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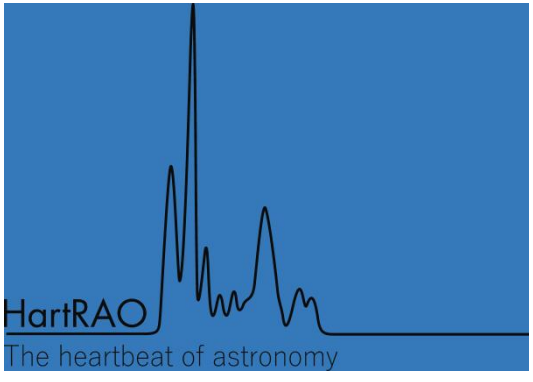
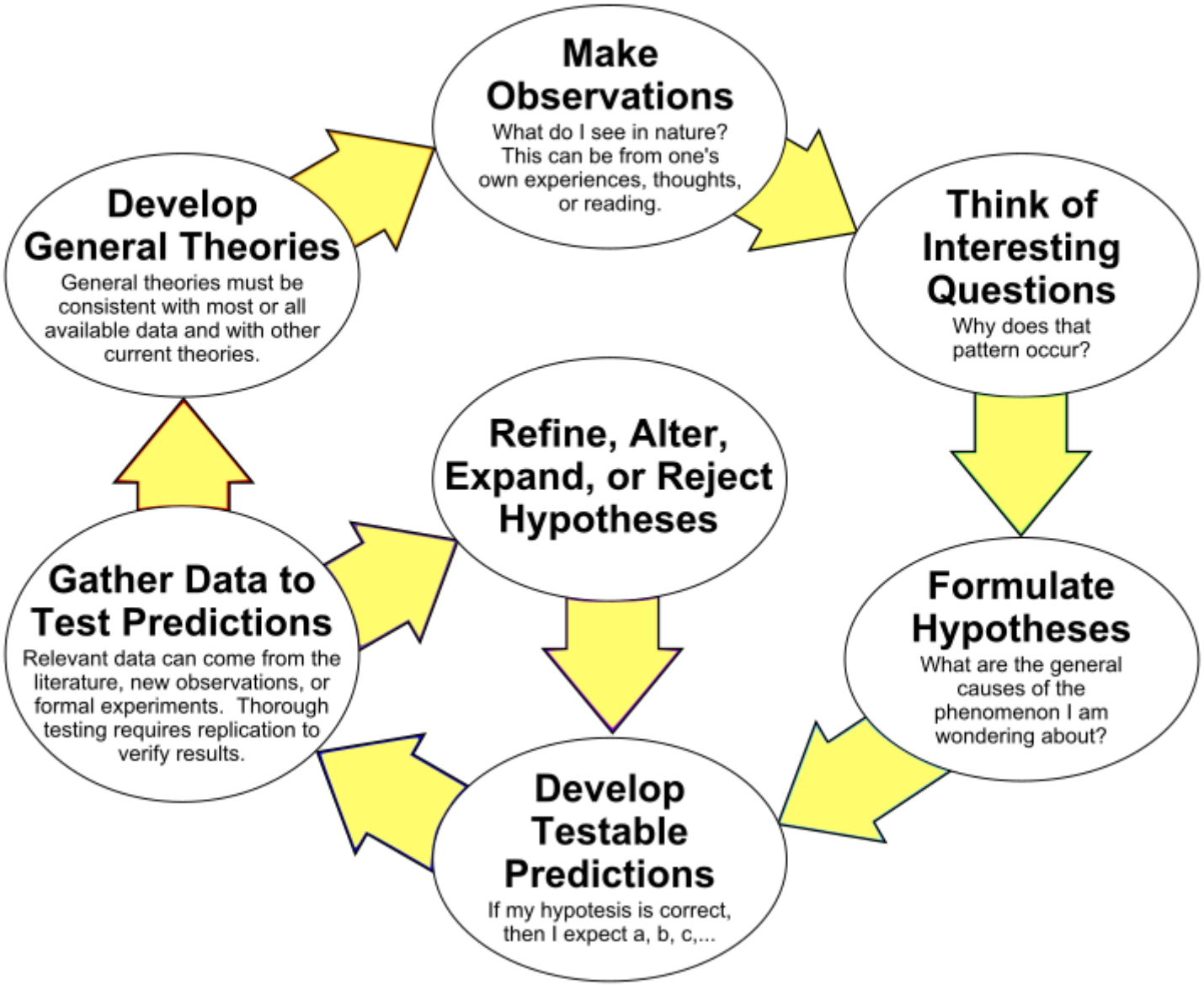
Scientific Method vs Serendipity

BY

G. MacLeod



The Scientific Method as an Ongoing Process



Serendipity

- accident
  - Unexpected result
- Unprecedented result
- luck

- Accident – Goodyear's vucanised rubber, Flemming's Penicillin, Tombaugh's Pluto
- Unexpected result – Jansky's radio waves, Penzias&Wilson's CMB
- Unprecedented result – Linden-Bell's discovery of pulsars, Weaver's OH masers
- Luck – mm obs of Kitty

Astronomical Serendipity

Accidental

Tombaugh
1930

Unexpected

Jansky
1933

Unprecedented

Bell 1967

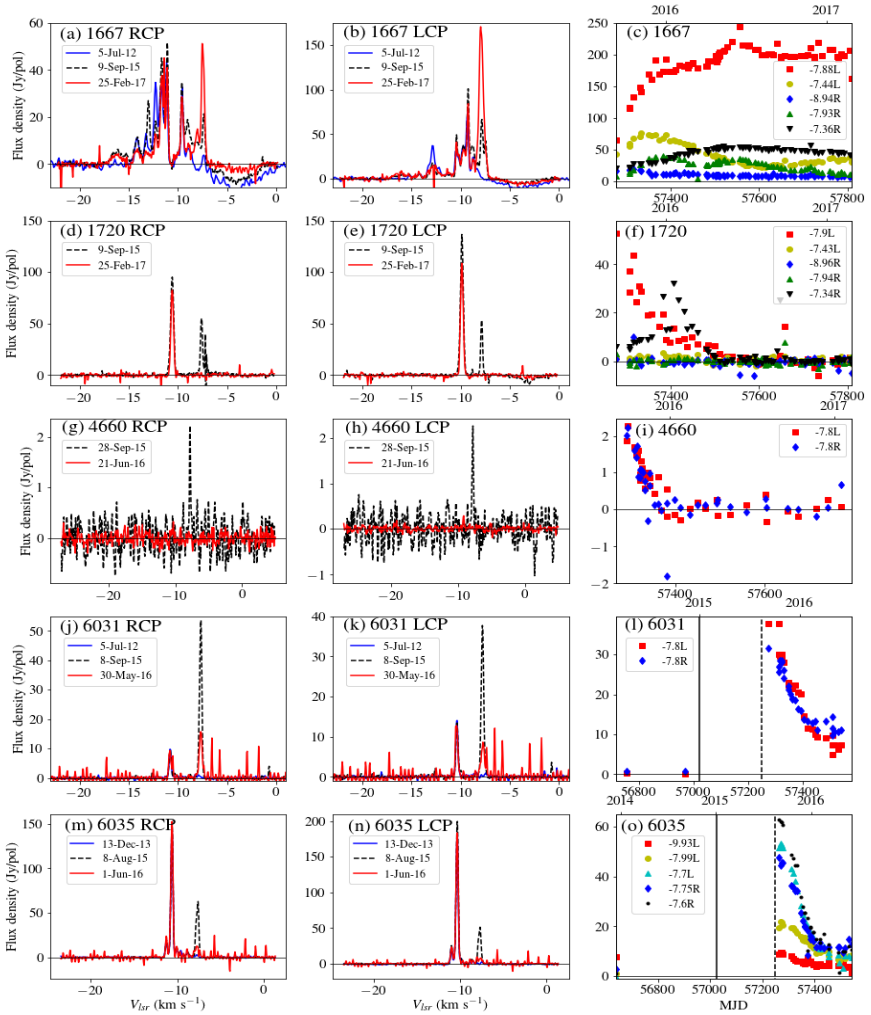
Scientific Method

Hypothesis – Excited OH masers are rare because they are variable

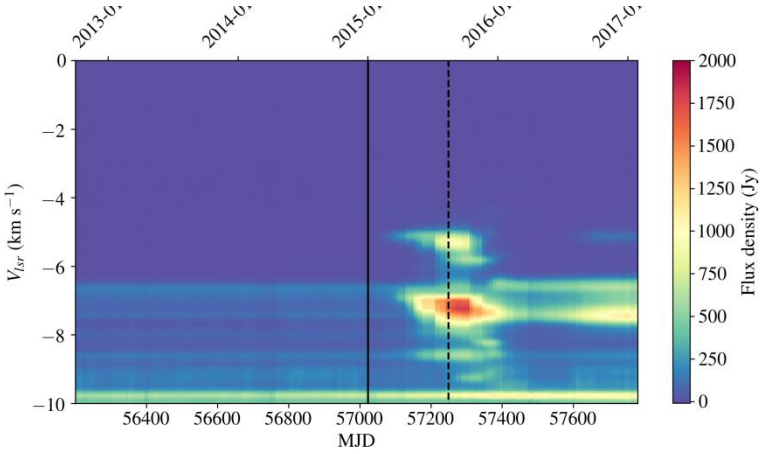
Experiment – multiple epochs of 100 OH masers

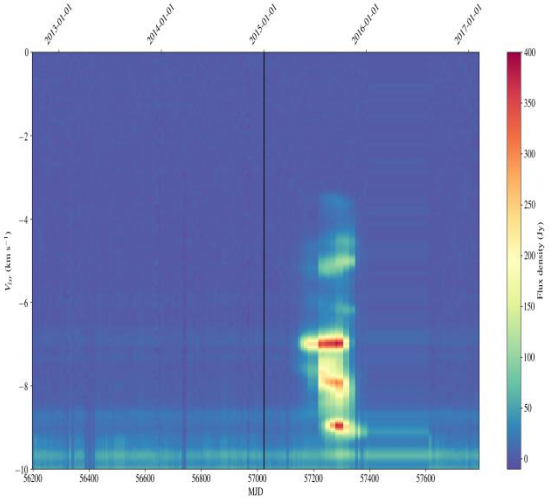
Results – new detections suggestive but must modify hypothesis

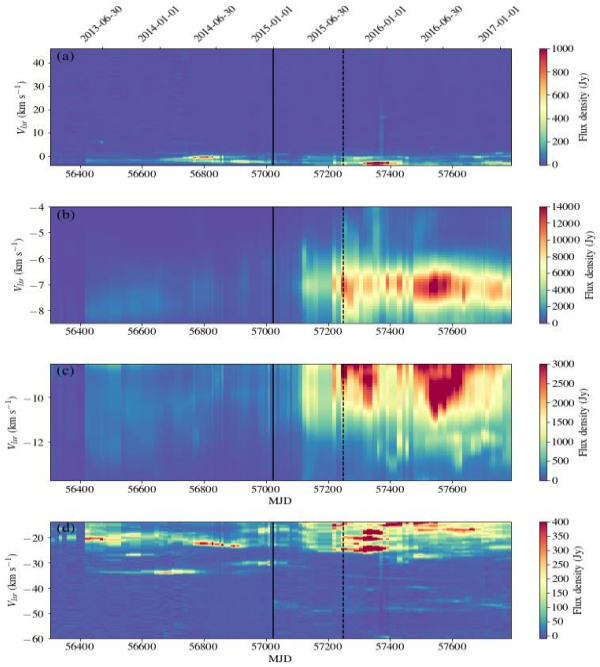
Experiment – monitor masers to see how long they live



LUCK







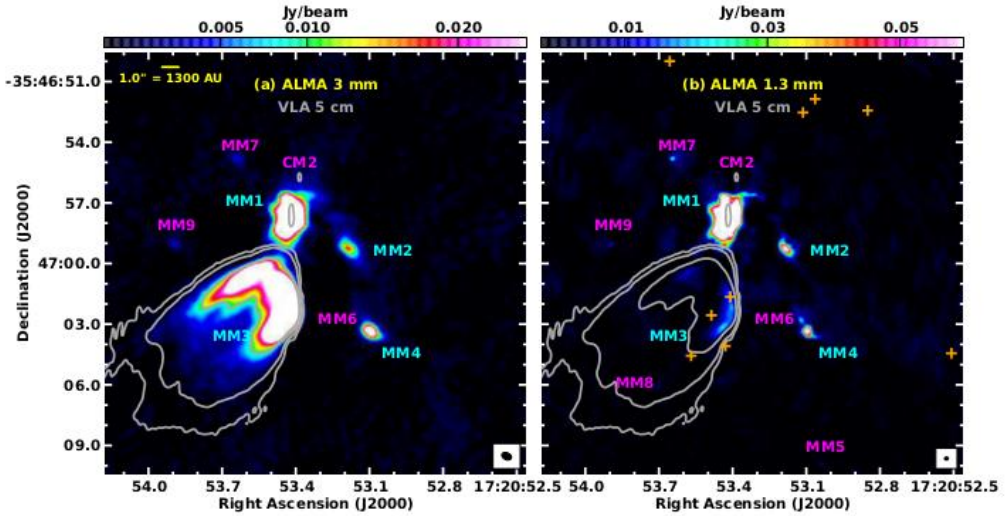
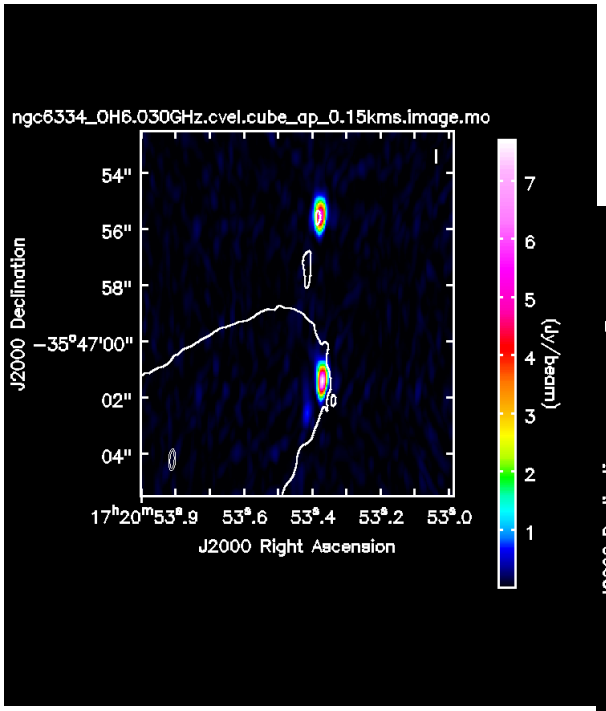
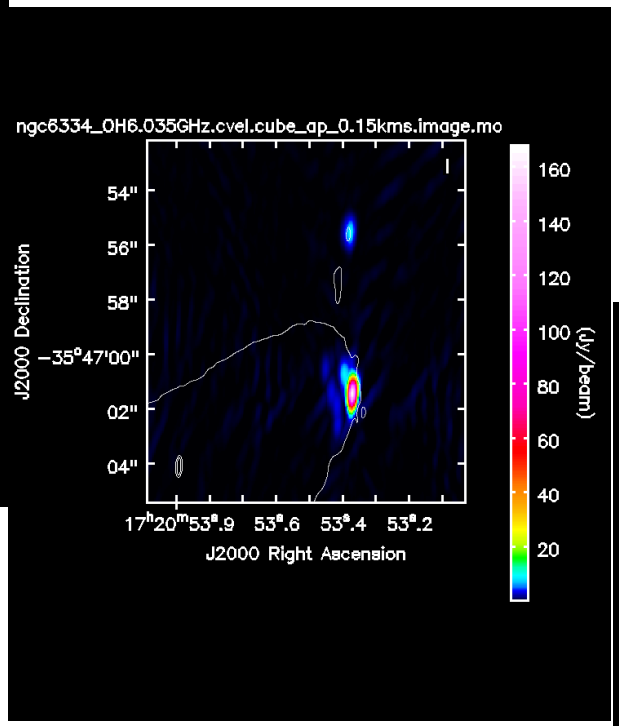
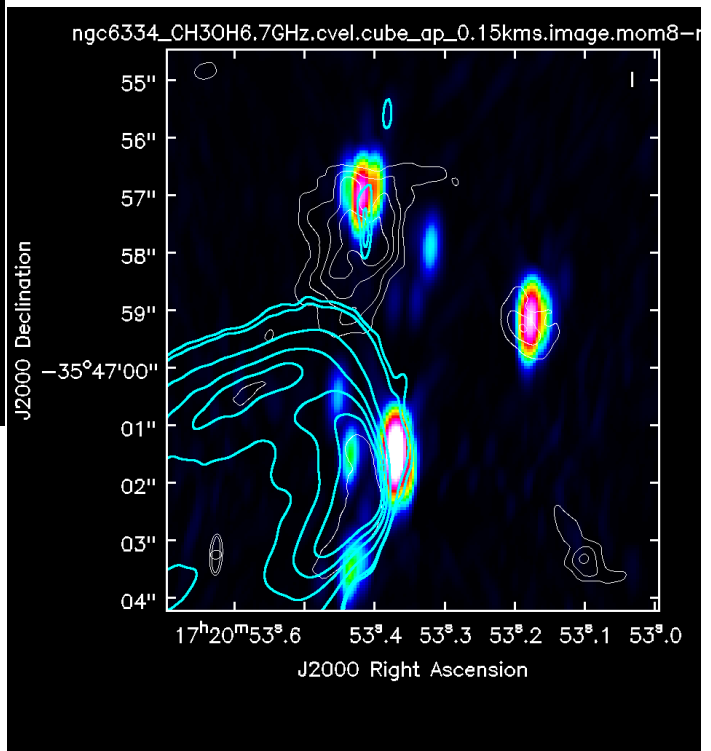


FIG. 1.— Colorscale of the (a) ALMA 3 mm, and (b) ALMA 1.3 mm images of NGC6334I over a 21″ field of view, with VLA 5 cm contours (grey) overlaid contour levels 0.042 mJy beam^{-1} (1σ) * [4, 20, 200]). The ALMA synthesized beam is shown in the lower right of each panel. Previously known sources e.g. Hunter et al. (2006) are labeled in cyan, while newly discovered sources are labeled in magenta in the panels corresponding to the bands in which they are detected. Note that the new source CM1 (see Table 2) is outside of the displayed field of view, and CM2 is only detected at 5 cm. In panel (b) the locations of X-ray point sources from Townsley et al. (2014) are marked with orange + symbols.

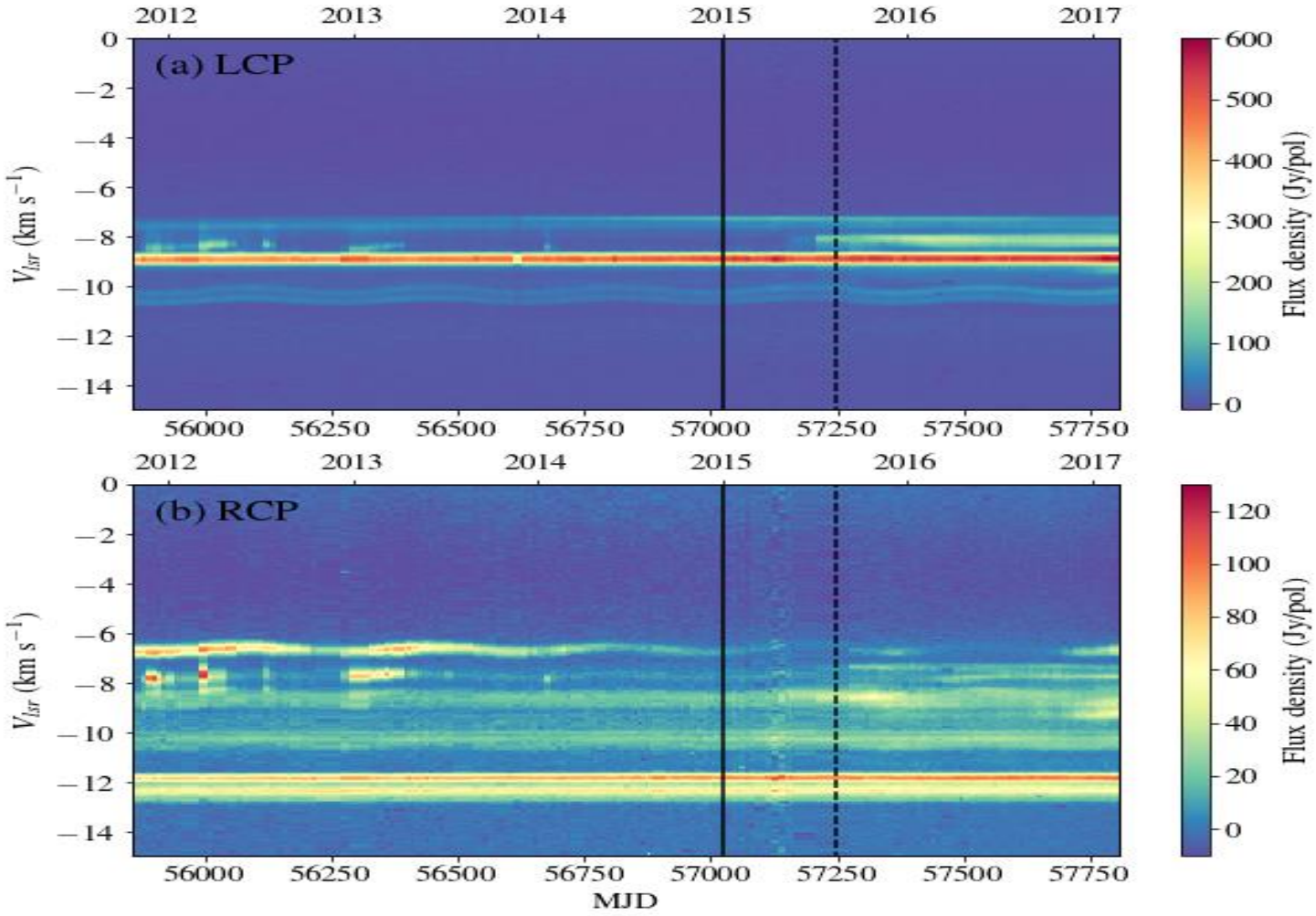
Result of Luck







Unexpected?


2012
2013
2014
2015
2016
2017
(a) LCP
(b) RCP
V_{lsr} (km s^{-1})
0
−2
−4
−6
−8
−10
−12
−14
56000
56250
56500
56750
57000
57250
57500
57750
MJD
Flux density (Jy/pol)
600
500
400
300
200
100
0
120
100
80
60
40
20
0

Telescopes for Serendipity

- Design for the unknown NOT know
- Optimise range of obs
- Allow for simultaneous obs
- Robust flexibility
- Allow for crazy ideas from wild-eyed astronomers

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Expect the Unexpected

No question, nor idea, is stupid…
But there are such things as bad timing…