A few selected slides from
http://www.cv.nrao.edu/~pdemores/
nanograv_2009/demorest_cv_colloq.pdf

Nanohertz Gravitational Waves and Pulsar Timing

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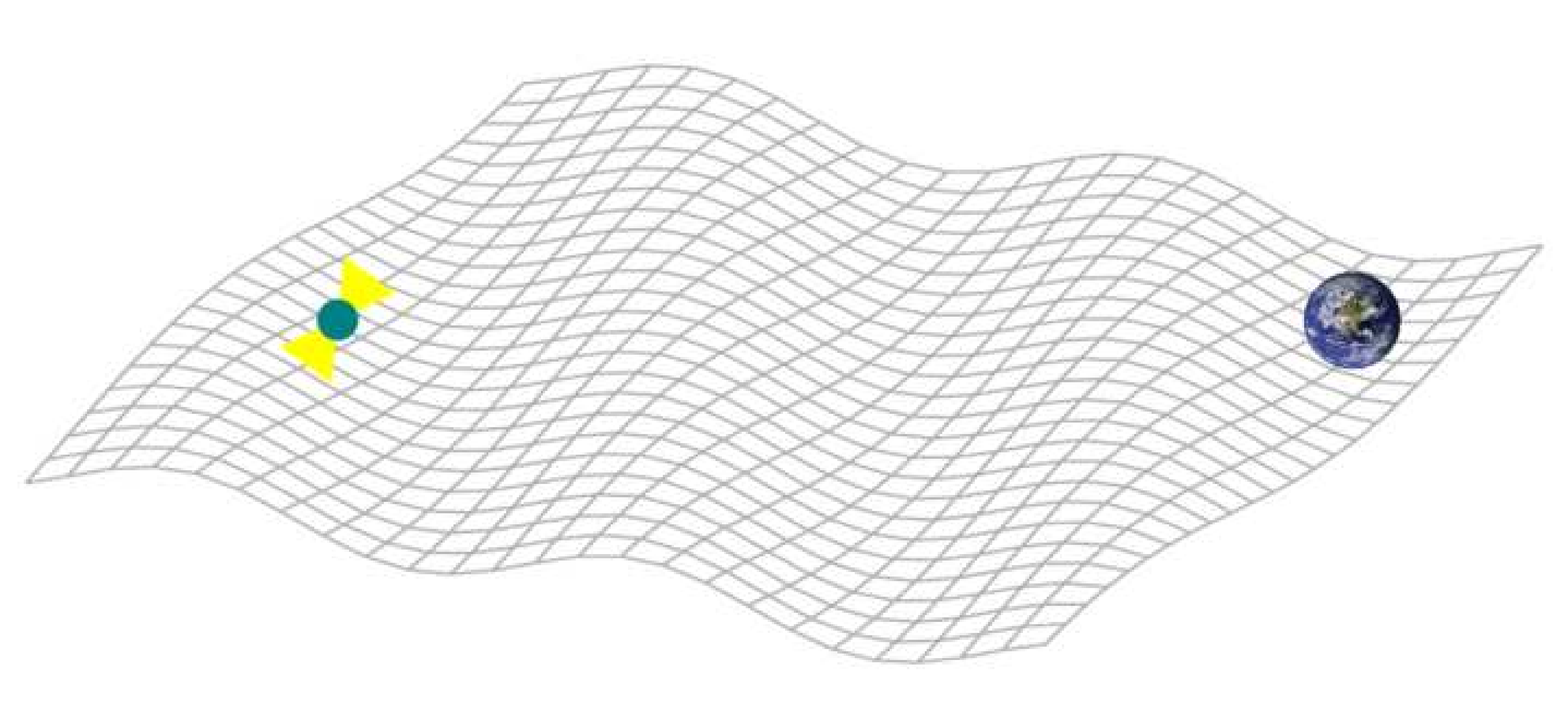
Pulsars as GW detectors



Radio pulses travelling through GW to Earth acquire additional delays.

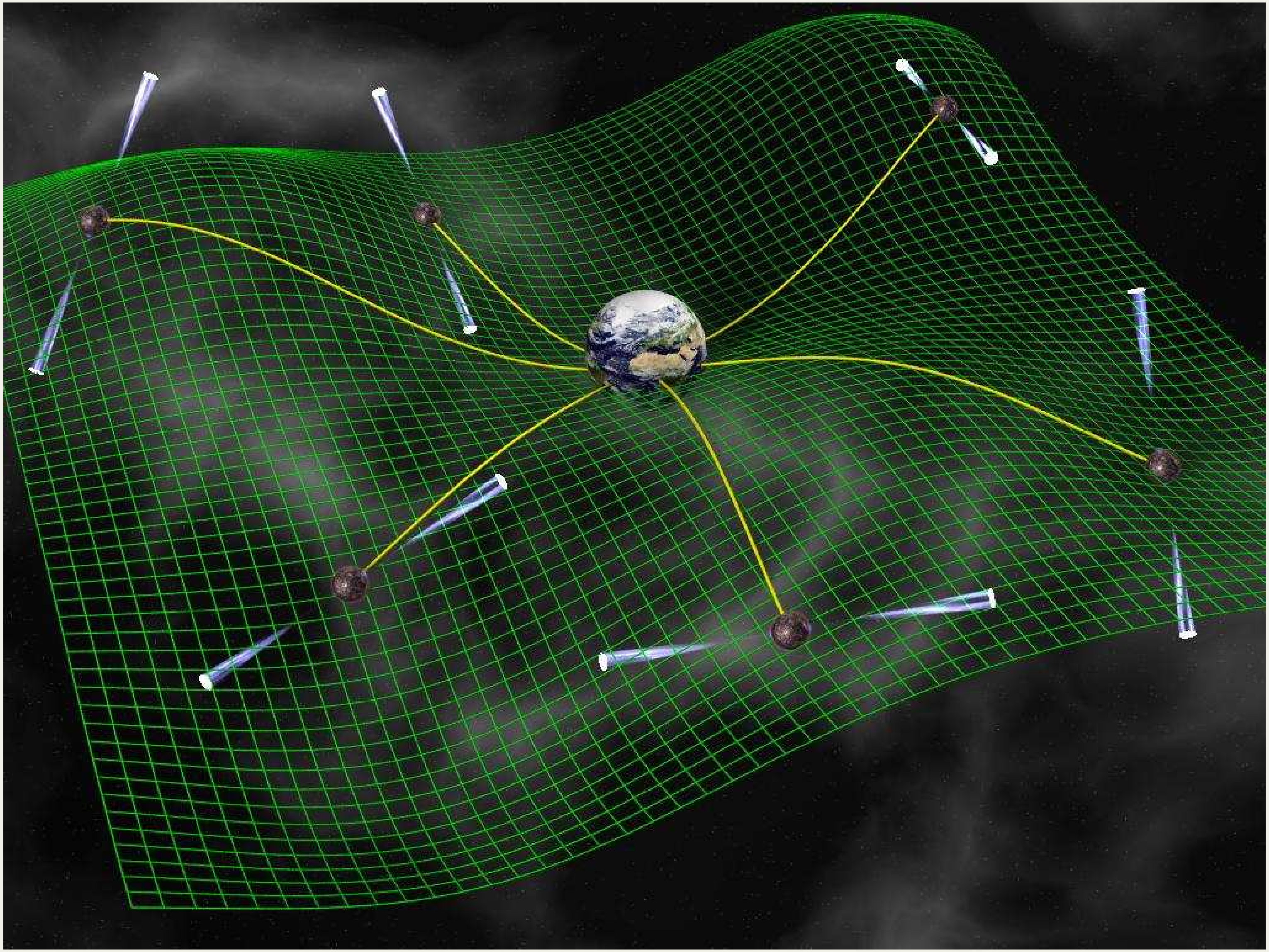
Effect on EM waves

- GW along an electromagnetic wave's path alters the travel time:

$$\Delta T = -\frac{1}{2} n_i n_j \int_0^d h_{ij}(x,t) dr$$

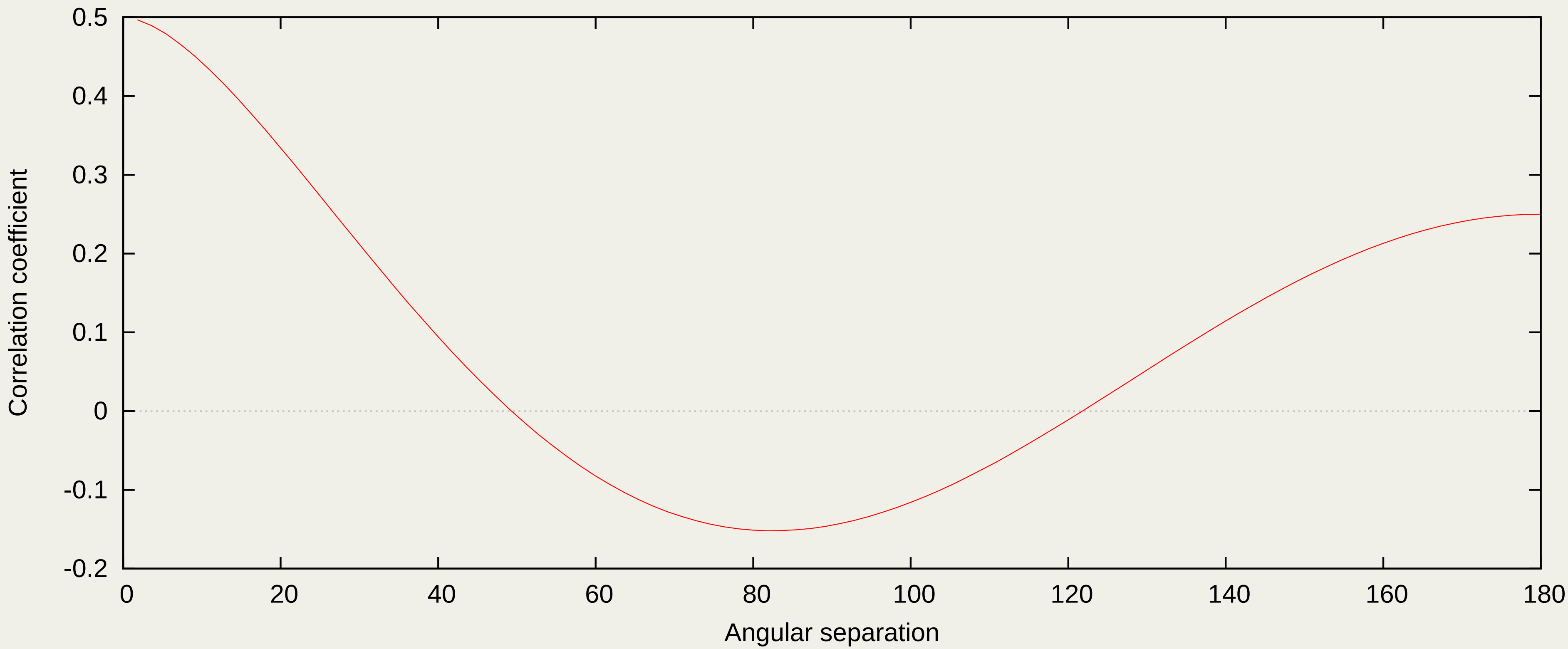
- ΔT varies with time, so we can potentially see its effect in measured radio pulse times of arrival.
- This is the principle behind all modern GW detectors. In the pulsar case, there are many GW wavelengths along the path.
- Very bright, stable pulsars (MSPs) are needed if this is to be successful: $h \sim 10^{-15} \sim 30\ \mathrm{ns}/1\ \mathrm{year}$.

Pulsar Timing Array



Pulsar Timing Array

GW-induced timing fluctuations will be correlated between different pulsars (Hellings & Downs, 1982; isotropic GWB):



This method makes GW *detection* possible!
In this case, sensitivity $h_c \sim \delta t/(T\sqrt{N_{psr}})$.

PTA Sensitivity

PTA sensitivity vs freq shape: