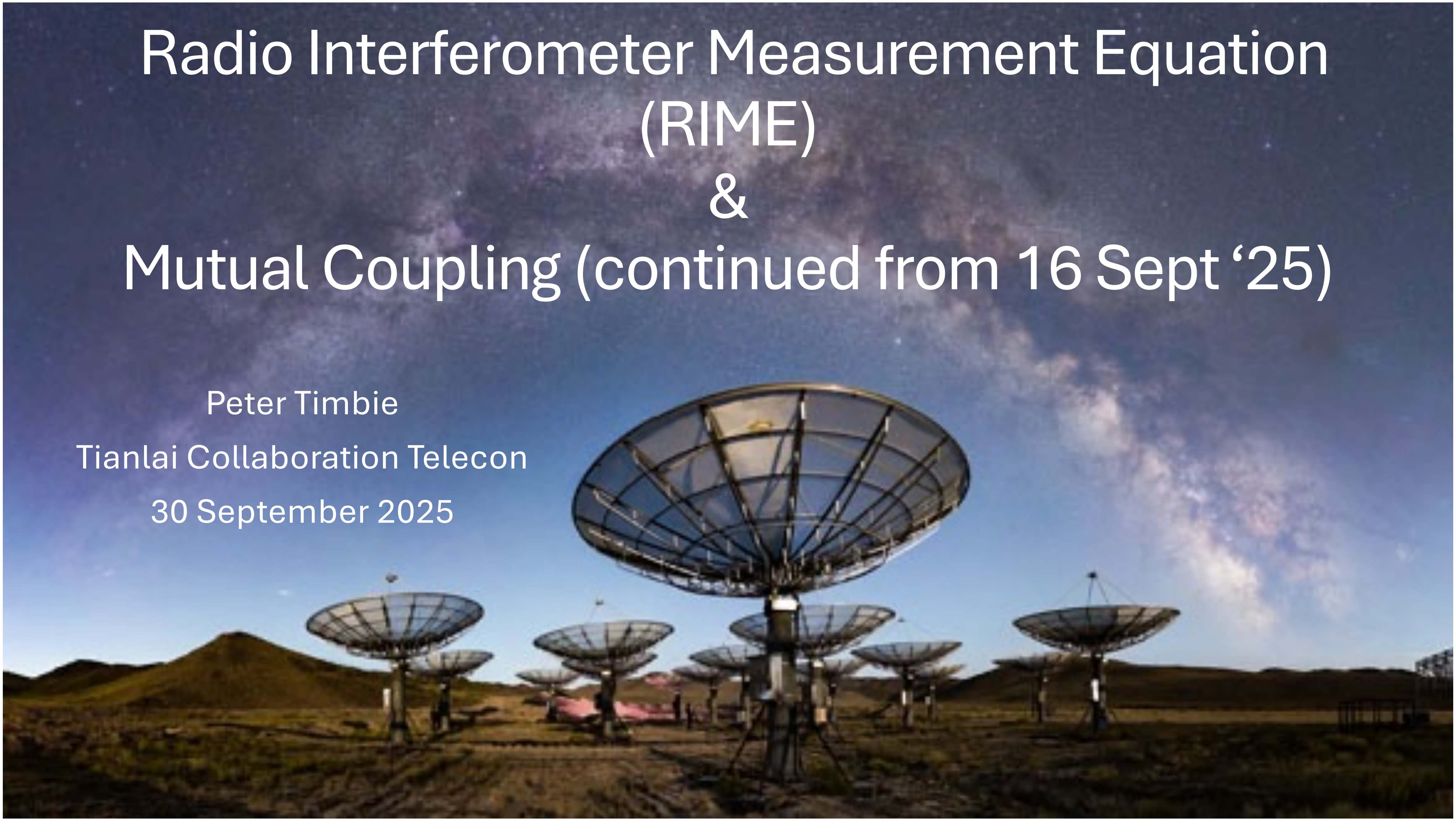
Radio Interferometer Measurement Equation (RIME) & Mutual Coupling (continued from 16 Sept ‘25)

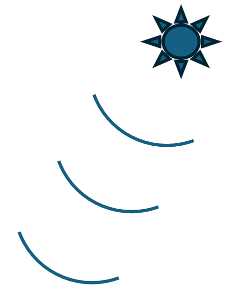
Peter Timbie

Tianlai Collaboration Telecon

30 September 2025



Voltage at an antenna '*p*' from a point source is a product of 2 x 2 Jones matrices:



$$\boldsymbol{e} = \begin{pmatrix} e_x \\ e_y \end{pmatrix}$$

Polarizations '*a*' and '*b*'

$$\begin{pmatrix} v_{pa} \\ v_{pb} \end{pmatrix} = \boldsymbol{v_p} = \boldsymbol{Je} = \boldsymbol{J_n J_{n-1} \dots J_1 e}$$

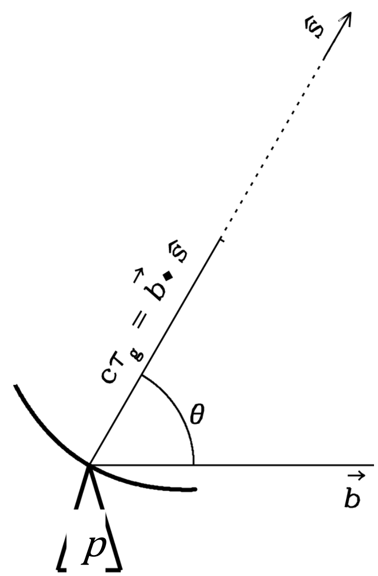
$$= \boldsymbol{G_p E_p K_p e}$$

Direction Independent Gain

Direction Dependent Gain

'Phase delay'

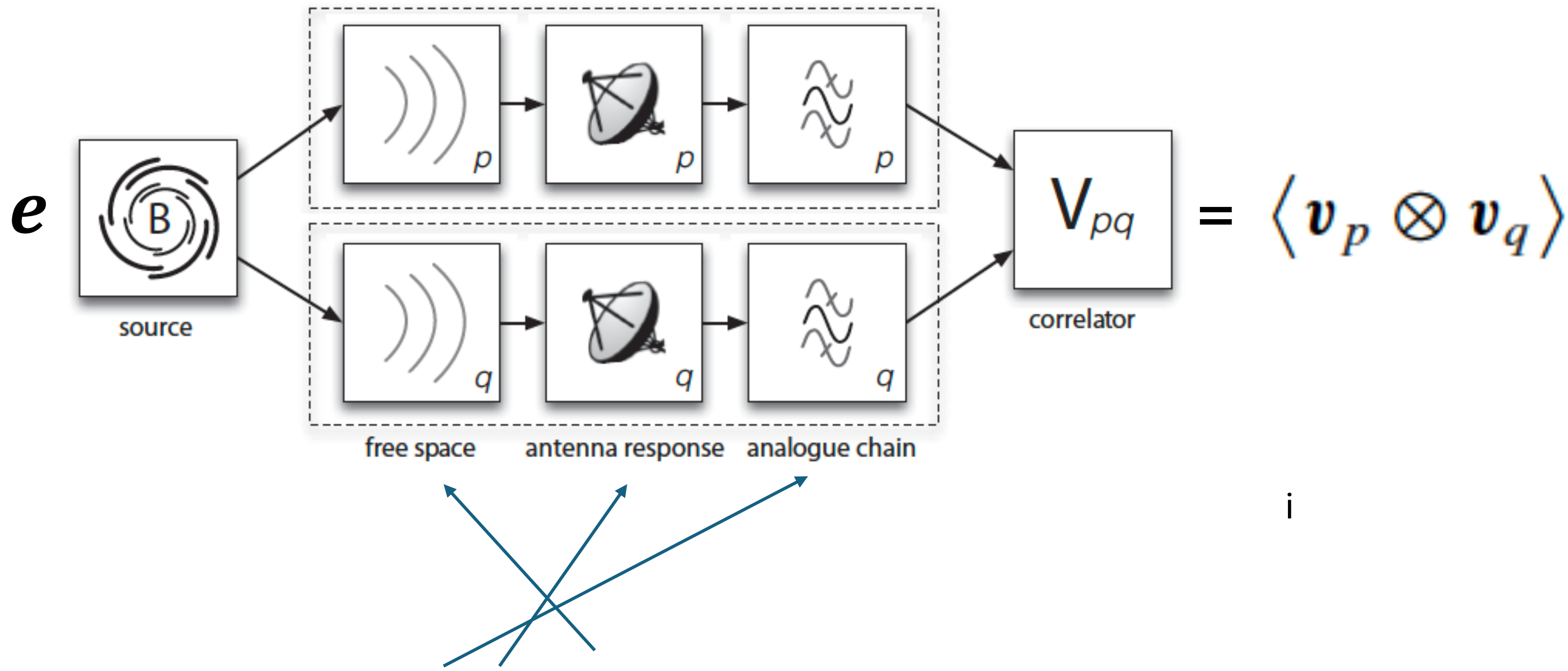
$$e^{i2\pi\vec{b}\cdot\hat{\mathbf{s}}}\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$



R. Clark Jones

Smirnov 2011

Visibility: Radio Interferometer Measurement Equation ‘RIME’

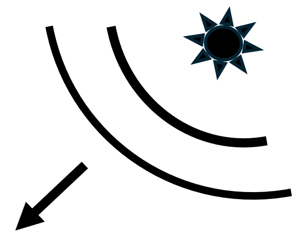


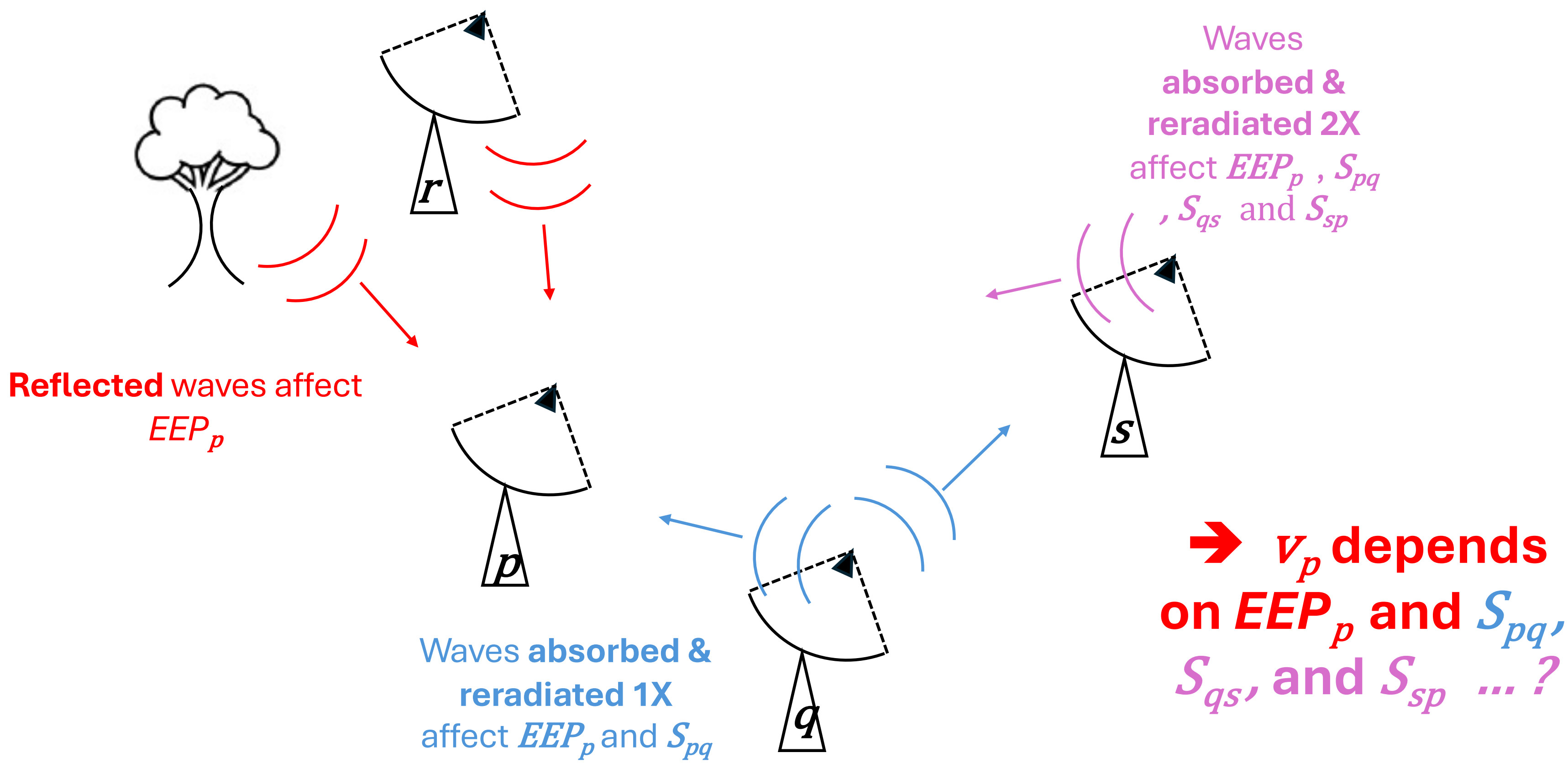
$$G_q E_q K_q e = v_q$$

product of Jones matrices

(Hamaker 1996, Smirnov 2011)

Mutual Coupling changes
'Embedded Element Patterns' (***EEPs***)
& scattering (***S***) parameters





If we knew all the S parameters (and beam patterns, EEPs) for an array, how would we account for them in a self-consistent way?

$$\begin{pmatrix} v_1^- \\ v_2^- \\ \vdots \\ v_n^- \end{pmatrix} = \begin{pmatrix} S_{11} & S_{12} & \cdots & S_{1n} \\ S_{21} & & & \vdots \\ \vdots & & \ddots & \vdots \\ S_{n1} & \cdots & \cdots & S_{nn} \end{pmatrix} \begin{pmatrix} v_1^+ \\ v_2^+ \\ \vdots \\ v_n^+ \end{pmatrix}$$

Voltage wave incident on port n

Voltage wave reflected from port n