



University of Amsterdam

Nikhef



Reconstruction Meeting

Bouke Jung (bjung@nikhef.nl)

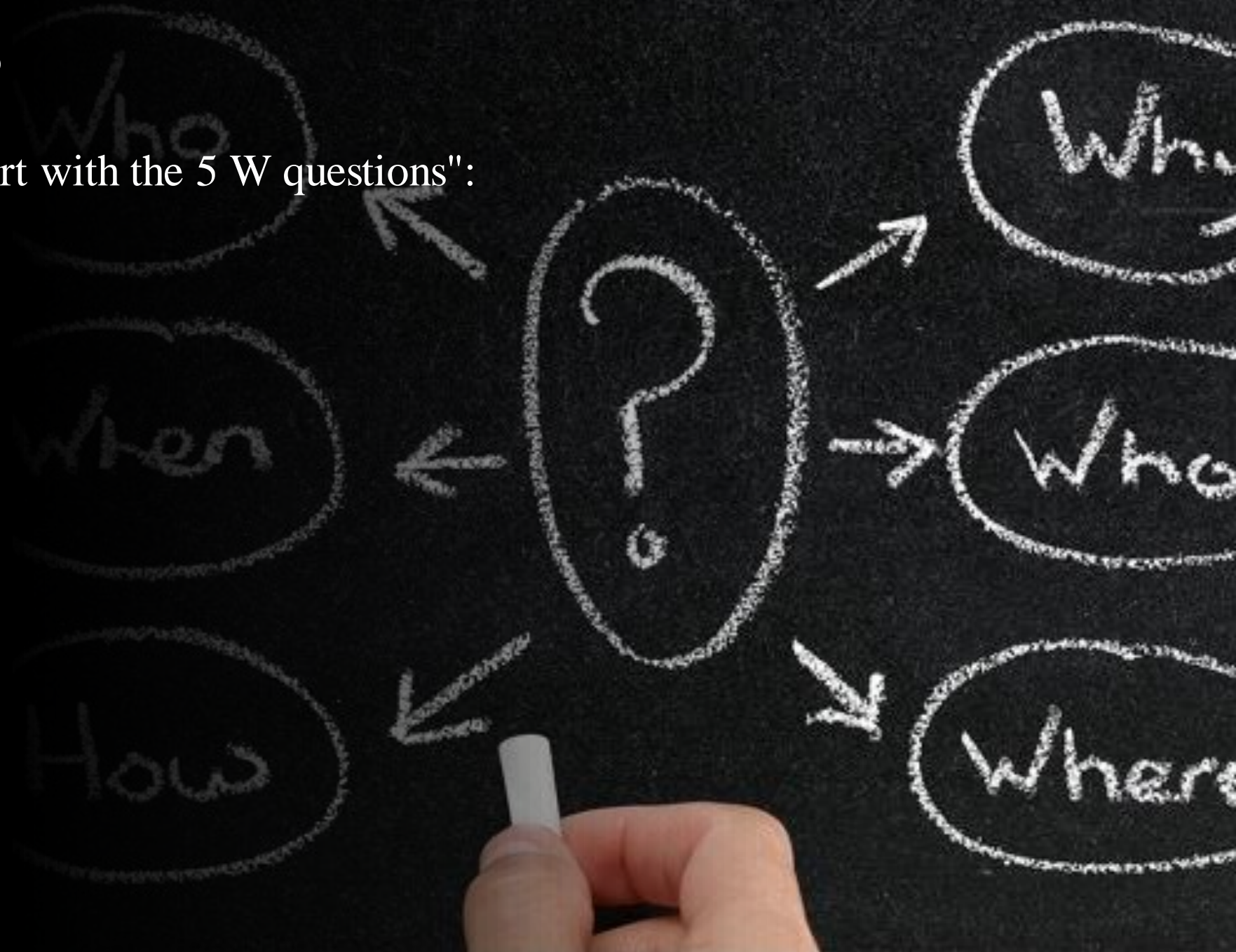
The Five W's

"Project planning should start with the 5 W questions":

1. Why?
2. When?
3. Where?
4. Who?
5. What?

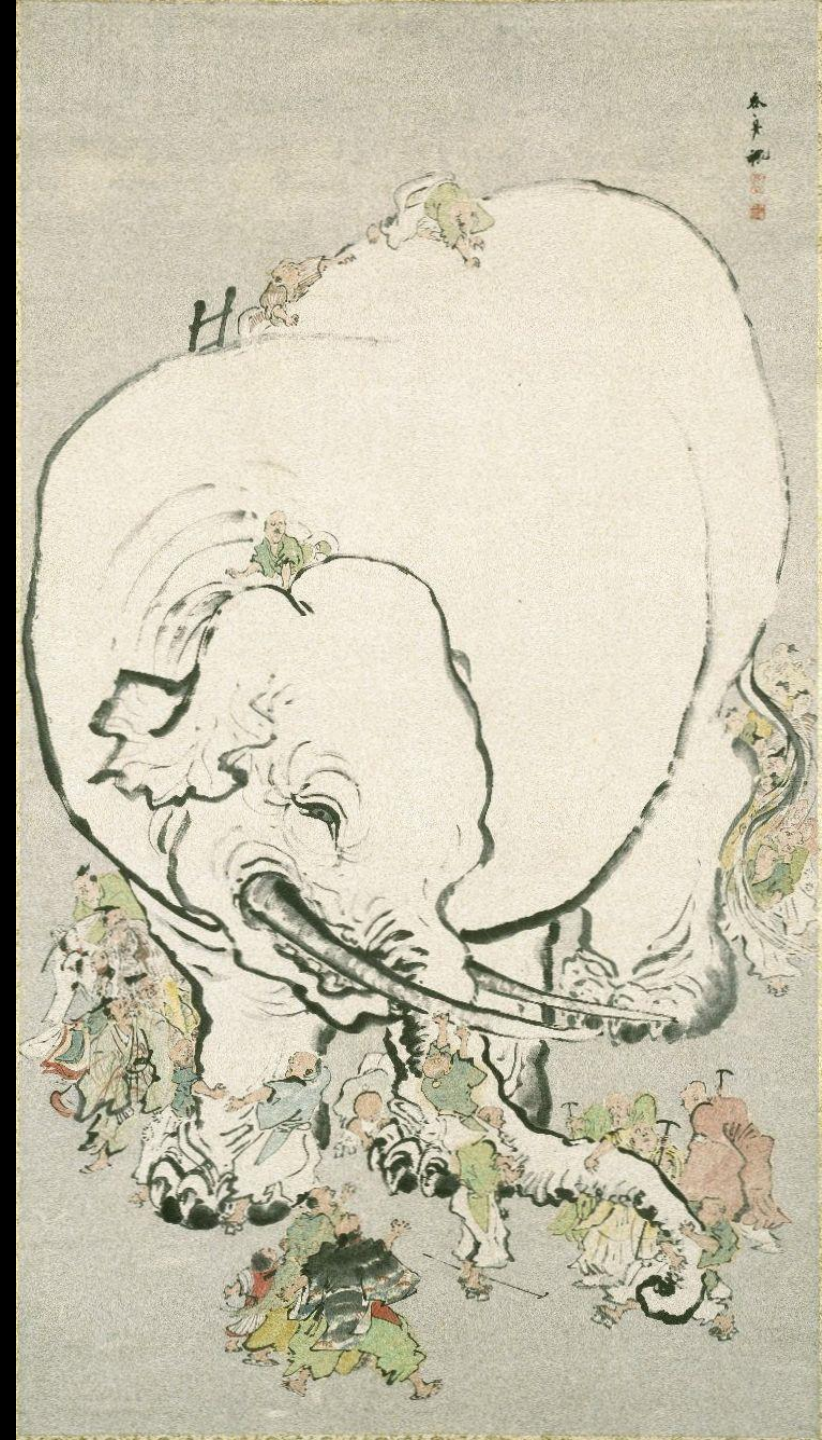
"Before getting to the how":

6. How?



Why?

- Current group meetings are large and suffer from time pressure
- ORCA and ARCA reconstruction people together
- We can benefit from each others knowledge and perspective!



When & Where?

Location:

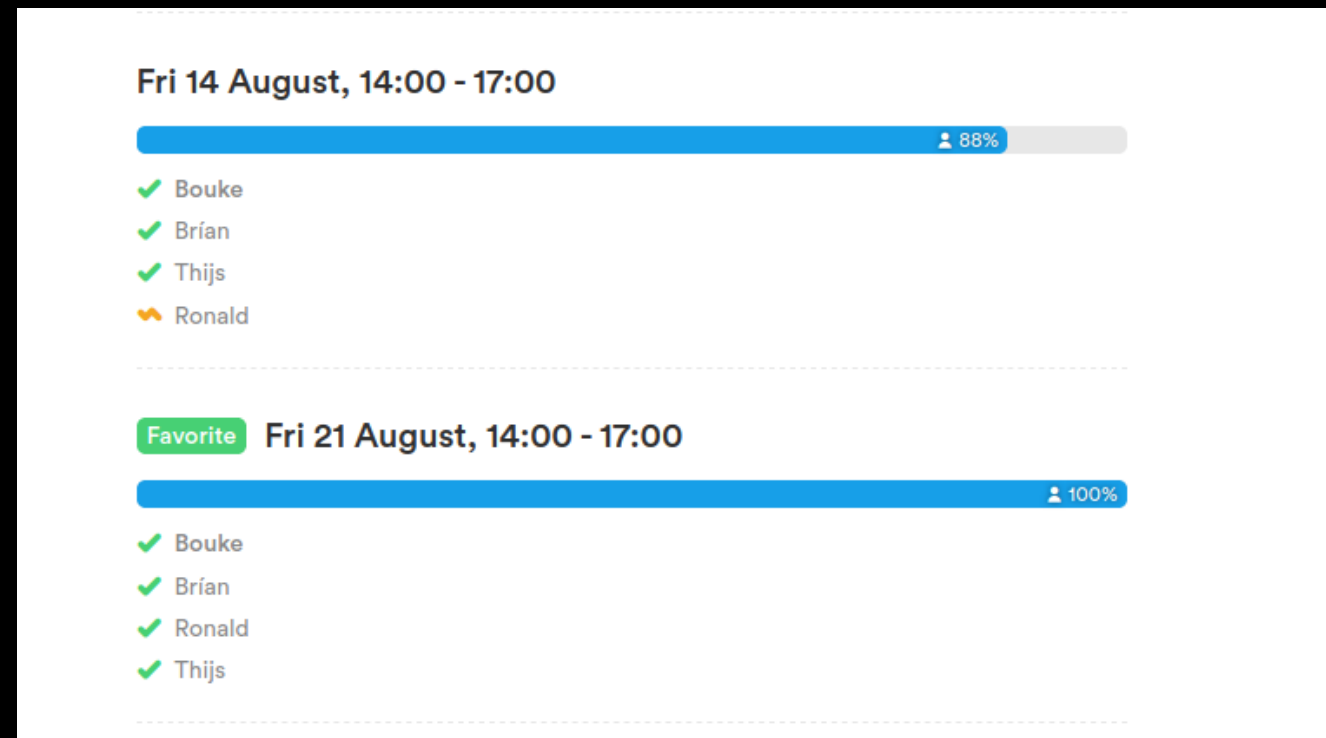
- Online meetings for the time being (Zoom)
- Material uploaded to Indico

Frequency / schedule:

- Once every two weeks?
- Proposal:
 - Friday afternoons
 - Every two weeks
 - Interchanged with ORCA meetings

Next meeting:

- Mid-August?



Who & What?

Accessibility:

- Maarten de Jong: "(...) start with a Nikhef open hour on this topic and then see how it goes"
- Strictly reco-people or open to all Nikhef-KM3NeTters?
- Anyone else?

Contents:

- On-going analyses
- Reviews of current reconstruction software
- Reconstruction techniques
- Software specifics
- ...

How?

- Aart:
"(obviously) this should not be a repeat of the existing (km3net-wide or nikhef group-meeting) meetings"
- Some possibilities:
 - Normal round
 - Longer, focused presentations
 - Mix of the two?
 - ...



Jpp Event Reconstruction

(Some ideas for future discussion)

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Introduction

ν -CC or -NC interaction

- Generates secondaries which emit Cherenkov light
 - Charged hadrons and leptons
 - Energetic knock-on electrons (δ -rays)

Light propagation

- Scattering
- Absorption

Light detection

- PMT hit:
 - i. Location
 - ii. Leading edge
 - iii. Time-over-threshold

Data Acquisition (DAQ)



Reconstruction



Introduction

ν -CC or -NC interaction

- Generates secondaries which emit Cherenkov light
 - Charged hadrons and leptons
 - Energetic knock-on electrons (δ -rays)

Backgrounds



Light propagation

- Scattering
- Absorption

Light detection

- PMT hit:
 - i. Location
 - ii. Leading edge
 - iii. Time-over-threshold

Inefficiencies



Data Acquisition (DAQ)



Reconstruction



Reconstruction Procedure

- For each event, reconstruct:

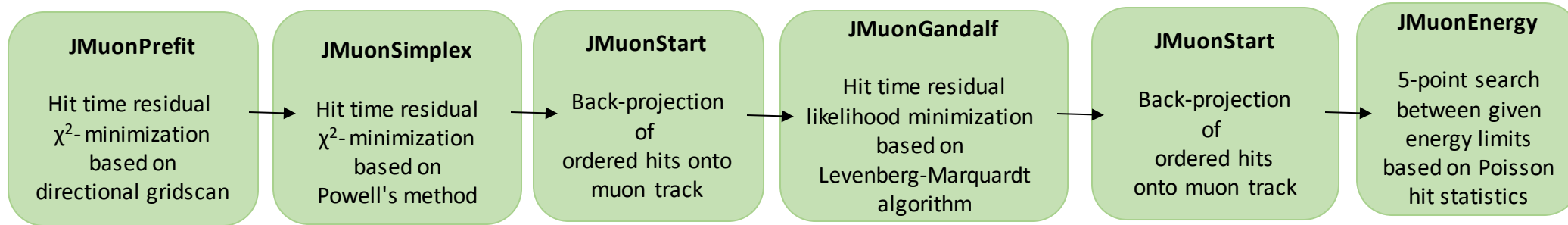
1. Interaction vertex
 2. Primary direction
 3. Primary energy
 4. Inelasticity
- Spatial-temporal hit correlations
↓
Poisson hit probabilities

- Different reconstruction chains for different event topologies:

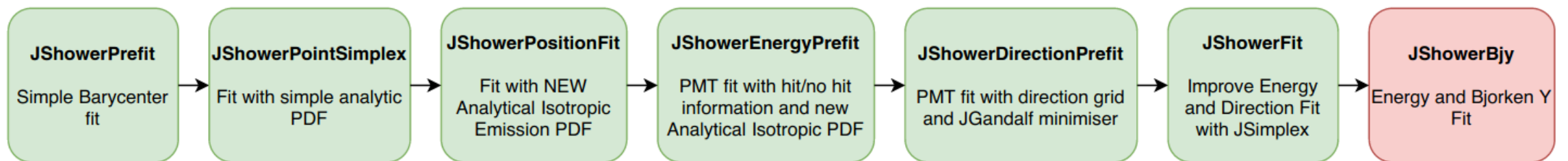
1. Showers
 - i. Hadronic
 - ii. Electro-Magnetic
 2. Tracks
 - i. Long-lived charged particles --> muons
- JShower-chain
JMuon-chain

Reconstruction Chains (software)

- JMuon chain

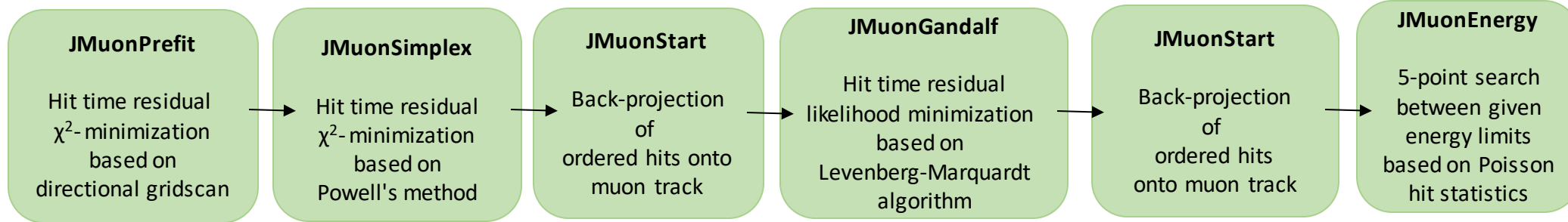


- JShower chain



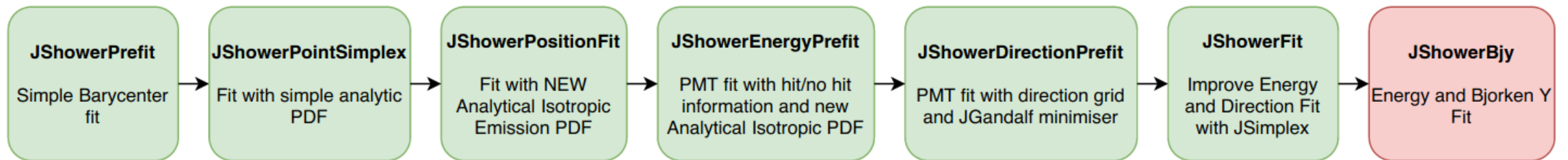
Discussion ideas

- JMuon chain



Based on Jpp arrival time PDFs

- JShower chain



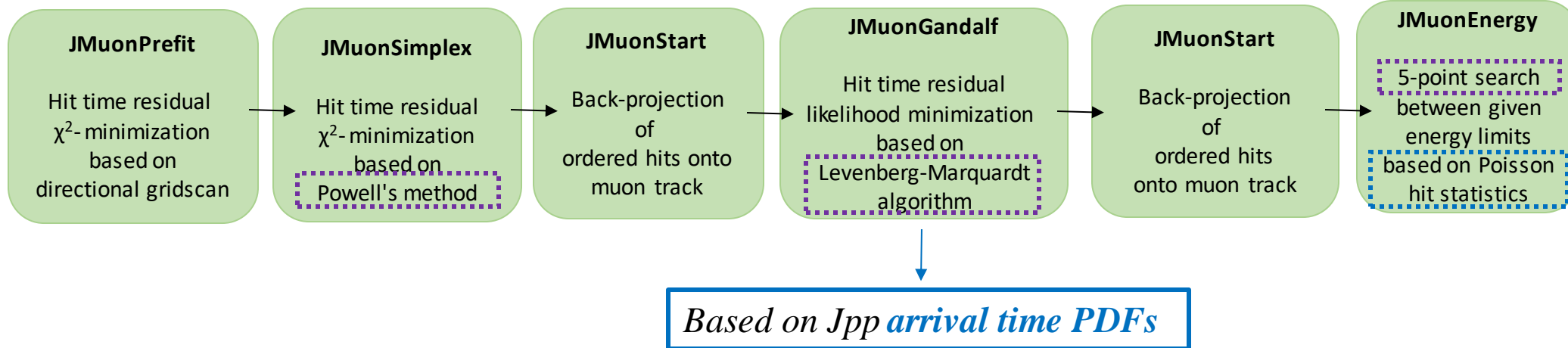
Some ideas for discussion

Probability densities

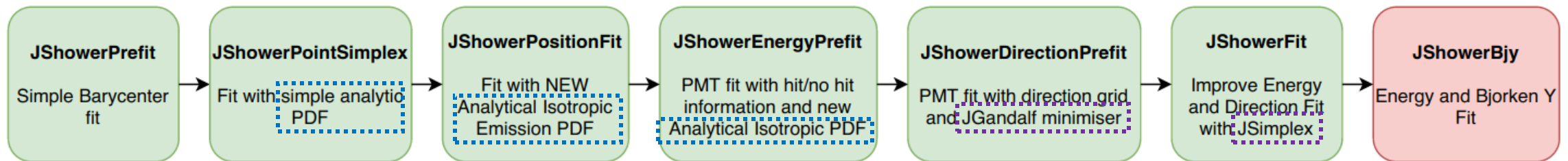
- *Event geometry*
- *Light propagation*
- *Light detection*
- *Elongation*

• JMuon chain

Individual software



• JShower chain



Algorithms

- *Minimization*
- *Clustering*



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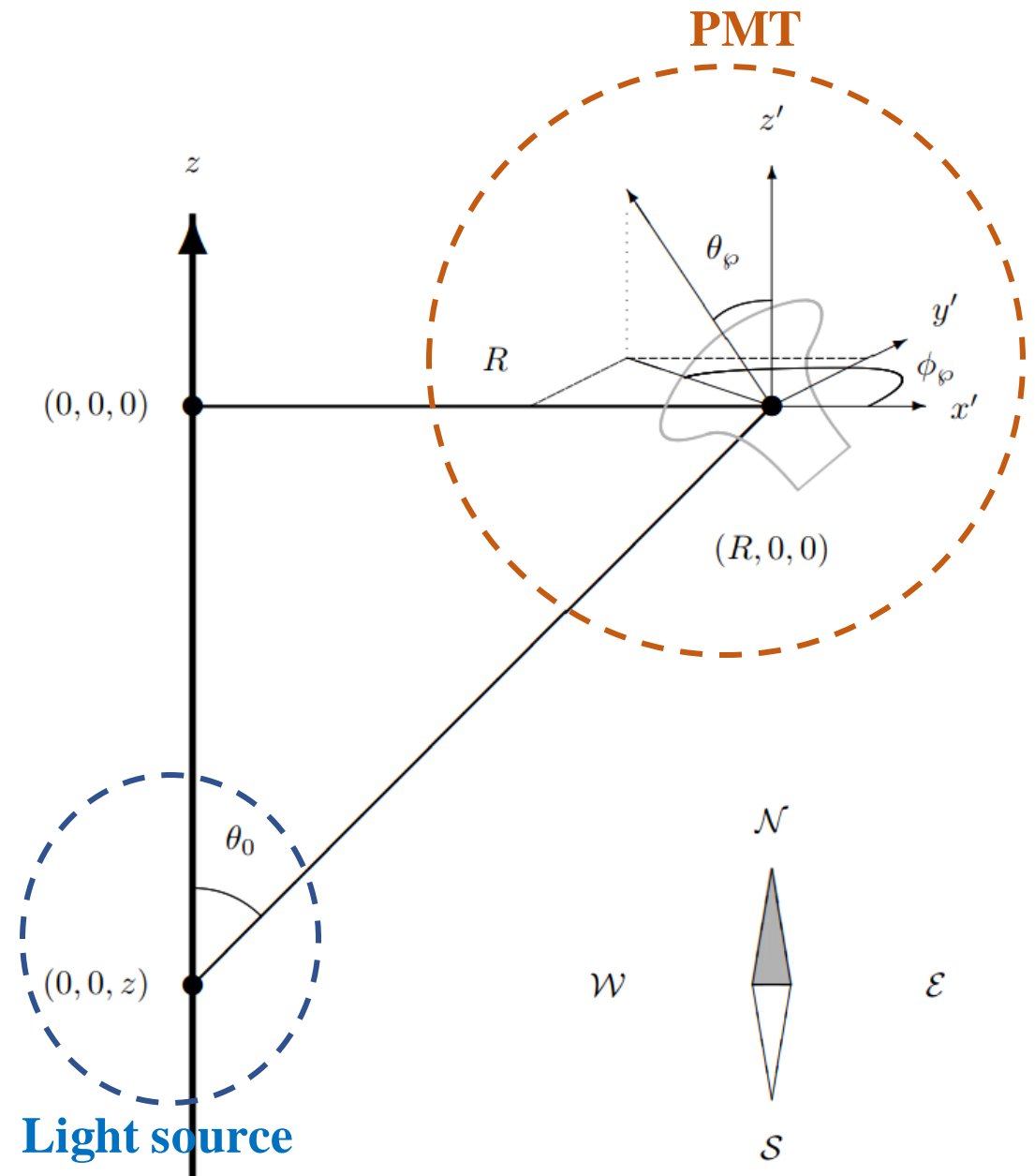


EXTRA

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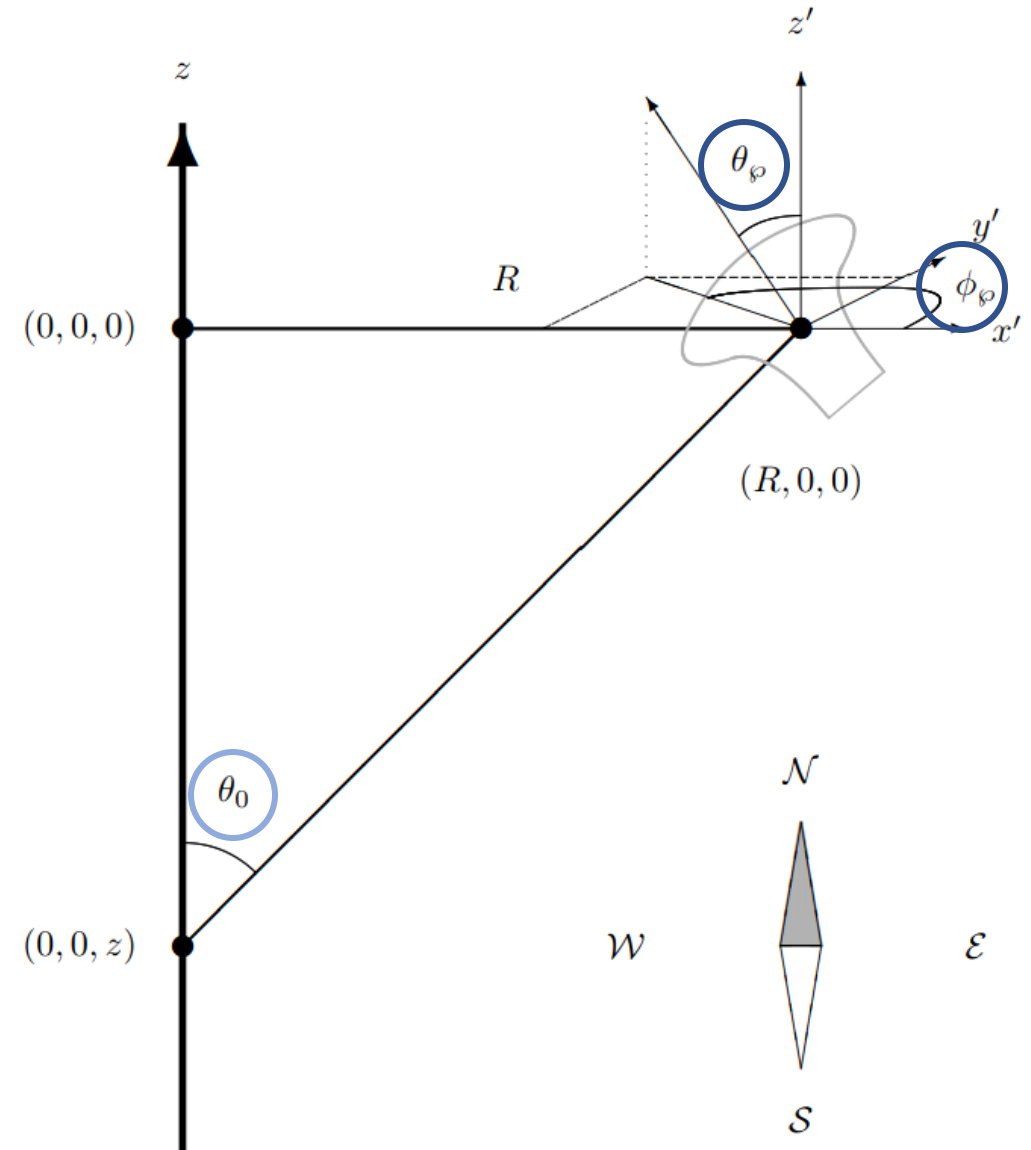
Arrival Time PDFs

- Yields the probability of observing N photo-electrons, given the:
 - Distance
 - Incidence angle
 - Time w.r.t. direct hit hypothesis
- Based on first-principle analytical descriptions of the:
 - Event geometry
 - Light emission profiles
 - Light propagation
 - Light detection



Event geometry

- Coordinate system defined
 - with z-axis pointing along
 - the muon direction (for tracks)
 - the primary direction (for showers)
 - with origin at intersection of z-axis with transversal plane containing PMT
 - with PMT on the x-axis
- Requires 3 steps:
 1. Rotate z-axis into muon/primary direction
 2. Translate origin into the transversal plane containing the PMT
 3. Rotate PMT onto the x-axis
- PMT orientation defined by **two angles**
- Photon direction defined by **emission angle**



Light production

- Coordinate system defined
 - with z-axis pointing along
 - the muon direction (for tracks)
 - the primary direction (for showers)
 - with origin at intersection of z-axis with transversal plane containing PMT
 - with PMT on the x-axis
- Requires 3 steps:
 1. Rotate z-axis into muon/primary direction
 2. Translate origin into the transversal plane containing the PMT
 3. Rotate PMT onto the x-axis
- PMT orientation defined by **two angles**
- Photon direction defined by **emission angle**

