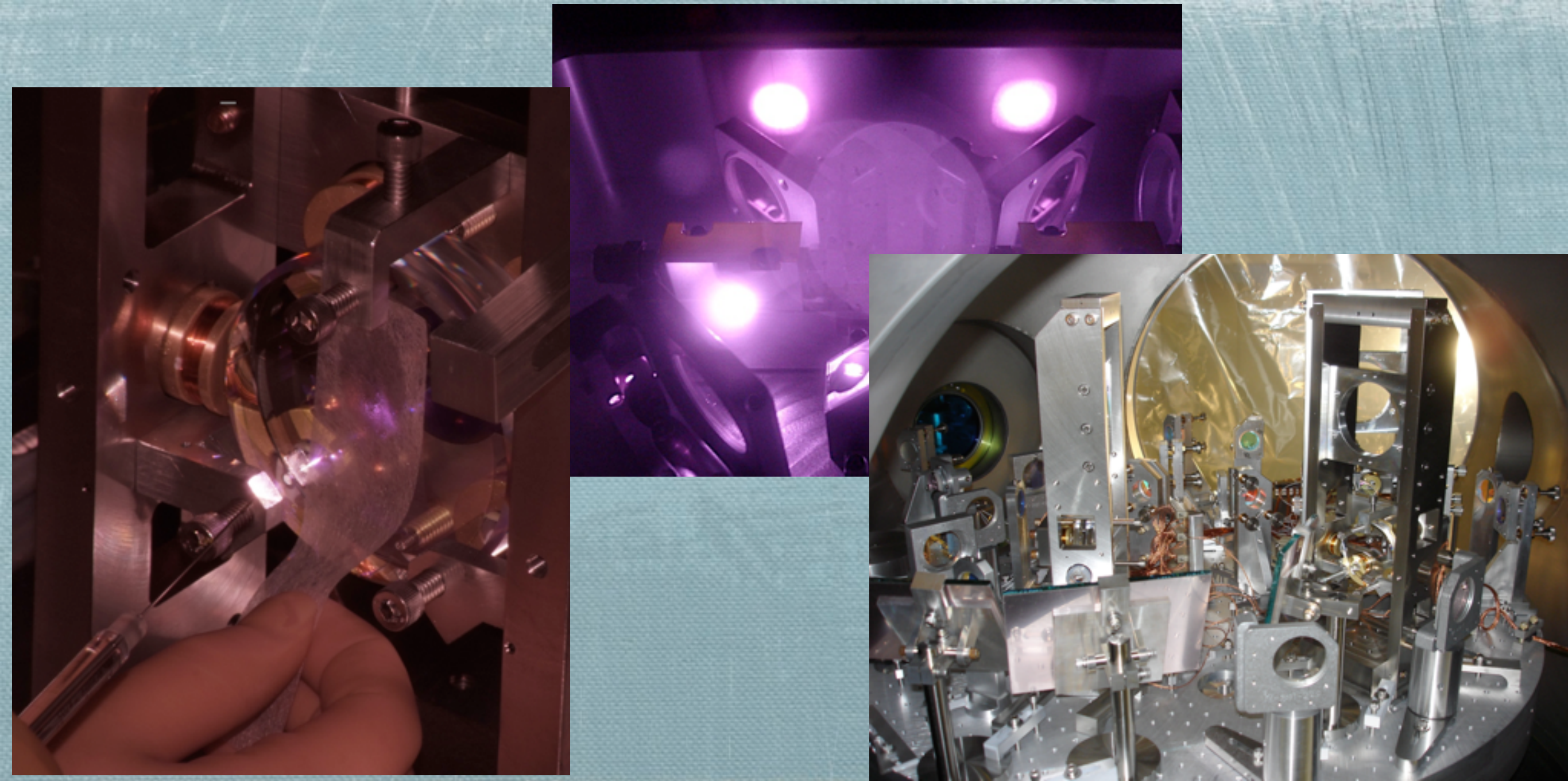




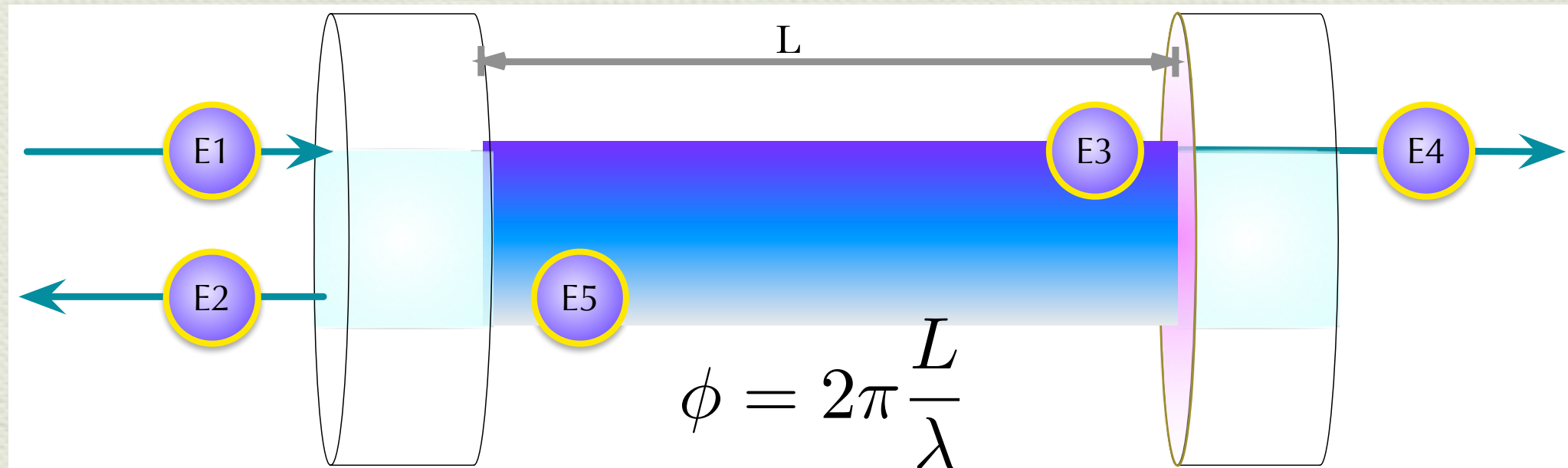
Optics in GW Detectors

RXA, ICTS GWS, RRCAT, 12-2013

more Topics in Optics

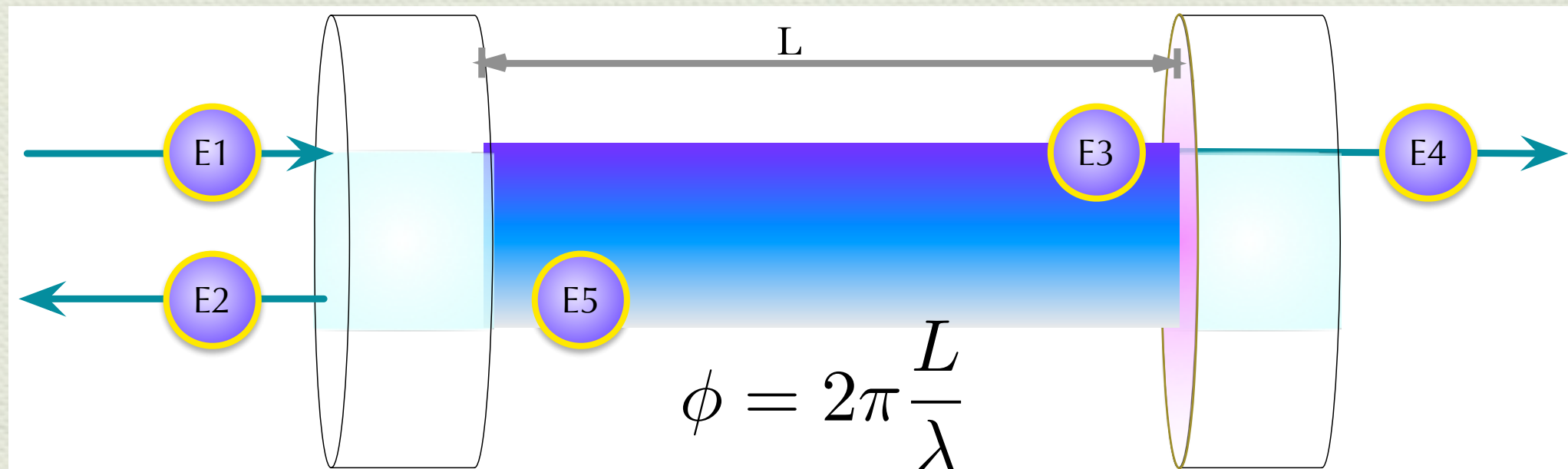
- ◆ matrix approach for complex resonators
- ◆ ABCD matrix approach for geometric and Gaussian optics
- ◆ Resonator Stability (g-factors, etc.)
- ◆ Higher Order transverse modes
- ◆ HOM Scattering, Perturbation in Cavities
- ◆ Transfer Matrix approach for etalons

Cavity Fields Algebra



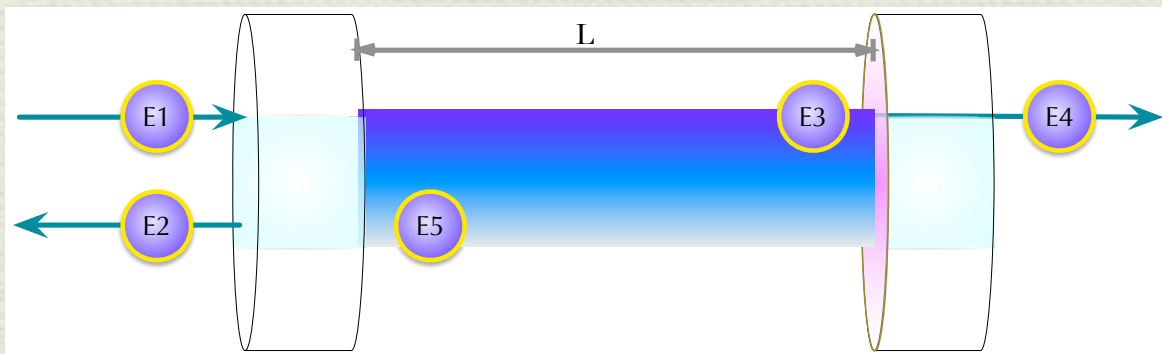
- ◆ Take 5 minutes: write down equations relating output fields to the input fields. e.g. $E_2 = r_1 E_1 + t_1 E_5$

matrix formulation



$$M = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 \\ r_1 & 0 & 0 & 0 & t_1 \\ e^{-i\phi} t_1 & 0 & 0 & 0 & -e^{-i\phi} r_1 \\ 0 & 0 & t_2 & 0 & 0 \\ 0 & 0 & -e^{-i\phi} r_2 & 0 & 0 \end{pmatrix}$$

matrix formulation



$$M = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 \\ r_1 & 0 & 0 & 0 & t_1 \\ e^{-i\phi} t_1 & 0 & 0 & 0 & -e^{-i\phi} r_1 \\ 0 & 0 & t_2 & 0 & 0 \\ 0 & 0 & -e^{-i\phi} r_2 & 0 & 0 \end{pmatrix}$$

$$(I - M)^{-1} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ \frac{-e^{-2i\phi} r_2 r_1^2 + r_1 - e^{-2i\phi} r_2 t_1^2}{1 - e^{-2i\phi} r_1 r_2} & 1 & -\frac{e^{-i\phi} r_2 t_1}{1 - e^{-2i\phi} r_1 r_2} & 0 \\ \frac{e^{-i\phi} t_1}{1 - e^{-2i\phi} r_1 r_2} & 0 & \frac{1}{1 - e^{-2i\phi} r_1 r_2} & 0 \\ \frac{e^{-i\phi} t_1 t_2}{1 - e^{-2i\phi} r_1 r_2} & 0 & \frac{t_2}{1 - e^{-2i\phi} r_1 r_2} & 1 \\ -\frac{e^{-2i\phi} r_2 t_1}{1 - e^{-2i\phi} r_1 r_2} & 0 & -\frac{e^{-i\phi} r_2}{1 - e^{-2i\phi} r_1 r_2} & 0 \end{pmatrix}$$