

Robot Physicist

Team = [Manoj Kumar, Michele Ceru, Phil Yeres]

Advisor = Kyle Cranmer

Project mentors

Professor Kyle Cranmer, NYU Physics

Brenden Lake, CDS (unofficial mentor)

The problem:

Particle physics experiments
are expensive to perform



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Physicists optimize their experiments by running simulated experiments



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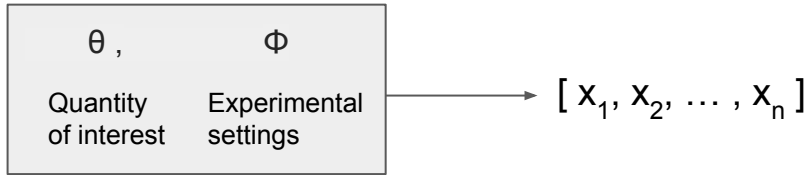
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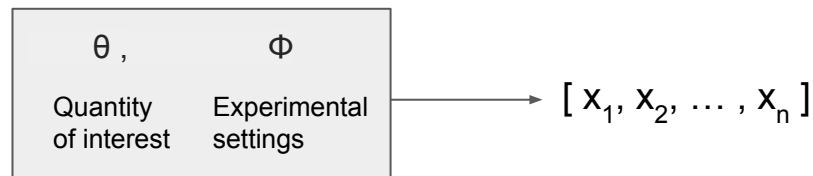
Our goal: design a proof of concept “robot physicist” that efficiently finds optimal experiment configurations



The black box



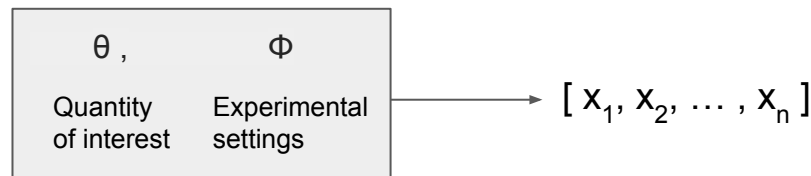
The Robot Physicist



for a single configuration of the experimental settings, $\Phi_j \dots$

we use a list of possible values of the unobservable parameter, $\theta = [\theta_1, \theta_2, \dots, \theta_m]$

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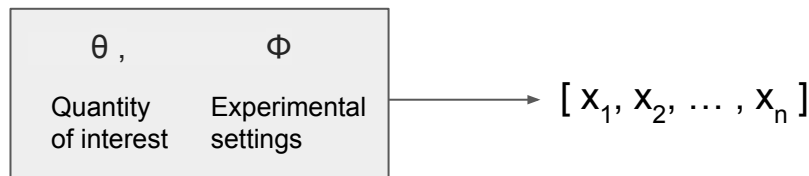


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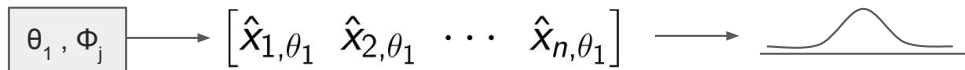
$$\theta_1, \Phi_j \longrightarrow [\hat{x}_{1,\theta_1} \quad \hat{x}_{2,\theta_1} \quad \cdots \quad \hat{x}_{n,\theta_1}]$$

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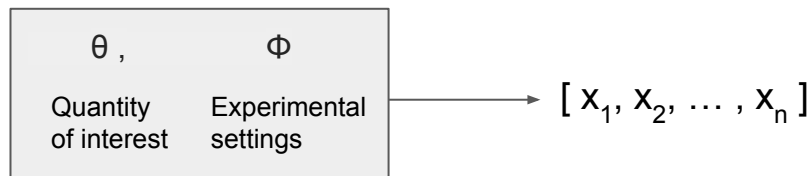


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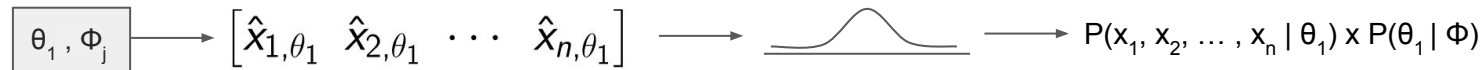


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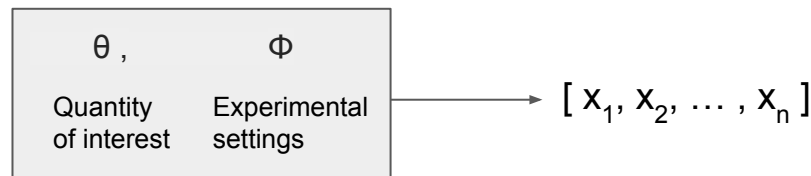


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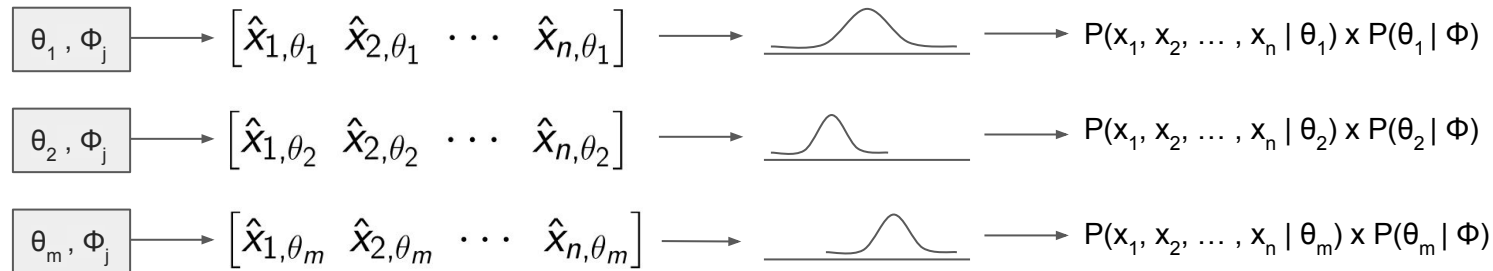


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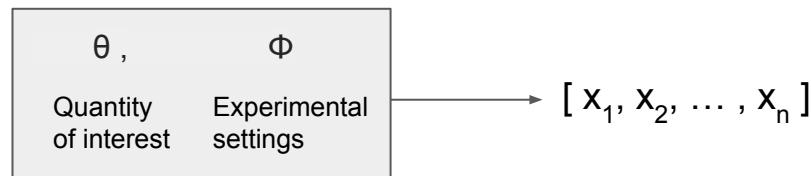


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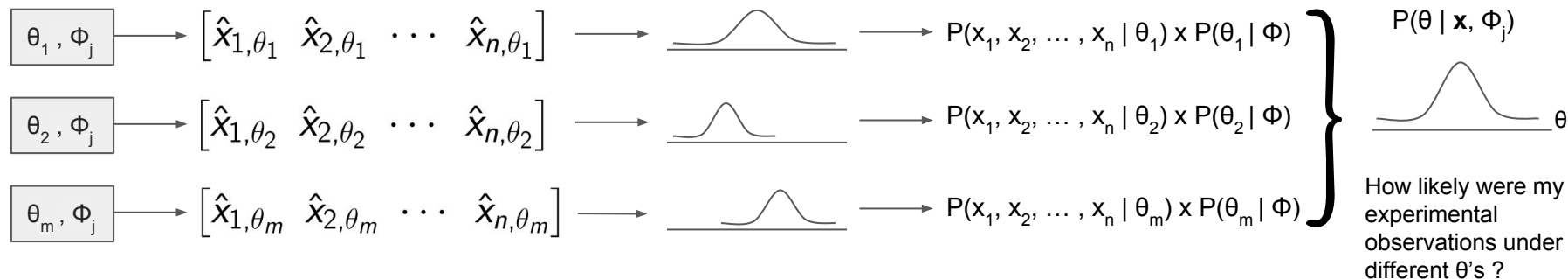


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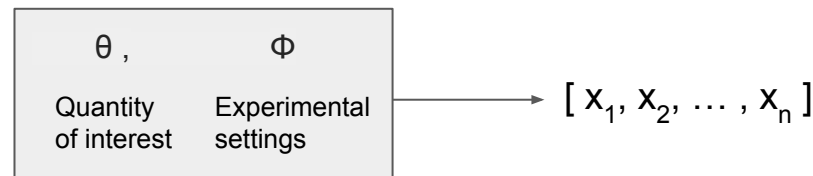


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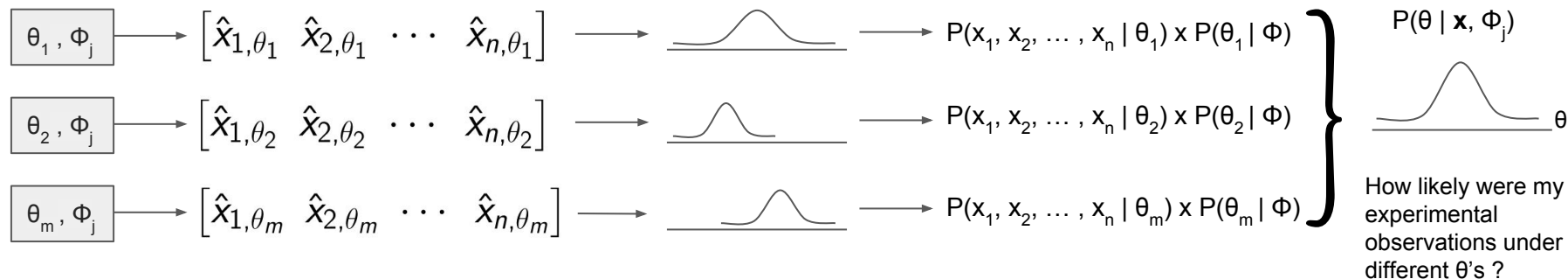


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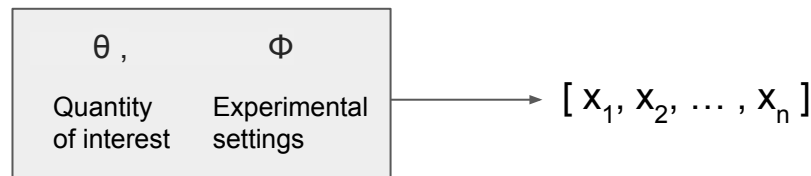
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$$P(\theta | \mathbf{x}, \Phi_1)$$

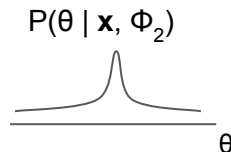
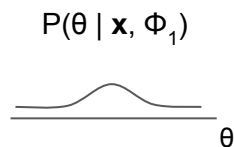
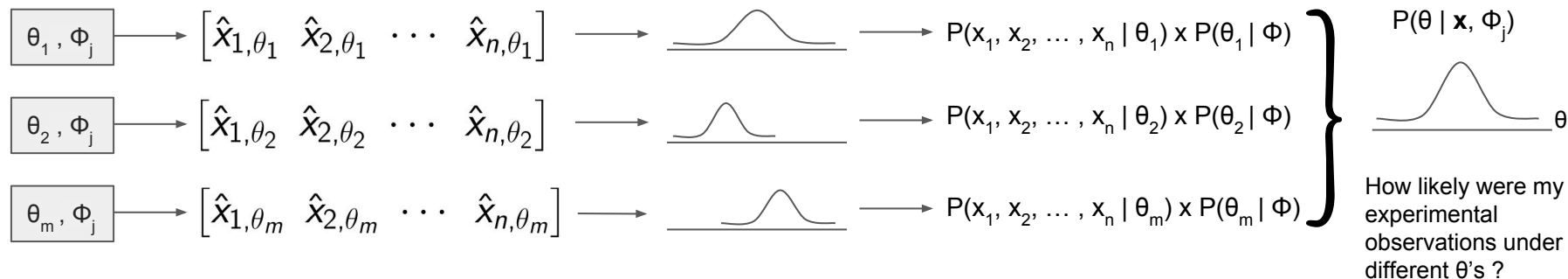


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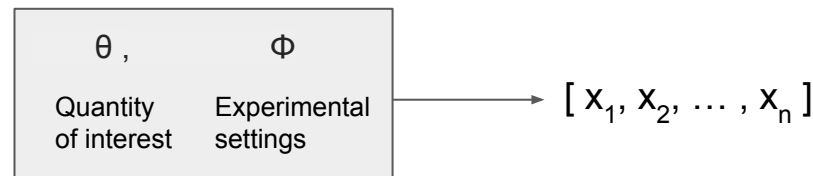


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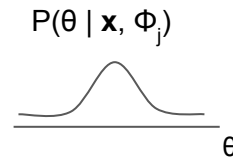
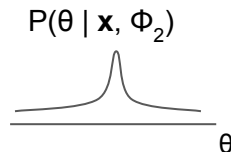
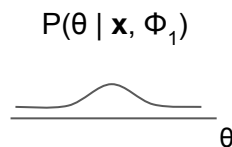
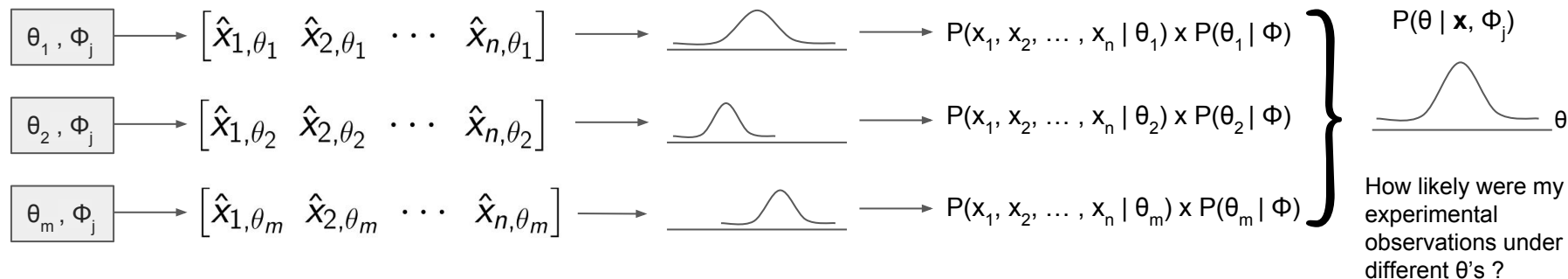


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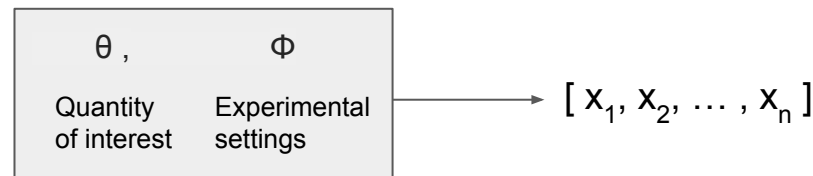


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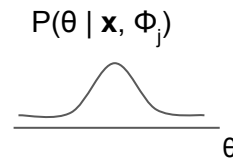
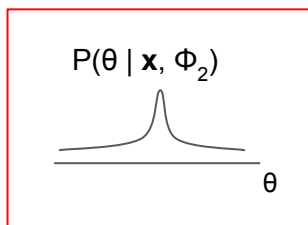
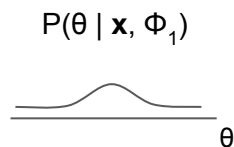
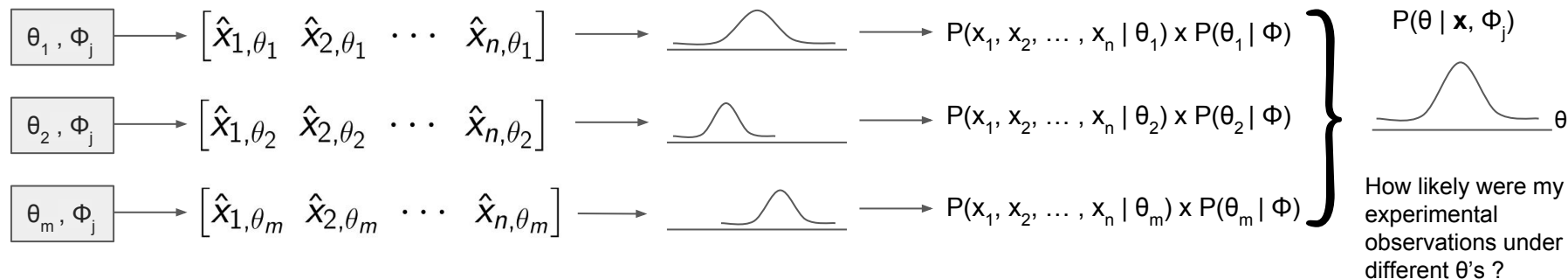


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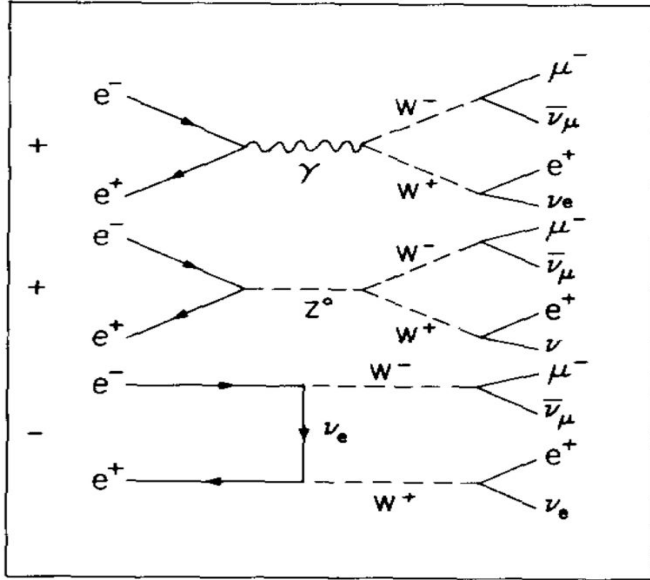
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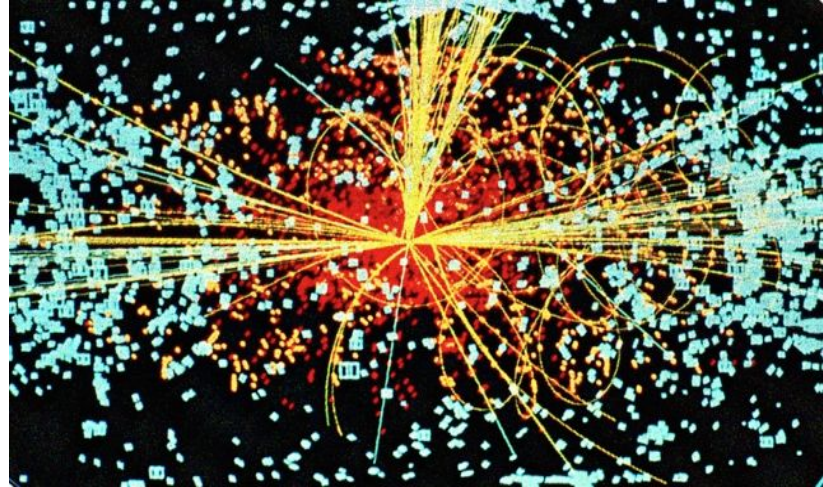
Project phase 2: physics data

Goal: choose the energy settings for an electron-positron collider in order to best measure the Weinberg angle parameter

Theory

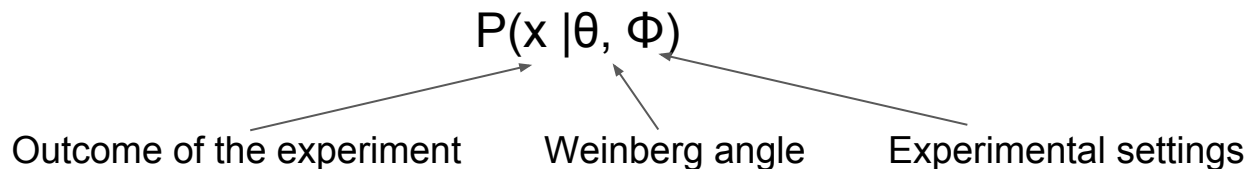


Experiment



Project phase 2: physics data

- Run a simulated experiment, generating data with an unknown distribution



- Estimate $P(\theta | x, \Phi)$
- Predict the experimental settings that measure the Weinberg angle with the least uncertainty

Thanks!