Host rumen gene expression modules associated with methane emissions

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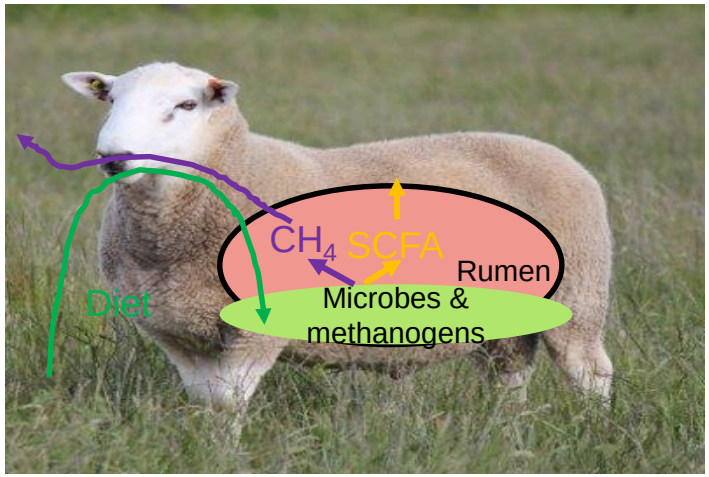
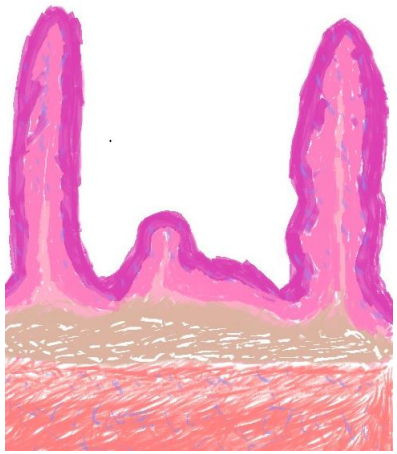
CH4: a complex phenotype



- CH_4 is a consequence of interaction between the diet, rumen microbes and the rumen wall
- Diet and microbial manipulations have been extensively studied
- The role of the multilayered rumen in the rumen-diet-microbe interaction?



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Understanding the host biology

Opening the black box:

- How the rumen interacts with the diet?
- Is host muscular or epithelial layer more involved?
- Consistent host biological processes correlated with CH_4?

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Rumen wall RNA sequencing

- High throughput quantification of expression of all of the genes in the rumen wall (not the microbiome or host DNA)
- Molecular features of tissue/cell activities
- Gene-gene relationships: base line biology
- Gene-phenotype relationships: tissue/cell responses to environment stimuli

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New Zealand and Australian experiments

Location	Sample size	Diet perturbation
NZ	24	large
AUS	62	small

- Ventral sheep rumen sample RNA sequenced
- First step: identify global gene-gene relationships

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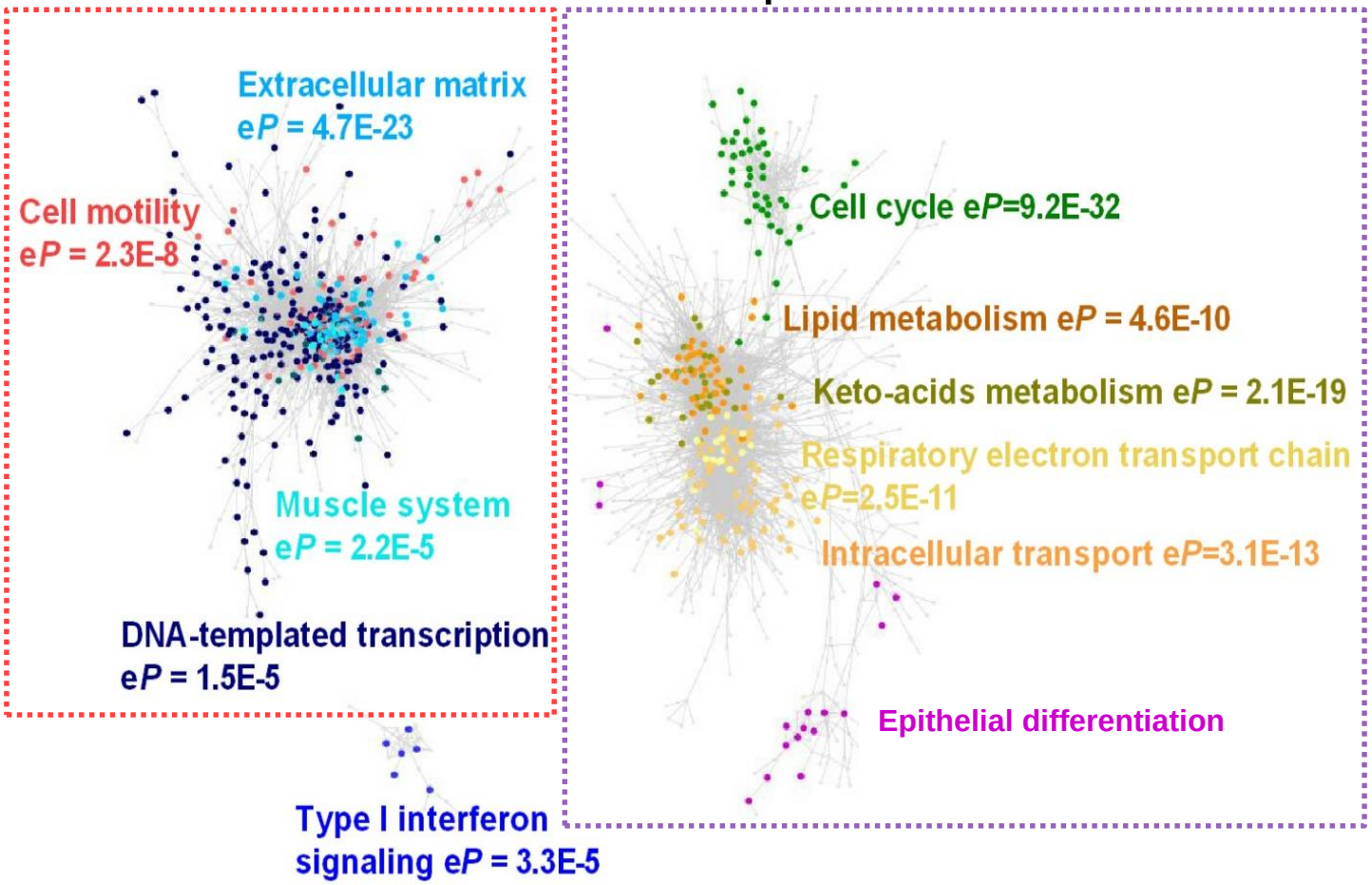
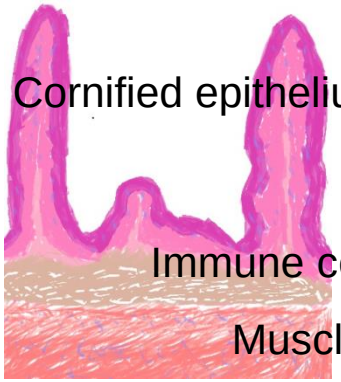
NZ Gene-gene relationship reconstitutes rumen muscle and epithelial layers

Muscle related

Epithelial-related





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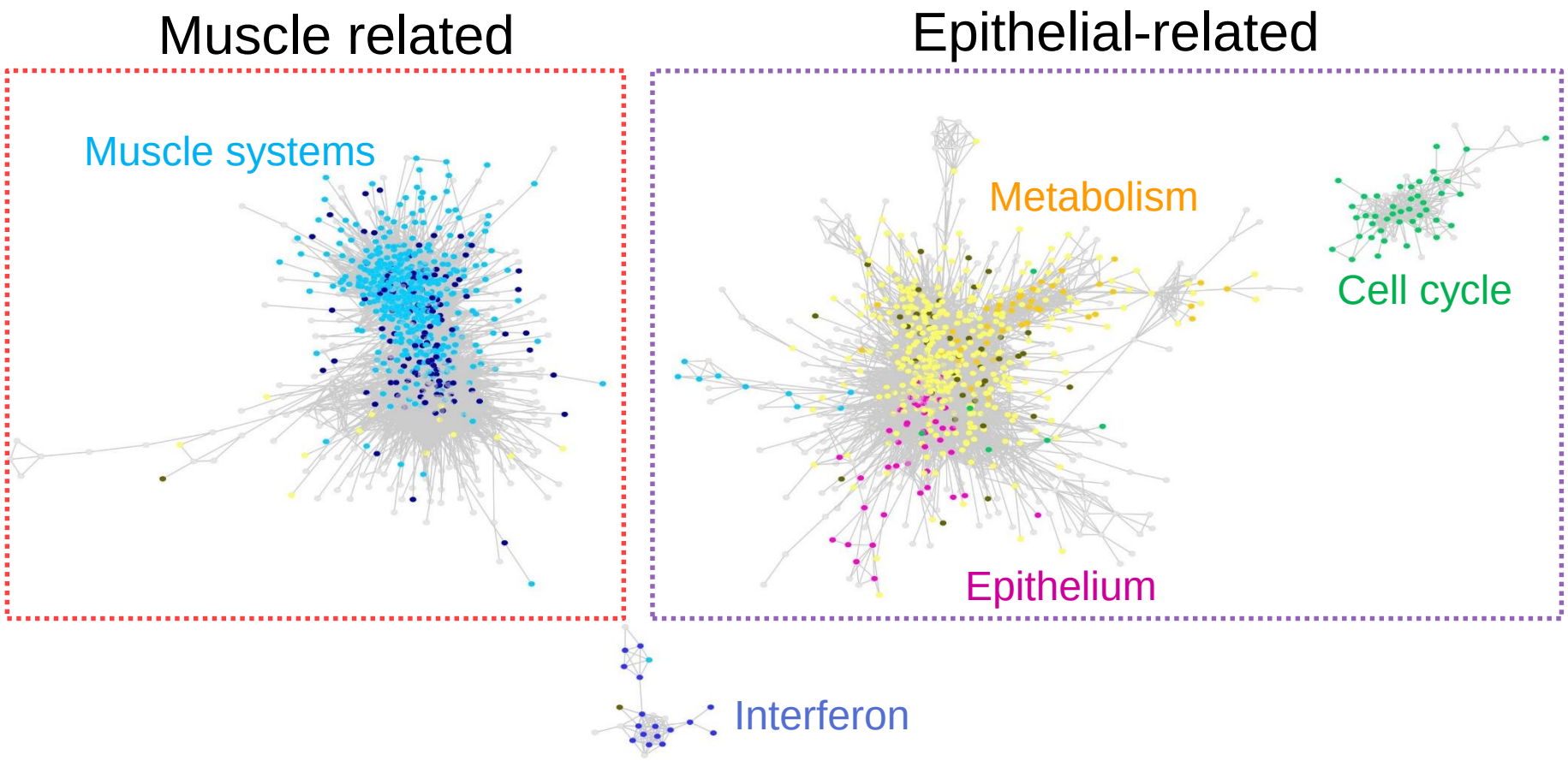
Recreation of rumen gene-gene relationships in AUS data



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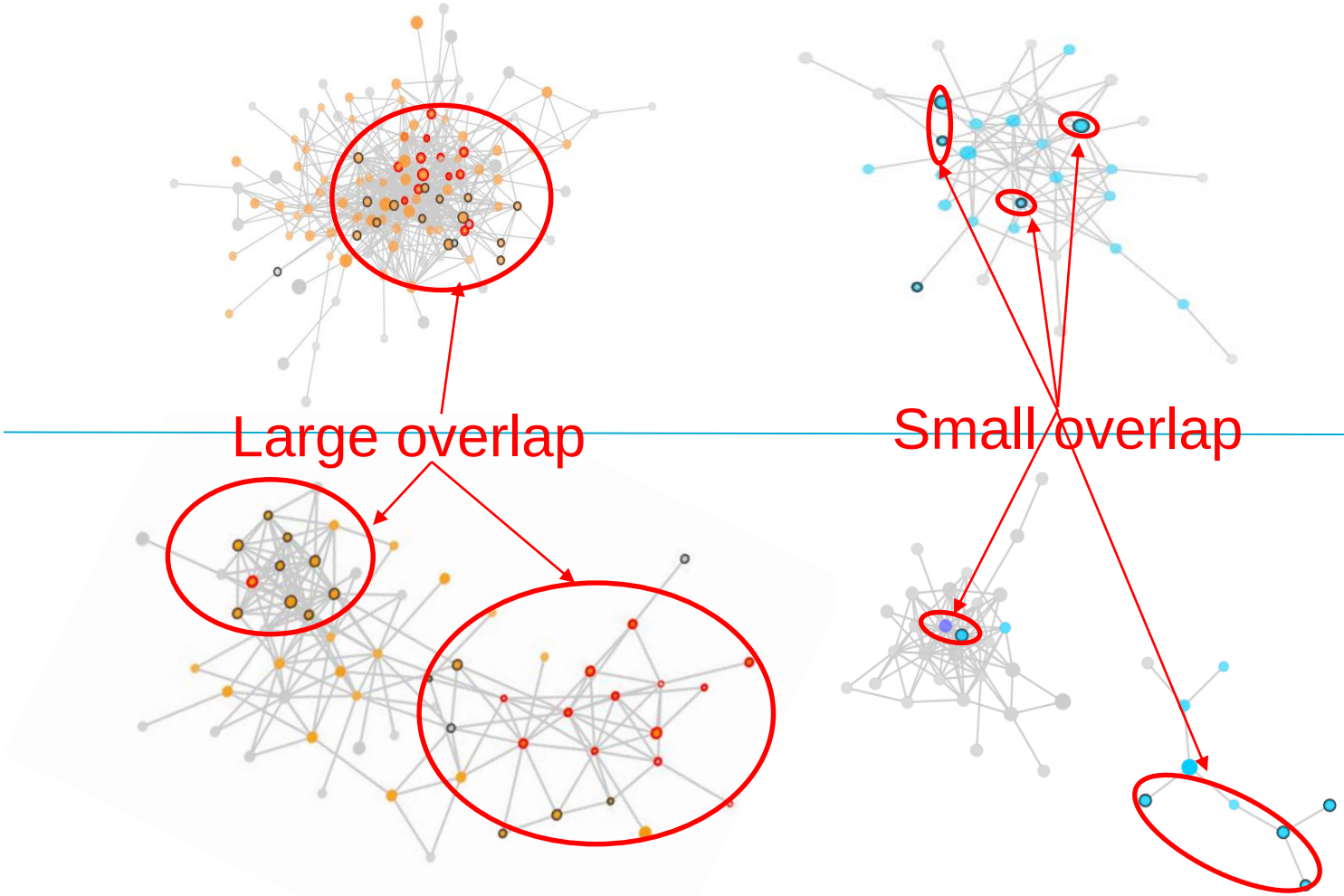
Gene-phenotype relationships for CH4 / DMI

Metabolic genes, + correlated with yield

Muscle genes, - correlated with yield



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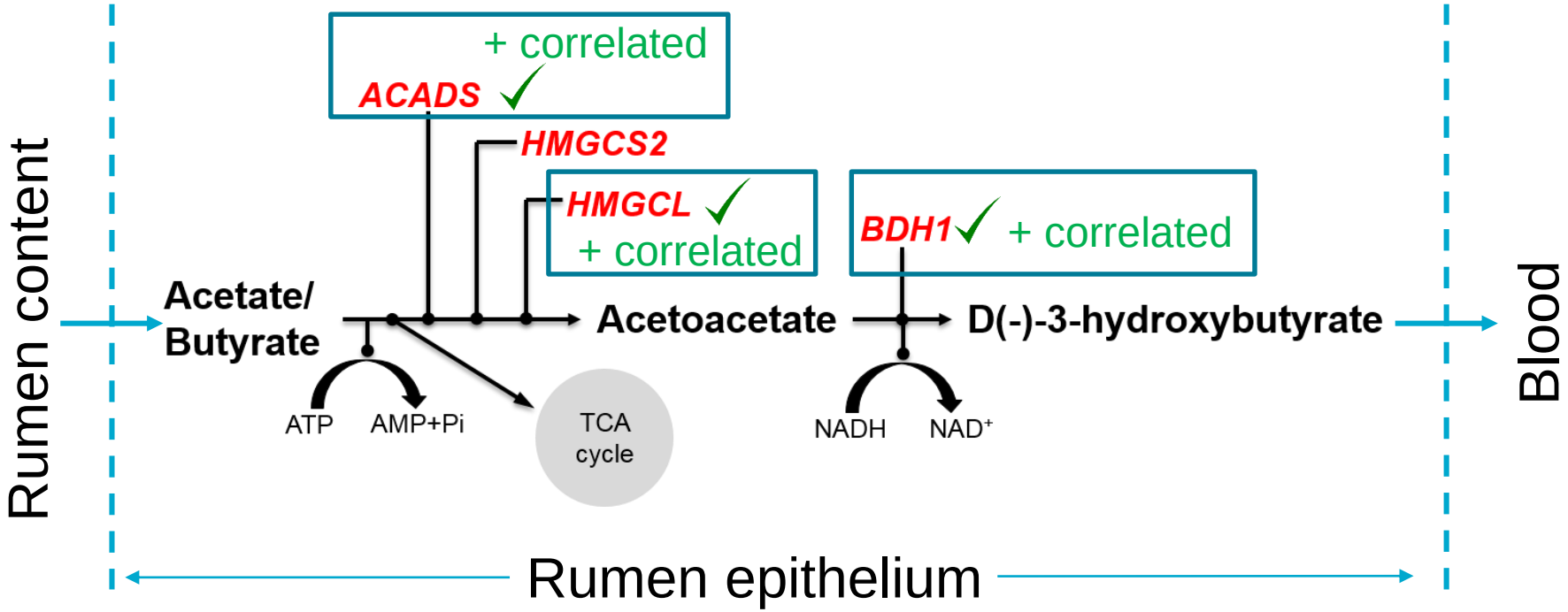
Ketone body metabolic pathway

An important rumen lipid metabolic feature:



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Conclusions

- Consistent gene modules related to methane traits in different datasets
- Rumen lipid metabolic gene members
- Positive relationships between methane emission and host energy intake?

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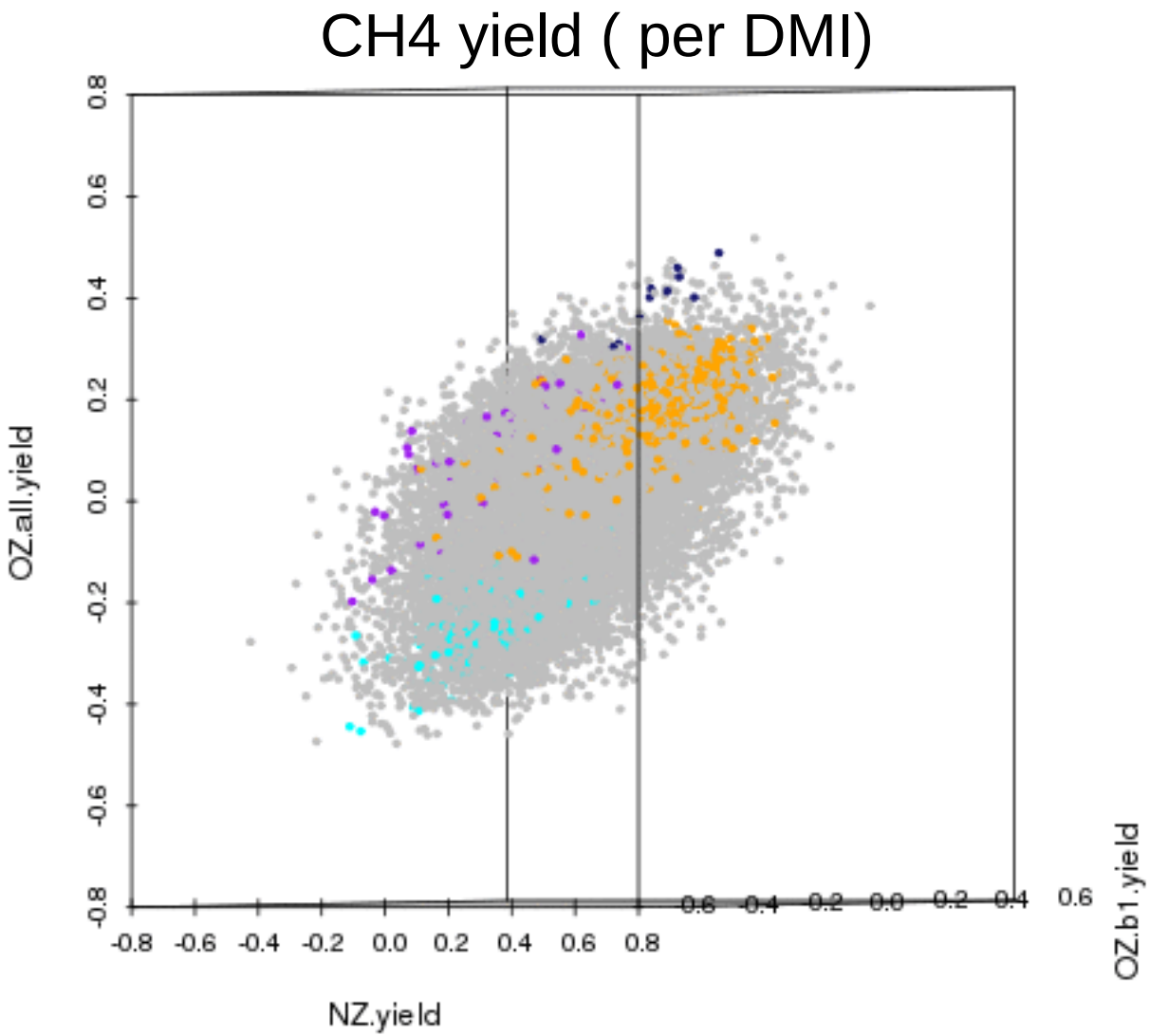
Acknowledgements

Jude Bond, Jody McNally, Margaret Cameron, Katie Austin, David Tucker, Phil Vercoe and many more…

Global gene-phenotype relationships



Gene sets colours:

Muscle systems

Metabolism

Cell cycle

Epithelium

Interferon

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