

# From partons to jets...

## how the strong force hides its power

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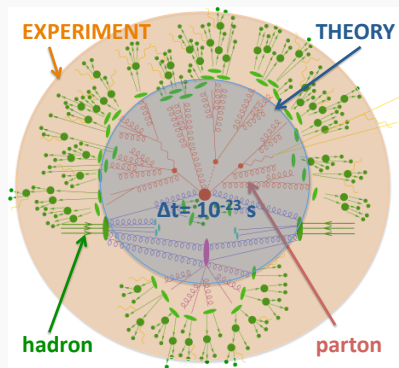
### Facts and Figures

- strong force is the interaction between quarks and gluons == partons
- **partons is what an atomic nucleus (us!!) is made of ☺**
- partons are quite "shy" about their "strong" properties...
- they prefer to cluster together inside objects that have no "strong" charge
- these chargeless objects are called "hadrons" and can be measured!

### IN TECHNICAL TERMS...

- ✓ **asymptotic freedom**: the strong force gets stronger as the distance increases
- ✓ **colour confinement**: observable particles have no strong charge

### THE OUTCOME IS QUITE "MESSY":



proton-proton collision at event generation level  
[<http://dx.doi.org/10.1016/j.pnpnp.2004.02.031>]

### Jets

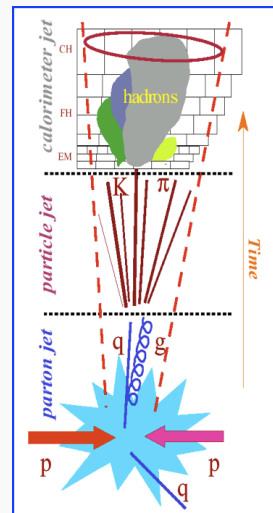
- 1 high energy parton → many hadrons!!!
- the parton radiates most of its energy in form of other partons ( $E=mc^2$ ), until they all have an energy low enough to cluster into hadrons: blue ball in the picture ☺

The radiation phase is called **Parton Shower** and can be analytically described. When the momentum transfer-squared becomes smaller than  $\sim$  few  $\text{GeV}^2$ , then the theory can not be analytically calculated → **hadronisation models**.

- if the hadrons coming from a parton are identified and combined properly, then they mirror the initial parton properties
- this proper combination is called **jet!**
- **a jet is what an experimentalist studies:**

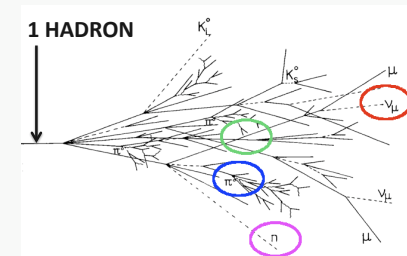


every hadron leaves a "signal" in our detector ATLAS: the signals have to be interpreted and understood to see the parton behind the scene...



### Hadronic Calibration

- 1 hadron interacting with the detector produces other particles: **hadronic shower**



- the shower energy consists of:
    - **electromagnetic (em) energy**  $\sim$  50 %
    - **visible non-em energy**  $\sim$  25 %
    - **invisible energy**  $\sim$  25 %
    - **escaped energy**  $\sim$  2%
- NOT MEASURED  
TO BE RECOVERED  
→ **CALIBRATION**

### LOCAL HADRON CALIBRATION in ATLAS:

- recovers the energy of every hadron
- jet is built from the calibrated hadrons

This calibration is based on clusters:

1. if the cluster contains invisible energy, this is recovered [e/n compensation]
2. the energy discarded by the cluster algorithm is recovered
3. the energy deposited in the dead part of the detector is recovered
4. jet is built from the calibrated clusters
5. jet corrections are applied for the hadrons lost before the calorimeter

**CALIBRATED JET → COMPARABLE TO THEORY !!! ☺**