + k_2$



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In fact you can encode more:

Div-Free:

$$\nabla f = 0$$

i.e. Processes that satisfy a linear contraint.

$$\mathcal{L} f = 0 \tag{1}$$

(Idea: Find an operator $\mathcal{G}$ such that $\mathcal{L}\mathcal{G} = 0$. Then, $\mathcal{G} f$ satisfies (1).)

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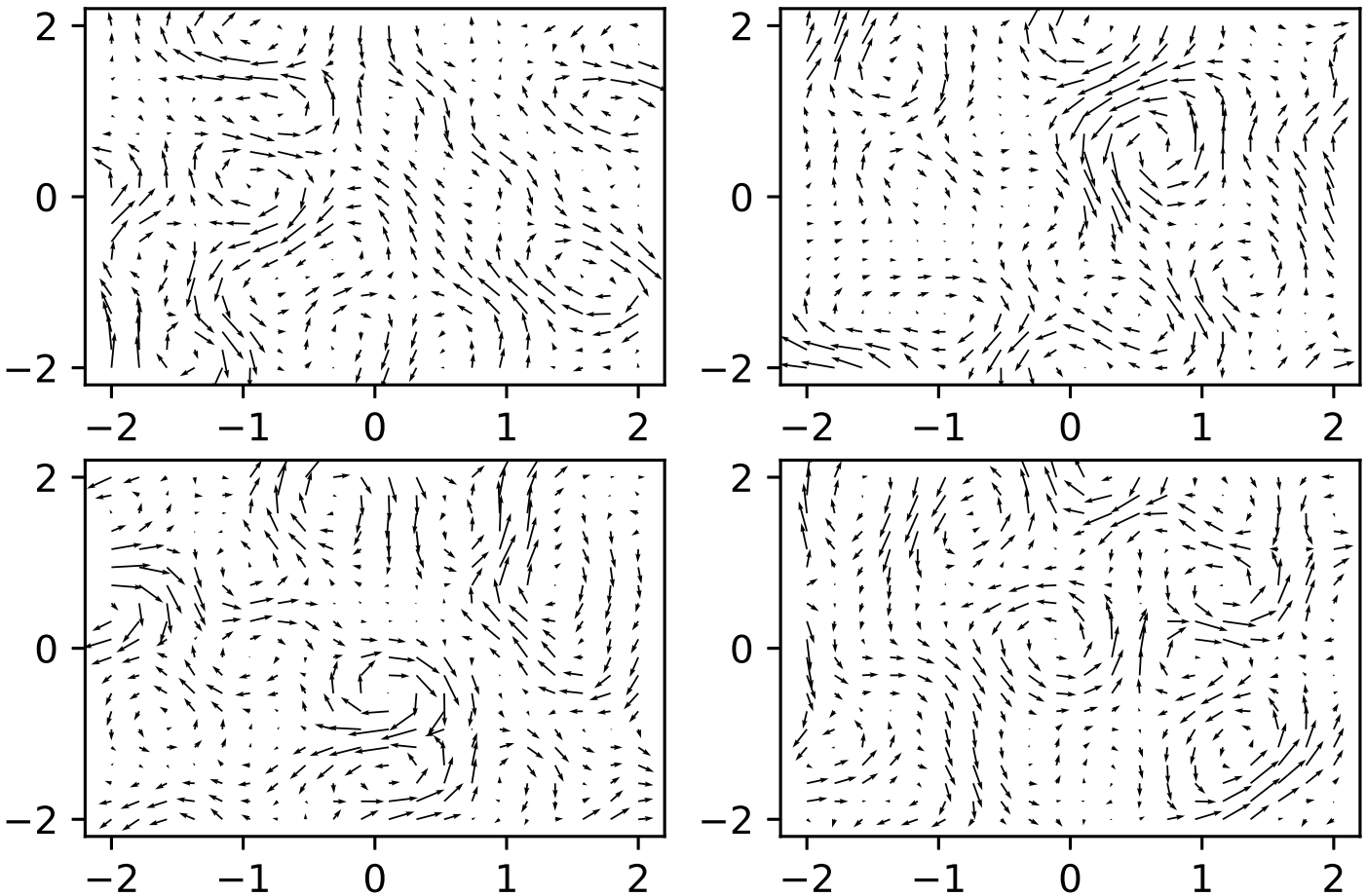
Div-Free: Samples from a div-free **GP**.



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Curl-Free: Samples from a curl-free **GP**.