

Systematic search for H₂O molecule (at 1.9 μ m) in M stars

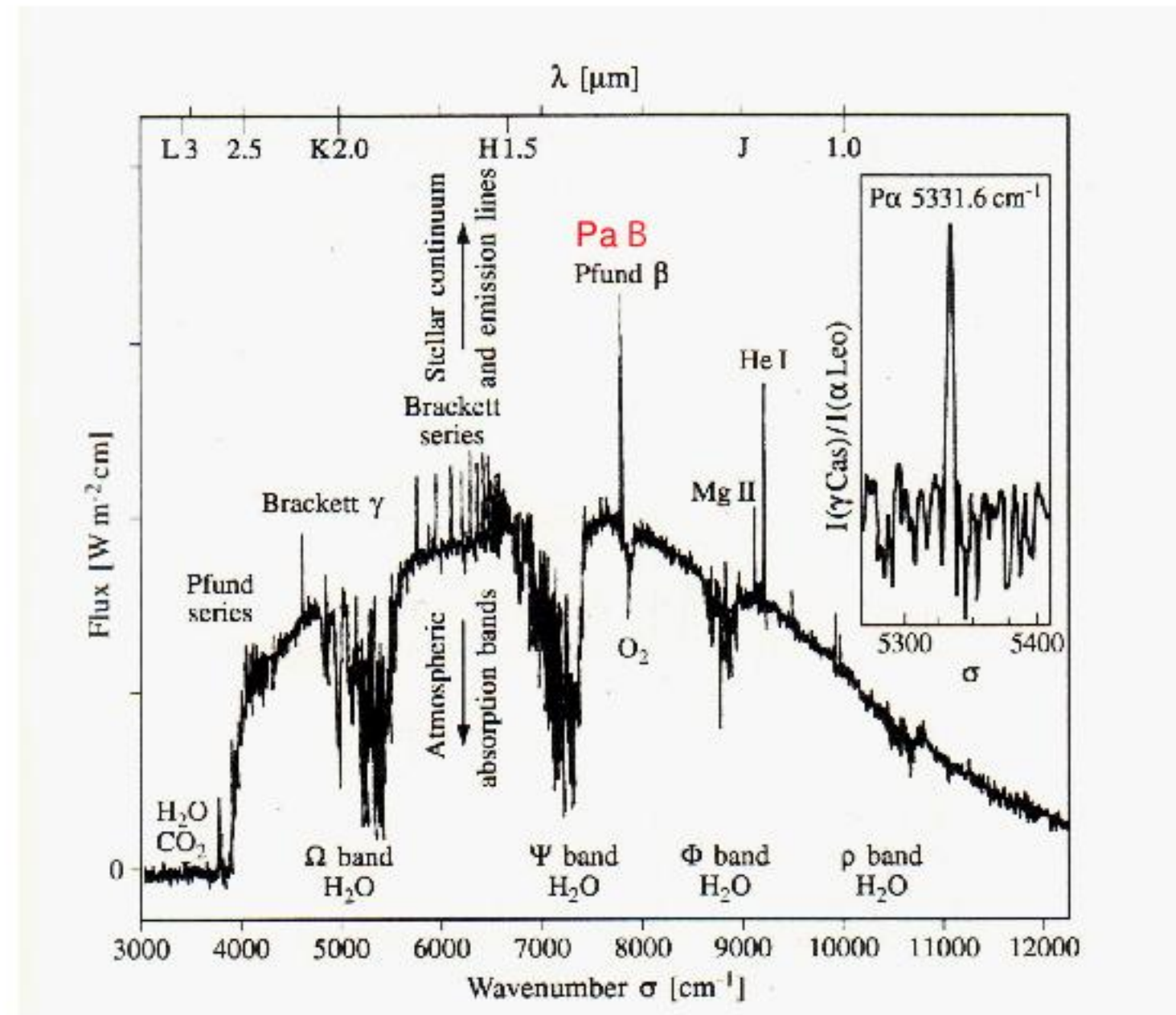
M型星における水(分子)の系統的探査

T. Tanabé

■ NIR atmospheric window

γ Cas

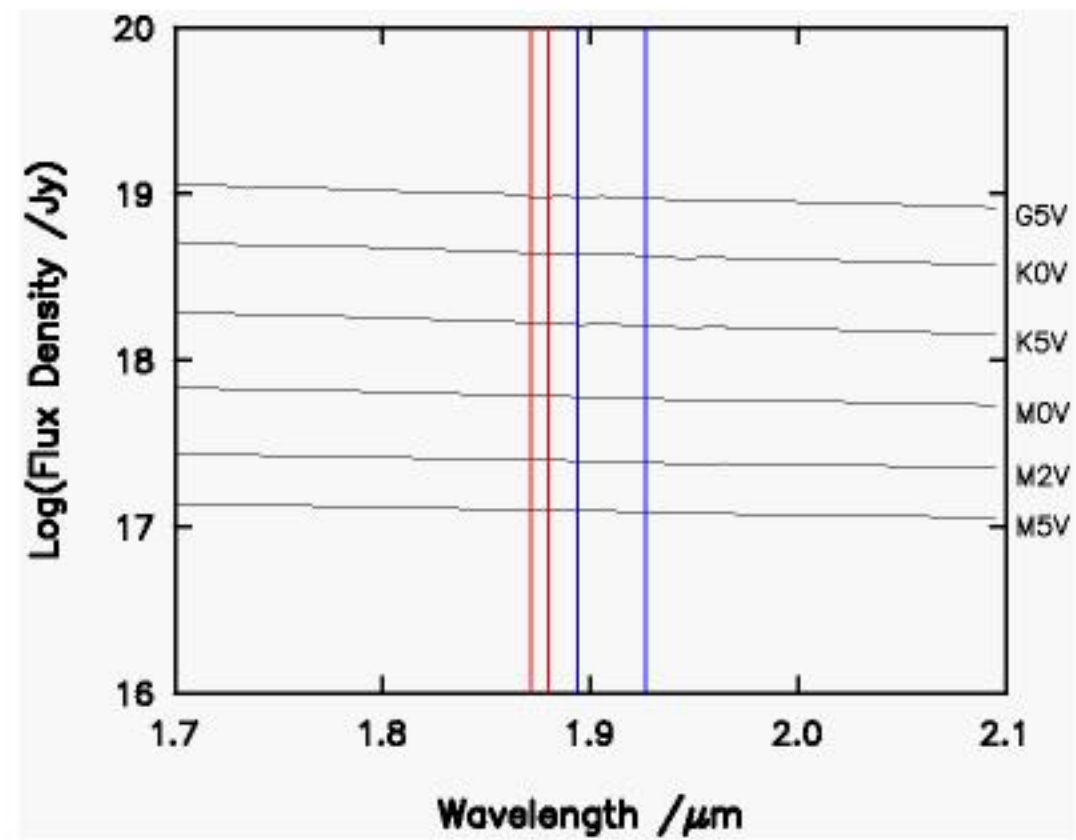
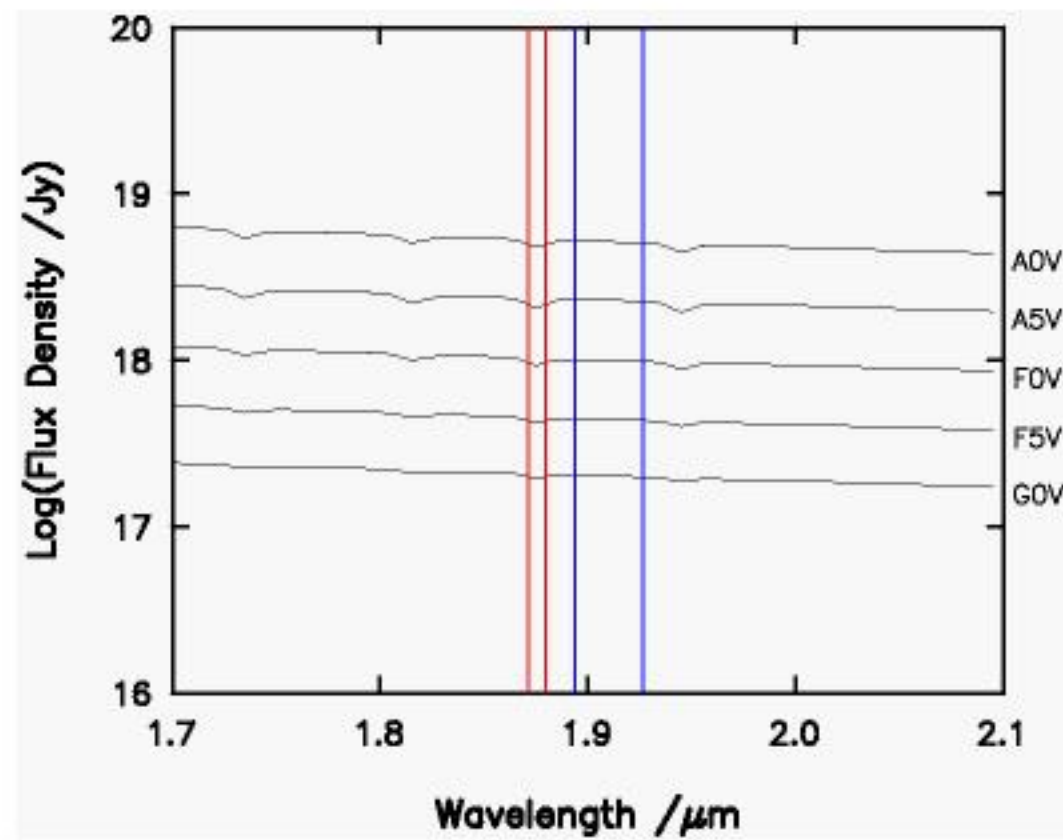
Paschen α : 1.8754 0.0079
 Paschen α -off: 1.910 0.033



P. Lena, F. Lebrun, F. Mignard: Observational Astrophysics
 (Chalavaev, A. A.)

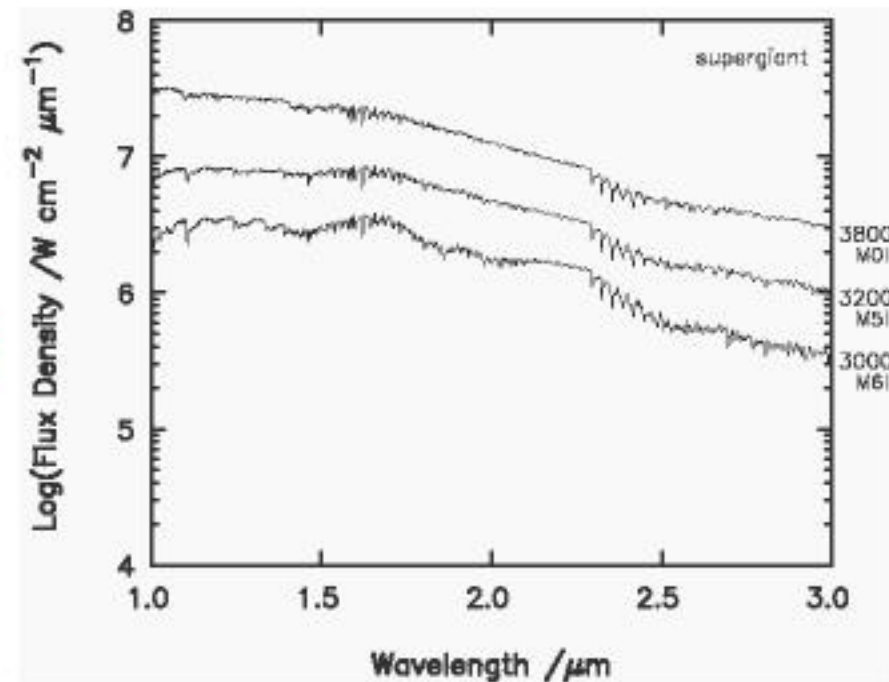
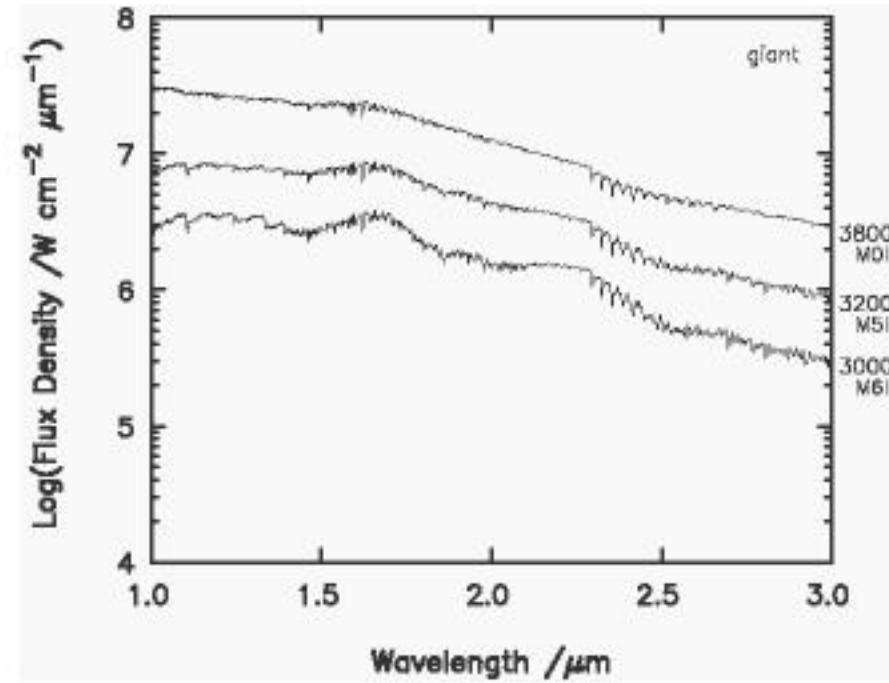
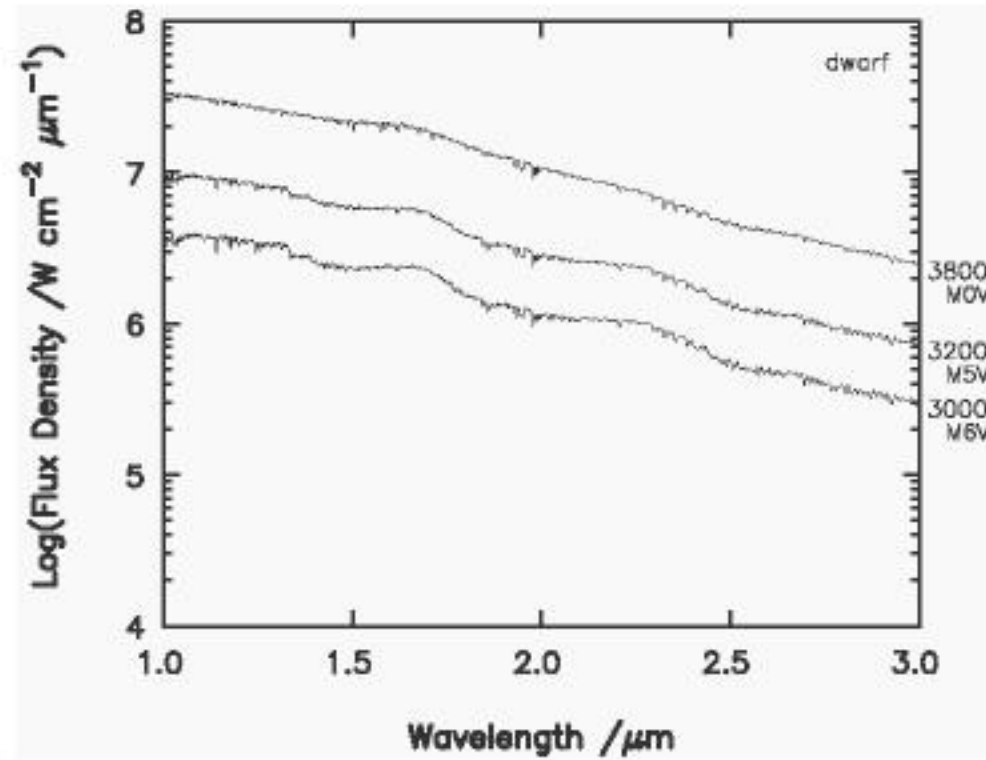
■ Water in M-type star

■ Kurucz model



■ Water in M-type star

■ MARCS model

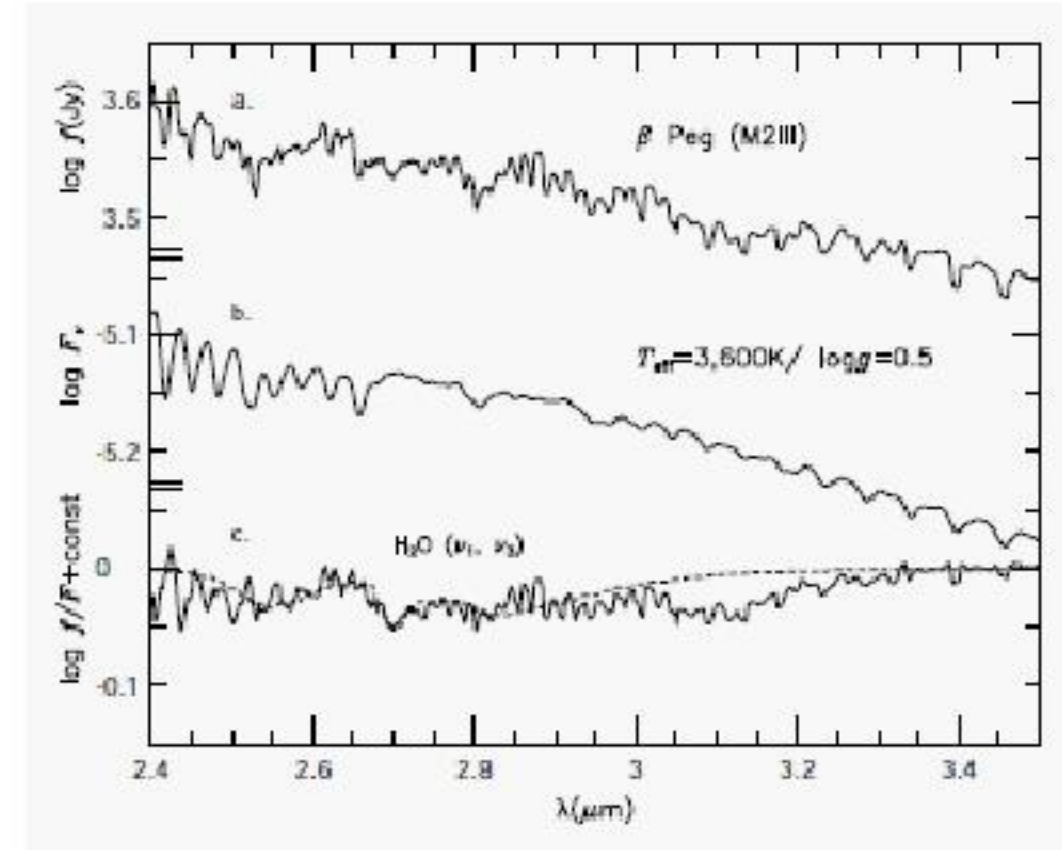


model photosphere indicates that H₂O molecule exists only in low temperature stars ($T_{\text{eff}} < 3000\text{K}$, M6 or later)

■ Discovery of water in early M-type star

1997 Tsuji (AA 320, L1)
ISO/SWS spectra

H₂O excess absorption in M2 giant B Peg



not photospheric --> MOLsphere

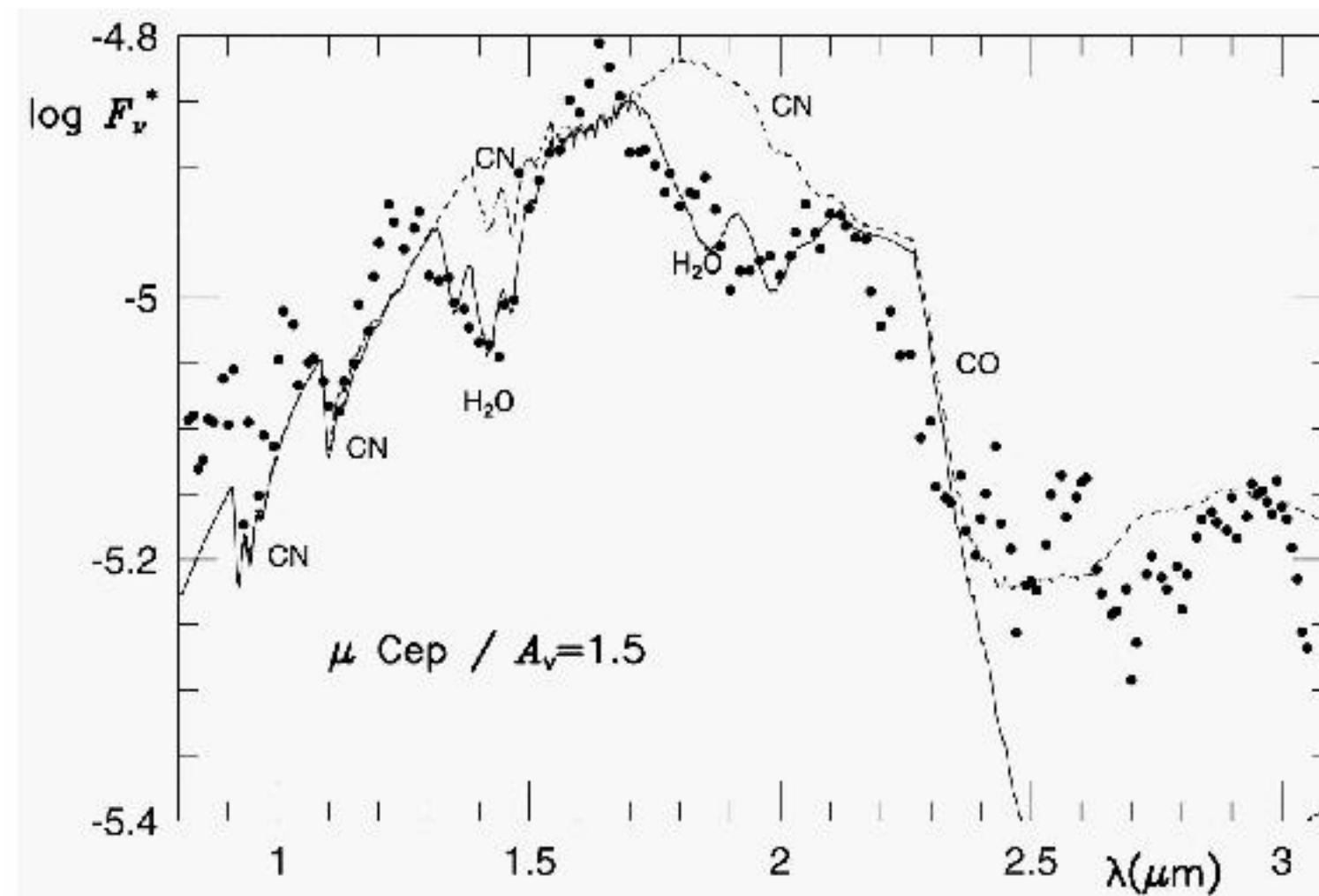
■ Discovery of water in early M-type star

2000 Tsuji (ApJ 538, 801)

Re-evaluation of 1963's Stratoscope II data

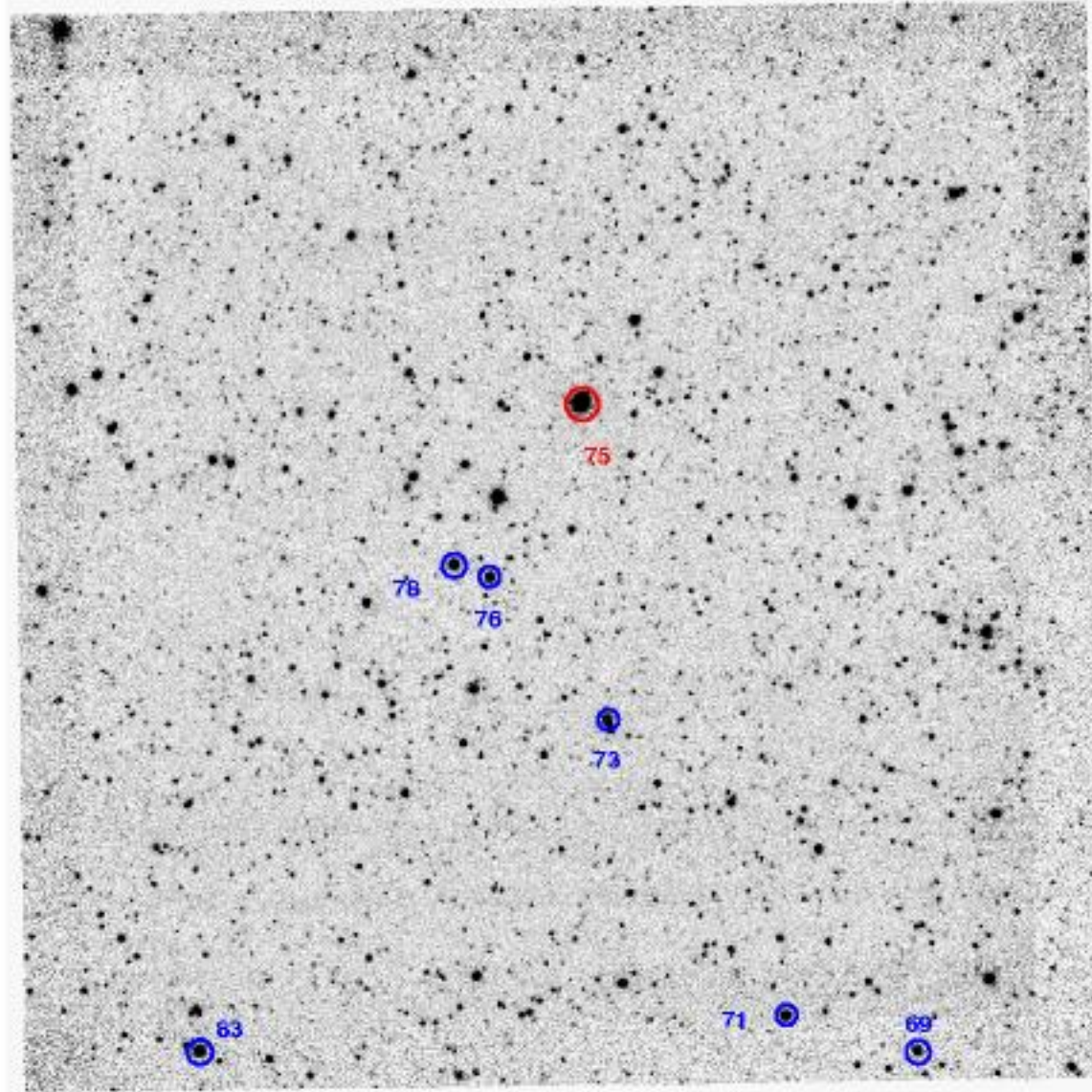
H₂O excess absorption in M2 supergiant μ Cep

even in late K giants

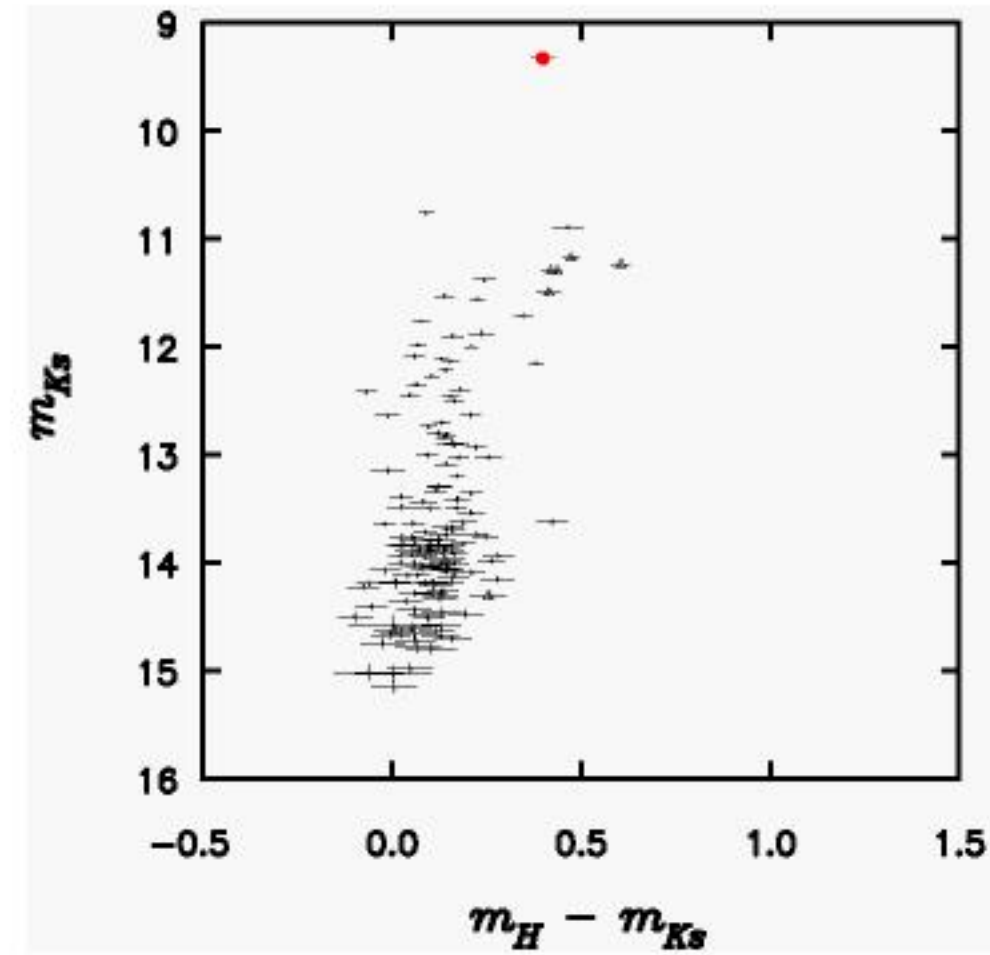


■ Search for H₂O in M-type stars

■ SMC field



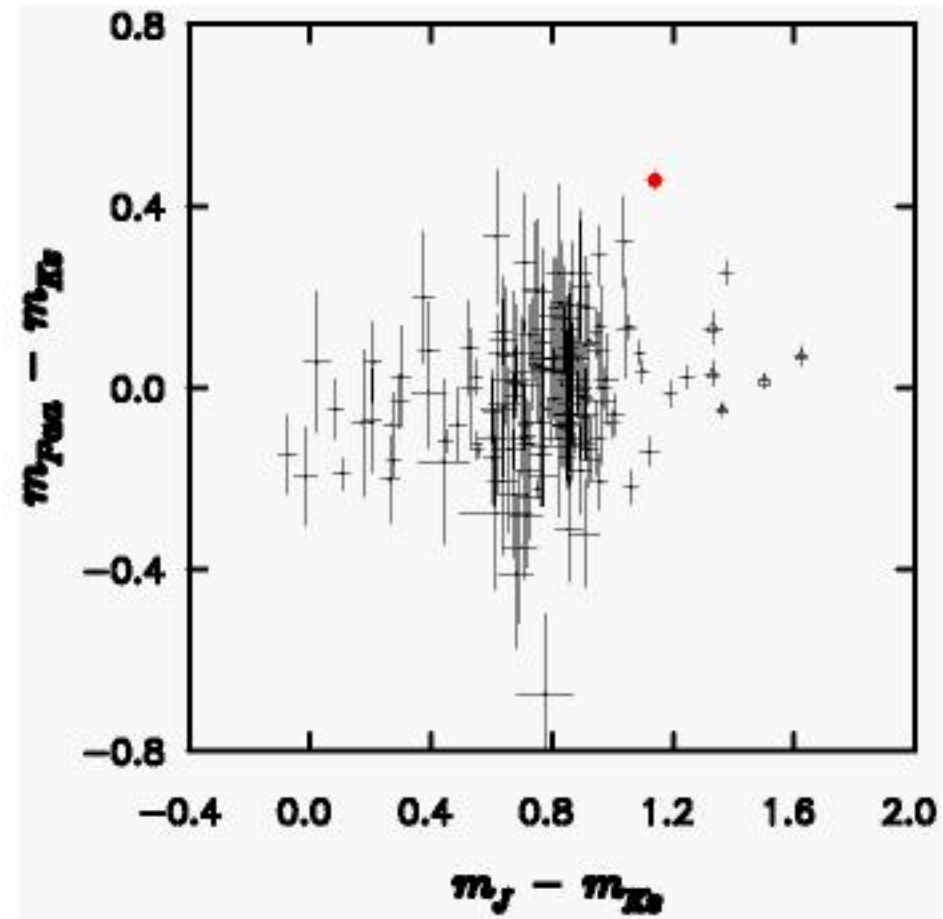
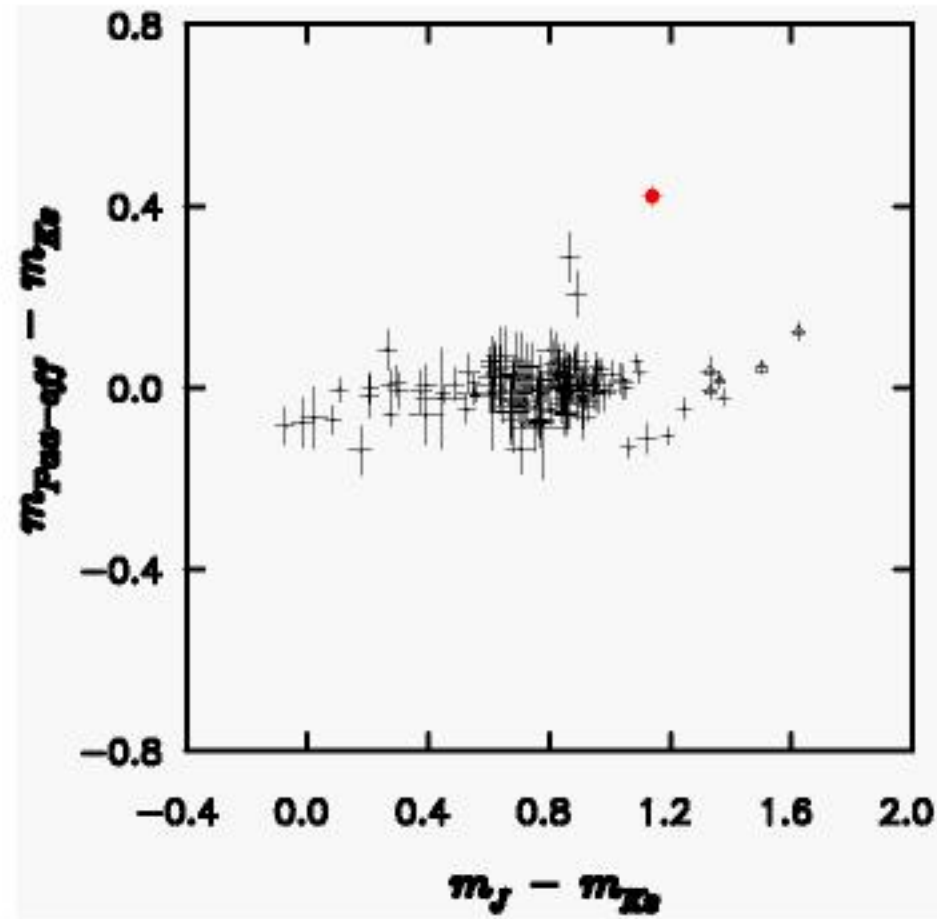
SMC field



Blanco, V. M., McCarthy, M. F. and Blanco, B. M., 1980, ApJ 242, 938-964

■ Search for H₂O in M-type stars

■ SMC field



H₂O was detected in (an) SMC M6 star

■ systematic search for H₂O molecule in M-type star

■ So far observed

AGB

NGC419 M1 (K5)
NGC152 M0
SMC_BMB_B75 M6
NGC1783 early Ms
NGC1978 early Ms
NGC1846 early Ms
LMC field1 many Ms
LMC field2 many Ms
SMC_BMB_B17 M5.5
SMC_BMB_B28 M6
SMC_BMB_B61 M5.5
SMC_BMB_W47 M5.5
NGC288
LMC field3 many Ms
LMC field4 many Ms
LMC field5 many Ms

giants

(02525434-1142200 M1III)
(23320262+2438430 M3III)
(06470274-6227251 M3III)
19215465-2904574 M4III
(04361684-6411316 M5III)
20255860-2746186 M6III
(23464476+1603590 M7III)
(04245037-7404429 M8III)
19204458-2034420 M8III
20284695+0259011 M4III
19401418-3439113 M5III
17482290+0439383 M6III

dwarfs

(G275-42 M3.0V)
(LP_701-59 M4.0V)
LHS_3762 M5.0V
(LHS_1146 M6.0V)
(LP_763-38 M7.0V)
(LP_523-55 M8.0V)
(LP_647-13 M9.0V)

() Too few stars in the field

■ calibration of $P\alpha$ and $P\alpha$ -off magnitudes

For $P\alpha$ and $P\alpha$ -off

Define

$$P\alpha - P\alpha(\text{interp}) = 0.0$$

$$P\alpha\text{-off} - P\alpha\text{-off}(\text{interp}) = 0.0$$

for bright ($K_s < 14.5$) stars in the color range

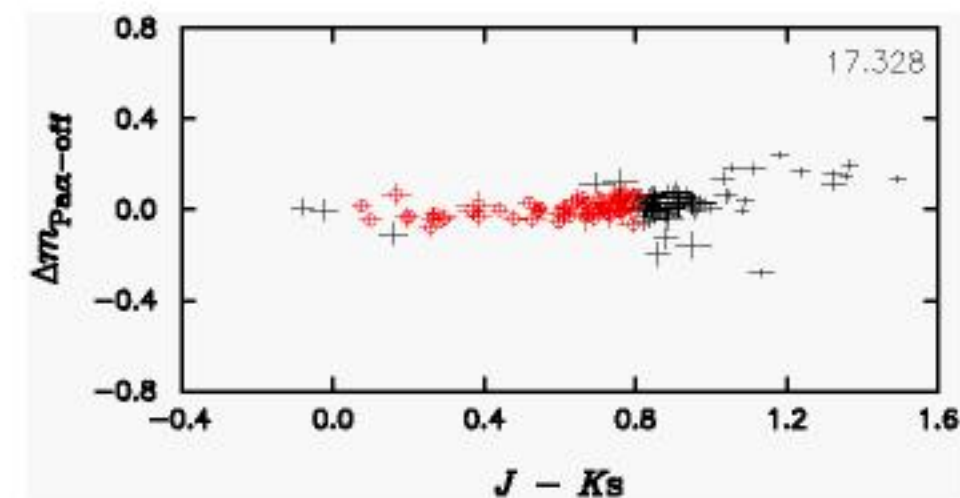
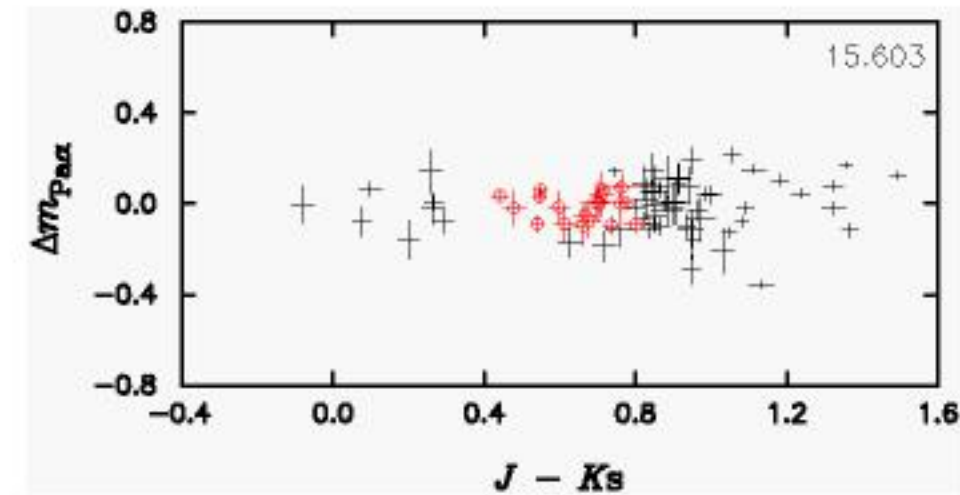
$$0.4 < J - K < 0.8 \text{ for } P\alpha$$

$$0.0 < J - K < 0.8 \text{ for } P\alpha\text{-off}$$

$$\rightarrow Z_{\text{mag}}(P\alpha) = 15.603$$

$$\rightarrow Z_{\text{mag}}(P\alpha\text{-off}) = 17.329$$

Needs relatively many field stars for calibration



■ Problem

In the regions of observed dwarf and giant M stars,
there are too few stars for calibrating P_{α} and P_{α} -off magnitude.

More observations are needed.

Proposal:

Imaging observations of M-type stars
at J, H, Ks, P_{α} and P_{α} -off filters
to systematically search for H₂O molecule