Which ingredients are important for what in cosmological simulations?

(or: which gaps should we mind when?)

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Most of this is in astroph/ 1211.1021 & 1211.3120
<table>
<thead>
<tr>
<th>Subgrid models for:</th>
<th>'Constrained' by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cooling</td>
<td>• Observations</td>
</tr>
<tr>
<td>• Multi-phase gas</td>
<td>• Physics</td>
</tr>
<tr>
<td>• <strong>Star formation</strong></td>
<td>• Higher resolution simulations</td>
</tr>
<tr>
<td>• Stellar evolution &amp; IMF</td>
<td></td>
</tr>
<tr>
<td>• Feedback from SF</td>
<td></td>
</tr>
<tr>
<td>• AGN growth and feedback</td>
<td></td>
</tr>
<tr>
<td>• ...</td>
<td></td>
</tr>
</tbody>
</table>
OWLS
Redshift 2
Baryonic particle mass: 2e6 Msun/h
Feedback variations
'Other' variations
• Winds implemented *kinetically*
• 40% of SN Energy
- Winds implemented *kinetically*
- 40% of SN Energy
- Mass loading and velocity constant:
  - Mass loading varied by factors of 2
  - Velocity varied by factors of $\sqrt{2}$

*None of these models is better motivated than any of the others!*
- OWLS, $z=0$
- Factor 2 difference in feedback energy
- Put only in mass loading ($v = 600$ km/s)
\[ \Sigma_{\text{SFR}} \propto \Sigma_{\text{gas}}^n \]

- \( n = 1.4 \) (as observed)  
- \( (1.75) \)

- Normalization as observed \((x3)\)

Schaye & Dalla Vecchia (2008)
• Schaye+10
Feedback energy

Net cooling

Gas supply

Lower SFR (Less gas)

Equilibrium SFR

Higher SFR (More gas)

See also Schaye+10, Bouche+10, Davé+12, Lilly+13, MRH+13a,b
Implications of self-regulation

- **Outflow rate set by inflow rate:**
  - Not dependent on SF FB efficiency
  - Not dependent on AGN FB efficiency
  - Not dependent on SF law (which sets amount of gas)
Implications of self-regulation

- **Outflow rate set by inflow rate:**
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  - Not dependent on SF law (which sets amount of gas)

- **Stellar mass strongly dependent on SF FB:**
  - Inversely proportional to outflow efficiency
  - \( M_\ast - M_{\text{halo}} \) practically assumed (stellar mass function!)
• Implementation on different scales should be different (i.e. resolution dependent!)

• How do SNe → superbubble → winds evolve?

• Depends on local conditions!
Same for star formation
Recap – Which gaps to mind when

- Inflow & Outflow: *Always.*
  - Stellar mass build-up
  - Gas around galaxies
  - Mass/luminosity function, (intrinsic) colors etc.

- ISM physics
  - Gas fraction
  - Structure of ISM
  - Second order influence on emergence of outflows
Different hydro solvers vs different subgrid physics

Vogelsberger+ (2012)
See also Scannapieco+12

Vogelsberger+ (2013)
Varying the efficiency of AGN feedback

Booth & JS (2009)