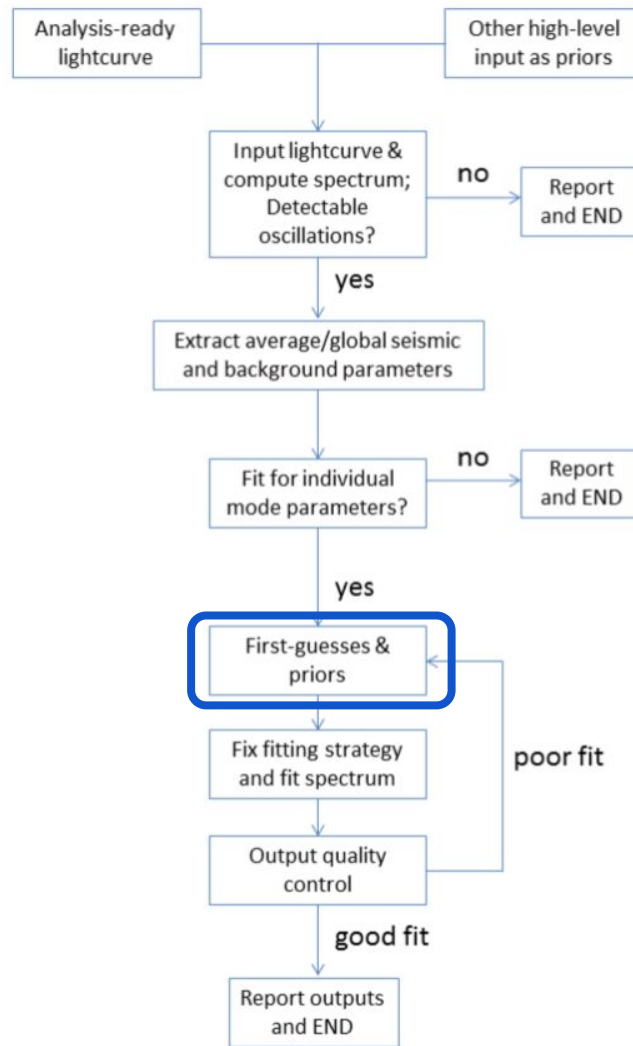




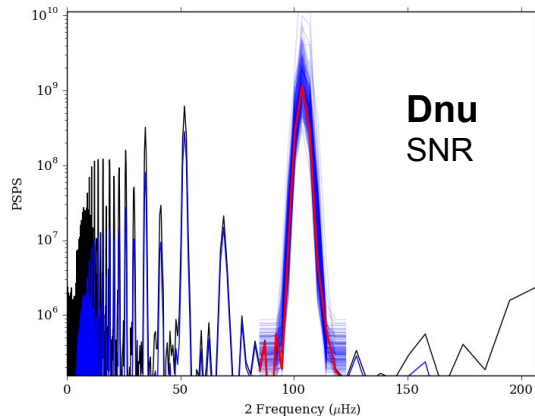
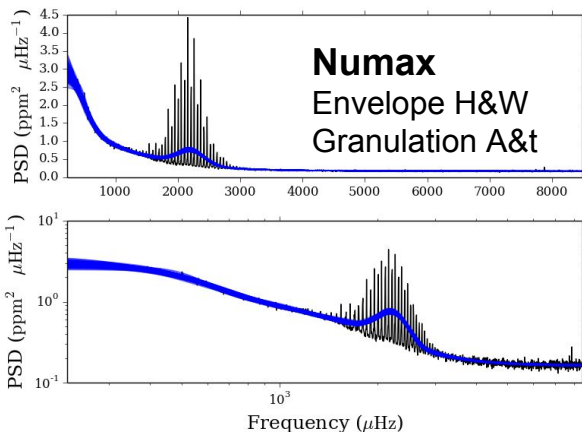
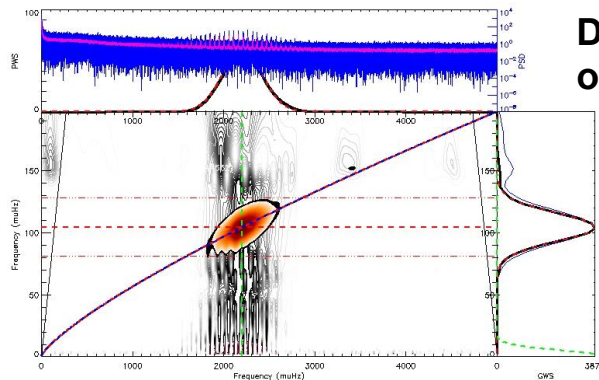
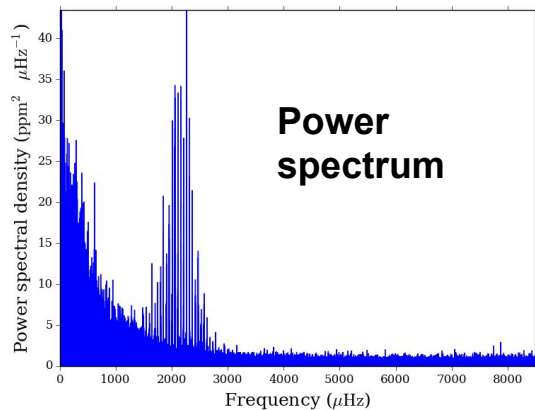
The first guess

Machine learning robust priors

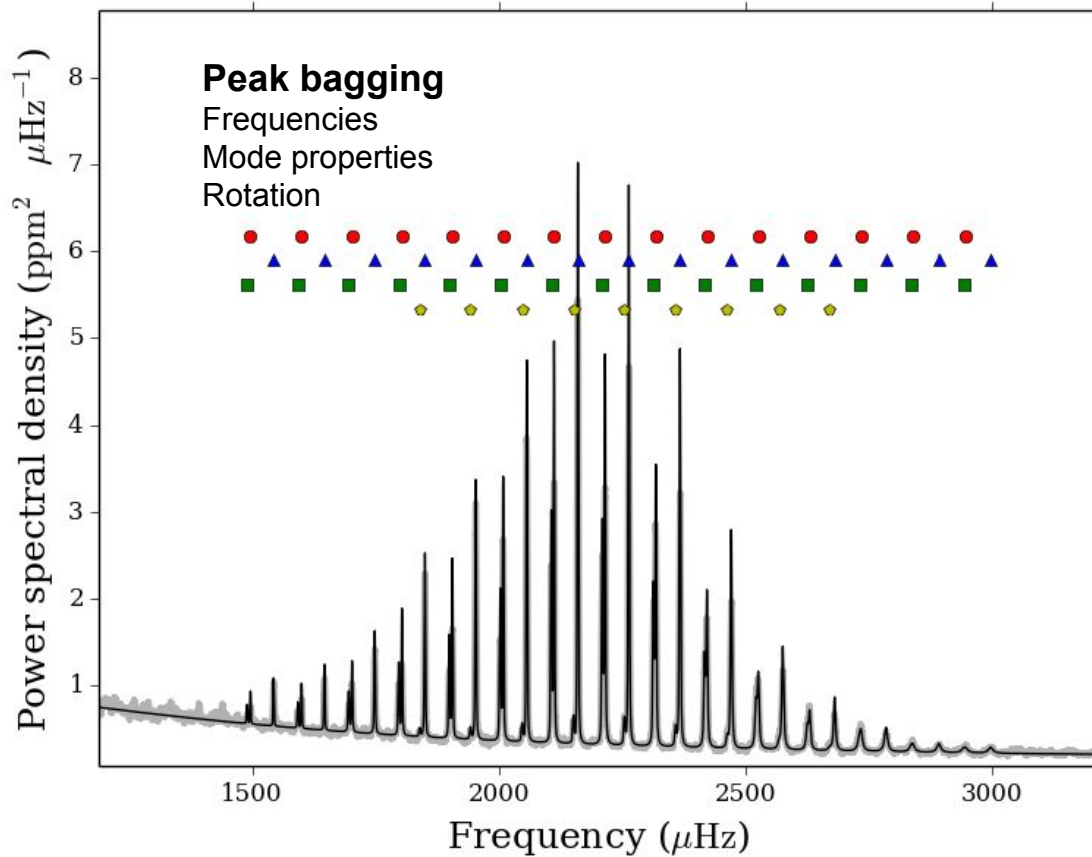
Guy R. Davies



Automated peak bagging: The beginning



The end point





Some decisions need to be made!

Encode prior knowledge into decision process

Mode ID

Which modes to fit

Model to fit

Quality control of output

Processes and choices largely understood. Implementation and fine tuning still required.

Mode ID: The problem is solved ...

THE ASTROPHYSICAL JOURNAL LETTERS, 751:L36 (7pp), 2012 June 1
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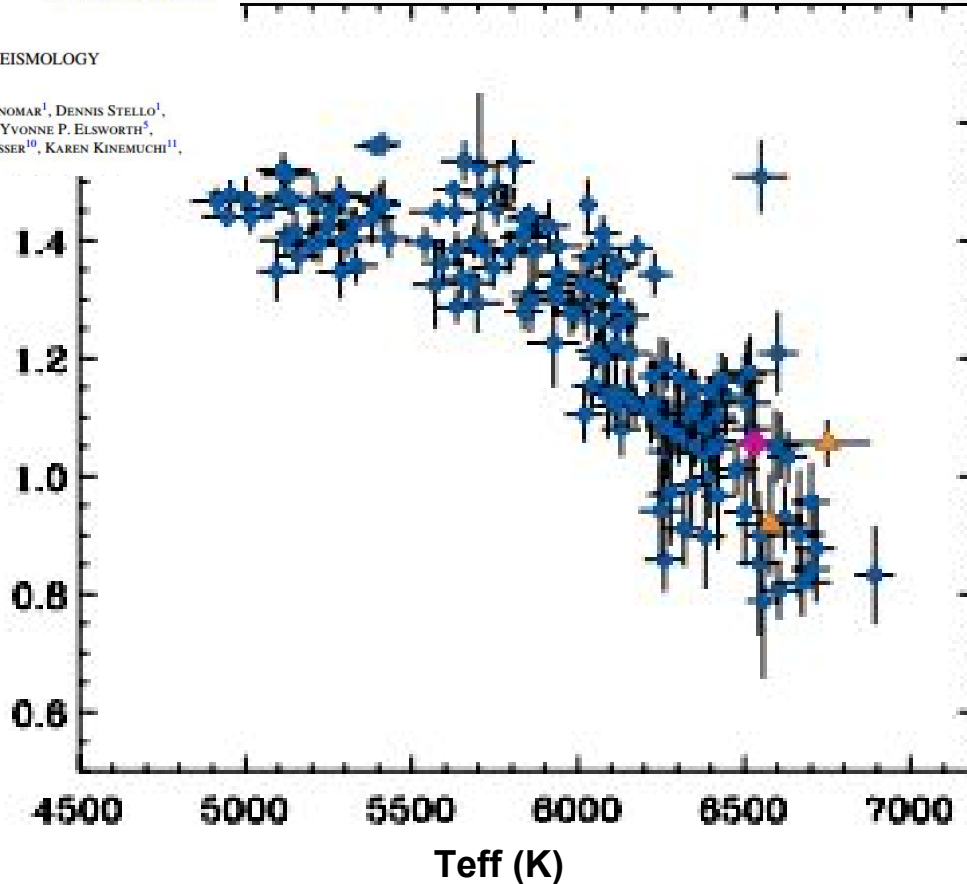
doi:10.1088/2041-8205/751/2/L36



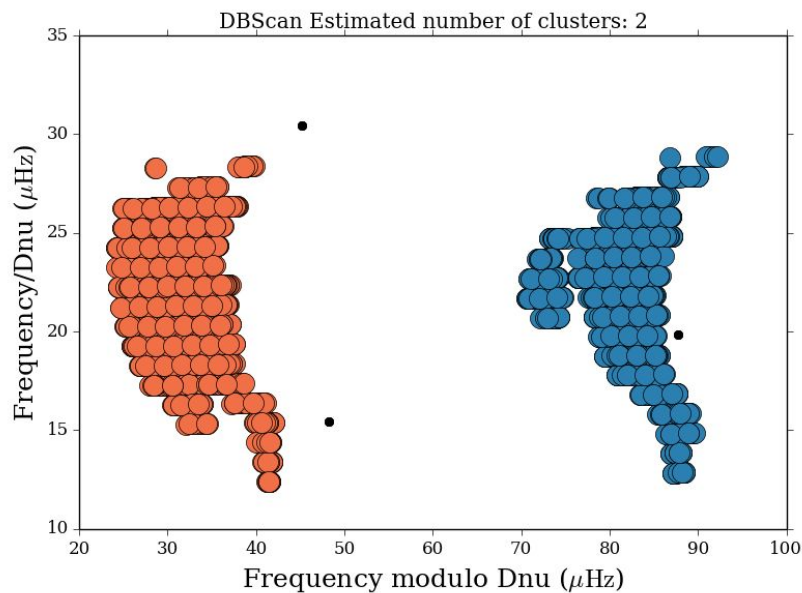
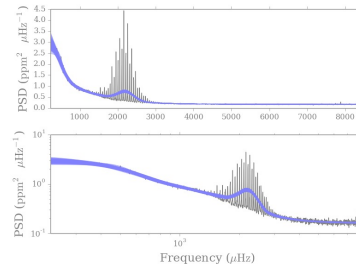
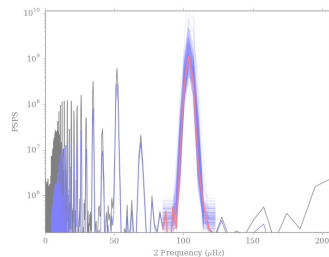
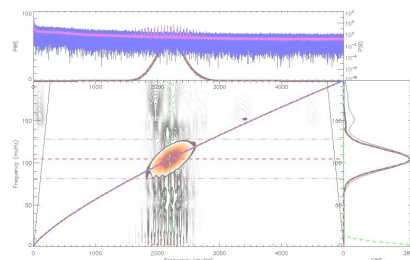
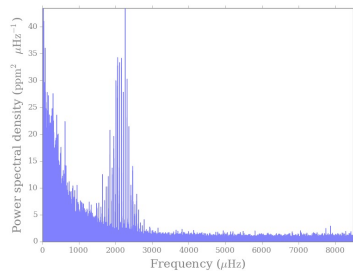
SOLVING THE MODE IDENTIFICATION PROBLEM IN ASTEROSEISMOLOGY OF F STARS OBSERVED WITH *KEPLER*

TIMOTHY R. WHITE^{1,2}, TIMOTHY R. BEDDING¹, MICHAEL GRUBERBAUER³, OTHMAN BENOMAR¹, DENNIS STELLO¹,
THIERRY APOURCHAUX⁴, WILLIAM J. CHAPLIN⁵, JØRGEN CHRISTENSEN-DALSGAARD⁶, YVONNE P. ELSWORTH⁵,
RAFAEL A. GARCÍA⁷, SASKIA HEKKER^{5,8}, DANIEL HUBER^{1,9}, HANS KJELDSEN⁶, BENOÎT MOSSER¹⁰, KAREN KINEMUCHI¹¹,
FERGAL MULLALLY¹², AND MARTIN STILL¹¹

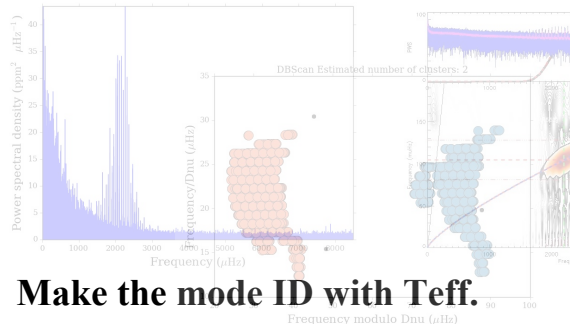
Epsilon



Automated peak bagging: ML Clustering



Automated peak bagging: Bayesian or ML Classification

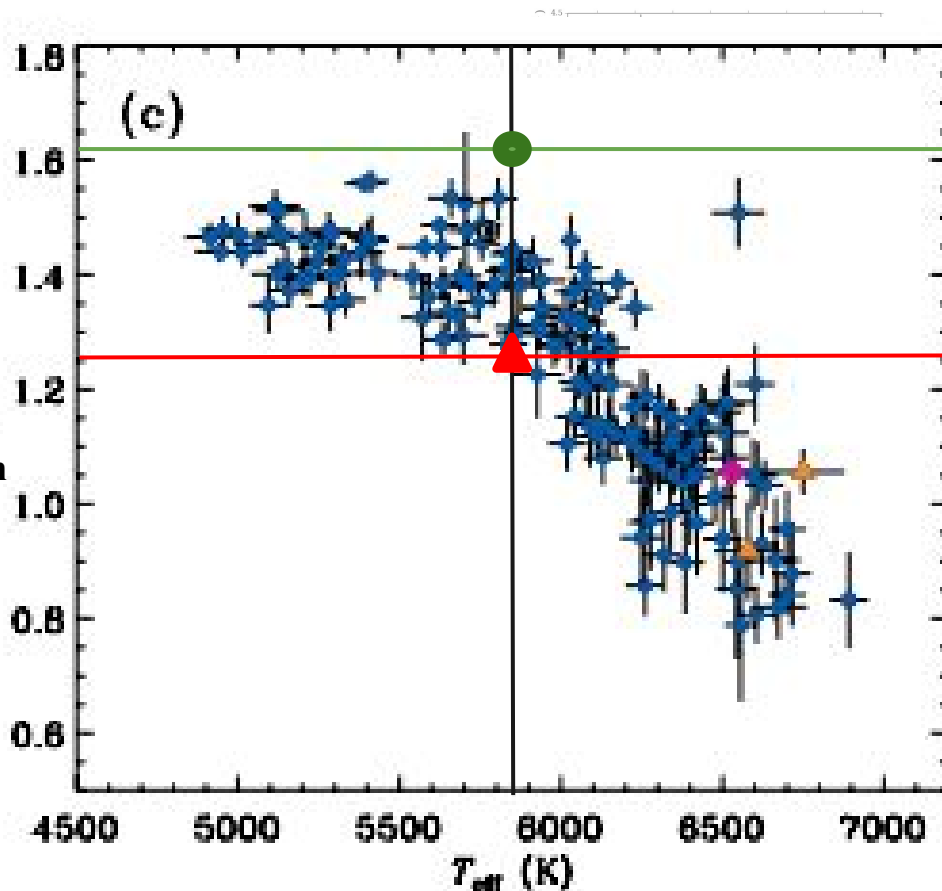


Make the mode ID with T_{eff} .

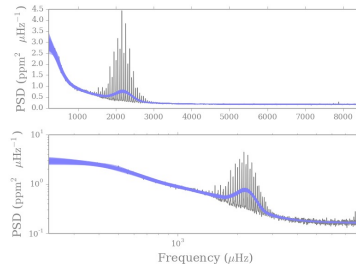
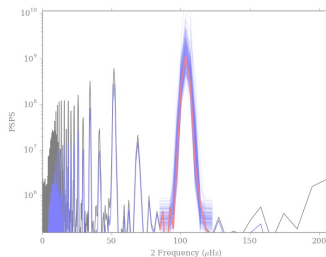
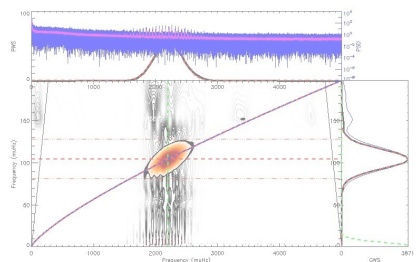
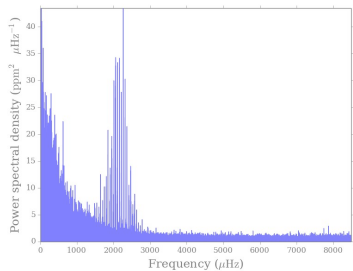
$T_{\text{eff}} = 5825 \text{ pm } 50$

epsilon = 1.25 or 1.62

Epsilon



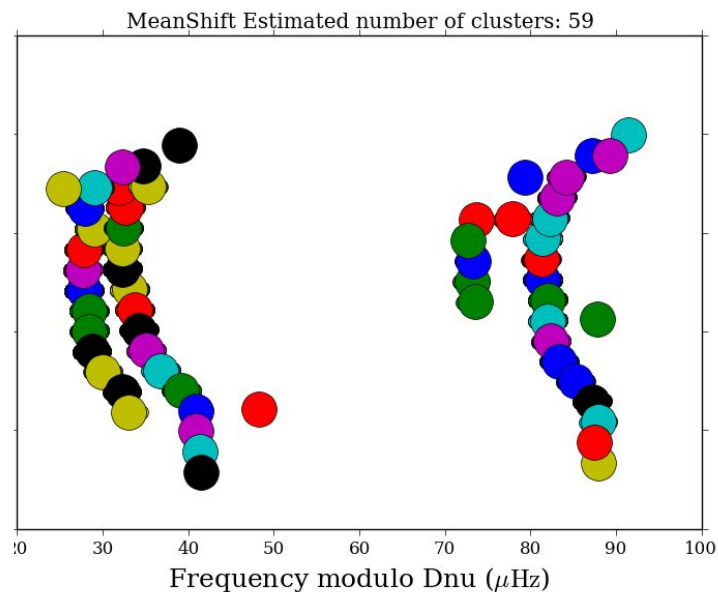
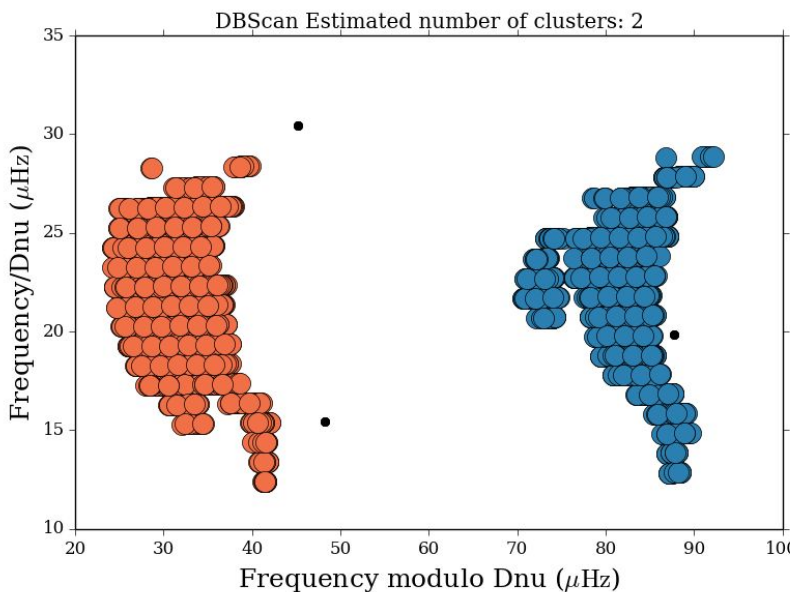
Automated peak bagging: ML Clustering



Locate the ridges of odd and even l.

Locate the modes of oscillation.

Total time ~ 130s





$$p(D|\vec{\theta}, p_a) = (1 - p_a) p(D|H_0, \vec{\theta}) + p_a p(D|H_1, \vec{\theta}),$$

**The likelihood
function**

**The probability of observing
some data given some model
multiplied by the probability
that the model is correct**

**The probability of observing
the same data given some
other model multiplied by the
probability that this model is
correct**



This *or* That

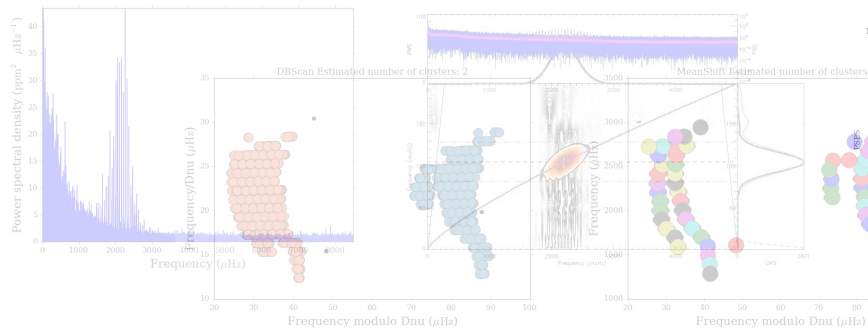
$$p(D|\vec{\theta}, p_a) = (1 - p_a) p(D|H_0, \vec{\theta}) + p_a p(D|H_1, \vec{\theta}),$$

The likelihood
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some data given some model
multiplied by the probability
that the model is correct

The probability of observing
the same data given some
other model multiplied by the
probability that this model is
correct

Automated peak bagging: Bayesian and ML mixture models



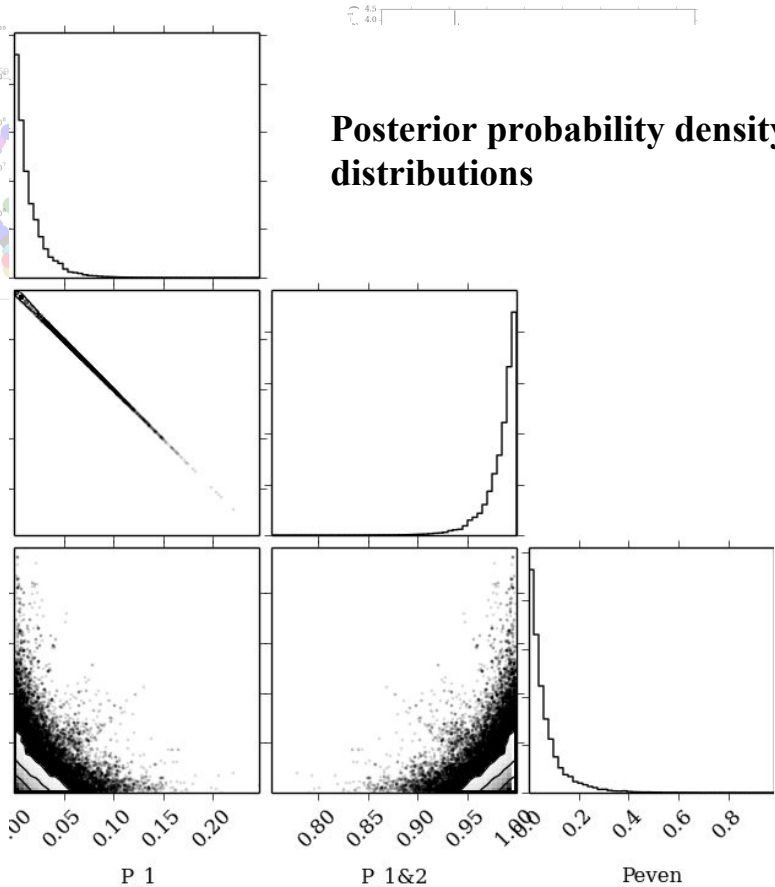
Posterior probability density distributions

Take a section of our ridge (contains two modes)

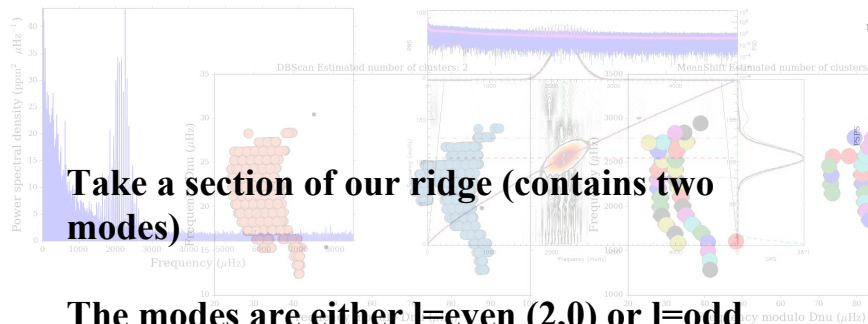
The modes are either l =even (2,0) or l =odd (3,1)

Either detect 0, 1 or 2 modes

Run a mixture model ...



Automated peak bagging: Bayesian and ML mixture models



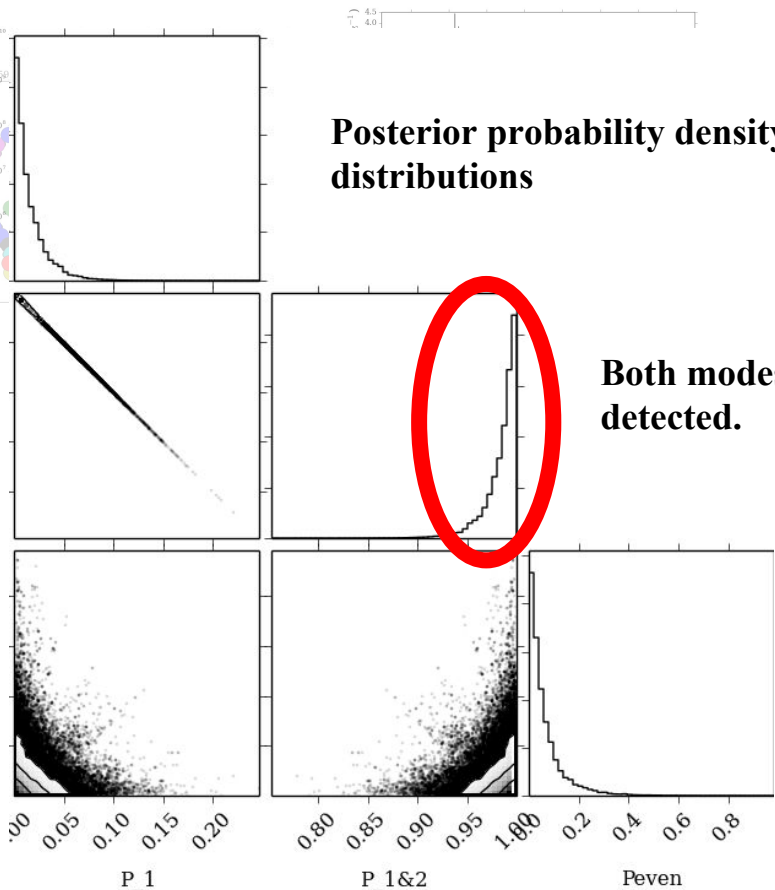
Take a section of our ridge (contains two modes)

The modes are either $l=\text{even}$ (2,0) or $l=\text{odd}$ (3,1)

Either detect 0, 1 or 2 modes

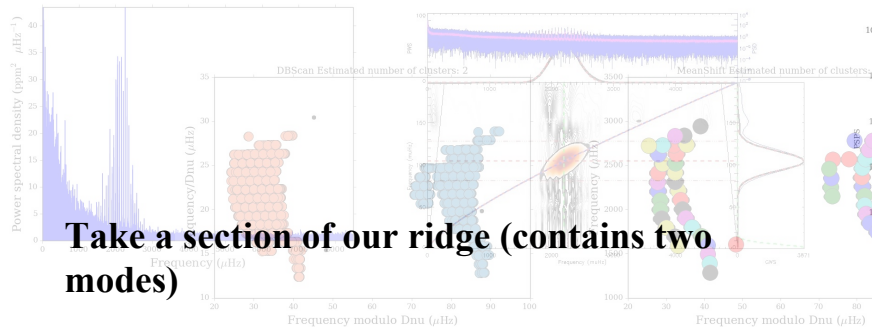
Run a mixture model ...

Posterior probability density distributions



Both modes are detected.

Automated peak bagging: Bayesian and ML mixture models



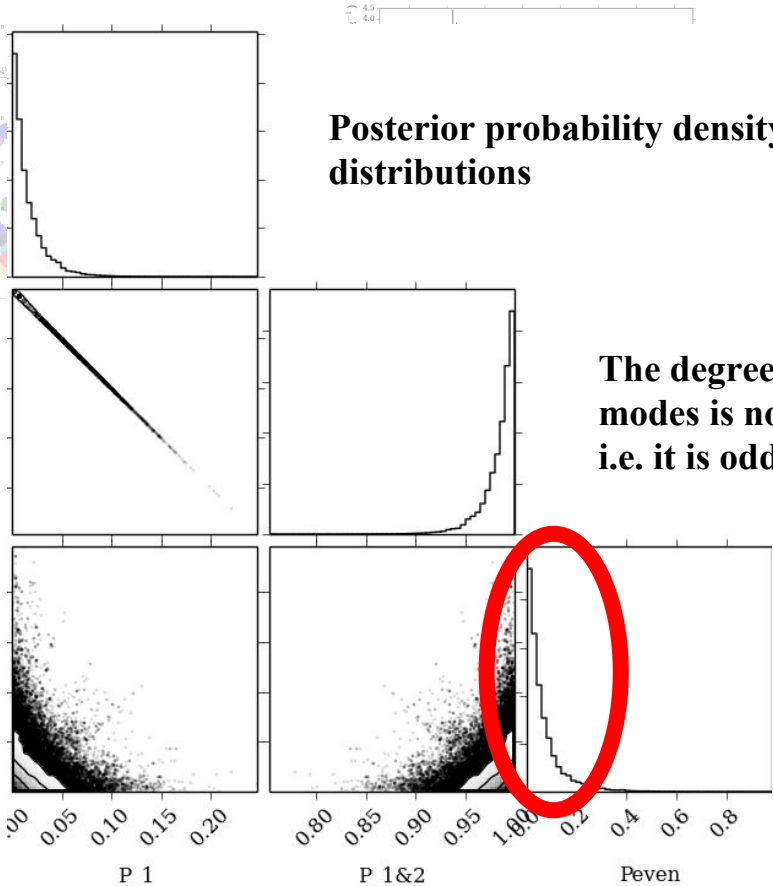
Take a section of our ridge (contains two modes)

The modes are either $l=\text{even}$ (2,0) or $l=\text{odd}$ (3,1)

Either detect 0, 1 or 2 modes

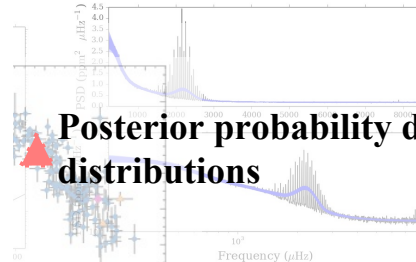
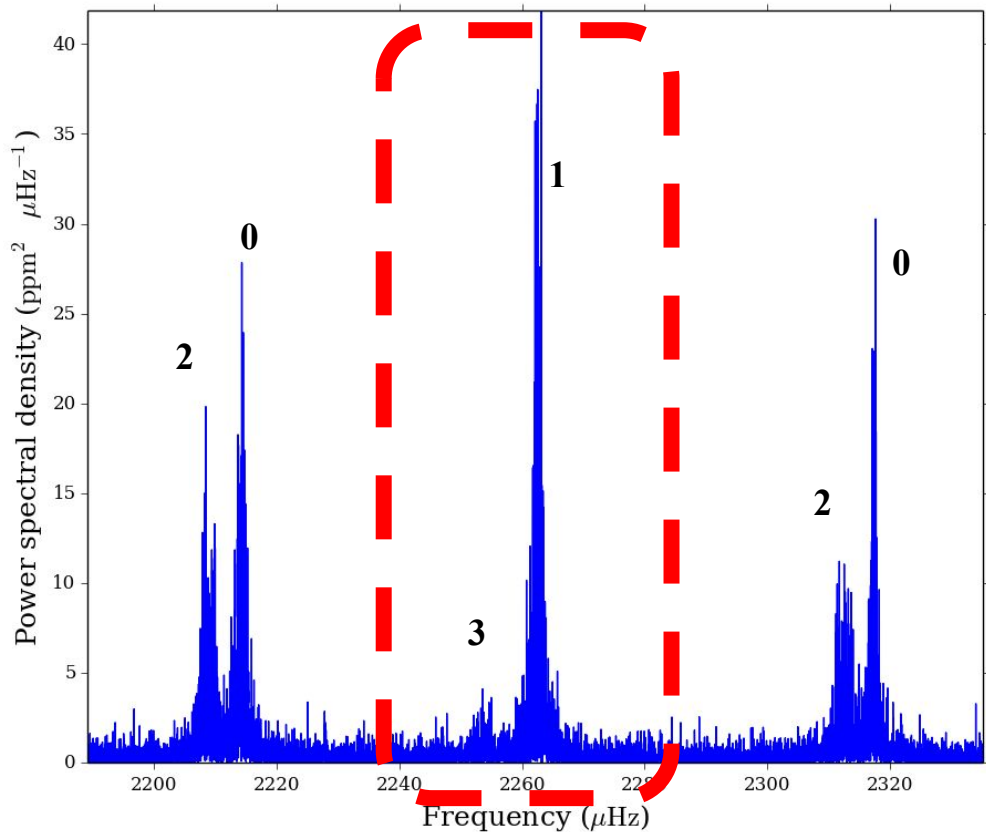
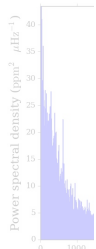
Run a mixture model ...

Posterior probability density distributions

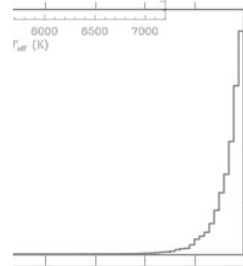


The degree of the modes is not even, i.e. it is odd

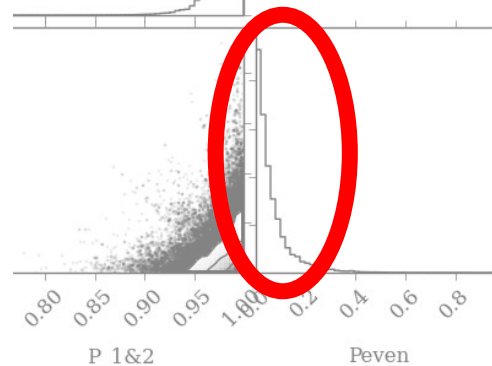
Automated peak bagging: Bayesian and ML mixture models



Posterior probability density distributions

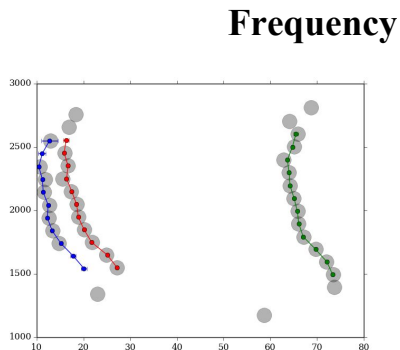
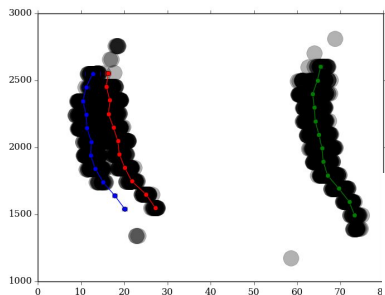


The degree of the modes is not even, i.e. it is odd



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Machine learning: Supervised learning



Training sets ...

Appourchaux+ 2012 61 stars

Davies+ 2015 Kages 35 planet host stars

Lund+ 2016 Kepler legacy 66 stars

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